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Relationships between Lean Practices, Organizational Culture, and Corporate Performance

DOCTORAL DISSERTATION

Social sciences,
Management S 003

VILNIUS 2020

This dissertation was written between 2015 and 2019 at Vilnius University.

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VILNIAUS UNIVERSITETAS

Darius
RUŽELĖ

Lean praktikų, organizacinės kultūros ir organizacijų veiklos rezultatų sąsajos

DAKTARO DISERTACIJA

Socialiniai mokslai
Vadyba S 003

VILNIUS 2020

Disertacija rengta 2015–2019 metais Vilniaus universitete.

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GLOSSARY

Corporate performance – results of main corporate activities.
Corporate success – a good corporate performance.
Culture – a pattern of shared basic assumptions and values.
Hard lean practices – technical practices related to production and processes.
Lean – a managerial approach based on Toyota's manufacturing system.
Lean culture – an organizational culture, based on lean thinking and lean principles.
Lean organization – an organization that implements lean practices.
Lean methods – lean behavioral routines.
Lean practices – lean behavioral routines and lean mental concepts.
Lean practitioner – a person involved in lean activities in an organization.
Lean principles – mental concepts of lean.
Lithuanian lean organizations - organizations in Lithuania that implement lean.
Operational performance – a performance related to the process level.
Organizational culture – a pattern of employees' habits related to an organization.
Performance – the efficiency and/or the effectiveness of an action.
Performance measurement – a process of collecting, analyzing and reporting information regarding the performance of action.
Performance measurement system – a system that provides the performance-based data.
Performance measures – a set of measures on the performance.
Practice – a bundle of behavioral routines, tools and mental concepts.
Research organizations – organizations that participated in current research.
Soft lean practices – practices related to managerial concepts, people, and relations.
Value – an unconscious and conscious feeling that manifest themselves in a behaviour.

ABBREVIATIONS

BSC	Balanced Scorecard
CP	Corporate performance
CVF	Competing values framework
DMP	The dynamic multi-dimensional performance framework
DOCS	Denison Organizational Culture Survey
ITTC	Item-to-total correlations
LM	Lean methods
LP	Lean practices
LI	Lean principles
OC	Organizational culture
PMS	Performance measurement system
PS	Problem solving
R&D	Research and development.
SD	Standard deviation
TPS	Toyota production system

INTRODUCTION

Relevance of the research

The corporate success depends on both internal and external factors. As to internal factors, excellent operational practices (Bortolotti, Danese, Flynn, & Romano, 2015; Fullerton & Wempe, 2009; Sisson & Elshennawy, 2015) and the organizational culture (Denison & Mishra, 1995; Murphy, Cooke, & Lopez, 2013; Sackmann, 2010) have been identified as the key determinants of the corporate success (Narasimhan, Kull, & Nahm, 2012). One of the practices living and growing as the best practice for the organizational excellence is lean (Holmemo, Rolfsen, & Ingvaldsen, 2018).

Lean is a business philosophy focused on the removal of waste and concentration on value-added processes (Sisson & Elshennawy, 2015). Lean is a managerial system to continuously develop people and create a problem-solving culture (Ballé, Chaize, & Jones, 2019). Lean shares principles of continuous learning and improvement to sustain business (Serafinas & Ruželė, 2014). The benefits of lean are great improvements of such performance characteristics as quality, cost, and delivery (Lander & Liker, 2007). However, to reach its full potential, lean must be adopted as a complex corporate strategy rather than an activity isolated in operations (Fullerton, Kennedy, & Widener, 2014). The magnificence of lean is growing day by day due to its positive impact on the organizational performance (Jasti & Kodali, 2015). Lean was developed by Toyota Motor company (D. F. M. Duque & Cadavid, 2013) and adopted in a wide range of industries beyond its origins in the motor industry (Bateman, Hines, & Davidson, 2014). Over the years, lean has evolved into a managerial paradigm applicable to different sectors and different processes with impressive results (Danese, Manfe, & Romano, 2017). Lean methods and principles are being applied by a growing number of organizations in Lithuania (Ruželė & Serafinas, 2015).

The before-mentioned practical relevance of lean is reflected in the scientific literature. More than 540 research articles investigated lean from 1988 to 2011 (Jasti & Kodali, 2015). More than 200 articles analyzed lean in academic journals from January 2003 to December 2015 (Danese et al., 2017). More than 440 scientific articles in more than 50 journals have addressed lean since 1994. From these, more than 300 articles on lean have been published since 2010. The growing popularity of lean is evident from the number of publications in the field. In the last three decades, the number of papers on lean increased exponentially (Sinha & Matharu, 2019).

The crucial role in business and management is played by cultural factors (Erthal & Marques, 2018). The culture of the organization (the organizational culture) most commonly refers to the collective way of thinking, values and ideology (Alvesson & Sveningsson, 2015). The organizational culture has theoretical and empirical links with the organizational effectiveness (Xenikou & Simosi, 2006). Various research (Boyce, Nieminen, Gillespie, Ryan, & Denison, 2015; Gambi, Boer, Gerolamo, Jørgensen, & Carpinetti, 2015; Garcia-Fernandez, Martelo-Landroguez, Velez-Colon, & Cepeda-Carrion, 2018; Kotrba et al., 2012) confirm that the organizational culture and cultural elements have high and mostly significant positive impact on many aspects of the organizational performance. The organizational culture highly impacts even performance measures and performance management systems (Jardioui, Garengo, & El Alami, 2019). Culture is also a key to implementation and continuity of lean (Erthal & Marques, 2018).

The field of cultural research is highly fragmented and continuously evolving (Jung et al., 2009). Development directions include research on the relation between culture and effectiveness (Denison, Nieminen, & Kotrba, 2014) and research on the link between culture and lean. Since 1994, more than 100 articles on lean culture have been listed in Thomson Reuters listing, in the journals with impact factors (Erthal & Marques, 2018).

The *'performance is the efficiency and/or the effectiveness of an action'* (Bititci, 2015). Accordingly, the corporate performance is the efficiency and effectiveness of corporate activities. The fundamental activity to manage the organization's performance and competitiveness is performance measurement. Performance measurement is important as it influences the performance itself (Hwang, Han, Jun, & Park, 2014). To support performance-measuring activities, organizations develop and implement performance measurement systems (PMSs) (Star, Russ-Eft, Braverman, & Levine, 2016). A good PMS provides '*performance-based data that can be easily converted into the actionable performance-based knowledge, thus enabling users to understand, manage, and improve what they measure*' (Harbour, 2011).

The field of scientific research on performance measurement blossomed in the 1990s, when in the span of about two years; nearly 4,000 articles were published on the topic. Now, the number of articles has diminished, though interest in research on performance measurement still remains (Star et al., 2016). Interest in the subject of performance measurement is increasing in both managerial and academic field (De Toni & Tonchia, 2012).

Current state of scientific research

Scientific papers on lean are classified into the categories of 'lean adoption', 'lean performance', 'leanness', 'lean supply chain', 'lean and other value creation tools', 'lean epistemology', 'organizational theory and lean', 'lean and sustainability', and 'industry 4.0 and lean' (Sinha & Matharu, 2019), and 'lean product development' (Jasti & Kodali, 2015). The most dominant themes in literature on lean are 'lean adoption', followed by 'relation of lean to performance' (Sinha & Matharu, 2019) and 'lean supply chain' (Jasti & Kodali, 2015). A large number of publications have studied the relationship between lean manufacturing adoption and organizational performance (Negrão, Filho, & Marodin, 2017).

Researchers have proposed many frameworks for measuring lean performance. Most of these frameworks concentrate on narrow areas of the corporate performance, such as the operational performance (Jasti & Kodali, 2015) or the financial performance (Negrão et al., 2017) rather than performance across all areas of activities. The field still lacks research on the influence of lean on the overall (cumulative) corporate performance. As an exception, the authority in the field of lean Sanjay Bhasin proposed a comprehensive lean performance measurement framework (Bhasin, 2008) based on the dynamic multi-dimensional performance (DMP) framework (Maltz, Shenhar, & Reilly, 2003). However, no published empirical studies reported results on testing the DMP as a basis for corporate performance measurement in the lean journey.

The organizational culture is a frequent object of research. Tobias Jung et.al found seventy instruments for exploring and assessing the organizational culture (Jung et al., 2009). Popular instruments in cultural research are the Hofstede model, the competing values framework (CVF), the GLOBE framework, and the Denison organizational culture survey (DOCS). Lean researchers use these cultural instruments. Several studies on lean applied the CVF as a tool for the cultural analysis (Hardcopf & Shah, 2014; Losonci, Kása, Demeter, Heidrich, & Jenei, 2017; Paro & Gerolamo, 2015, 2017), and several studies applied the GLOBE framework (Bortolotti, Boscari, & Danese, 2015; Gelei, Losonci, & Matyusz, 2015; Kull, Yan, Liu, & Wacker, 2014). However, both the CVF and the GLOBE are limited in assessing the strength of culture and both of them lack links with performance measurement. M. Al-Najem, H. Djakal, and N. Bennet adapted the conceptual Denison model as the basis for creating an original Lean Culture Assessment Model (Al-Najem, Djakal, & Bennet, 2012). However, the lack of studies

using the DOCS as a cultural tool in research on lean and particularly in research on 'lean performance' is evident.

There are two conflicting streams in the scientific literature on the direction of causal relationships of practices and the organizational culture. The first stream treats the organizational culture as the antecedent of practices (Erthal & Marques, 2018). The idea is that non-integrative culture and the approach 'not invented here' may discourage the implementation of practices (Narasimhan et al., 2012). These views are best expressed by the adage 'culture eats strategy for breakfast' (Hanson & Melnyk, 2014). The second stream maintains that the prolonged implementation of practices changes culture – the process change comes first and then drives the cultural change (Mann, 2015). The way to change culture is not by first changing how and what people think but instead, by first changing how they behave – what people do (Shook, 2010). Within lean, the major way of changing the organizational culture is by doing (Ingelsson & Mårtensson, 2014). For now, researchers still have not reached an agreement on the issue of the direction of causal relationships of practices and the organizational culture.

One group of researchers has maintained that both lean practices and the organizational culture are elements influencing the corporate performance. Several such studies (Bortolotti, Boscari, et al., 2015; Bortolotti, Danese, & Flynn, 2016; Hardcopf & Shah, 2014; Iranmanesh, Zailani, Hyun, Ali, & Kim, 2019) analyzed the impact of lean and organizational culture on the corporate performance in the framework 'lean practices-organizational culture-corporate performance'. Another group of researchers carried out the analysis of the mediation effect in the framework 'lean practices-organizational culture-corporate performance'. A few of these studies (Nahm et al., 2004) have treated the organizational culture as a phenomenon influencing the implementation of lean practices that ultimately affect the corporate performance. A few other studies) (Canato, Ravasi, & Phillips, 2013; Narasimhan et al., 2012) have found that lean practices influence and induce the evolution of the organizational culture, and then, the organizational culture directly impacts the corporate performance. The third group of researchers (Kull, Yan, Liu, & Wacker, 2014; Iranmanesh, Zailani, Hyun, Ali, & Kim, 2019) analysed moderation effects in the framework 'lean practices-organizational culture-corporate performance'. However, the topic of complex relationships between lean practices, organizational culture, and corporate performance is still attractive for deeper empirical research.

In summary, the analysis of the current state of scientific research reveals some gaps. No published empirical studies reported results on testing the DMP

as a basis for corporate performance measurement in the lean journey. No published empirical studies reported using the DOCS as the cultural tool, investigating 'lean performance'. For now, researchers still have not reached an agreement on the issue of the direction of causal relationships between practices and the organizational culture. For now, there is a lack of research on complex relationships between lean practices, the organizational culture, and the corporate performance, and this field is attractive for deeper empirical research.

The problem statement

The lack of research on lean-culture-performance relationships.

The object of the research is relationships between lean practices, the organizational culture, and corporate performance.

The research question

What are one-to-one and complex relationships between lean practices, the organizational culture, and the corporate performance?

The aim of the research is to theoretically and empirically investigate and evaluate one-to-one and complex relationships between lean practices, the organizational culture and corporate performance.

Objectives of the research are:

1. To identify and categorize main lean practices.
2. To identify and test relevant framework for the investigation of the organizational culture in the lean setting.
3. To identify and categorize main corporate performance measures.
4. To investigate and evaluate relationships between lean practices and the corporate performance.
5. To investigate and evaluate relationships between the organizational culture and corporate performance in lean organizations.
6. To investigate and evaluate relationships between lean practices and the organizational culture.
7. To investigate and evaluate complex relationships between lean practices, the organizational culture and corporate performance.

Research methodology

The current research used the functionalist paradigm for discovering the cause-effect relationships and providing solutions to problems. Pragmatist approach allowed reconciling both subjectivism and objectivism, values and facts, different contextual experiences and accurate rigorous 'objective' knowledge. Produced law-like generalizations linked the current research to the positivism. The current research used an abductive logic moving from theory to data (as in deduction) and from data to theory (as in induction). As for time dimension, the current research was cross-sectional - a "snapshot" taken at a particular time - rather than longitudinal.

Most researchers agree that the relation of practices and the performance is causal – lean is influencing various performance measures (Gambi et al., 2015; Hofer, Eroglu, & Hofer, 2012; Losonci & Demeter, 2013a; Narasimhan et al., 2012; Nawanir, Kong, Siti, & Othman, 2013). In the same way, longitudinal studies show that the organizational culture has causal priority over various performance outcomes (Boyce et al., 2015) - a culture influences the performance (Murphy et al., 2013). In combination, three views on relationships of practices-performance, culture-performance, and practices-culture - when applied to lean practices - represent a complex conceptual framework of possible relationships between research variables (see Figure 1).

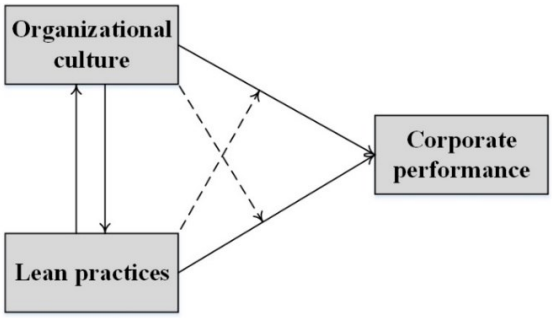

Figure 1. **Complex conceptual framework for possible relationships between lean practices, organizational culture, and corporate performance**
(source: based on Narasimhan, Kull, & Nahm, 2012)

This conceptual framework hides few simple research models on one-to-one relationships: (1) an impact of lean practices on the corporate performance, (2) an impact of the organizational culture on the corporate performance, (3) impact of lean practices on the organizational culture, and (4) impact of the organizational culture on lean practices.

This framework also hides few complex research models. The first complex model sees both lean practices and the organizational culture are influencing the corporate performance. The second complex model sees the organizational culture as a moderator of the relationship 'lean practices - corporate performance'. The third complex model sees lean practices as a moderator of the relationship 'organizational culture - corporate performance'. The fourth complex model suggests that lean practices influence and induce the evolution of an organizational culture, and a culture has a direct impact of the corporate performance – the organizational culture is a mediator of the influence of lean practices on the corporate performance. The fifth complex model sees a culture as phenomenon, which influences the implementation of lean practices and these practices ultimately affect performance – lean practices are a mediator of the influence of the organizational culture on the corporate performance.

Together these research models assume several causal relationships between variables, what makes this research explanatory. The current research used before mentioned conceptual framework as the basis for the study.

Research methods

Methods for review of the literature were the systemic analysis, the synthesis of concepts and the generalization. Methods for collection of the empirical data were the mail survey and the internet survey. The survey, as most survey research (Shaughnessy, Zechmeister, & Zechmeister, 2015) relied on the questionnaire as an instrument to measure variables. A self-report type of the questionnaire aimed collecting an opinion type data (namely a data on lean principles, the organizational culture and the corporate performance), a data on behaviors (namely the data on lean methods) and a demographic type data. Methods for analysis of the empirical data were quantitative statistical methods, including the analysis of the correlation, regression, moderation, mediation, and exploratory factor analysis.

Scientific novelty of research and contribution to science

The current research contributes in several ways to the science:

1. The mainstream literature assumes lean practices are one bunch of similar practices. In contrast, the current research contributes to the science by suggesting the grouping of lean practices into the matrix that contains two dimensions, namely 'principles - methods' and 'hard - problem solving - soft', where hard lean practices address production

and processes, and soft lean practices address managerial concepts, people, and relations.

2. The famous framework for corporate performance measurement, the Balanced Scorecard (BSC), proposed measuring four perspectives: 'financial', 'customer', 'internal processes', and 'innovation and learning'. The improved version of the BSC, the Dynamic Multi-dimensional Performance framework (DMP), proposed measuring five perspectives: 'financial', 'customer/market', 'process', 'people development', and 'preparing for the future'. The empirical data of the current research suggests proposing the division of the 'process' measures into two distinct factors namely the 'product development process' and the 'product delivery process'. Thus, the current research contributes to the science by proposing the corporate performance measurement framework that includes six perspectives: 'financial', 'customer/market', 'product development process', 'product delivery process', 'people development' and 'preparing for future'.
3. No published studies addressed the links of individual lean practices to the complex performance measures. The current research fills this gap by presenting empirical evidences of links of 34 individual lean practices (22 lean methods and 12 lean principles) and various performance measures.
4. No published studies addressed the impact of the strength of the organizational culture on the corporate performance in lean settings. The current research ads to the science by showing that the strength of the organizational culture in lean organizations positively influences the corporate performance.
5. The current research ads insights on the direction of causal relationships between lean practices and the organizational culture. It shows that the impact of lean practices and the organizational culture is mutual although the impact of the organizational culture on lean practices is higher than other way around.
6. The current research address few not studied relationships of moderation and mediation. It claims that a complex framework 'lean practices-organizational culture-corporate performance' involves mediation effects and does not involve moderation effects.

Practical implications

For lean practitioners, the current research reminded that the aim of the implementation of strategic initiatives is not the implementation itself, but the

improvement of the performance in particular areas of corporate activities. The current research proves that some lean practices having high influence on the corporate performance were implemented/adopted in lesser degree, and some lean practices that have low influence on the corporate performance were implemented/adopted in higher degree. Supposedly, lean practitioners should monitor the influence of implemented lean practices and adjust the implementation according to the influence of the practice on the performance.

For managers, the current research reminded the need for strengthening organizational culture, while the strength of the organizational culture is very important factor for the corporate success. The strength of the organizational culture highly influences cumulative organizational performance, product delivery performance, people development performance, and preparing for future performance.

For organizations, the current research suggested measuring six groups of the performance: (1) financial, (2) customer/market, (3) product development process, (4) product delivery process, (5) people development, and (6) preparing for the future. Together, all these performance groups will result in the overall (cumulative) corporate performance.

Defended propositions

The current state of the scientific research and the before presented conceptual framework creates a basis for defended propositions:

1. Lean practices have a positive impact on the corporate performance.
2. The organizational culture has a positive impact on the corporate performance.
3. Lean practices and the organizational culture mutually influence each other.
4. The complex framework of lean practices, the organizational culture, and the corporate performance involves mediation effects and does not involve moderation effects.

Structure of dissertation

The current dissertation consists of the list of figures, the list of tables, the glossary, the list of abbreviations, the introduction, the main part (three chapters), conclusions, references, and the appendixes. The first chapter of the main part acknowledge with literature on lean, the organizational culture, and the corporate performance. Then, it presents the literature review on relations of lean practices, the organizational culture, and the corporate performance. The second chapter lays methodological foundations for the empirical

research. The third chapter presents the empirical data, the analysis of the empirical data, and results of the research.

The current dissertation amounts 202 pages (without appendixes), 87 tables, 35 figures, 200 references, and 11 appendixes.

Approbation and dissemination of research results

In conferences:

1. Conference paper 'Combining quantitative and qualitative approaches to identify the typology of organizational culture'. Presented at international conference 'Sustainable regional development: economical, management, technological and law possibilities', held in Lithuania business University of applied sciences October 27-28, 2017, in Klaipeda, Lithuania.
2. Conference paper 'Prerequisites for survival of organizations in context of globalization'. Presented at international conference 'Harmony of business and science' held in Vilnius' College of cooperation May 29, 2014, in Vilnius, Lithuania.
3. Conference paper 'Influence of managerial tools Lean and Six Sigma on evolution of organizations'. Presented at conference of Scientific Society of Students (SMD) held in Vilnius University May 8, 2013, in Vilnius, Lithuania.

In scientific research journals:

1. Ruželė, D. & Serafinas, D. (2015). Preconditions and critical success factors of Lean management innovations in Lithuania's wood sector enterprises. *Current Issues of Business and Law*, p. 109-130. Doi: 10.5200/1822-9530.2015.08
2. Serafinas, D. & Ruželė, D. (2014). Evolution of Organizations in the Context of Total Quality Management. *International business: innovations, psychology, economics.* Vol. 5, No. 1 (8), p. 42–65.
3. Serafinas, D. & Ruželė, D. (2014). Evolution of Lean Organizations. *Management of Organizations: Systematic Research*. Issue 69, p. 119-136. Doi: 10.7220/MOSR.1392.1142.2014.69.8
4. Ruželė, D. (2014). Survival of Organizations in Context of Globalization. Proceedings of conference 'Harmony of business and science', Vilnius' cooperation college, 29 May 2014, p. 1-14.
5. Ruželė, D. (2013). Influence of managerial tools Lean and Six Sigma on evolution of organizations. Proceedings of conference "Insights of young scholars in economics and management", Scientific Society of Students (SMD), p.199-209. Vilnius: Vilnius University Publishing.

1. LITERATURE REVIEW

1.1. Review of literature on lean

1.1.1.Concept of lean

The term 'lean' emerged from studies of the Toyota's manufacturing system (Arlbjørn & Freytag, 2013), the system that often is called the 'Toyota Production System' (TPS). Toyota's manufacturing system relies on some basic principles including a focus on the customer, continual improvement, quality through waste reduction, and tightly integrated upstream and downstream processes as part of a lean value chain (Liker & Morgan, 2006). The production system is termed 'lean', while it uses less of everything compared with the mass production - half of the human effort in the factory, half of the manufacturing space, half the investment in tools, half the engineering hours to develop a new product in half the time (Womack, Jones, & Roos, 1990).

As we understand today, lean is a managerial approach for improving processes based on a system of interrelated socio-technical practices (Bortolotti, Boscari, et al., 2015). Lean is a business philosophy; this philosophy focuses on shortening lead times by removing waste and concentrating on value-added processes (Sisson & Elshennawy, 2015). Lean is a philosophy that includes a set of general principles of organizing and managing (Lander & Liker, 2007). Lean is an ideology, which enables the organization to reap the full benefits lean processes to offer (Bhasin, 2011). The essence of lean is that all business processes and functions integrate into a coordinated system with the purpose of using lean tools and lean principles to provide better value to customers through continuous improvement and elimination of waste (Fullerton et al., 2014; *The Shingo prize for operational excellence*, 2016).

Lean combines the best features of both the low volume production and the high volume production – it combines the ability to reduce costs per unit and dramatically improve quality while at the same time providing a wide range of products (Womack et al., 1990). The heart of lean is the principle of eliminating waste (Liker, 2004). In the context of management, the waste is any 'non-value added activity' in the system, an activity for which the customer is not ready to pay for (Lander & Liker, 2007). In contrast, a value is something the customer is ready and willing to pay for. Value is a capability provided to a customer at the right time at an appropriate price, as defined by

the customer (Stone, 2012). If the customer is not willing to pay for something, then it is a waste and a squandering of organizational resources. Therefore, the concept of lean is very simple - removing the 'waste' from a system (S. Shetty, Componation, Gholston, & Utley, 2010). In everyday practice, lean is a set of practices to remove 'waste' from processes (Lander & Liker, 2007).

Lean is not just a set of practices for eliminating waste; lean is a managerial system – 'an integrated socio-technical system' (Shah & Ward, 2007). The aim of lean is achieving the optimal performance at the corporate level by deploying human-related values and principles and process-related principles and tools (Salhieh & Abdallah, 2019). Lean is a system aimed continuously developing people and creating a culture of problem-solving; a strategy aimed solving challenges by engaging and involving (Ballé et al., 2019).

Some authors (Shah & Ward, 2003; Shetty, Ali, & Cummings, 2010; Mackelprang & Nair, 2010) see lean as one bunch of practices. However, the grouping of lean practices into the specific groups is sensible. Possible groupings of lean practices are 'internal-external' (Shah & Ward, 2007), 'process' – 'people and partners' – 'problem solving' (Shang & Sui Pheng, 2013), 'technical-managerial-philosophical' (Liker, 2004), 'technical-managerial' (Rother, 2010), 'hard-soft' (Bortolotti, Boscari, et al., 2015), and 'tools-principles' (Arlbjørn & Freytag, 2013).

Summarizing, lean is a system viewed as the specific philosophy, principles, and practices. Lean addresses both the soft side of organizations (people), and the hard side of organizations (processes). Lean helps organizations to provide better value to customers and to improve the performance even at the corporate level.

1.1.2. Lean practices: tools-principles approach

'*A practice is a bundle of behavioral routines and mental concepts used to accomplish a certain task'* (Canato et al., 2013). Based on this definition, lean practices are behavioral routines (lean tools and lean methods) and lean mental concepts (lean thinking, lean values, and lean principles). Lean behaviour and thinking lean are different activities, although both based on lean philosophy. The layers of lean visualize that differentiation (see Figure 2).

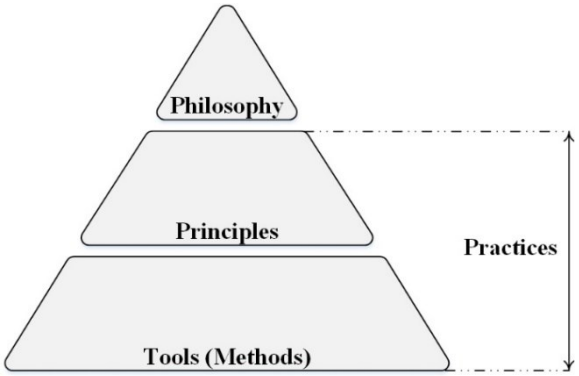

Figure 2. **Layers of lean: philosophy, principles, and tools (methods)** (source: based on Arlbjørn, Freytag, & de Haas, 2011)

Many articles (when defining behavioral routines) does not distinguish the term 'lean tools' and the term 'lean practices'; such situation creates some ambiguity of the terms. For purposefully standardized behavioral routines, the current research uses the term 'methods' rather than using the term 'tools'.

Lean methods. Many organizations see only a basic layer of lean – some tools that are implemented with the aim achieving greater efficiency (S. Shetty, Componation, Gholston, & Utley, 2010). They are about learning to adopt the best lean tools to improve performance, whereas lean as a complete system is more about learning to understand how the lean principles and methods interact in specific situations. Lean as an operational improvement program rarely succeed beyond a few easy short-term wins (Ballé, Chaize, & Jones, 2015). Nevertheless, organizations should emphasize the use of lean methods at the beginning of their lean efforts, since this is a means to introduce the lean thinking, even though integration of lean philosophy and lean principles into the organizational culture is a very slow process (Mann, 2015).

The Table 1 presents results of the analysis of lean tools (methods) distinctly mentioned as such by various prominent lean researchers. A method is included into the table only if two or more researchers have mentioned it.

Table 1. **Lean methods mentioned in literature** (source: own analysis)

Lean method	Source											
	1	2	3	4	5	6	7	8	9	10	11	12
Proper arrangement (5S)	*	*	*	*	*	*	*	*	*	*	*	
Production Kanban	*	*	*		*	*	*	*	*	*	*	*
Kaizen workshops (Kaizen events)		*	*	*	*	*	*	*	*	*	*	
Information boards (actual data)	*	*	*	*		*	*	*	*	*		
Calculation of the Takt /cycle time			*		*	*	*	*	*	*	*	*
Value stream mapping	*		*		*	*			*	*	*	*
Setup time reduction (SMED)	*	*	*		*		*		*	*	*	
Root cause analysis ("5 Why?")		*	*		*	*		*	*	*		*
Total preventive maintenance (TPM)	*	*	*		*	*	*		*	*		
Cellular layout	*	*	*		*	*	*				*	
Statistical process charts (SPC)			*		*	*	*			*		*
Cross-functional training		*	*		*		*			*	*	*
Standard operation procedures (SOP)			*		*		*	*		*		*
Error proofing (Poka-Yoke)			*		*	*	*					*
Visiting actual place (Gemba)			*	*				*		*		
Problem solving standard (A3)			*				*			*		
Kaizen board							*		*		*	
Reflection after activity (Hansei)			*	*				*				
Supermarket			*		*					*		
Strategy deployment (Hoshin)			*	*				*				
Consensus decisions (Ringi)							*	*				*
Leader's standard work sheets				*						*		
Morning meetings (Asaichi)				*						*		
Alert system (Andon)		*	*									
War room (Obeya)			*									*
Obtaining support (Nemawashi)			*	*								

Sources: (1) Bhasin & Burcher, 2006; (2) Duque & Cadavid, 2007; (3) Lean Enterprise Institute, 2008; (4) Murti, 2009; (5) Woehl, 2011; (6) D. Shetty et al., 2010; (7) Lyons et al., 2013; (8) Shang & Sui Pheng, 2013; (9) Arlbjørn & Freytag, 2013; (10) Mann, 2015; (11) Jasti & Kodali, 2015; (12) Yadav, Mittal, & Jain, 2018

The analysis reveals the tendency that most frequently in the literature mentioned methods are hard (related to production and processes) rather than soft (related to managerial concepts, people, and relations). This tendency

hypothetically shows the lack of balance between usages of hard versus soft lean methods.

Lean principles. *'Organizations should have practice lean tools, lean principles and lean philosophy while keeping the implementation of the principles as the most central issue'* (Arlbjørn et al., 2011). Instead of trying to implement methods (tools), they would better design a comprehensive system that satisfies the principles (Lander & Liker, 2007).

Lean has the base of two core principles: 'cost reduction through the elimination of waste', and 'full utilization of worker's capabilities'. Fully utilizing worker's capabilities requires a system of 'respect for people' based on optimizing ergonomics of the worker's job, ensuring worker's safety, and giving them greater responsibility by allowing them to participate in improving the workplace. Cost reduction is achieved using just-in-time production (which is about managing time of processes) and Jidoka (which relates to build-in quality), the main lean components of what today is recognized as the Toyota production system house (Lander & Liker, 2007), see Figure 3.

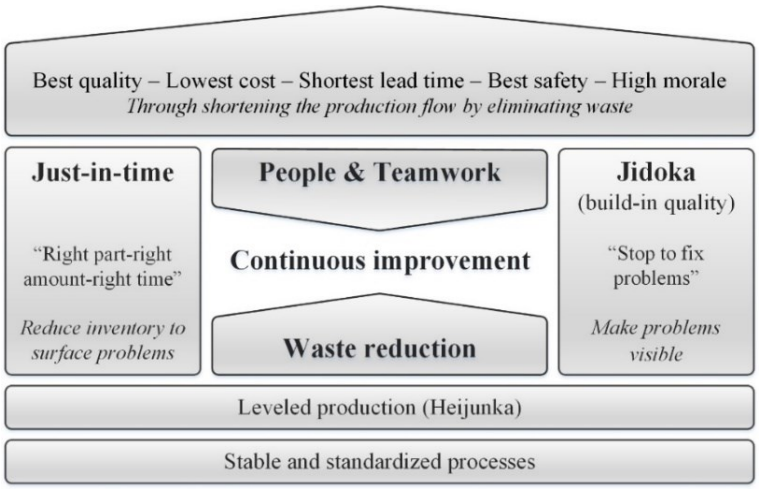

Figure 3. **Toyota production system house**
(source: Liker & Morgan, 2006)

Lean is represented this way because a house is a system and only as strong as the weakest part of the system. With a weak foundation or a weak pillar, the house is not stable, even if other parts are very strong. The parts work together to create the whole (Liker & Morgan, 2006).

The Toyota production system house (TPS house) represents basic lean principles. Various lean researchers have identified and described many other lean principles. The Table 2 presents the results of the analysis of lean principles distinctly mentioned as such by various researchers. A principle is included into the table only if two or more researchers have mentioned it.

Table 2. **Lean principles mentioned in literature** (source: own analysis)

Lean principle	Source								
	1	2	3	4	5	6	7	8	9
Standardization	*	*	*	*	*	*	*	*	*
Elimination of waste		*	*	*	*	*		*	*
Leveled work-load (Heijunka)	*	*	*			*	*	*	*
Continuous flow	*		*		*	*	*	*	*
Continuous improvement (Kaizen)	*	*	*	*	*		*		*
Teamwork	*	*			*	*	*		*
Visual management / visualization	*	*	*				*	*	*
Pull	*		*		*	*		*	*
Quality right first time	*	*		*			*	*	
Empowerment / decentralization	*		*		*	*	*		
Stability of processes	*	*	*		*				
Leaders promoted from within	*						*		*
Just in time delivery (JIT)		*			*	*			
Long-term philosophy	*					*	*		
Respect for people and partners		*				*	*		
Effective communication			*				*		*

The analysis of distinctly in literature mentioned lean principles reveals the tendency that most frequently mentioned lean principles are hard (related to production and processes) rather than soft (related to managerial concepts, people, and relations). This tendency hypothetically shows the lack of balance between usages of hard versus soft lean principles.

1.1.3. Lean practices: hard-soft approach

Lean is a socio-technical system, which consist of two constructs, namely technical (process related) practices and social (human related) practices (Hadid & Mansouri, 2014). The technical practices that address the production and processes are hard while practices that address managerial concepts,

people, and relations are soft (Bortolotti *et al.*, 2015). A set of soft lean tools supported by a social lean system provides the basis to effectively implement the hard technical lean tools (Badurdeen, Marksberry, Hall, & Gregory, 2009).

Hard technical side of lean, also named 'lean production', is a production system that aims quickly responding to changes in market demand with changes in the production volume and variety (Inamizu, Fukuzawa, Fujimoto, Shintaku, & Suzuki, 2014). Hard practices of lean production are represented by extended version of the Toyota production system house (TPS house), which identifies philosophy, principles and tools critical to achieving and sustaining best quality, lower cost, faster delivery, best worker safety, and high morale (Badurdeen, Wijekoon, & Marksberry, 2011), see Figure 4.

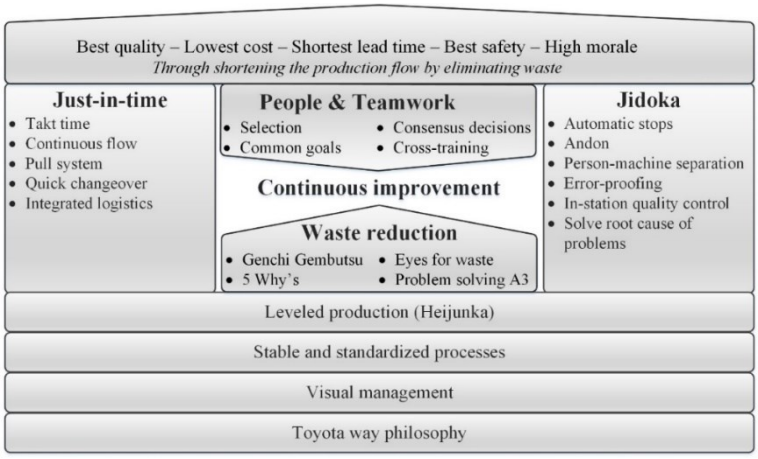

Figure 4. **Extended version of Toyota production system house** (source: Liker, 2004)

Many companies view lean as a technical program to eliminate waste, a methodology. The assumption is that proper implementation of lean tools will sustain the efficiency gains. Unfortunately, these companies are missing the essence of lean. Lean viewed as a solely technical toolkit is destined to fail. In contrast, Toyota's underlying assumption is that carefully developed people (the soft side) will continuously improve processes (the hard side) and this will ultimately lead to a competitive advantage (Liker & Hoseus, 2010). Soft lean practices are lean principles and lean tools related to people and culture. Soft lean practices help create the appropriate environment for implementing hard lean tools (Bortolotti, Boscari, et al., 2015).

The guiding document named the 'Toyota way' reveals the soft side of lean. The Toyota Way clarifies five key values that all employees should

embrace. Two main pillars of the Toyota Way are 'continuous improvement' and 'respect for people'. 'Continuous improvement' means that Toyota employees are never satisfied with where they are and consistently seek further knowledge to pursue higher value. 'Respect for people' means that Toyota employees respect all Toyota stakeholders and believe that the growth of each employee will connect to the success of the Toyota business (*Sustainability Data Book*, 2016), see Figure 5.

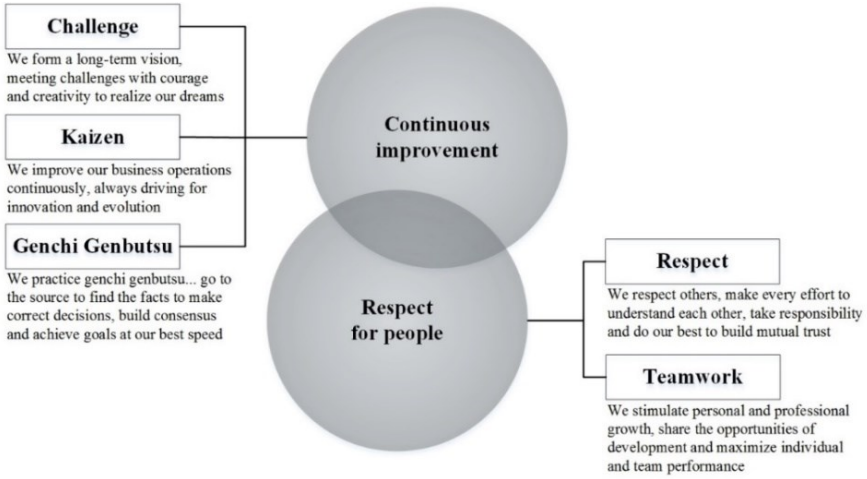

Figure 5. **The two pillars and five keywords of Toyota Way**
(sources: Badurdeen et al., 2011; *Sustainability Data Book*, 2016)

There is no clear agreement in literature, which particular lean practices are hard, and which are soft. Some authors did perform the grouping of lean practices into hard and soft. Table 3 represents the results of the analysis of various groupings by various authors. A practice is included only if it was mentioned by two or more authors. Practices related to TPS, operations and process were categorized as hard, and practices related to people, culture, and Toyota way were categorized as soft (see Table 3).

Table 3. **Lean practices classified as hard or soft in literature** (source: own analysis)

Hard lean practices	Source									
	1	2	3	4	5	6	7	8	9	10
Pull and/or Kanban systems	*	*	*	*		*	*	*	*	*
Continuous one piece flow operations	*	*		*		*	*	*		*
Leveling the workload and production	*	*		*		*			*	*
Setup time reduction (SMED)		*	*	*			*	*		*
Total preventive / autonomous maintenance			*	*			*	*	*	*
Layout optimization / cellular layout			*	*		*	*	*		*
Build in quality and autonomation (Jidoka)	*	*		*		*			*	*
Just in Time delivery (JIT)	*	*	*				*	*		
Statistical process control (SPC)							*	*		*
Elimination of waste		*				*				
Performance metrics / whiteboards				*						*
Soft lean practices	Source									
	1	2	3	4	5	6	7	8	9	10
Teamwork and leadership	*			*		*	*	*		*
Training multifunctional employees, job		*		*		*	*		*	*
Customer focus and involvement	*				*		*	*		*
Small group problem solving							*	*	*	
Problem solving standard A3	*						*	*		
Employee involvement					*				*	*
Supplier partnership	*						*	*		
Consensus decisions	*					*				
Go and see (Gemba)	*					*				
Long-term relationships and thinking					*	*				
Self-critique and Hansei					*	*				
Lean practices defined hard either soft	Source									
	1	2	3	4	5	6	7	8	9	10
Continuous improvement (Kaizen)	S	H		S		S	S	S		S
Standardization and stability	H	S		S		H				S
Housekeeping 5S		H		S		H			H	S
Visual management	H			H	S	H				H
Effective communication / information				H	S	S			H	
Root cause solving (5 Why?)		H			S	S				H

(1) Liker, 2004; (2) Hirano, 2009; (3) Mackelprang and Nair, 2010; (4) Saurin et al., 2011; H – hard lean practice; S – soft lean practice

The analysis of the classification of lean practices into hard or soft reveals that some lean practices classifies either as solely hard or solely soft. However, some lean practices were classified as hard by some authors, and as soft by other authors. Thus, the existing classification is ambiguous and needs further research.

Summarizing, the literature shows that lean is a specific business philosophy and specific 'lean' practices. Lean practices are seen through the approach 'methods-principles' and through the approach 'hard-soft'. The approach 'methods-principles' distinguishes behavioral routines (methods) and thinking patterns (principles). The approach 'hard-soft' distinguishes lean practices related to the process management and lean practices related to the people management.

1.2. Review of literature on organizational culture

1.2.1. Definition of organizational culture: meaning and discourse

Edgar Schein gives perhaps the most popular definition of the term 'culture'. According him, a culture is '*a pattern of shared basic assumptions learned by a group as it solved its problems of external adaptation and internal integration, which has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems'* (Schein, 2010). Researchers use different metaphors of a culture: culture as values, stories, frames, categories, and a toolkit (Giorgi, Lockwood, & Glynn, 2015). A culture is:

- Observed behavioral regularities when people interact;
- Group norms: the implicit standards and values;
- Espoused values: the articulated and/or publicly announced principles and values;
- Formal philosophy: policies and ideological principles that guide a thinking;
- Rules of the game: the implicit, unwritten rules for getting along in the organization;
- Climate: the feeling that is conveyed in the way of interacting with each other;
- Embedded skills: the special competencies;
- Habits of thinking, and mental models: the shared cognitive frames;
- Shared meanings: the emergent understandings created during the interaction;
- Formal rituals: the ways in which a group celebrates key events, etc. (Schein 2010).

All these concepts and phenomena relate to a culture, but none of them is a culture. A culture is the deepest, often unconscious part and is less tangible and less visible. From this point of view, most of the categories used to describe a culture listed earlier are not a culture but rather manifestations of a culture. A confusion surrounding the definition of what a culture really is results from not differentiating the levels at which a culture manifests itself (Schein, 2010). The three major levels of a culture are (1) artifacts, (2) espoused beliefs and values, and (3) basic underlying assumptions (see Figure 6).

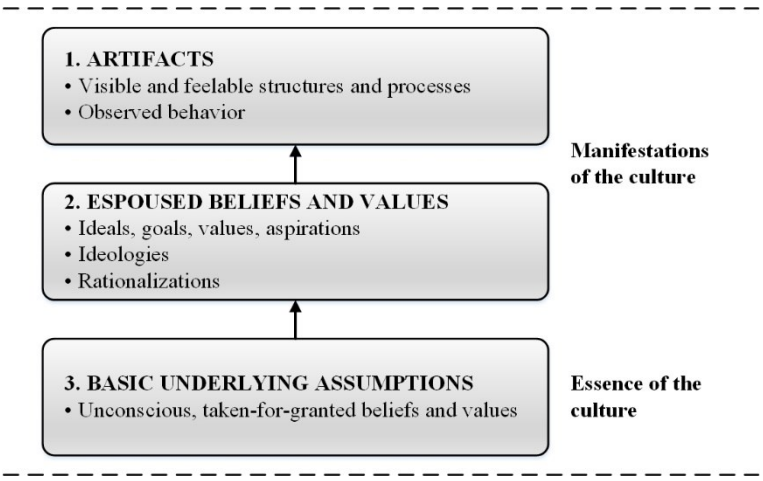

Figure 6. **Manifestations and core elements of culture**
(source: Schein, 2010)

The essence of a culture are basic underlying assumptions. However, a culture manifest itself at the levels of observable artefacts and espoused beliefs and values (Schein, 2010). Artifacts and observed behavioral patterns are noticeable at the surface level and hence visible but often not comprehensible. Values are located at the intermediate level (with some understanding of them), and basic assumptions are located at the deepest level. They are invisible, subconscious, and taken for granted (Sackmann, 2010). According to this hierarchical conceptual structure of organizational culture, informal working practices reflect behavioral norms and expectations, which in turn places on a deeper set of beliefs and values (Canato et al., 2013).

A culture refers to a group as well as to an organization. The organizational culture (the culture of an organization, the corporate culture) could be defined as the sum of many individuals' habits related to the particular organization (Mann, 2009) or as a collective program of the mind that distinguishes members of a particular organization (Hofstede, Hofstede, & Minkov, 2010). An organizational culture most commonly refers to the collective way of thinking, values and ideology in an organization (Alvesson & Sveningsson, 2015). Organizational culture is a set of deeply embedded, commonly held values and beliefs (Van der Merwe, 2014). An organizational culture answers two critical questions: (1) what is important to the organization; and, (2) how employees should most appropriately act on achieving these important things (Hanson & Melnyk, 2014).

There are several different perspectives of an organizational culture (Sackmann, 2010):

- The organizational reality is socially constructed and organizations produce culture;
- A culture is a metaphor for understanding life in organizations;
- A culture is a variable; managers can measure, control, manipulate, and manage the culture for the best organizational performance.

Literature on an organizational culture commonly focuses on two aspects of a culture: (1) the content, which embodies typology and particular values, and (2) the strength, which embodies the depth of those values and behaviors embedded among the members (Prajogo & McDermott, 2011). The cultural content distinguishes one organization from another and sort organizations into different types (Giorgi et al., 2015). Cultural strength means consistency, organization-wide consensus, and clarity of values in an organization (Sackmann, 2010).

A culture as a set of values can make organizations internally homogenous but externally heterogeneous, distinct from other organizations. As a result, a culture can generate either negative outcomes either positive outcomes (Giorgi et al., 2015). As for cultural content, particular values, as specific attributes of an organizational culture, can be useful predictors of the organizational performance and the effectiveness (Denison & Mishra, 1995).

If a culture affects organizational performance, can one manage and change it? The management of an organizational culture relates to the awareness, recognition and optimal using of the current culture, changing or weakening undesirable norms and beliefs, fortifying desirable norms and beliefs and generally, stabilizing a desirable organizational culture (Alexander, 2012). One view to the management of a culture is that a culture is beyond control. The second view is that changing a culture is very difficult. The third view to the management of a culture is that leaders can change organizational culture with the use of sufficient skills and resources (Alvesson & Sveningsson, 2015). The leaders through shared practices can shape existing cultures (Hofstede et al., 2010).

While it is problematic to operationalize basic assumptions, espoused beliefs and values are more tractable and common in research (Narasimhan, Kull, Nahm, & Narasimhan, 2012). A tradition in organizational research relates culture to the ‘values’, that is, what we prefer, hold dear, or desire (Giorgi et al., 2015). The notion that beliefs and values should be studied is usual when researching an organizational culture (Narasimhan et al., 2012),

values often are considered as the central element of the culture for the assessment (Sackmann, 2010).

1.2.2. Measurement of organizational culture

Research instruments of organizational cultures tend adapting either a typological or a dimensional approach. A typological approach allows categorize organization into predefined types. A dimensional approach explores the extent to which any particular cultural dimension is present in an organization (Jung et al., 2009). Organizational culture survey instruments and assessment approaches represent three different categories: (1) survey instruments with pre-defined categories and approaches, (2) methods that extract culturally important dimensions from the inside of an organization, and (3) methods that are aiming to develop the present corporate culture further (Sackmann, 2010). Popular instruments measuring and assessing organizational cultures are Hofstede model, GLOBE framework, Trompenaars Corporate Culture Assessment Profile, Competing Values Framework (CVF), and the Denison Organizational Culture Survey (DOCS).

Hofstede model. Hofstede model proposes five predefined dimensions for research of national cultures. These dimensions are (1) power distance, (2) collectivism versus individualism (3) femininity versus masculinity (4) uncertainty avoidance, and (5) long-term versus short-term orientation. Yet, despite Hofstede's repeated warnings that his dimensions do not make sense at the individual or organizational level, many researchers attempted to use them for research of organizational cultures. However, for organizational cultures, entirely different dimensions exist (Minkov & Hofstede, 2011).

GLOBE framework. The GLOBE framework go beyond the Hofstede model and looks at the link between leadership, organizations, and national cultures (Evans, 2014). The GLOBE framework conceptualizes nine dimensions of a culture and six dimensions of the leadership. The GLOBE uses cultural dimensions named future orientation, gender equality, assertiveness, humane orientation, in-group collectivism, institutional collectivism, performance orientation, power distance, and uncertainty avoidance. While answering the GLOBE questions regarding these cultural dimensions, respondents judge what 'is' and what 'should be' (House, 2004). Although the GLOBE provides the empirical data only at the national level, conceptual definitions of the GLOBE cultural dimensions also apply to the organizational level (Naor, Linderman, & Schroeder, 2010).

Trompenaars Corporate Culture Assessment Profile. Trompenaars profile presents a seven-dimensional model of national culture differences with a focus on the impact of the various dimensions on how international business is conducted (Evans, 2014). The Trompenaars profile uses cultural dimensions named universalism–particularism, individualism–communitarianism, neutral–affective, specific–diffuse, achievement–ascription, sequential–synchronic, and internal–external control (Trompenaars & Woolliams, 2003). While answering the GLOBE questions regarding these seven cultural dimensions, respondents use bipolar values (Evans, 2014).

Competing values framework (CVF). CVF is a model based on the work by Quinn and Rohrbaugh and later refined by Cameron and Quinn to diagnose a cultural typology for the purpose changing the organizational culture (Cameron & Quinn, 2006; Voyt, 2011). For the diagnosis, CVF uses the 'organizational culture assessment instrument' (OCAI) questionnaire. CVF is a well-established and theoretically sound instrument. It has been widely used in quality management studies (Gambi et al., 2015) and in lean studies (Prajogo & McDermott, 2011; Paro & Gerolamo, 2017; Losonci, Kása, Demeter, Heidrich, & Jenei, 2017). The CVF is one of the most frequently used frameworks to explore culture typology and examine it association with organizational effectiveness (Ashkanasy, 2011).

Denison Organizational Culture Survey (DOCS). The DOCS measures cultural aspects as espoused beliefs and values (Alexander, 2012) as well as the corporate performance results - profitability, innovation, sales growth, quality, market share, and employee satisfaction. The DOCS assesses four primary cultural traits: involvement, consistency, adaptability, and mission. The full version of the survey questionnaire consists of 60 items regarding cultural aspects, 15 items per aspect (Denison & Neale, 1999; Skarphedinsson & Gudlaugsson, 2013). The short version of the survey consists of 36 items regarding cultural aspects (9 items per aspect), each of which uses a 5-point scale ranging from 1 = strongly disagree to 5 = strongly agree (Fey & Denison, 2004). The DOCS also assesses the corporate performance. Performance measures include profitability, market share, sales growth, innovation, and employee satisfaction and they have a link to return on shareholders' equity, customer satisfaction, and sales increase. These characteristics of the DOCS allows considering it a welcome instrument for assessing organizational culture with an interest in the corporate performance (Sackmann, 2010). The Denison Organizational Culture Survey (DOCS) is well established and has a solid theoretical foundation with good psychometric measures. Prior studies

have supported the DOCS factor structure with the four cultural traits as second-order factors and demonstrated acceptable levels of internal consistency for the 15-item sub-scales (Boyce et al., 2015; Denison et al., 2014). Though there are no reports on using the DOCS for research in lean setting, the DOCS hypothetically is a proper instrument for researching organizational cultures in lean settings.

Summarizing, the three major levels of a culture are (1) artifacts, (2) espoused beliefs and values, and (3) basic underlying assumptions. Most research considers values as the central element of the empirical cultural research. Hofstede cultural research model concentrates on the research of national cultures. GLOBE model includes research of leadership. Trompenaars profile and Competing Values Framework has the viewpoint of competing characteristics, allows measuring the typology of the organizational culture and does not directly allow measuring the strength of the corporate culture. In contrast, the Denison Organizational Culture Survey (DOCS) concentrates on research of the culture in organizations, allows measuring the cultural typology, the strength of the organizational culture, and the corporate performance, and is an attractive framework for the current research.

1.3. Review of literature on corporate performance

1.3.1. Definition and measurement of corporate performance

The old adage says that you can only manage what you do measure. The performance measurement enables better understanding, managing, and improving the performance (Harbour, 2011). The *'performance is the efficiency and/or effectiveness of an action*' (Bititci, 2015). There are different definitions of the corporate performance and corporate performance is clearly multi-dimensional (Sackmann, 2010). The need for a comprehensive view of corporate performance management has been widely recognized and discussed (Maltz, Shenhar, & Reilly, 2003).

The fundamental activity to evaluate and manage the performance and the competitiveness of an organization is the performance measurement (Hwang, Han, Jun, & Park, 2014). The *'performance measurement is the process of collecting, analyzing and reporting the information regarding the performance of an action'* (Bititci, 2015). The performance measurement may ensure that employee's behaviour is consistent with corporate goals and strategic objectives (Kaplan & Norton, 1992; Tangen, 2005). The performance measurement is important while is influences the performance itself. The performance measurement helps managing the organizational system and taking appropriate actions for maintaining the corporate competitiveness (Hwang, Han, Jun, & Park, 2014). The performance measures should reflect the most important factors (Tangen, 2005). Key performance measures focus an organization towards their chosen areas (Bhasin, 2008).

Capital markets emphasize the financial reporting. Consequently, firms practice the financial measurement, control and activities, even if it comes at the expense of investing for the future. It is crucial that performance measures provide organizations with tools to build their future. That includes measures that are indicative of investing in and developing long-term resources, facilities, and infrastructure (Maltz, Shenhar, & Reilly, 2003). The need exist for integrating non-financial measures, such as strategic, operational, quality perspectives, as complementary to the financial measures (N. Yadav & Sagar, 2013).

There is a widespread agreement on the two dimensions of organizational measures – technical and social. Rational and technical measures describe mechanistic, process things to manage operational performance. In contrast, cultural and social measures describe the human dimension. Technical and

social controls both are drivers of the corporate performance; they should be balanced one with another. What organizations measure (technical measures) and how organizations use these measures (social measures) appear to have an impact on the engagement of people and, ultimately, on the corporate performance (Bititci, 2015).

One set of measures does not fit all organizations. In contrast, different types of organizations should employ different performance measures. However, some measurements are fundamental across the sectors. These measurements could be adapted as 'baseline' or 'core' measures. Thus, while there is no universal prescription for performance metrics, baseline measures can be viewed as a starting point for measurement not regarding sector, size or other peculiarities of the firm (Maltz, Shenhar, & Reilly, 2003). Specific industries may still have their own key metrics metrics—for example, ROI may be a critical measure for investment firms, while the market position can be critical to firms in competitive markets (Maltz, Shenhar, & Reilly, 2003). Lean organizations may use specific 'lean metrics' (Woehl, 2011; D. F. M. Duque & Cadavid, 2013; Narayanamurthy & Gurumurthy, 2016).

1.3.2. Dimensions of corporate performance

The performance measures must be designed to reflect the most important factors (Tangen, 2005). The performance measurement can measure and affect three managerial levels: strategic level, tactical level, and operational level (Hwang, Han, Jun, & Park, 2014). As defined by various researchers, two dimensions of the corporate performance measurement are financial and non-financial (Maltz, Shenhar, & Reilly, 2003).

Traditional **financial measure**s are: (1) EBITDA – earnings before interest, taxes, depreciation and amortization. EBITDA is a measure of operating profitability, which measures how much profit a company makes with its present assets, operations and cash flow. EBITDA appears a common measure to value a business when selling and buying businesses; (2) return on investment (RoI). A RoI measure of investment gains used to evaluate the performance of an investment. In business terms, it considers profits in the context of the capital invested; (3) return on net assets (RoNA). RoNA is a measure of financial performance in relation to the value of a company's assets. It is a measure of how well a company is using its assets and working capital; (4) economic value added (EVA). EVA is a measure of a company's financial performance, based on the residual wealth calculated by deducting cost of capital from operating profit, adjusted for taxes on a cash basis (Bititci,

2015). Other financial measures are operating profits, profit/sales ratio, cash flow, average revenue growth, return on sales (ROS), profitability, and growth in net income (Maltz, Shenhar, & Reilly, 2003).

There is a debate on the appropriateness of financial measures for assessing the performance of organizations. Many argue that they do not represent the full picture – the real performance of the organization – and that they could be manipulated to show the performance of an organization better than it is in reality (Bititci, 2015). Classic financial measures are incapable of distinguishing differences in long-term performance; accounting related measures of the financial performance record only a history of a firm (Maltz, 2000). All these measures are a function of revenues, costs, profitability and cash flow at a given point in time. They do not effectively consider factors such as customer satisfaction and goodwill, employee morale and engagement, operational performance factors such as on-time delivery, end-to-end turnaround times, product, and service quality amongst many others. So they are all somewhat flawed. They tell us very little about the potential of the company - the likely performance of the business in the future (Bititci, 2015). Limitations of traditional financial measures together with intense competitive pressures and changing external demands have led to the increased advocacy for non-financial measures (Tung, Baird, & Schoch, 2011).

As of **non-financial measures**, **operational** (process) **measures** are perhaps most often used. The operational performance is one of the antecedents of the financial performance, and organizations often have more control over operations than over the financial performance, which is often affected by external factors (Prajogo & McDermott, 2011). The operational performance has a major impact on the product cost, product reliability, cycle time, etc. Therefore, the measurement of the operational performance is an important subject. Operational metrics measure how a manufacturing or service business is performing, how effectively operations and business is achieving its defined goals (Hwang et al., 2014).

The most important concept when managing the performance of operations is a flow. In general, three things flow through a process: information, materials and customers. In manufacturing, primarily flowing objects are information and materials. In service, primarily flowing objects are information and/or customers. The operational performance is the efficiency and effectiveness of these processes. Basic flow operations to measure are: (1) development of products and services that customers want (2) generation of

the demand for products and services; (3) fulfillment of the demand by customers; (4) provision of the aftersales service (Bititci, 2015).

The operational performance is conceptualized in terms of the quality performance (e.g. scrap rate, rework rate), the operations cost (e.g. unit cost), the inventory (e.g. inventory turns, inventory levels), the cycle time (e.g. manufacturing cycle time, lead time, and throughput time), the manufacturing flexibility (e.g. mix, modification, volume, new product, and expansion) and the delivery performance (e.g. delivery reliability, delivery speed) (Mackelprang and Nair, 2010). Organizations measure cost of manufacturing, quality conformance, on time delivery performance, fast delivery, flexibility to change product mix, flexibility to change volume (Bortolotti, Danese, et al., 2015). Yet other operational performance measures are manufacturing cost performance, quality, delivery performance, flexibility to change product mix, flexibility to change volume, flexibility to change volume, inventory turnover, cycle time, speed of new product introduction, customer support and service, and product capability and performance (Matsui, 2007). Measuring only the operational efficiency can be dangerous. Operations of Swiss watch companies were very efficient in making mechanical watches yet these companies are now out of the business (Liker, 2004). Many mediocre companies focus on operational measures without a strong connection or linkage to the customer need in the targeted market segments (Bhasin, 2007; Frigo, 2003).

Non-financial **'customer/market' measures** are conceptualized in terms of product reliability in service, defect ratio, customer delivery commitments met, customer satisfaction, productivity (Wiengarten, Gimenez, Fynes, & Ferdows, 2015). Classic customer related measures also are product support, styling/design, image/brand identity, customer support, flexibility and responsiveness, innovation, relationship and empathy (Bititci, 2015), customer satisfaction index, customer retention rate, service quality (Maltz, 2000). High-performance organizations focus first and foremost on the customer need, and then adjust internal processes appropriately (Frigo, 2003).

Non-financial **'people' (people development) measures.** The corporate performance, particularly the long-term sustainable performance, is all about people. However, modern management systems in contemporary organizations largely lack the measurement of the human component (Bititci, 2015). The level of employee skills, commitment to technological leadership, personnel development, staff slack resources are indicative of the essential role of employees in the organizational performance (Maltz, Shenhar, & Reilly, 2003). The people performance is conceptualized in terms of 'retention

of top employees', 'quality of professional/technical development', 'quality of leadership development' (Maltz, 2000).

All before mentioned performance groups result in the **overall (cumulative) corporate performance**. The perspective of the overall (cumulative) performance refers to the simultaneous pursuit and measurement of multiple dimensions of the performance (Bortolotti, Danese, et al., 2015).

1.3.3. Performance measurement systems and frameworks

A performance measurement system (PMS) is a structured set of performance measures (i.e. a metric used to quantify the efficiency and the effectiveness of an action) that provides useful information that helps to manage, control, plan and perform activities (Tangen, 2005). A PMS plays an important role in managing business as it provides the information necessary for decision-making actions and therefore it is essential to measure the right things at the right time in a supply chain (Karim & Arif-Uz-Zaman, 2013). A good PMS: (1) provides accurate information; (2) supports strategic, tactical and operational goals; (3) protects against sub-optimization; and (4) includes a limited number of measures (Tangen, 2005). Traditionally, PMSs focuses on financial measures such as profit, cash flow and return on investment to evaluate the performance (Tung et al., 2011). However, traditional financial accounting measures alone are no longer appropriate in today's business environment. There is the need to integrate non-financial perspectives, such as strategic, operational, quality perspectives, as complementary to the financial perspective (N. Yadav & Sagar, 2013).

Many PMS separate the traditional cost performances (the production costs and the productivity) and the more innovative non-cost measures as quality, time and flexibility. However, to make the most of the potentialities of PMS, formalization and integration are of prime importance (De Toni & Tonchia, 2012).

The widely known PMSs in the business are: (1) the supply chain operations reference (SCOR) model; (2) Denison organizational culture survey (DOCS), which includes performance measures; (3) the Balanced Scorecard (BSC); (4) the dynamic multi-dimensional performance framework (DMP).

Supply chain operations reference (SCOR) is an operational performance measurement system. The SCOR model advocates for performance metrics used in conjunction with five performance attributes:

reliability, responsiveness, flexibility, cost, and asset volume (Hwang et al., 2014).

Denison organizational culture survey (DOCS) focuses on cultural measures but includes measures of the business level performance. DOCS' respondents rate organizations on six dimensions of the corporate performance relative to similar companies: (1) sales/revenue growth, (2) market share, (3) profitability, (4) quality of goods and services, (5) new product development, (6) employee satisfaction. All items use a five-point Likert-type scale ranging from 1 = 'low performer' to 5 = 'high performer' (Denison et al., 2014).

Balanced Scorecard (BSC) is perhaps the most popular performance measurement framework (Bititci, 2015). About half of large US firms have adopted the BSC and many are considering implementation (Marr & Neely, 2003). The Balanced Scorecard uses 15-20 measures, which are organized around four distinct perspectives: (1) financial, (2) customer, (3) internal processes, and (4) innovation and learning (Kaplan & Norton, 1992). Despite the popularity of the BSC, it has proven inadequate in certain circumstances. A weakness of BSC is the omission of the shop floor level operational measures. While the BSC framework provides constructs for multiple measures and overcomes the limitations of single measures, it has no clear provision for very long-term success measures. The lack of focus on a company's human resources dimension is perhaps the most notable weakness of the BSC (Bhasin, 2008; Maltz, Shenhar, & Reilly, 2003).

Dynamic Multi-dimensional Performance framework (DMP) has the similarities with BSC. However, the DMP distinguishes baseline and firm/sector specific measures / variables. Baseline variables are suitable for all firms in all sectors; firm/sector specific variables are suitable in specific cases. Baseline variables have five perspectives: (1) financial, (2) customer/market, (3) process, (4) people development, and (5) preparing for the future (Maltz, Shenhar, & Reilly, 2003), see Table 4.

Table 4. **Structure and measures of DMP** (source: Maltz, Shenhar, & Reilly, 2003)

Perspective	Measure
Financial	'Sales', 'profit margin', 'revenue growth', 'cash flow', and 'net operating income'.
Customer /Market	'Customer satisfaction', 'customer retention rate', 'service quality', 'responsiveness', and 'customer benefits from product/service'.
Process	'Time to market for new products and services', 'quality of new product development and project management processes', 'quantity and depth of standardized process', 'quality of manufacturing process', and 'quality initiative processes'.
People Development	'Retention of top employees', 'quality of professional/technical development', 'quality of leadership development', 'encourage employees to suggest and test new ideas' 'employee skills training', and 'employee satisfaction survey'.
Preparing for future	'Depth and quality of strategic planning', 'anticipating and preparing for unexpected changes in the external environment', 'extent of joint ventures and strategic alliances to gain competitiveness in new technologies,' 'investment in new market development', and 'investment in new technology development'.

The final set of measures is a function of the context; it depends on the firm's strategy, the particular industry and environment in which a firm competes (Maltz, Shenhar, & Reilly, 2003). The DMP stresses the need utilizing a small set of multidimensional metrics, the criteria for including particular metric is the alignment of the metric to the firm's strategy. The DMP shows more robustness than its predecessors' do (Bhasin, 2008).

Summarizing, (1) the performance measurement is an important activity for the corporate success, (2) ideally, performance measures should report on all areas of corporate activities, (3) performance measurement systems help measuring the performance in a structured way, and (4) one of the structured contemporary PMS's, the dynamic multi-dimensional performance framework (DMP) is attractive for measuring complex corporate activities. The current research used the DMP as the measurement system that (1) was promoted by lean authority Sanjay Bhasin (Bhasin, 2008) as proper measurement instrument in lean settings and (2) is able measuring various performance areas.

1.4. Relationships of lean and corporate performance

1.4.1. Influence of lean on corporate performance

Plenty of research views the relation of lean and performance as causal – lean is influencing various performance measures (Chavez, Gimenez, Fynes, Wiengarten, & Yu, 2013a; Gambi et al., 2015; Hofer et al., 2012; Losonci & Demeter, 2013a; Narasimhan et al., 2012; Nawanir et al., 2013). Furthermore, most articles suggest a positive effect of lean practices on at least one of several performance measures – financial, operational, and/or other (Negrão et al., 2017).

There are two dominant views on the influence of some practices on the performance - the 'best practice' view and the 'best fit' view. The former view says that some practice or the set of practices are applicable anywhere; the latter view argues that practices have to be consistent with each other ('internal fit') and with the context of the particular organization ('external fit'). However, the 'best practice' and 'best fit' concepts need not be alternatives. One possibility is that a set of basic good practices benefit all organizations. Another possibility is that the particular practices may need to be tailored to the needs of the specific organization, to the strategy being followed, to the expectations of employees' and to the organizational context (Colling & Terry, 2010). The question is, if lean practices are the 'best practices' that are applicable and do provide positive influence on the corporate performance anywhere, and if the 'best fit' thinking applies, where lean practices will only provide the positive influence on the performance, if there is a fit between lean practices and a business context of the particular organization.

Influence of lean on financial performance. In 2003, Toyota's return on assets was 8 times higher than the industry average. Toyota's corporate performance attributes during many years were top quality, steadily growing sales, and consistent profitability (Liker, 2004). However, empirical results regarding improvements of the financial performance of lean companies are ambiguous. In spite of the popularity of lean production academic community cannot prove positive effects of lean production on the financial performance (Losonci & Demeter, 2013a). Some studies confirm the positive other researchers do not find any relationships (Fullerton & Wempe, 2009). According these studies, adopting JIT or TQM did not improve profitability (Fullerton and Wempe, 2009); there is no positive link between lean production and financial business performance metrics namely sales, market ratio, return on sales (ROS), and return on investment (ROI) (Losonci &

Demeter, 2013b). Degree of leanness (defined as extent to which a firm implement a variety of lean practices) was not associated with financial performance (Galeazzo, 2019). However, other studies (Olsen, 2004; Hofer et al., 2012) did find a support for a positive causal association between lean practices and the financial performance. Some studies reported that there was a large performance gap between companies that had applied lean practices solely on the shop floor, as opposed to companies that had developed a lean culture throughout the organization (Fullerton et al., 2014). Some researchers (Sackmann, 2010) even argue that the link to financial performance may be difficult to establish at all. In a large organization, lean takes one to three years before its effects show up on corporate financial statements (Mann, 2015).

Influence of lean on customer / market performance. One of the main lean principles is the 'customer focus' (Thomas, Antony, Francis, & Fisher, 2015). The lean philosophy is about satisfying customer's demand. Lean eliminates waste and adds customer value (Hozak & Olsen, 2015). Despite the fact that lean declares the focus on the customer, only few studies analyzed the influence of lean on the customer performance. These studies concluded that implementation of lean places great benefits on areas that includes increase the customer satisfaction (Sohal & Egglestone, 1994), and that better lean value chain practices have direct positive impact on the quality of relationships with customers (Sharma, Dixit, & Qadri, 2015).

Influence of lean on operational performance. The majority of empirical studies supports the overall positive impact of lean on a firm's operational performance (Moyano-Fuentes and Sacristán-Díaz, 2012). Toyota shows the best class through high quality, high productivity, manufacturing speed, and flexibility (Liker, 2004). The lean management has a significant relationship with the operational performance (Fullerton, Kennedy, & Widener, 2014). Lean practices have a positive influence on the operational performance (Nawanir et al., 2013). Lean management is widely recognized as improving the overall operational performance of a company (Liker, 2004). A direct relationship exists between hard and soft practices implementation and physical work environment and job characteristics, which, in turn, directly affect operational outcome in the short term (Gaiardelli et al., 2018). Implementation of lean principles results in reduction of inventory, floor space, transportation, manpower, equipment requirements, changeover time, order lead time, system flow time and reduces variability in supplier demand (Detty & Yingling, 2000). The main benefits consist of reducing process variability, scraps, and rework time, which in turn reduce production costs, lead-time and increase process flexibility and quality conformance (Bortolotti,

Danese, et al., 2015). The results indicate that the relationships between internal lean practices and quality, delivery, flexibility and cost were found to be positive and significant (Chavez, Gimenez, Fynes, Wiengarten, & Yu, 2013b). Lean maturity positively influence such operational performance elements as cost, delivery, flexibility, overtime, launch of new products, lead time, and quality (Bento & Tontini, 2018). Overall, implementation of lean practices is frequently associated with improvements in operational performance measures (Shah and Ward, 2003, p. 133).

Influence of lean on people development performance. Two main lean principles regarding people are 'respect' and 'development' (Liker, 2004). The people development is related to a 'people value stream' and includes the development of individual skills, on-the-job development, section-specific training, coaching etc. (Liker & Hoseus, 2010). Lean human resources policies relies on the long-term philosophy, leaders teach subordinates with the goal of developing exceptional teams and people (Lacksonen, Rathinam, Pakdil, & Gülel, 2010). Despite the fact that lean philosophy highly value the people development, there is a lack of empirical studies regarding the people results and the people development performance. Results of these few studies show that implementation of lean tends to reduce the number of employees, reduce diversity of people behaviors and beliefs, reduce disruptions due to information and human-related problems, and increase richness and frequency of interactions of people (Soliman, Saurin, & Anzanello, 2018).

Influence of lean on preparing for future performance. Preparing for future is defined as the degree of activities to which an organization focuses on future-oriented behaviors such as strategic planning, anticipating and preparing for unexpected changes in the external environment, joining strategic alliances to gain competitiveness, investment in new market development, and investment in new technology development (Maltz et al., 2003). Theoretically, lean has tools that aim to the preparing for future. For example, Hoshin Kanri is a method used to help lean practitioners identify and deploy their strategic goals as well as providing them with valuable insights into the future needs of their business (Testani & Ramakrishnan, 2013), value stream mapping (VSM) allows creating future-state maps (Hadid & Mansouri, 2014) and Kaizen events help realize a waste free future state (Ahrens, 2006). Few empirical studies on impact of lean on preparing for future showed positive results on the preparing for future performance. Hard lean practices were most effective in countries that have low future orientation' (Kull et al., 2014), lean practices, like VSM, helped in understanding current value streams and defining future value streams (Sharma et al., 2015), and lean

practices implementation had a positive impact on the product innovation (Bevilacqua, Ciarapica, & Sanctis, 2017).

Influence of lean on overall (cumulative, business level) performance. An overall (cumulative) performance is a sum of all (financial, customer / market, operational, people development, preparing for future) performances. Empirical research show that lean practices have a positive and significant impact on business level performance (Nawanir et al., 2013). A strong connection exist between lean production, product quality performance, and business performance (Agus & Hajinoor, 2012). The performance benefits of lean systems are often remarkable, greatly improving quality, cost, and delivery (Lander & Liker, 2007). Lean works well on enhancing organization performance (Salhieh & Abdallah, 2019). Although, lean production is not a guarantee for business success. It might be a necessary but definitely not a sufficient condition (Losonci & Demeter, 2013b).

Influence of lean methods versus influence of lean principles. Organizations tend deploying easy results-oriented and tools-only approach. This approach does not work for long. A different evolutionary approach relies on principles-led behaviors, systems, and cultural change. This approach appears to be more successful and more sustainable (Hines, Taylor, & Walsh, 2018).

Summarizing, the literature claims the positive influence of lean practices on the operational performance. However, there is few empirical research on the influence of lean on other (financial, customer/market, people development, preparing for future) areas of the performance. The current research aims to fulfil this empirical gap.

1.4.2. Hypothesized relationship of lean and corporate performance

Most research show that relation of lean practices (LP) and corporate performance (CP) is causal – lean practices influence the performance. Further, the literature show a systemic structure of both a set of lean practices and a set of performance measures. Such point of view provides the basis for creating a set of hypotheses (see Table 5).

Table 5. **Influence of LP on CP: hypotheses based on literature** (source: own analysis)

No	Initially hypothesized relationship
1.	Lean practices are positively influencing corporate performance
2.	Either lean methods or lean principles are positively influencing corporate performance
3.	Either hard lean methods, soft lean methods, hard lean principles, or soft lean principles are positively influencing corporate performance
4.	Lean practices are influencing financial performance
5.	Either lean methods or lean principles are influencing financial performance
6.	Either hard lean methods, soft lean methods, hard lean principles, or soft lean principles are influencing financial performance
7.	Lean practices are influencing customer / market performance
8.	Either lean methods or lean principles are influencing customer / market performance
9.	Either hard lean methods, soft lean methods, hard lean principles, or soft lean principles are influencing customer / market performance
10.	Lean practices are positively influencing process / operational performance
11.	Either lean methods or lean principles are positively influencing process / operational performance
12.	Either hard lean methods, soft lean methods, hard lean principles, or soft lean principles are positively influencing process / operational performance
13.	Lean practices are influencing people development results
14.	Either lean methods or lean principles are influencing people development results
15.	Either hard lean methods, soft lean methods, hard lean principles, or soft lean principles are influencing people development results
16.	Lean practices are influencing preparing for future performance
17.	Either lean methods or lean principles are influencing preparing for future performance
18.	Either hard lean methods, soft lean methods, hard lean principles, or soft lean principles are influencing preparing for future performance

For the current research, the initial structure of lean practices includes four structural elements, namely hard lean methods, soft lean methods, hard lean principles, and soft lean principles. Research hypotheses involve a summated variable of all lean practices, two variables for both lean methods and lean principles, and four variables for hard lean methods, soft lean methods, hard lean principles, and soft lean principles. Additionally, the current research measures links of each individual lean practice and complex performance outcomes. The systemic structure of the corporate performance measurement is based on the dynamic multi-dimensional performance framework (DMP framework) and includes five performance areas, namely financial performance, customer / market performance, process performance, people development performance, and preparing for future performance. Research

hypotheses involve all individual variables of each area of performance as well as the summated variable of cumulative corporate performance. While literature suggests that a lean practices positively influence the performance, all research hypotheses state the positive influence.

1.5. Relationships of organizational culture and corporate performance

1.5.1. Influence of organizational culture on corporate performance

A specific kind of the corporate culture may contribute to the success of the organization. On the other hand, the success of an organization reinforces the existing organizational culture. Accordingly, some authors argue that the link between the organizational culture and the corporate performance is reciprocal (Sackmann, 2010). However, longitudinal studies show that the organizational culture has a causal priority over the performance outcomes (Boyce et al., 2015) and the organizational culture do influence the performance (Murphy et al., 2013).

There are three hypotheses regarding the influence of a culture on the performance:

- Adaptive culture hypothesis says that culture is able to respond and adapt to changes in the environment. Adaptation of the culture is the main key to excellent corporate performance (Alvesson, 2002).
- Contingency culture hypothesis assumes that under certain conditions a particular type of culture is appropriate, and contributes to performance (Alvesson, 2002).
- Strong culture hypothesis assumes that strong commitment of employees to the same set of values will produce positive results; the 'strength' of the culture directly correlates with the performance of the organization. A 'strong' culture causes high corporate performance and is desirable (Sackmann, 2010).

The empirical research on the **adaptive culture hypothesis** shows that specific culture traits may be useful predictors of performance and effectiveness (Denison & Mishra, 1995). An adaptive culture is anticipated to be positively associated with the performance in dynamic business environment (Xenikou & Simosi, 2006). The organizational culture can be a potent competitive advantage, but it can also hold companies back if it is not adaptive to the marketplace or not aligned with strategy and business needs (Nathan, 2014). If the business philosophy and management approach does not include constant adaptiveness, then business stuck in patterns that grow less applicable in changing circumstances (Rother, 2010). An adaptive culture is important in affecting good performance in addition to the strength of a culture (Prajogo & McDermott, 2011). An adaptive organization is able successfully facing current and future challenges (Ballé et al., 2019).

Companies with adaptive cultures will experience a higher economic performance (Deem, 2009).

The empirical research on the **contingency culture hypothesis** shows that the cultural typology affect interaction between the technique (e.g. lean) and the organization (Lozeau, Langley, & Denis, 2002). Some research show that '*a specific cultural profile characterizes successful lean plants*' (Bortolotti, Boscari, et al., 2015). Certain levels of cultural dimensions associates to different performance outcomes (Bortolotti, Boscari, et al., 2015). As an example, cultural trait involvement is positively related to effectiveness (Denison & Mishra, 1995).

The empirical research on the **strong culture hypothesis** shows that a 'cultural strength' relates to the extent to which certain core values are present (Sawner, 2000). It determines how many important shared assumptions there are, how widely they are shared, and what the importance ranking of these assumptions is (Alvesson, 2002). Organizations are effective because they have 'strong' cultures that are highly consistent and well-integrated (Denison, Haaland, & Goelzer, 2004). All four Dennison's cultural traits have a strong relationship with business performance (You, Coulthard, & Petkovic-Lazarevic, 2010). High overall levels of involvement, consistency, adaptability, and mission characterizes effective cultures (Boyce et al., 2015).

Influence of organizational culture on financial performance. Cultural elements namely mission and consistency influence profitability (Denison & Mishra, 1995; You et al., 2010). All four Dennison's cultural traits significantly correlate with profitability (Nazir & Lone, 2008). The findings indicate that there is no relationship between culture and its financial performance as measured by ROS (Banton, 2002).

Influence of organizational culture on customer / market performance. A culture has causal priority over customer satisfaction (Boyce et al., 2015). A organizational culture relates significantly and positively to customer satisfaction (Gillespie, Denison, Haaland, Smerek, & Neale, 2008). Consistency and adaptability positively influence customer satisfaction. In contrast, influence of involvement and mission on customer satisfaction is negative (Gillespie et al., 2008). Cultural elements namely mission and adaptability influence sales growth (Denison & Mishra, 1995; You et al., 2010). All four Dennison's cultural traits significantly correlate with market share (Nazir & Lone, 2008).

Influence of organizational culture on operational performance. Operational performance is a main antecedent of financial performance. Organizations often have more control over the operational performance than

over financial performance, while external factors such as macroeconomic conditions often affect the financial performance. Organizational culture positively influences such operational performance measures as 'product quality' and 'process quality' (Prajogo & McDermott, 2011).

Influence of organizational culture on people development performance. Cultural element involvement encourages team orientation and employees' empowerment (You et al., 2010). All four Dennison's cultural traits significantly correlate with employee satisfaction (Nazir & Lone, 2008).

Influence of organizational culture on preparing for future performance. Organizational culture positively influences such preparing for future measures as 'product innovation' and 'process innovation' (Prajogo & McDermott, 2011). All four Dennison's cultural traits significantly correlate with new product development (Nazir & Lone, 2008).

Influence of organizational culture on overall (cumulative, business level) performance. Cultural values influence the daily decisions that employees make. Then, these daily decisions affect organizational processes. This is why it has been widely accepted that organizational culture has an influence on organizational performance (Van der Merwe, 2014). Corporate performance, particularly long-term sustainable performance, depends on culture (Bititci, 2015). High DOCS cultural scores associate with superior performance when compared to the companies with low DOCS cultural scores (Sackmann, 2010). The most effective organizations have high levels of all four traits (Denison et al., 2014).

1.5.2. Hypothesized relationship of organizational culture and corporate performance

Contingency culture hypothesis suggests that a specific cultural profile associates with good performance. In the case of DOCS, this means that one or few of the cultural elements namely involvement, consistency, adaptability, and mission would have greater influence on performance than other cultural elements. Contingency culture' hypothesized relationships include hypotheses regarding each element of Dennison's profile. Strong culture hypothesis suggests that a strong culture associates with good performance. Strong culture' hypothesized relationships include hypotheses regarding strength of the organizational culture.

Literature show a systemic structure of corporate performance measures. While DMP is the basis for measurement of the corporate performance, the structure includes five elements, namely financial, customer / market, process,

people development, and preparing for future performance. Hypothesized relationships include hypotheses regarding the overall corporate performance, and hypotheses regarding each structural element of the performance. Such point of view provide the basis for creating a set of hypotheses (see Table 6).

Table 6. **Influence of OC on CP: hypotheses based on literature** (source: own analysis)

No	Initially hypothesized relationship
1.	Strength of an organizational culture positively influences corporate performance
2.	Either involvement, consistency, adaptability or mission positively influence corporate performance
3.	Strength of an organizational culture positively influences financial performance
4.	Either involvement, consistency, adaptability or mission positively influence financial performance
5.	Strength of an organizational culture positively influences customer / market results
6.	Either involvement, consistency, adaptability or mission positively influence customer / market results
7.	Strength of an organizational culture positively influences process / operational results
8.	Either involvement, consistency, adaptability or mission positively influence process / operational results
9.	Strength of an organizational culture positively influences people development results
10.	Either involvement, consistency, adaptability or mission positively influence people development results
11.	Strength of an organizational culture positively influences preparing for future results
12.	Either involvement, consistency, adaptability or mission positively influence preparing for future results

The current research takes contingency culture and strong culture approaches and addresses the influence of the organizational culture on financial, customer/market, operational, people development, preparing for future performance, and overall performance. In the current research, the contingency approach looks for the appropriate typology of the organizational culture ('strategy-culture fit') and analyses the influences of cultural dimensions on the corporate performance. Similarly, the strong culture approach looks for the strength of the culture and analyses the influence of the cultural strength on the corporate performance.

The literature suggests that a culture as well as each structural dimensions namely involvement, consistency, adaptability, and mission positively influence the performance, all hypotheses of the current research states the positive influence.

1.6. Relationships of lean and organizational culture

1.6.1. Relations of introduced techniques and organizational cultures

The divergence hypothesis argues that a national culture rather than industry practices drives values. Even if nation becomes industrialized, the values systems in the work force in the same industries will vary across the nations. Thus, even if organizations located within different nations adopt similar industry practices, cultural forces rather than industrial practices will govern behavior of people. The convergence hypothesis implies that as organizations adopt particular industrial practices, they embrace work-related behavior and culture related to these practices. Thus, organizations can alter the behavior of people and undermine the effect of national cultures (Naor et al., 2010). In the same way, cultural theorists generally consider social practices as the manifestation of underlying belief structures that shape an action (including managerial practices), and managerial practitioners emphasize routines and managerial practices as having a power in altering values and attitudes (Canato et al., 2013). In practice, when an organization starts implementing a new managerial technique, different outcomes are possible:

- transformation of an organization - the technique may transform the culture of the organization so that the functioning fits the theory behind the technique;
- customization of the technique - the technique may be adapted and customized to make it more compatible with the organizational culture without destroying its aims;
- loose-coupling - the technique may be adopted superficially, as a behavioral ritual;
- corruption of the technique - the technique may be captured and used to reinforce existing roles and power structures while the culture of the organization does not change (Lozeau et al., 2002).

Managers in an organization may work to adapt new techniques while changing the organization, may adapt new techniques to fit the organization, or alternatively may do both (Stensaker & Falkenberg, 2007). Fidelity and extensiveness characterize the adaptation of new technique. Fidelity is the extent to which organization follows the theory behind new technique rather than customizing it. Extensiveness is the degree of implementation of new technique into the organization — that is, the extent to which the new technique is adopted across organizational units (Ansari, Fiss, & Zajac, 2010). People in organizations may react differently to the implementation of a new

technique. A reaction may be convergent - a majority of people understands corporate intentions and act accordingly, implementation of a new technique lead to organizational transformation. A reaction may be divergent - people interpret the changes differently from corporate intentions and their actions therefore do not coincide with the corporate intentions; such responses lead to the corrupted implementation outcomes. A reaction may be customized/creative - people translate techniques into the corporate context and develop them. Reaction may be 'loosely coupled' - people are unable to understand the sense introducing new technique, and few action follows (Stensaker & Falkenberg, 2007).

Introduction of new techniques often develops as a single project with specific milestones and deadlines. Although, behavioral patterns tend to change over long time rather then immediately, by the end of a milestone. Corporate managers need to recognize the temporary and changing nature of initial responses and proceed shaping the development of responses over long time (Stensaker & Falkenberg, 2007). '*Behavioral change alone will not last unless it is accompanied by cognitive redefinition*' (Schein, 2010).

1.6.2. Influence of lean practices on organizational culture

Making such significant organizsational change as lean does involve creating the right culture: a lean culture (Hines, 2000). The old model for creating a lean culture was first implementing a lean philosophy and lean culture within their organizations and then hoping that the behaviour of people will change. The idea was that organizational change is about by first changing people's attitudes and values (S. Shetty et al., 2010). A culture could be intentionally build, however consciously changing a culture is a hard work (Pennington, 2009). Organizations that apply lean and want to reach perfection, need to change the way they think first (Seddon, 2005). The lean philosophy and culture has been the focus of numerous continuous improvement initiatives; however, the effectiveness and sustainment of philosophical and cultural lean principles has been highly variable (S. Shetty et al., 2010). Conventional habits and behaviors live on, even if the operation layouts, individual roles, process sequences, material, and information flows have been changed (Mann, 2015).

Relating to other colleagues at work forms conventional cultural practices and work-related organizational-wide habits. Such habits are just as difficult to change as personal habits. In contrast, lean practices are tied to strict adherence to the defined process. In such case, the principles and the new

change model is that process change must come first and drive cultural change (Mann, 2015). An evolution of a lean organization goes through stages, characterized as (1) tool-based change, (2) systems-based change, and (3) culture-based change (Hines et al., 2018). The way to change the culture is not to first change how and what people think, but instead to start by changing how they behave — what people do (Shook, 2010), see Figure 7.

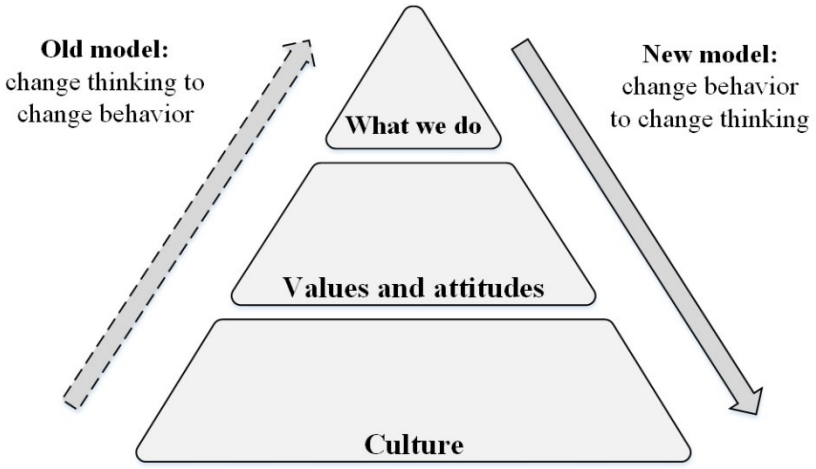

Figure 7. **Influence of lean on organizational culture**
(source: Shook, 2010)

A company's culture is a result of its management system. As lean management, with its focus on processes becomes habitual, a lean culture begins to develop (Mann, 2015). While an organization implements lean tools and techniques, lean culture is likely to evolve (Bortolotti, Boscari, et al., 2015). Within lean the major way of changing the organizational culture is by doing (Ingelsson & Mårtensson, 2014). When you change the design and management of work, and make those who do the work the central part of the focus, the culture changes because of this (Seddon, 2005).

Habits changes through extinguishing. The term 'extinguishing' implies a process that occurs gradually over time, rather than an event producing a suddenly changed norm (Mann, 2015). Under normal circumstances, extinguishing likely to occur slowly and incrementally (Canato et al., 2013). Extinguishing also implies a change that can be reversed under certain conditions (Mann, 2015).

Many of existing cultural habits in organizations are likely incompatible with lean environment (Mann, 2009). Then, in the absence of prolonged

actions, lean changes that are inconsistent with such cultural habits would be fragile and susceptive to regression (Canato et al., 2013). The need changing a culture can be considered as a part of the change process, not necessarily an impediment for an organization when it chooses implement new managerial techniques (Narasimhan et al., 2012). This process could lead to different outcomes. Past research on adoption of new techniques generally suggests that in cases of low cultural fit, widespread resistance to a new technique leads to its ceremonial adoption, adaptation, or abandonment (Ansari et al., 2010; Lozeau et al., 2002). Although a prolonged coercion to adopt a new technique may eventually induce members to internalize some patterns of this technique, and to engage in these patterns of action without need of further coercion (Canato et al., 2013). People who engage in routines adjust their actions as they develop new understandings of what they do (Feldman & Orlikowski, 2011).

1.6.3. Influence of organizational culture on lean

Organizations often see the culture as an obstacle, something that is irrational and difficult to deal with. These views are best expressed though the adage '*culture eats strategy for breakfast*' (Hanson & Melnyk, 2014). When values of an organization are not congruent with the new initiative, the culture may deter the implementation or diminish the effectiveness of the implementation. A non-integrative culture and the approach 'not-invented-here' may discourage the implementation of lean practices (Narasimhan et al., 2012). Given the deep embedded nature of a culture, the difficulty in changing it and the fact that the organizational culture reflects the combination of the various characteristics and practices adopted, it is unlikely that the implementation of one managerial technique would have a substantial impact on the culture. Rather otherwise - the prevailing organizational culture may support the practice by providing an cultural environment that is conducive to successful implementation of the practice (Baird, Hu, & Reeve, 2011). While a culture is often cast as a source of inertia and cause for rejection of change, it may play an essential helping to implement new initiatives (Hanson & Melnyk, 2014).

A culture has increasingly been suggested as the key to lean implementation and continuity (Erthal & Marques, 2018). An organizational culture has an impact on the implementation of lean. The root of most lean failures is the organization's culture and the change process (Bhasin, 2011). New practices do not diffuse into the cultural void but, rather, into the preexisting culture that delineates roles and responsibilities of individuals and

patterns of the appropriate behavior (Ansari et al., 2010). A new practice may create a conflict between what people are required to do and the ways in which they were doing for a long time, the ways they feel it is appropriate do the things. New practices that require a behavior that contradicts the established beliefs, will create anxiety and emotional discomfort, resulting in reluctance to implement new practices (Canato et al., 2013). When a misfit between the organizational culture and practices occurs, the organization may corrupt and distort practices in order to make them compatible with the values and behaviors of the organization (Lozeau et al., 2002). When the compatibility gap of the culture and practice is large, there is greater likelihood that corruption of the technique will occur than that the technique will transform the organization (Lozeau et al., 2002). The cultural misfit with a technique tends to decrease either the fidelity or the extension of the practice (Ansari et al., 2010).

A compatibility between a practice and the existing organizational culture is a 'cultural fit' - a degree to which the characteristics of a diffusing practice are compatible with the cultural values, beliefs, and practices of potential adopters. A 'cultural fit' is an important determinant of the outcome of practice adaptation (Ansari et al., 2010). When an organization adopts new practices, it may adapt them to increase their fit with the culture, technology, strategy, and politics of the organization (Canato et al., 2013).

1.6.4. Hypotheses on relations of lean practices and organizational culture

Examination of the reciprocal influence between lean practices and culture advocates for a middle-ground perspective, which points out that lean practices and culture shape and affect one another over time (Giorgi et al., 2015). The 'lean culture' supports lean practices, and lean practices support the 'lean culture' (Hozak & Olsen, 2015). Such recursive relationship of lean practices and culture manifests itself in the fact that the implementation of a new practice may induce changes in established beliefs and values. At the same time, the enactment of the new practice is affected by beliefs and values (Canato et al., 2013). The research agenda needs shifting from a unidirectional focus on the effect of change initiatives on organizations to recognition of the reciprocal relationship between organizations and change initiatives (Stensaker & Falkenberg, 2007). The recursive effect between change initiative and organizational culture is an interesting topic to examine although it can only be done using a longitudinal study (Prajogo & McDermott, 2005).

The current research takes the approach that influence between lean practices and culture advocates is reciprocal, two-directional. Research hypotheses address two approaches: (1) lean practices are influencing organizational culture, and (2) the organizational culture is influencing lean practices (see Table 7).

Table 7. **LP and OC relations: hypotheses based on literature** (source: own analysis)

No	Initially hypothesized relationship
1.	Lean practices are influencing organizational culture
2.	Organizational culture is influencing lean practices

The literature suggests that relation of lean practices and organizational culture is causal; the hypotheses are causal. The literature suggests that relation of lean practices and organizational culture is reciprocal; the hypotheses are reciprocal.

Summarizing, when organizations introduce a new managerial practice, this practice may transform the organization or the organization may transform the practice. Literature advocates for both these approaches. Cultural researchers agree that a culture affects practices. The same approach may apply to lean practices, however lean practitioners prefer the view that lean practices are influencing or should influence the organizational culture. The current research takes the approach that both these conflicting views are promising objects of the research and addresses both these views.

1.7. Complex conceptual framework for possible relationships of lean, organizational culture, and corporate performance

Many lean organizations rely on technical performance measures to demonstrate success, ignoring the importance of building a culture that supports the lean journey (Snyder, Ingelsson, & Bäckström, 2016). Deep understanding of the role of an organizational culture in successfully implementing lean practices requires a comprehensive view of the phenomenon, which should be based on a complex model comprising various dimensions of organizational culture, lean practices, and corporate performance (Bortolotti, Boscari, et al., 2015). Empirical findings suggest that both direct and indirect links between culture and performance exist (Sackmann, 2010).

Based on before mentioned ideas, the current research aims modeling and analyzing complex relations of lean practices, the organizational culture, and the corporate performance. While the corporate performance is widely accepted as the outcome variable, the complex conceptual framework of lean practices, the organizational culture, and the corporate performance (see Figure 8) includes five hypothetical models of research:

1) 'both lean practices and the organizational culture are direct influencers on the performance' (Narasimhan et al., 2012);
2) 'a organizational culture is a moderator of the performance' (Kull, Yan, Liu, & Wacker, 2014; Iranmanesh, Zailani, Hyun, Ali, & Kim, 2019);
3) 'a set of lean practices is a moderator of the performance' (authors assumption);
4) 'the organizational culture is a mediator of the lean influence on the performance' (authors assumption);
5) 'a set of lean practices is a mediator of the culture influence on the performance' (Pakdil & Leonard, 2015).

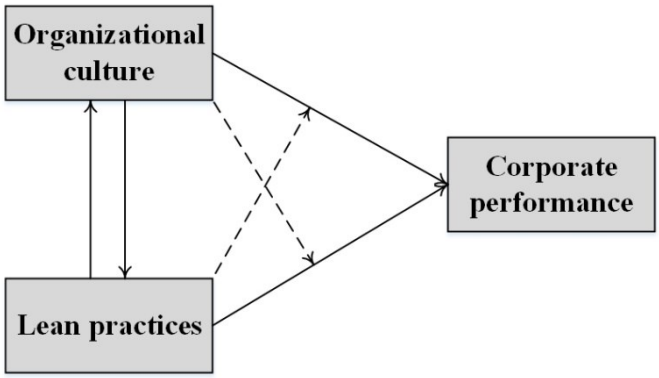

Figure 8. **Complex conceptual framework for possible relationships between lean practices, organizational culture, and corporate performance**
(source: based on Narasimhan et al., 2012)

Lean practices and organizational culture as influencers on performance. Particular lean practices and some cultural dimensions differentiate unsuccessful and successful lean organizations (Bortolotti, Boscari, et al., 2015). Companies with different organizational cultures have different levels of lean management implementation (Bortolotti et al., 2016).

Organizational culture moderates influence of lean practices on corporate performance. Hypothetically, cultural dimensions may function as moderators of lean practices' effectiveness, although research proved no such moderating effect for all except one GLOBE dimension (Kull et al., 2014). Some research (Iranmanesh et al., 2019) confirmed the moderating effect of lean culture on some particular lean practices while other research (Narasimhan et al., 2012) rejected a moderating role of an organizational culture. Moreover, some research (Mackelprang & Nair, 2010)stated that the relationship of lean practices and performance is not influenced by moderating variables.

Lean practices mediates the influence of organizational culture on corporate performance. Some lean practices mediate the culture-performance relationship (Gambi et al., 2015).

Other relationships. There is a lack of research regarding two other hypothetical relations, namely 'lean practices moderates the influence of organizational culture on corporate performance' and 'organizational culture mediates the influence of lean practices on corporate performance'.

The Table 8 summarizes those five hypothetical relationships.

Table 8. **Complex framework: hypotheses based on literature** (source: own analysis)

No	Initially hypothesized relationship
1.	Lean practices and organizational culture influence corporate performance
2.	Organizational culture moderates the influence of lean practices on corporate performance
3.	Lean practices moderates the influence of organizational culture on corporate performance
4.	Organizational culture mediates the influence of lean practices on corporate performance
5.	Lean practices mediates the influence of organizational culture on corporate performance

While there is a lack of comprehensive studies on particular mediation and moderation effects, all hypotheses of the current research state positive effect.

Summarizing, relations of lean practices, the organizational culture, and the corporate performance form a complex model that hypothetically includes regression, moderation, and mediation effects. The current research aimed analyzing and evaluating all these effects.

2. METHODOLOGICAL FOUNDATIONS

2.1. Research philosophy and design

A research could rely on either functionalist, interpretive, radical humanist, or radical structuralist philosophical paradigm. The functionalist research paradigm is used by many researchers of organizational cultures (Sawner, 2000; Ashkanasy, 2011; Imre, Jenei, & Losonci, 2011; Denison & Mishra, 2015), of lean (Bhasin, 2008; Dibia, 2012; Bhasin, 2013) and of the corporate performance (Mackelprang & Nair, 2010; Kotrba et al., 2012; Kataria, Rastogi, & Garg, 2013). Approaches to the research classifies as subjectivist, objectivist, and pragmatist. The **pragmatist approach** strives to reconcile both the subjectivism and the objectivism, values and facts, different contextual experiences and an accurate rigorous 'objective' knowledge. The pragmatic research starts with a problem, and aims to create practical solutions that affects the future practice, and in it is perfectly possible to work with different types of knowledge and methods (Saunders, Lewis, & Thornhill, 2016).

Main research perspectives are a constructionism and a positivism. The positivism is a perspective whereby the researcher analyses a social reality to produce law-like generalizations. The positivism emphasizes the availability to yield pure data uninfluenced by a human interpretation or bias (Saunders, Lewis, & Thornhill, 2016). Today's organizational studies are dominated by the **positivist perspective** (Bellot, 2011).

The logic of the research could be deductive, inductive, or abductive. The **abductive logi**c (also known as a retroduction) instead of moving from theory to data (as in deduction) or from data to theory (as in induction), combines and complements the deduction and the induction (Saunders, Lewis, & Thornhill, 2016). The abductive research infers explanatory hypotheses; then tests their veracity using deductive logic; and, finally, using the inductive logic confirms that the hypothesized relations are intact. In the abduction, the initial theoretical research framework is usually modified, as a consequence of unanticipated results of the analysis of the empirical data, but also as a consequence of new theoretical insights gained during the process (Cassell, Cunliffe, & Grandy, 2018).

A scientific research may have designs that are experimental, quasi-experimental, or nonexperimental. Experimental designs induce a specific treatment and then measure the effect of this treatment on the outcome. When experimental conditions are not possible, practical, or ethical, a

nonexperimental research may be a better choice. The **nonexperimental design** of a research may be chosen while using such research methods as surveys, polls, interviews, and observations (Patten & Newhart, 2017).

A research methodology may rely on a quantitative, qualitative or mixed method research design (Saunders, Lewis, & Thornhill, 2016). Management and organizational studies traditionally relies upon facts, numbers and quantification (Cassell, Cunliffe, & Grandy, 2018). The **quantitative researc**h usually relies on a deductive approach, where the data allows testing an existing theory. However, it may also incorporate an inductive approach, where the data allows developing a new theory (Saunders, Lewis, & Thornhill, 2016). A distinctive feature of a quantitative research is that researchers gather data in such a way that the data is easy to quantify, allowing statistical and graphical examination for causal relationships between variables (Patten & Newhart, 2017).

The nature of the study could be either exploratory, descriptive, evaluative, explanatory or a combination of these. **Explanatory studie**s establish causal relationships between variables (Saunders, Lewis, & Thornhill, 2016). The explanatory nature is closely related to causality relationships between variables (Sarstedt & Mooi, 2019). The explanatory nature is most appropriate for studies that analyze relationships using a quantitative research, but also wants to be able to address underlying reasons (Patten & Newhart, 2017). Many studies of lean (Ahrens, 2006; Demeter, 2009; Fullerton, Kennedy, & Widener, 2014; Stone, 2010; Losonci et al., 2017) are explanatory.

A research could be cross-sectional or longitudinal. Some research is like a "snapshot" taken at a particular time, a series of snapshots, or a representation of events over a given period – some "diary" of events. The 'snapshot' perspective of one moment in time is named 'cross-sectional research' while the 'diary' perspective when researchers repeatedly measure traits of the same participants to capture similarity or change over a period of time is named 'longitudinal research' (Saunders, Lewis, & Thornhill, 2016; Patten & Newhart, 2017). The **cross-sectional design** is one of the most commonly used in a survey-research. In a cross-sectional design, one or more samples are drawn from the population at one time (Shaughnessy et al., 2015). The Table 9 summarizes possible research philosophies and shows methodological choices of the current research.

Table 9. **Methodological choices of current research** (source: author)

Criteria	Possible choices and choice of the research (marked bold)
Paradigm	**Functionalist**, interpretive, radical humanist or radical structuralist
Approach to research	Subjectivist, objectivist or **pragmatist**
Research perspective	Constructionism or **positivism**
Logic of the research	Deductive, inductive or **abductive**
Research design	Experimental, quasi-experimental or **nonexperimental**
Research methodology	**Quantitative**, qualitative or mixed method
The nature of the study	Exploratory, descriptive, evaluative, **explanatory** or combination of these
Time frame	**Cross-sectional** or longitudinal

The current research relied on functionalist, pragmatist, positivist, abductive, non-experimental, quantitative, explanatory, cross-sectional methodological research choices. Mentioned research choices were basis for designing the flow of the research process (see Figure 9).

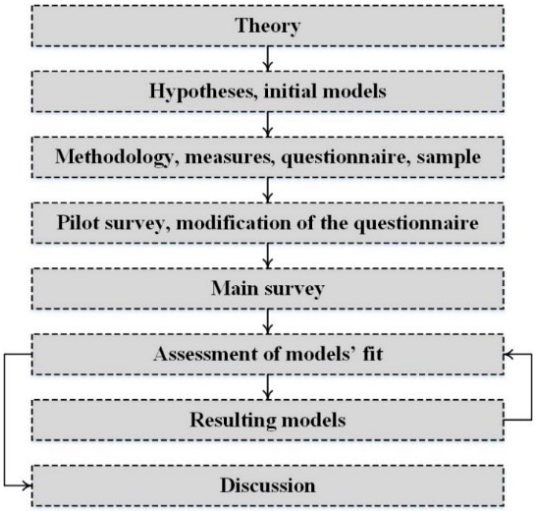

Figure 9. **Flow of research process**
(source: author)

The theory was the basis for inferring hypotheses and developing initial conceptual models. New theoretical insights gained during the research process also empirical data analysis suggested the modification of initial models. Assessment of the fit allowed justification of resulting models.

2.2. Survey strategy

Main research strategies are experiment, survey, case study, action research, grounded theory, documentary research, ethnography, and narrative inquiry. In business and management research, a common strategy is the survey. Surveys using questionnaires are popular as they allow the collection of a standardized data in a highly economical way, allowing easy comparison. In addition, the survey strategy is authoritative by people in general and is comparatively easy both to explain and to understand (Saunders, Lewis, & Thornhill, 2016). The internet technology offers several advantages for the survey strategy in a research because it is an efficient, low-cost method for obtaining responses from large samples (Shaughnessy et al., 2015).

Surveys are popular in the quantitative research of organizational cultures. Many of such research aim researching the organizational culture by asking respondents to indicate the degree of an agreement on particular cultural values (Imre et al., 2011). The numerical data on organizational culture provides indications on the organizational culture, and allows comparisons between organizations or groups (Jung et al., 2009). For the comparative research, surveys provide the foundation for the quantitative assessment (Denison et al., 2014). Many researchers (Shetty, Componation, Gholston, & Utley, 2010; Mackelprang & Nair, 2010; Bhasin, 2012; Fullerton et al., 2014; Bortolotti, Boscari, & Danese, 2015) used survey strategies to research lean. Many researchers (Parker, 2004; Bititci et al., 2006; Demeter, 2009; Murphy, Cooke, & Lopez, 2013) used survey strategies to research the corporate performance.

A limitation of survey strategies in research of organizational cultures is the inability to access ‘deeper’ cultural elements such as a symbolic meaning, semiotics, and fundamental assumptions. Another limitation is that surveys use the predetermined content, which may fail to capture most relevant aspects of the culture in a particular situation (Denison et al., 2014). Predetermined categories within a survey instrument makes it possible for important items not contained within them to remain unnoticed (Jung et al., 2009). In addition, surveys uses an assumption that individual perceptions of organizational realities can give a valid data on organizational cultures (Sackmann, 2010).

When respondents record their own answers, the questionnaires are self-completed (Saunders, Lewis, & Thornhill, 2016), self-administered (Shaughnessy et al., 2015) or self-report. Self-report questionnaires are a prominent tool in exploring organizational cultures, as they are cost- and time-effective and easy to administer and analyze (Jung et al., 2009). Survey

questionnaires in many studies (Carver, 2011; Chin, Henseler, & Wang, 2011; Agus & Hajinoor, 2012) were self-report questionnaires.

The current research used **survey strategy** and **self-report questionnaire**. Regarding the type of a data, this research collected an **opinion type** data (data on lean practices, organizational culture and corporate performance), a **data on behaviors** (data on lean methods) and a **demographic type data** (other data in demographic section of the questionnaire). To achieve as high as possible response rate, each respondent was clearly informed on the purpose of the research, a simple structure of the questions was used, and submission of a completed questionnaire was made simple and convenient for respondent.

2.3. Operationalization of concepts

2.3.1. Operationalization of lean practices (LP)

While there are many lean practices, researchers often group them into various bundles. The dominant method in operations management literature has been to use exploratory factor analysis combining individual practices in a multiplicative function to form unidimensional factors (Cua et al., 2001; Shah and Ward, 2003).

Lean practices comprise both lean methods and lean principles. However, lean methods and lean principles lay on different conceptual layers (Arlbjørn, Freytag, & de Haas, 2011; Lyons, Vidamour, Jain, & Sutherland, 2013; Panwar, Nepal, Jain, & Rathore, 2015). Lean methods and lean principles are regarded as different latent constructs (Bateman et al., 2014). A measurement scale of lean methods should include the level of experimentation, and a measurement scale of lean principles does not. Thus, measurement of implementation of lean methods should differ from measurement of adoption of lean principles. Based on this, operationalization of lean methods and operationalization of lean principles needs different approaches.

In the current research, **the operationalization of lean methods** (LM) involved a list of structured items. Individual method was included to the list if two conditions were satisfied: (1) two or more researchers have mentioned it, (2) the method suits for using in both manufacturing and service sectors.

Similar as in some studies (Fotopoulos & Psomas, 2009; Badurdeen & Gregory, 2012; Bortolotti et al., 2015), the current research initially divided lean methods into hard and soft. The research aimed balancing the number of hard lean methods and soft lean methods. If available, the questionnaire presented an alternative name of the method in Japanese (see Table 10).

Table 10. **Questionnaire items for measuring implementation of LM** (source: author)

Category	Item
Hard	1. Proper arrangement (5S). 2. Value stream mapping (VSM). 3. Production Kanban. 4. Problem solving standard (A3). 5. Root cause analysis ("5 Why?"). 6. Total preventive maintenance (TPM). 7. Error proofing (Poka-Yoke). 8. Alert system (Andon). 9. Statistical process charts (SPC). 10. Standard operation procedures (SOP). 11. Information boards
Soft	12. Improvement events (Kaizen workshops) 13. Leader's daily management standard work sheets 14. Visiting actual place (Genchi Gembutsu) 15. The suggestion system (Kaizen board) 16. Morning meetings (Asaichi) 17. Cross-functional training 18. Reflection after the activity (Hansei) 19. Policy/strategy deployment (Hoshin Kanri) 20. War room (Obeya) 21. Obtaining management support (Nemawashi) 22. Consensus decisions (Ringi decision making)

Literature show that questionnaires often use Likert scales to measure the implementation of lean methods. Questionnaires measure various criteria of the implementation: duration, frequency, completeness, agreement on implementation, and other criteria (see Table 11).

Table 11. **Measurement scales for implementation of LM** (source: own analysis, based on Fullerton & Wempe, 2009; Losonci & Demeter, 2013a; Olsen, 2004; *The Shingo prize ...,* 2016)

Criteria	Level 1	Level 2	Level 3	Level 4	Level 5
completeness	no	little	some	extensive	complete
extent	not at all	little	some	considerably	extremely
duration	initiated	experimental	repeatable	established	culturally ingrained
frequency	infrequent	event-based	frequent	consistent	constant
frequency	rare	irregular	common	predominant	uniform
various	does not implement	experimental	repeatable	established	culturally ingrained

In the current research, respondents were asked to '*rate the level your organization implements the lean method: 1- does not implement; 2- experimental; 3- repeatable; 4- established; 5- culturally ingrained*'.

Operationalization of lean principles (LI) in the current research involves structured questionnaire items (see Table 12).

Table 12. **Questionnaire items aimed to measure adoption of LI** (source: author)

Category	Item
Hard	1. Elimination of waste 2. Just in time delivery 3. Standardization of processes and materials 4. Visual management 5. Getting quality right first time (Jidoka) 6. Leveling the workload (Heijunka)
Soft	7. Long-term philosophy 8. Continuous improvement (Kaizen) 9. Leaders promoted from within 10. Respect for people and partners 11. Teamwork 12. Effective communication

Similarly to other research (Fotopoulos & Psomas, 2009; Badurdeen & Gregory, 2012; Bortolotti et al., 2015), the current research initially divided lean principles into hard and soft. The research aimed balancing the number of hard lean principles and soft lean principles. If available, the questionnaire presented an alternative name of the principle in Japanese. The list of lean principles involves by authors most frequently mentioned lean principles.

Questionnaires on adoption of lean principles often relies on Likert scales, which measure levels of adoption. It is likely to be difficult for a respondent to imagine what the particular level of lean principle entails (Malmbrandt & Åhlström, 2013). This can however be solved or at least partially solved by using general definitions of each level as a base (Hofer et al., 2012; Nawanir et al., 2013; Malmbrandt & Åhlström, 2013), although definitions of each level makes the questionnaire for respondent more difficult to read and requires more effort to answer the research questions. Based on this, levels without general definitions of each level are often used. Various length scales were deployed, like seven-point Likert-type scale 1 = 'no adoption'; 4 =

'partial adoption'; 7 = 'total adoption' (Soriano-Meier & Forrester, 2002) although five-point Likert-type scales are usually deployed (see Table 13).

Table 13. **Measurement scales for adoption of LI** (source: own analysis, based on Al-Ashaab et al., 2016; Bortolotti, Boscari, et al., 2015; Malmbrandt & Åhlström, 2013; Olsen, 2004; Shang & Sui Pheng, 2013; Stone, 2010)

Category	Level 1	Level 2	Level 3	Level 4	Level 5
Implementation	No	Little	Some	Extensive	Complete
Extent	Very small	*Not defined*	Some	*Not defined*	Very great
Extent	Not at all	*Not defined*	*Not defined*	*Not defined*	Large extent
Adoption level	No adoption	General awareness	Systematic approach	On-going refinement	Exceptional, approach
Agreeing	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Other	Start	Awareness	Unstructured	Continued	Evolved

Adoption of the principle could possibly be accidental or purposeful. If management initiates the adoption of the particular principle, which in seeking to implement Lean practices, such adoption should be purposeful. The questionnaire of the current research asked respondents on the 'purposeful' adoption of the lean principle. Respondents were asked to *'rate the level your organization purposefully implements the principle: 1- no adoption; 2- little adoption; 3- some adoption; 4- extensive adoption; 5- complete adoption of the principle'*.

2.3.2. Operationalization of organizational culture (OC)

The basis for operationalization of organizational culture was the Denison organizational culture survey (DOCS) questionnaire. The main focus of the usual 60-item version DOCS questionnaire (Denison, Haaland, & Goelzer, 2004; Denison, Nieminen, & Kotrba, 2014) is the research of the organizational culture while the current research seeks to deploy balanced number of questions to measure each of the structural elements' - lean practices (LP), organizational culture (OC), and corporate performance (CP). Based on this, the short 36-item version of the DOCS questionnaire (Fey & Denison, 2004) was used. Following items aimed to measure organizational cultures (see Table 14):

Table 14. **Questionnaire items aimed to measure OC** (source: Fey & Denison, 2004)

Dim.	Index	Item
Involvement	Empowerment	1. Decisions are usually made at the level where the best information is available. 2. Information is widely shared so that everyone can get the information he or she needs when it's needed. 3. Everyone believes that he or she can have a positive impact.
	Team orientation	4. Working in this organization is like being part of a team. 5. This organization relies on horizontal control and coordination to get work done, rather than hierarchy. 6. Teams are the primary building blocks of this organization.
	Capability development	7. This organization is constantly improving compared with its competitors in many dimensions. 8. This organization continuous invests in the skills of employees. 9. The capability of people in this organization is viewed as an important source of competitive advantage.
Consistency	Core values	10. The leaders and managers follow the guidelines that they set for the rest of the organization. 11. There is a clear and consistent set of values in this organization that governs the way we do business. 12. This organization has an ethical code that guides our behaviour and tells us right from wrong
	Agreement	13. When disagreements occur, we work hard to achieve solutions that benefit both parties in the disagreement. 14. It is easy to reach consensus, even on difficult issues. 15. We often have trouble reaching agreement on key issues *
	Coordination and integration	16. People from different organizational units still share a common perspective. 17. It is easy to coordinate projects across functional units in this organization. 18. There is good alignment of goals across levels of this organization.
Adaptability	Creating change	19. This organization is very responsive and changes easily. 20. This organization responds well to competitors and other changes in the environment. 21. This organization continually adopts new and improved ways to do work
	Customer focus	22. Customer comments and recommendations often lead to changes in this organization. 23. Customer input directly influences our decisions. 24. The interests of the final customer often get ignored in our decisions *
	Organizational learning	25. We view failure as an opportunity for learning and improvement. 26. This organization encourages and rewards those who take risk. 27. We make certain that we coordinate our actions and efforts between different units.
Mission	Strategic direction and intent	28. This organization has long-term purpose and direction. 29. This organization has a clear mission that gives meaning and direction to our work. 30. This organization has a clear strategy for the future.
	Goals, objectives	31. There is widespread agreement about goals of this organization. 32. Leaders of this organization set goals that are ambitious, but realistic. 33. The leadership has clearly stated the objectives we are trying to meet.
	Vision	34. We have a shared vision of what this organization will be like in the future. 35. Leaders of this organization have a long-term orientation. 36. Our vision creates excitement and motivation for our employees

* - reversed question

Measurement of organizational culture items in typical DOCS questionnaires relies on a 5-point Likert-type scale, where 1 = 'strongly disagree', 2 = 'disagree', 3 = 'neutral', 4 = 'agree', and 5 = 'strongly agree' (Denison, Haaland, & Goelzer, 2004; Fey & Denison, 2004; Denison, Nieminen, & Kotrba, 2014). Accordingly, in the current research respondents were asked to *'rate your agreement with following statements about the organization you work at: 1—strongly disagree, 2—disagree, 3—neutral, 4—agree, and 5—strongly agree'*.

2.3.3. Operationalization of corporate performance (CP)

The DMP questionnaire asks respondents to rate the organization, indicating his individual opinions about how his organization compares to its competitors in the same industry, on a global basis. All items are based on a 5-point Likert-type scale, where the number indications are: 1 = 'poor or low', 2 = 'below average', 3 = 'average or equal to the competition in the same industry', 4 = 'better than average', and 5 = 'superior' (Maltz, 2000; Bortolotti, Boscari, et al., 2015). Similarly, in the current research respondents were asked to *'indicate your opinion about how your organization compares to its competitors in the same industry, in your market: 1—poor or low, 2—below average, 3—average or equal to the competition, 4—better than average, and 5—superior to competition'*.

Denison Organizational Culture Survey (DOCS) rates the corporate performance by measuring six items of effectiveness relative to similar companies: (1) sales/revenue growth, (2) market share, (3) profitability/ROA, (4) quality of goods and services, (5) new product development, and (6) employee satisfaction. All items use a 5-point Likert-type scale ranging from 1 = 'low performer' to 5 = 'high performer' (Denison *et al*., 2014). Thus, DOCS measures an organizational culture using 60 items (full version) or 36 items (short version), and measures a corporate performance using 6 items (Fey & Denison, 2004). Such approach creates somewhat unbalanced number of questions on the organizational culture and on the corporate performance. In contrast, Dynamic Multi-dimensional Performance (DMP) framework has the baseline of 12 organizational performance measures and several additional firm- or sector-specific measures (Maltz et al., 2003). While DMP allows tailoring additional individual items to the particular research, the current research used five additional measures. Such approach resulted in 17-item questionnaire, grouped into five dimensions of performance (see Table 15).

Table 15. **Questionnaire items aimed to measure CP** (source: based on Maltz et al., 2003)

Criteria	Item
Financial	1. Sale numbers*. 2. Profit margin*. 3. Revenue growth*.
Customer/Market	4. Customer satisfaction*. 5. Customer retention rate*. 6. Service quality*.
Process	7. Time to market for new products and services*. 8. Quality of new product development and project management processes*. 9. Product lead-time. 10. Quantity and depth of standardized processes
People Development	11. Retention of top employees*. 12. Quality of leadership development*. 13. Employee satisfaction level.
Preparing for the Future	14. Depth and quality of strategic planning*. 15. Anticipating and preparing for changes in the external environment*. 16. Investment in R&D. 17. Investment in new market development.

The baseline of 12 organizational performance measures are marked with '*', and five additional measures are not marked.

2.3.4. Initial measurement framework

The first part of the questionnaire ('lean methods', LM) relates to the managerial level of activities. Respondents were answering, what lean methods they are deploying. Thus, the first part of the questionnaire asks, how employees '*are behaving'*. The second part of the questionnaire ('lean principles', LI) relates to managerial level of thinking. Respondents were answering, which lean principles are promoted as a potential basis for the managerial decisions, which lean principles are being purposefully implanted into the organization. Thus, the second part of the questionnaire asks, how employees '*should think*'. The third part of the questionnaire ('organizational culture', OC) relates to organizational level of understanding. Respondents were answering, what they think about their organization, what are values of the organization. Thus the third part of the questionnaire asks, what the organizational and employee' thinking is, how employees *'are thinking*'. The fourth part of the questionnaire ('corporate performance', CP) relates to understanding by respondents on the performance of the organization they are working in. Respondents were evaluating achievements of the organization comparing to its competitors in the market where the organization competes, how an organization *'is succeeding'*.

Initial measurement framework involved the structural framework of possible relationships and measurement models of latent variables (see Figure 10).

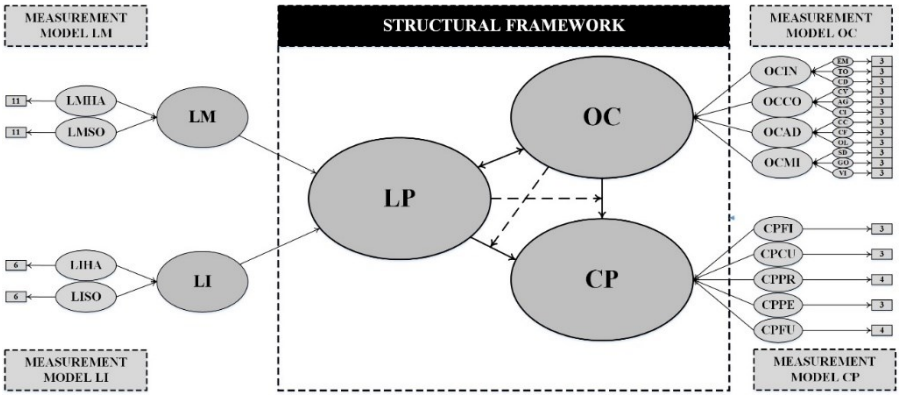

Figure 10. **Initial measurement framework**
(source: author)

For lean practices (LP), the model involves lean methods (LM) and lean principles (LI). For lean methods, the model involves latent variables namely hard (LMHA) and soft (LMSO) lean methods. For lean principles, the model involves latent variables namely hard (LIHA) and soft (LISO) lean principles. For organizational culture, the model involves nested structure. First-level latent variable is the strength of the organizational culture (OC). Second-level latent variables are involvement (OCIN), consistency (OCCO), adaptability (OCAD), and mission (OCMI). Third-level latent variables are empowerment (EM), team orientation (TO), capability development (CD), core values (CV), agreement (AG), coordination and integration (CI), creating change (CC), customer focus (CF), organizational learning (OL), strategic direction and intent (SD), goals and objectives (GO), and vision (VI). For the corporate performance, the model involves latent variables namely financial (CPFI), customer /market (CPCU), process (CPPR), people development (CPPD), and preparing for future (CPFU). All measures are formative.

3. EMPIRICAL STUDY AND RESULTS

3.1. Data collection procedure

3.1.1. Target population, sampling method, and sample size

The aim of the empirical research was to empirically examine and evaluate one-to-one and complex relationships between lean practices, the organizational culture and the corporate performance. Objectives of the empirical research were:

1. To gather the primary empirical data on the research object.
2. To categorize lean practices on the basis of the empirical data.
3. To create validated structured framework for measuring the corporate performance.
4. To empirically measure and evaluate the influence of lean practices on the corporate performance.
5. To empirically measure and evaluate influence of the organizational culture on the corporate performance in lean organizations.
6. To empirically measure and evaluate reciprocal relationships of lean practices and the organizational culture.
7. To empirically measure and evaluate complex relationships of lean practices, the organizational culture and corporate performance.

Target population. The current research investigates perceptions of employees of Lithuanian lean organizations of lean practices, the organizational culture and corporate performance. Thus, the population included employees at different organizational levels: operational workers, lean experts, managers. The research classifies the organization as the 'Lithuanian lean organization', if the organization operates in Lithuania and purposefully implements managerial methods and principles relating to lean.

As there is no any available official list or database of organizations in Lithuania that employ lean, in order to create a research frame, a comprehensive search for lean organizations was conducted. Search activities included:

1. Search for public information on the websites of organizations.
2. Search in publicly available customer databases of lean consulting companies.
3. Search in the lists of participants of lean conferences.
4. Personal participation in lean conferences and contacting individual lean experts and employees of lean organizations.

5. Asking colleagues and students at universities to provide contacts of lean organizations.
6. Using a 'snowball' technique: a question '*Please name other less known Lithuanian organizations that are implementing lean*' was added to the questionnaire.

The above-mentioned search activities allowed creating the list of 160 Lithuanian organizations implementing lean practices.

Sampling method. Researchers use three sampling methods, namely Census, the probability sampling, and the non-probability sampling. The census sample could be defined as such sample which includes every unit of the population into the research frame (Sarstedt & Mooi, 2019). The probability sample is such sample where every unit of the population has a known, non-zero probability of being included in the sample. Probability sampling methods require to have a sampling list, a sampling frame (Levy & Lemeshow, 2008). When there is no available sample frame, especially when conducting a web research, a market research or public opinion surveys, surveyors use non-probability sampling methods rather than rely on the probability sampling (Dillman, Smyth, & Christian, 2014). There is no way to generate a random sample in a web research, consequently, the web research deals with non-probability samples (Shaughnessy et al., 2015). The non-probability sampling does not guarantee that every unit in the population has an equal chance of being included in the sample (Levy & Lemeshow, 2008; Patten & Newhart, 2017), it does not ensure that the selected sample represents the population (Shaughnessy et al., 2015). The non-probability sampling is frequently used while it could be easily performed and requires usually less resources than the probability sampling (Sarstedt & Mooi, 2019).

The non-probability sampling includes a judgmental sampling (sometimes called a 'purposive sampling'), a snowball sampling, a quota sampling, and a convenience sampling (Patten & Newhart, 2017; Sarstedt & Mooi, 2019). The judgmental sampling supposes that the researcher will judge individually which units will be included. The snowball sampling involves such process when existing respondents invite other individuals from among their acquaintances. The quota sampling involves selecting observations for the sample that are based on predefined characteristics, resulting in the total sample having the same distribution of characteristics as all the population has. The convenience sampling is a mix-term for methods in which the researcher chooses a sample from that part of the population which is convenient to reach (Sarstedt & Mooi, 2019). It involves selection of potential respondents primarily based on their availability and willingness to respond.

The convenience sample is non-representative; the large convenience sample is as non-representative as any other size convenience sample (Shaughnessy et al., 2015). The non-probability sampling does not allow generalizing the findings to all population with any degree of safety (Bento & Tontini, 2018).

As the whole research population is unknown, the current research uses the **judgmental non-probability sampling** technique. Respondents of the judgmental sample were managers, lean experts and operational level workers of lean organizations. A heterogeneous sampling chooses respondents with sufficiently diverse characteristics to provide the maximum variation possible in the data collected. On this basis, the first purposive sampling group was business professionals who had actively participated and contributed to the implementation of lean practices in organizations (lean experts), namely lean coordinators, lean project managers, production managers, directors of organizations and lean consultants. The second purposive sampling group was operational level workers that were potential implementers of lean practices at the operational level in the organization. The current research imposed no requirements for respondents with regard to a specific function, the experience of working in the organization, the experience of practicing lean or nationality.

Sample size. A rule of thumb for the sample size is that for samples of under 30 items, non-parametric techniques are used. Sample sizes of 30 or more will usually result in the distribution for the mean that is very close to the normal distribution, such sample size allows using parametric techniques (The Economist, 2003). As no list of Lithuanian lean organizations and of employees working in those organizations exists and sampling was judgmental, the current research imposed no other requirements for the sample size. As this research used non-probability sampling, the results were non-representative and were generalized aiming at the theoretical models rather than at all population.

3.1.2. Survey distribution

For the survey distribution, researchers typically use two **types of access**. One type is the traditional access involving face-to-face interactions (experiments, interviews, focus groups, observations or personally delivered questionnaires), telephone conversations (telephone interviews), correspondence (postal questionnaires) or visiting data archives. Another type is the internet-mediated access, which involves the use of different information technology tools (internet sites, e-mail, and messenger) to deliver questionnaires virtually. **Typical strategies** to gain access are: (1) using

existing contacts (2) establishing personal credibility; (3) providing a clear account of the purpose of the research and the type of access required; (4) identifying possible benefits to the organization granting access, and (5) ensuring familiarity with the organization or group before contacting it (Saunders, Lewis, & Thornhill, 2016). The request for access may fail due to the contacting person who receives it and makes a decision whether or not to allow the researcher to undertake the research (Saunders et al., 2016). Mail surveys are quick and convenient; however, there may be problems with the response rate when individuals do not return the questionnaire (Shaughnessy et al., 2015).

In order to **increase the participation rate**, researchers (1) specify usefulness of the survey results; (2) utilize sponsorship by a legitimate organization; (3) inform that others have already responded; (4) make questionnaires easy to complete; (5) make it convenient to respond; (6) minimize requests to obtain personal or sensitive information (Dillman et al., 2014), and write an introductory (cover) letter. The **introductory letter** requesting access should briefly outline the purpose of the research, how the person being contacted might be asked to act, and what is likely to be involved in participating (Saunders et al., 2016). Organizational surveys are single-respondent and multiple-respondent. Using a single-respondent survey researching a culture has some limitations. However, the use of the multiple-respondent survey requires a huge investment of resources. A comparative citation analysis shows that **single-respondent** studies published in top journals are cited frequently, suggesting that when they are properly conducted, their results are accepted (Fey & Denison, 2004).

The current research aimed to involve lean organizations that are located in many regions of Lithuania. This fact makes delivering questionnaires personally problematic. Seeking to maximize the response rate, the phone call was selected as a practical method contacting potential respondents in Lithuanian lean organizations. During the first contact (first phone call), the contacting person was asked if the organization implemented lean practices. In case of a positive answer, he/she was asked to provide contacts of the lean expert in the organization. Then, the contacting person or the lean expert was informed that:

- the current research would be carried-out by a researcher of the prominent educational institution – Vilnius university;
- after the data analysis, all research organizations would be introduced to summarized research results;

- though the questionnaire contained nearly 100 questions, it would take only about 15 minutes to answer all questions because he/she would only need to rate items;
- for the sake of convenience, he/she could choose between answering the Microsoft Word-based questionnaire or the online questionnaire on the platform https://apklausa.lt/private/forms/lean-itaka-darbuotoju-mastymui-ir-imoniu-veiklos-rezultatams-7q21tln?published_now=false;
- many respondents had already participated in the research;
- he/she would not be asked to provide any sensitive information.

Initially, lean experts were asked to involve 2-4 colleagues into this research, including operational level workers. The survey (see Appendixes) was distributed in Lithuanian, as adequate proficiency in the English language was not assumed for the respondents.

The preliminary (pilot) survey of the current research was conducted in February-April, 2018. Several respondents returned completed questionnaires and provided some insight into the research. The main insight points were:

- The dynamic multi-dimensional performance framework (DMP) asks to rate the organization, indicating individual opinions about how one's organization compares to its competitors in the same industry, on a global basis. However, many respondents were not able to compare the performance on the global basis. Instead, they were able to compare on the basis of the competition in their (usually local) market;
- Lean experts tended to benevolently answer questions personally although were reluctant to invite their colleagues to participate in this research.

The information and insights from respondents obtained during the preliminary research enabled to adjust the questionnaire. In the last version of the research questionnaire, lean experts were asked to involve 1-3 colleagues in the research, including operational level workers, and to compare the corporate performance based on the competition in their market rather than on the global basis.

The main survey of the current research was conducted in October-November, 2018. The first contact was the phone call to the organization. The contacting person (usually the administrator) was requested to redirect the call to the lean expert or to provide the contact information of the lean expert. First, the lean expert was asked about the implementation of lean practices with the aim to make sure that the company meets the sampling criteria. In the positive

case, the lean expert was informed about the purpose of this research and was asked to participate in this research. To motivate the expert's participation, he/she was informed that upon the completion of the research, he/she would be given the summarized research results. If the lean expert agreed to participate in the research, his/her anonymity was guaranteed and the lean expert was provided with the **.docx* version of the questionnaire in Lithuanian and, if requested, in English. For the convenience of respondents, the survey was also available on the online survey platform (https://apklausa.lt/private/forms/lean-itaka-darbuotoju-mastymui-ir-imoniu-veiklos-rezultatams-7q21tln?published_now=false).

If completed questionnaires or the message from the online platform about the completed questionnaire was not received within two weeks, a follow-up procedure including another telephone call as a final reminder was carried out. If respondents after the follow-up procedure did not answer within another two weeks or explicitly refused to participate, they were not considered as respondents.

All discovered Lithuanian lean organizations (160 organizations) were contacted during the survey procedure. On this basis, the current survey has characteristics of the census sampling of organizations. However, only 69 organizations out of 160 participated in the current research. The real population was employees, and the respondents were specific type employees of lean organizations, namely lean practitioners. Thus, the current survey relies on the judgmental non-probability sampling.

3.1.3. Research ethics

A research ethics means that the research is based on the principles of ethics. The ethical principle of beneficence means that research should strive to do no harm, minimize risks, and maximize possible benefits. The ethical principle of justice means that the researcher treats all subjects equitably and any burdens or benefits related to the research are shared fairly. The ethical principle of autonomy means that all individuals are free to make choices and participate in the research voluntarily (Patten & Newhart, 2017). The ethical principle of informed consent involves provision of sufficient information about taking part in the research by the researcher to allow individuals to understand the implications of participation and to reach a fully informed, considered and freely given decision about whether to participate or not to participate, without any pressure or coercion. The ethical principle of anonymity of responses means maintenance of anonymity of those taking part

in the research. The ethical principle of confidentiality of the data means that the data provided to researcher remains undisclosed to the third party. The principle of the ethical analysis of data and reporting of findings means that primary empirical data should not be altered and analysis results should not be falsified. Findings should be reported fully and accurately, no matter whether they contradict or confirm the expected outcomes. The ethical principle of secure management of data mean secure data transmission and secure data storage. Among the provided data, personal data is defined as the data relating to a living person, which allow that individual to be identified, perhaps in combination with other information (Saunders et al., 2016).

The current research was conducted in accordance with the above-mentioned ethical principles. According to the principle of beneficence, the empirical data was not open to public, kept safely, and research participants obtained summarized results of the research. Following the principle of justice, the current research contacted and treated all respondents in a standard way. Based on the principle of autonomy, the current research asked all respondents to participate of their free will rather than demanded to participate. According to the principle of informed consent, all participants of the current research were introduced to the following: (1) the aim of the research, (2) what they were asked to do during the research, (3) what potential benefits they would have, (4) what potential for risks they might encounter, and (5) the fact that they were not obliged to participate in the research. In order to maintain the principle of anonymity of responses, the current research neither requested nor disclosed any names of organizations or respondents. In order to maintain the principle of confidentiality of the data, the current research did not disclose any data related to any respondent or particular organization. According to the principle of the ethical analysis of data and reporting of findings, the current research did not alter any empirical data, fully presented correct results of the analysis and findings. According to the principle of secure management of data, personal data in the current research was:

- Obtained only for this research;
- Accurate and kept up to date;
- Kept securely in the main database and in the reserve database;
- Not excessive with regard to the purpose of informing about the research results;
- Not transferred to any researchers, other individuals or organizations.

3.2. Data analysis

3.2.1. Data cleaning

The data cleaning should be performed by checking for and dealing with possible interviewer fraud, suspicious regular response patterns, data entry errors, outliers, and missing data (Sarstedt & Mooi, 2019).

In the current research, the possibility of the **interviewer fraud** was dealt by personally contacting potential respondents and receiving filled questionnaires from relatively known respondents, known e-mail addresses, or known sources. **Suspicious regular response patterns** were analyzed searching for straight lining (a cases when a respondent marks the same response in almost all the items), and inconsistent answers in completed questionnaires of the current research. While the straight lining is common in web surveys and in long surveys (Sarstedt & Mooi, 2019), two reverse-scaled items were included into the questionnaire with the aim to identify possible straight lining cases. However, the data cleaning procedure detected no unambiguous straight lining or inconsistent answers. For the prevention of the **data entry error,** the research questionnaire used checkboxes rather than required inputting numbers. Additionally, if the questionnaire was saved as the Microsoft Word file, double data entry check was performed during the data input from the Microsoft Word files into the SPSS database. Univariate or bivariate graphs and statistics helped detecting **outliers**.

There are two cases how **missing data** occur. First case are survey non-response when entire surveys are not in place. The second case is item non-response when respondents have not answered all the items. One of the main problems for researchers who analyze data from surveys is that of dealing with item non-response. Item non-response occurs when respondents do not provide answers to some individual questions of the questionnaire. Item non-response is common and up to 10% of items in the questionnaire may remain unanswered (Sarstedt & Mooi, 2019). The dealing with the item non-response usually bases on such principles as:

- the missing data under 10 percent for an individual respondent can be ignored, except when it occurs in a specific way (e.g., concentration in a specific set of questions),
- the number of cases with no missing data must be sufficient for the selected analysis technique, and

- cases with the missing data for dependent variable(s) typically are candidates for deletion to avoid any artificial increase in relationships with independent variables (Hair et al., 2014).

Various missing data methods are used to deal with this problem: complete case methods, imputation-based methods, reweighting methods, model-based methods, and other methods (Levy & Lemeshow, 2008). In the current research (1) missing data under 10 percent for an individual respondent was ignored, (2) cases with missing data for dependent variable(s) were not deleted from the dataset but rather not included into the specific analysis, and (3) the deletion of individual cases was not performed seeking to preserve maximum available number of cases. Instead, missing cases were excluded from particular model-based analysis using listwise method.

3.2.2. Descriptive sample statistics

During the survey distribution period, lean managers from all known Lithuanian Lean organizations were contacted by phone. While the list of Lithuanian Lean organizations covered 160 organizations, 160 lean managers were contacted. They received invitation to participate themselves and to invite their colleagues to participate in this research. As many as 69 lean managers from 69 organizations out of 160 returned properly completed questionnaires. Consequently, the lean managers' response rate was 43%. Additionally, colleagues of these lean managers provided another 52 properly completed questionnaires. In sum, the survey distribution procedure yielded 121 usable questionnaires properly completed by lean practitioners (managers, lean consultants and operational level workers).

According to literature, general questions of questionnaires in the research on lean, organizational culture, and corporate performance address various employees' and organizational characteristics. Those characteristics could be:

- job title, organization size, and the quality program's age (Knapp, 2015);
- function of the employee, organizational level of the respondent, years with the organization, industry, number of employees (Denison et al., 2014);
- low volume, high volume, number of employees (Boyle, Scherrer-Rathje, & Stuart, 2011);
- position, tenure, function of the employee, number of employees, industry (Hofer et al., 2012);
- job title, number of employees, industry sector (Chavez et al., 2013b).

The current research asked respondents to answer three general questions on the individual employee' characteristics (tenure, position, years of personal experience with lean), and three general questions on the organizational characteristics (number of employees, years of implementation of lean, industrial sector).

The results of the survey show that most respondents who participated in this research have 3-year tenure in employing organizations. The tenure of several respondents exceeds 20 years. Three answers on the tenure were missing (marked as 'MI', see Figure 11).

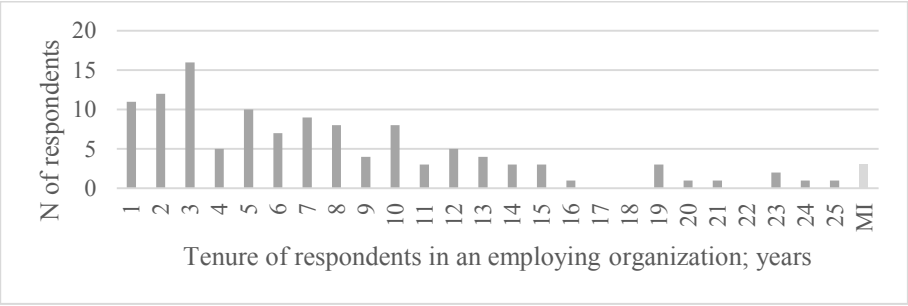

Figure 11. **Tenure of respondents in employing organizations**
(source: own analysis)

Most respondents have 2 years lean experience. Minority of respondents have lean experience that exceeds 10 years. Four answers regarding the lean experience of respondents were missing (marked as 'MI', see Figure 12).

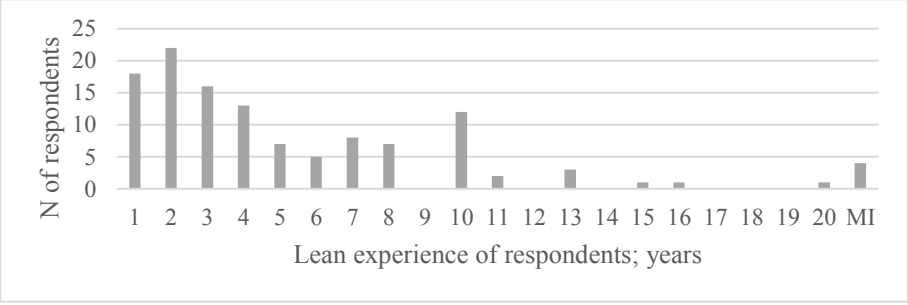

Figure 12. **Lean experience of respondents**
(source: own analysis)

Most respondents were managers who are closely familiar with lean. Part of respondents were operational level workers who are practicing lean in their

workplaces. Few respondents were specializing in lean as external consultants. No values regarding position of respondent were missing.

Most of respondents were representatives of big size companies. No values regarding size of employers' organizations were missing.

Most of respondents were representing the manufacturing industry, particularly the high volume manufacturing. Service sector was another sector, represented by the big number of respondents. No values regarding respondents' industry sector were missing (see Table 16).

Table 16. **Position of respondents, employers' size, and industry sector** (source: own analysis)

Category	n	% of sample
Position of respondents		
Manager	80	66.1
Worker	38	31.4
Consultant	3	2.5
Size of employers' organizations by number of employees		
Small (1-49)	10	8.3
Medium (50-249)	39	32.2
Big (250 and more)	72	59.5
Industry sector		
Manufacturing (total)	71	58.7
High volume manufacturing	*50*	*41.3*
Low volume manufacturing	*21*	*17.4*
Service	48	39.7
Other	2	1.7

Most of research organizations were implementing lean over 3 years. One answer regarding the duration of implementation of lean by the research organizations was missing (marked as 'MI', see Figure 13).

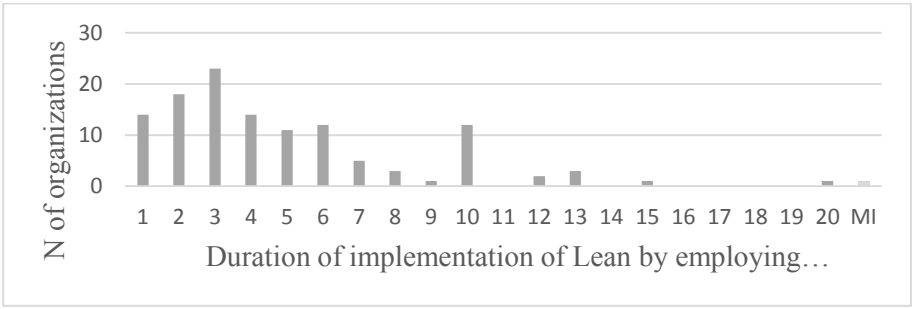

Figure 13. **Duration of implementation of lean by organizations** (source: own analysis)

Descriptive sample statistics generalizes as follows:

- most respondents have 3 year tenure in research organizations;
- most of them have 2 years lean experience;
- many of them work as managers;
- they are representatives of mostly big companies;
- they usually work in manufacturing or in service sector;
- most research organizations have 3 years' experience implementing lean.

3.2.3. Assumptions for assessment of measurement models

In the current research, the factor analysis procedure helped test the structure among the set of empirical variables. However, the deployment of the factor analysis required considering some assumptions. The first assumption was that empirical data is **interval** type data. In the current research, the scores from the answers to Likert-type questions on lean practices, organizational culture, and corporate performance were considered interval type.

The second assumption is that some **underlying structure does exist** in the set of selected variables (Hair, Black, Babin, & Anderson, 2014). In the current research, the assumption of underlying structure holds on the research model, which incorporates the underlying structural construct. Accordingly, the empirical data obtained during the survey was the basis for answering questions: (1) if the analysis of the empirical data suggests analogous structures to the structures based on the theory review; and (2) if the empirical data confirms that individual items taken from theory analysis indeed relate to the theoretically assumed particular structural element and are relevant.

The construct of the current research uses formative measures. Accordingly, the third assumption was **that covariance-based approach is proper** for the analysis of the empirical data.

Yet fourth assumption particularly for factor analysis was that there is **no excessive multicollinearity**. Predictor variables in the correlation matrix were checked and looked for coefficients with magnitudes of .70 (Chavez et al., 2013), .80 (Hair et al., 2014) or higher to fulfill condition of no excessive multicollinearity.

According to the literature on the **sample size requirements in the factor analysis**, the preferable sample size is higher than 100 and the minimal requirement *'is to have at least five times as many observations as the number of variables to be analyzed'* (Hair et al., 2014). The research model of the current research included three original constructs namely 'lean methods' (22 items), 'lean principles' (12 items), and 'corporate performance' (17 items), and one construct from the other research namely 'organizational culture' (36 items), which is validated in many previous research and does not require validation. The current research proceeded the factor analysis separately on each original construct. Assuming the sample size was 121, minimum sample size requirements for factor analysis having *'at least five times as many observations as the number of variables'* in all these three cases have been met.

According to the literature, the quality of the measurement models relates on the validity and the reliability of the data. In the current research, the factorial validity of the constructs 'lean practices' and 'corporate performance was examined while these constructs are original, and the factorial validity of the construct 'organizational culture' was not examined, while many studies (Fey & Denison, 2004; Kotrba et al., 2012; Denison et al., 2014) already have shown the validity of the DOCS questionnaire.

According to the literature, the **predictive validity** (also called convergent validity) requires a measure to be highly correlated with an outcome variable, measured at a later point in time, to which it is conceptually strongly related. The method for testing predictive validity was examination of the factor loadings values in the constructs. Factor loadings ≥.45 are significant for sample size 150, factor loadings ≥.50 are significant for sample size 120, and factor loadings ≥.55 are significant for sample size 100 (Hair, Black, Babin, & Anderson, 2014). As the sample size in the current research is 121, factor loadings higher than .50 would be significant and acceptable for the predictive validity.

According to the literature, the **discriminant validity** (also called divergent validity) ensures that a measure is empirically unique and represents phenomena of interest that other measures in a model do not capture. For cross-loadings, the discriminant validity is acceptable if cross-loadings in the constructs are ≤.40 (Hooper, 2012).

The current research examined **the reliability** of the data. Criterions for estimating the reliability were:

1. **Internal consistency reliability**. It assumes that if all items in a scale or construct truly measure the same thing, they should be highly inter-correlated with each other (Sarstedt & Mooi, 2019). Calculation of Cronbach's alpha coefficients for each construct allows evaluating the internal consistency reliability (Prajogo and McDermot, 2005). A rule of thumb is: α≥.90—excellent; α≥.80—good; α≥.70—acceptable; α≥.60—questionable; α≥.50—poor; α<.50—unacceptable (George & Mallery, 2019). New scales (in an exploratory research) should have alpha ≥.60, and existing scales (in a confirmatory research) should have alpha ≥.70 (Naor et al., 2010; Hair et al., 2014).
2. **Split-half reliability**. It assumes that a scale that is measuring the same phenomena is reliable, if a randomly selected set of the items from that scale correlates with another randomly selected set of the items from the same scale (Garson, 2013). Split-half reliability is used when the number of items is large and it is possible to create two halves of the test, which is aimed measuring one phenomena (George & Mallery, 2019). In the current research, the Spearman-Brown coefficient helped estimating split-half reliability of a sample. A common rule of thumb was that Spearman-Brown coefficient value should be ≥.60 for exploratory purposes and ≥.70 for confirmatory purposes (Garson, 2013).
3. **Inter-item correlation** (sometimes called item-to-total correlation). In reliability analysis it is descriptive information about the correlation of each variable with the mean of all other variables (George & Mallery, 2019). Values of inter-item correlations were additional internal consistency measure (Denison, Nieminen, & Kotrba, 2014).

In the current research, **correlation effect sizes** were assumed as follows: absolute value of .00-.09 equals no correlation; absolute value of .10-.29 equals a low correlation or a small effect; absolute value of .30-.49 equals a medium correlation or a medium effect; and absolute value of .50-1.00 equals a high correlation or a large effect (Field, 2018).

Kaiser-Meyer-Olkin Measure of Sampling Adequacy (MSA) was a measure of whether the distribution of values is adequate for conducting factor analysis (George & Mallery, 2019). MSA allows assessing the factorability of the overall set of variables and individual variables (Hair et al., 2014). MSA levels are designated as follows: a value ≥ .9 is marvelous, ≥ .8 is meritorious, ≥ .7 is middling, ≥ .6 is mediocre, ≥ .5 is miserable, and ≤ .5 is unacceptable (George & Mallery, 2019).

Bartlett's test for sphericity helped testing the multivariate normality of the set of distributions. It also tests whether the correlation matrix is an identity matrix, while the factor analysis would be meaningless with an identity matrix (George & Mallery, 2019). Bartlett's test for sphericity (Hair et al., 2014) helps determining whether the dependent measures of the correlation matrix are significantly correlated. A significance level indicates that this dataset does not produce an identity matrix, is approximately multivariate normal and acceptable for factor analysis (George & Mallery, 2019). A significance value ≤ .05 is an acceptable threshold.

Scree test (Hair et al., 2014; George & Mallery, 2019) helped to identify the optimum number of factors that can be extracted before the amount of unique variance begins to dominate the common variance structure.

Principal component analysis (Toni & Tonchia, 2012; Jacobs, 2014; George & Mallery, 2019) was the default method for factor extraction. By providing an empirical estimate of the structure of the variables considered (Hair et al., 2014), factor analysis was a basis for creating summated scales.

Direct Oblimin rotation method allowed refraining from orthogonal factors to achieve a better simple factor structure (George & Mallery, 2019). The current research used the direct Oblimin, while the literature insist that factors of lean methods, lean principles, organizational culture and factors of corporate performance should correlate with each other. Factors were the basis for creating new latent variables. The calculation of new latent variables used summated scales and 'mean' function.

3.2.4. Assessment of measurement model on lean methods (LM)

The correlation matrix of lean methods served as a visual test for testing lean methods for data multicollinearity. Result of data multicollinearity test was negative while no correlation coefficients exceeded the limit .80 in the lean methods' correlation matrix. At the same time, many significant correlations were greater than .30 what allows considering factor analysis appropriate for lean methods (see Appendixes). Kaiser-Meyer-Olkin measure of sampling

adequacy and Bartlett's test of sphericity indicated correlations among the variables for lean methods. Resulting MSA value = .82 **(**above .80) indicated that the LM sampling adequacy is meritorious. Significance level value ≤ .05 (=.00) of Bartlett's test of sphericity showed that sufficient correlations exist among the tested LM variables which is an indication to proceed factor analysis (see Table 17).

Table 17. **Test for correlations of variables for lean methods (LM)** (source: own analysis)

KMO and Bartlett's Test for lean methods		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**.82**
Bartlett's Test of Sphericity	Approx. Chi-Square	991.14
	df	231
	Sig.	**.00**

The scree plot allowed the visualization of Eigenvalues, and helped to indicate the plausible number of factor solutions. Resulting scree plot indicates that two, three or four factor solutions are possible while theoretical model suggest two factors. The first four factors would be strong while they have Eigenvalues over one (see Figure 14).

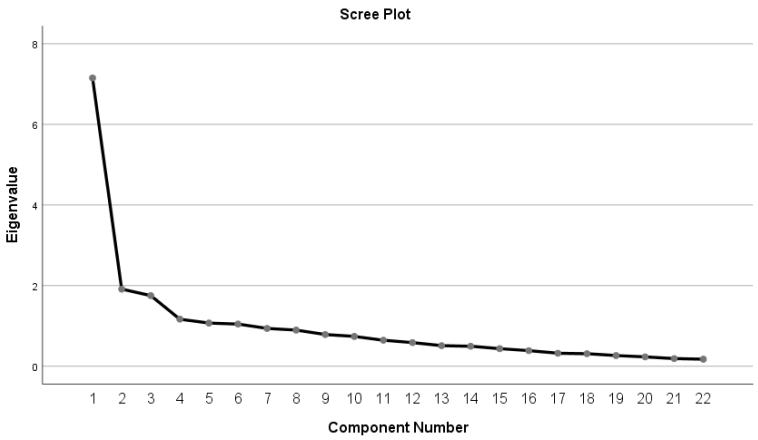

Figure 14. **Scree plot for lean methods (LM)**
(source: own analysis)

The principal component analysis allowed extracting the components for lean methods (see Table 18). While the extracted components should not be orthogonal, factor analysis uses Oblimin rotation.

Table 18. **Matrix of principal components of lean methods (LM)** [a] (source: own analysis)

Lean method	Component		
	1	2	3
1.6 Total preventive maintenance (TPM)	**1.06**		-.35
1.1 Proper arrangement (5S)	**.91**		**-.41**
1.10 Standard operation procedures (SOP)	**.82**	-.39	
1.3 Production Kanban	**.78**		
1.7 Error proofing (Poka-Yoke)	**.64**		.38
1.9 Statistical process charts (SPC)	**.56**		
1.8 Alert system (Andon)	**.51**		
1.17 Cross-functional training	.47		
1.16 Morning meetings (Asaichi)		**.98**	
1.11 Information white-boards		**.82**	
1.4 Problem solving standard (A3)		**.72**	
1.12 Kaizen workshops		**.67**	
1.15 Kaizen board		**.55**	
1.21 Obtaining management support (Nemawashi)			**1.03**
1.22 Consensus Decisions (Ringi)		-.32	**.97**
1.20 War room (Obeya)			**.76**
1.19 Policy/strategy deployment (Hoshin Kanri)			**.75**
1.2 Value Stream Mapping (VSM)			**.60**
1.5 Root cause analysis (“5 Why?”)			**.57**
1.18 Reflection after the activity (Hansei)			**.52**
1.14 Visiting actual place (Gemba Walk)			**.50**
1.13 Leader’s daily standard work sheets			.42

Extraction Method: Principal Component Analysis, eigenvalues greater than 1.2. Rotation Method: Oblimin with Kaiser Normalization, delta = 0.5. Missing values excluded listwise. Loadings sorted by size. Loadings <0.3 are suppressed. Loadings > .50 considered as significant and marked bold.

a. Rotation converged in 8 iterations.

Principal component analysis resulted in extraction of three factors. The first factor (component 1) associates to lean methods related to production and processes. This factor was hypothetically named ‘hard lean methods’. The second factor (component 2) associates to lean methods related to sharing of information between people and continuous improvement activities. This factor is related to the soft side of lean and was hypothetically named ‘soft lean methods’. The third factor (component 3) associates both with processes and with people; it embraces analytical, decisional and problem solving methods. The third factor, as in other studies (Liker, 2004; Shang & Sui Pheng, 2013), was hypothetically named ‘problem solving lean methods’.

The loading of item ‘Cross-functional training’ (.47) and loading of item ‘Leader’s daily management standard work sheets’ (.42) were characterized by loading values ≤.50 and possibly should be considered as non-significant. Although, both these items were retained because (1) both items were evaluated as having adequate content validity based on theory-related list of lean methods and (2) the construct is formative. Despite cross loading’ values of four items were ≥.30, all these four items were retained for consequent analysis while their loading values are much higher than the cross loading’ values.

Newly created factors were tested on reliability. Values of Cronbach’s alpha and Spearman-Brown split-half reliability coefficients showed that scales for all three newly created factors are reliable (see Table 19).

Table 19. **Reliability coefficients and descriptive stats for LM items** (source: own analysis)

Index	Item	ITTC	Mean	SD
Hard lean methods (LMHA); α = .84 SB = .82	1.1 Proper arrangement (5S)	.60	3.76	1.15
	1.10 Standard operation procedures (SOP)	.63	3.15	1.46
	1.6 Total preventive maintenance (TPM)	.63	3.10	1.43
	1.3 Production Kanban	.55	2.64	1.48
	1.9 Statistical process charts (SPC)	.55	2.52	1.37
	1.17 Cross-functional training	.46	2.48	1.24
	1.7 Error proofing (Poka-Yoke)	.65	2.26	1.31
	1.8 Alert system (Andon)	*.47*	1.84	1.13
Soft lean methods (LMSO); α = .77 SB = .76	1.16 Morning meetings (Asaichi)	.51	4.17	1.17
	1.11 Information white-boards	.59	4.03	1.12
	1.12 Kaizen workshops	.55	2.98	1.35
	1.4 Problem solving standard (A3)	.55	2.80	1.38
	1.15 Kaizen board	.50	2.79	1.51
Problem solving lean methods (LMPS); α = .82 SB = .82	1.14 Visiting actual place (Gemba Walk)	*.42*	3.02	1.38
	1.5 Root cause analysis ("5 Why?")	*.38*	2.95	1.25
	1.22 Consensus Decisions (Ringi)	.64	2.70	1.33
	1.13 Leader's daily standard work sheets	*.38*	2.38	1.33
	1.2 Value Stream Mapping (VSM)	*.44*	2.28	1.18
	1.19 Policy/strategy deployment (Hoshin)	.62	2.13	1.35
	1.21 Obtaining management support (Nemawashi)	.67	2.06	1.34
	1.20 War room (Obeya)	.62	1.95	1.29
	1.18 Reflection after the activity (Hansei)	.58	1.83	1.10

α – Cronbach's alpha reliability coefficient; SB - Spearman-Brown split-half reliability coefficient; Sorted by mean
ITTC - Item-to-total correlation

Item-to-total correlations exceeded .50 for over three-fourths of the 22 LM items. All items with item-to-total correlation values ≤.50 were retained because (1) the alpha for the index itself still reaches an excellent level of ≥.80, and (2) all items were interpreted as having adequate content validity based on theoretical LM construct. LM factor scores were calculated as summated scales using 'mean' function. Table 20 shows means and standard deviations of newly created LM factors.

Table 20. **Descriptive statistics and correlation matrix for LM factors** (source: own analysis)

	N		Descriptive stats		Factor correlations		
Factors	Valid	Missing	Mean	SD	1.	2.	3.
1. Hard lean methods	121	0	2.72	.91			
2. Soft lean methods	121	0	3.35	.94	.44**		
3. Problem solving lean methods	121	0	2.38	.85	.61**	.43**	

** Correlation is significant at the .01 level (2-tailed).

Analysis of the LM factors' descriptive statistics showed that respondents identified 'soft lean methods' as most often used. Usage of 'problem solving lean methods' was lowest. All three LM factors significantly correlated with each other.

3.2.5. Assessment of measurement model on lean principles (LI)

The correlation matrix of lean principles served as a visual test for testing lean principles for data multicollinearity. Result of data multicollinearity test was negative while no correlation coefficients exceeded the limit .80 in the lean principles' correlation matrix. At the same time, many significant correlations were greater than .30 what allows considering factor analysis appropriate for lean principles (see Appendixes). Kaiser-Meyer-Olkin measure of sampling adequacy and Bartlett's test of sphericity indicated correlations among the variables for lean principles. Resulting MSA value = .85 **(**above .80) indicated that the LI sampling adequacy is meritorious. Significance level value = .00 (less than .05) of Bartlett's test of sphericity showed that sufficient correlations exist among the tested LI variables which is an indication to proceed factor analysis (see Table 21).

Table 21. **Test for correlations for variables of lean principles (LI)** (source: own analysis)

KMO and Bartlett's Test for lean principles		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**.85**
Bartlett's Test of Sphericity	Approx. Chi-Square	664.07
	df	66
	Sig.	**.00**

The scree plot allowed the visualization of Eigenvalues, and helped to indicate the plausible number of LI factor solutions. The resulting scree plot indicated that two-factor solution is appropriate while theoretical analysis suggest the same number of factors namely two factors. The first three factors would be strong while they have Eigenvalues over one (see Figure 15).

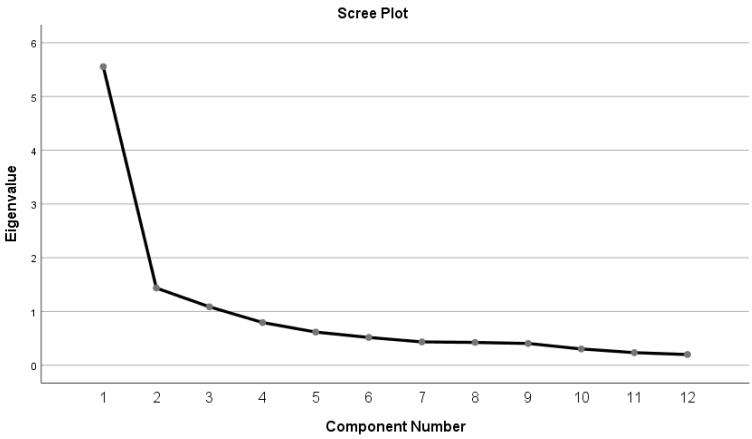

Figure 15. **Scree plot for lean principles (LI)**
(source: own analysis)

The principal component analysis helped to extract LI components. While the extracted components should not be orthogonal, factor rotation was Oblimin. Principal component analysis resulted in extraction of two LI factors. Those two factors can be identified as ‘hard lean principles’ (component 1), and ‘soft lean principles’ (component 2), see Table 22.

Table 22. **Matrix of principal components of lean principles (LI)** [a] (source: own analysis)

Lean principle	Component	
	1	2
1.24 Just in time delivery, JIT	**.97**	
1.28 Heijunka	**.87**	
1.27 Jidoka	**.83**	
1.23 Elimination of waste	**.82**	
1.25 Standardization	**.71**	
1.29 Long-term philosophy	**.70**	
1.26 Visual management	**.67**	
1.30 Continuous improvement (Kaizen)	.41	
1.33 Teamwork	-.34	**1.09**
1.32 Respect for people and partners		**.98**
1.34 Effective communication		**.78**
1.31 Leaders promoted from within		**.60**

Extraction Method: Principal Component Analysis, eigenvalues greater than 1.2. Rotation Method: Oblimin with Kaiser Normalization, delta = 0.5. Missing values excluded listwise. Loadings sorted by size. Loadings <0.3 are suppressed. Loadings > .50 considered as significant and marked bold.

a. Rotation converged in 4 iterations.

Loading of an item 'Continuous improvement' (.41) was characterized by loading value ≤.50 and could be considered as non-significant. Although, this item was retained because (1) this item was evaluated as having adequate content validity based on theory-related list of lean principles and (2) the construct is formative. The principal component analysis of lean principles' showed clear factor structure with the cross loading =-.34 of the item 'Teamwork'. While the loading of this item was much higher (=1.09), the item was retained for consequent analysis.

Factors both 'hard lean principles' and 'soft lean principles' were tested on reliability of the scales. Values of Cronbach's alpha and Spearman-Brown split-half reliability coefficients show that scales for both newly created LI factors are reliable (see Table 23).

Table 23. **Reliability coefficients and descriptive stats for LI items** (source: own analysis)

Index	Item	ITTC	Mean	SD
Hard lean principles (LIHA) α = .87 SB = .87	1.30 Continuous improvement (Kaizen)	*.46*	3.82	1.11
	1.25 Standardization	.69	3.50	.90
	1.23 Elimination of waste	.65	3.24	1.13
	1.26 Visual management	.63	3.22	1.26
	1.27 Jidoka	.64	2.90	1.34
	1.24 Just in time delivery, JIT	.68	2.89	1.27
	1.29 Long-term philosophy	.62	2.66	1.47
	1.28 Heijunka	.65	2.60	1.23
Soft lean principles (LISO) α = .80 SB = .80	1.32 Respect for people and partners	.69	3.72	.99
	1.33 Teamwork	.67	3.62	1.03
	1.31 Leaders promoted from within	*.47*	3.19	1.21
	1.34 Effective communication	.65	3.15	1.05

α – Cronbach's alpha reliability coefficient; SB - Spearman-Brown split-half reliability coefficient; ITTC - Item-to-total correlation

Item-to-total correlations exceeded .50 for all except one of the 12 LI items in the survey. Item 1.31 'Leaders promoted from within' showed low level of item-to-total correlations. This item was retained because (1) the alpha coefficient for the index itself still reaches an excellent level of ≥.80, and (2) the item was evaluated as having adequate content validity based on theoretical LI construct.

Factor scores were calculated as summated scales using 'mean' function. Analysis of the factors' descriptive statistics showed that respondents identified 'soft lean principles' as more often adopted (mean = 3.42). Though adoption of 'hard lean principles' was lower, they, as the 'soft lean principles', were adopted at high level (mean = 3.11). Factors 'hard lean principles' and adoption of 'soft lean principles' significantly correlate with each other (see Table 24).

Table 24. **Descriptive statistics and correlation matrix for LI factors** (source: own analysis)

	N		Descriptive stats		Factor correlations	
Factors	Valid	Missing	Mean	SD	1.	2.
1. Hard lean principles	121	0	3.11	.88		
2. Soft lean principles	121	0	3.42	.85	**.59****	

** Correlation is significant at the 0.01 level (2-tailed).

High correlations marked **bold**

Summarizing, the current research revealed that organizations implemented/adopted bigger number of hard lean practices then the number of soft lean practices. However, implementation of soft lean practices was more extensive, deeper. Implementation/adoption of hard process oriented lean practices means the effort directly influencing process, customer or financial performance. Implementation/adoption of soft people oriented lean practices means the effort indirectly influencing process, customer or financial performance.

3.2.6. Assessment of measurement model on organizational culture (OC)

Organizational culture' measurement model was based on DOCS questionnaire, which was validated in many studies (Fey & Denison, 2004; Gillespie, Denison, Haaland, Smerek, & Neale, 2008; Kotrba et al., 2012; Denison & Mishra, 2015). In this research, original structure of DOCS and original items of the short version of DOCS were retained and reliability of the data was assessed without questioning the validity of the DOCS. The small number of items measuring the particular DOCS' indexes assumes that the calculation of the split-half reliability is not suitable. Thus, the evaluation of the OC data reliability uses Cronbach's alpha.

The short DOCS questionnaire (Fey & Denison, 2004) has a nested structure that involves 4 dimensions, 12 indexes, and 36 items. Initially, reliability of the OC data was tested for a measurement model that contains 12 indexes (see Table 25).

Table 25. **Descriptive statistics for nested OC model with 12 indexes** (source: own analysis)

Dimens	Index	Item	ITTC	Mean	SD
Involvement	Empowerment	1.	.58	3.60	.71
	Mean = 3.54	2.	.57	3.60	.81
	α = .76	3.	.61	3.41	.83
	Team orientation	4.	.56	3.79	.88
	Mean = 3.61	5.	.53	3.43	1.07
	α = .73	6.	.57	3.62	.99
	Capability development	7.	.69	4.16	.72
	Mean = 3.96	8.	.77	3.79	.99
	α = .85	9.	.72	3.96	.89
Consistency	Core values	10.	*.48*	3.66	.99
	Mean = 3.79	11.	.70	3.84	.98
	α = .75	12.	.55	3.86	1.1
	Agreement	13.	*.30*	3.88	.75
	Mean = 3.40	14.	*.49*	3.29	.75
	α = .54	15. *	*.27*	3.05	.84
	Coordination and integration	16.	.51	3.59	.77
	Mean = 3.40	17.	.58	3.09	.87
	α = .74	18.	.61	3.53	1.01
Adaptability	Creating change	19.	.70	3.42	.93
	Mean = 3.66	20.	.70	3.83	.79
	α = .82	21.	.64	3.71	.79
	Customer focus	22.	*.49*	3.93	.75
	Mean = 3.94	23.	.58	3.76	.84
	α = .69	24. *	*.46*	4.11	.83
	Organizational learning	25.	*.48*	3.79	.80
	Mean = 3.50	26.	.52	3.44	.90
	α = .68	27.	*.49*	3.28	.93
Mission	Strategic direction and intent	28.	.84	4.22	.83
	Mean = 4.01	29.	.78	3.90	1.01
	α = .90	30.	.79	3.91	1.01
	Goals and objectives	31.	.69	3.34	.97
	Mean = 3.55	32.	.67	3.71	.93
	α = .81	33.	.62	3.60	.86
	Vision	34.	.77	3.37	.96
	Mean = 3.53	35.	.61	3.98	.83
	α = .84	36.	.76	3.22	.95

α – Cronbach's alpha reliability coefficient; * - item based on reverse question

While the values of α≥.70 are acceptable; α≥.60 are questionable; α≥.50 are poor; α<.50 are unacceptable (George & Mallery, 2019, p. 244), the data for indexes 'customer focus' (α = .69) and 'organizational learning' (α = .68) showed a questionable reliability and the data for index 'agreement' (α = .54) showed a poor reliability. Most item-to-total correlations for these three items were ≤.50. While the reliability of the data for OC measurement model that contains 12 indexes proved poor, the model was acknowledged not appropriate for the dataset of the current research.

Summarizing, in the short version of DOCS, 12 cultural indexes are measured using 36 items and some items include reverse scale. For 12 cultural indexes (empowerment, team orientation, capability development, core values, agreement, coordination and integration, creating change, customer focus, organizational learning, strategic direction and intent, goals and objectives, vision), the data of the current research was not reliable. In contrast, for four cultural dimensions (involvement, consistency, adaptability, and mission) the data of the current research was reliable. This allows concluding that the short 36-items version of the Denison Organizational Culture Survey (DOCS) in complex research frameworks (as the lean-culture-performance framework) for the structure with 12 cultural indexes proves as a questionable instrument because of issues of the data reliability. Instead, the structure with four cultural dimensions proves as the reliable instrument, although it narrows the cultural typology analysis to only four types of the culture.

The reliability of the empirical data was tested for a measurement model that contains 4 dimensions of OC, namely 'involvement', 'consistency', 'adaptability', and 'mission' (see Table 26).

Table 26. **Reliability coefficients and descriptive stats for OC items** (source: own analysis)

Dimension	Item	Item-to-total correlation, ITTC	Mean	SD
Involvement α = .87 SB = .80	1.	.55	3.60	.71
	2.	.62	3.60	.81
	3.	.61	3.41	.83
	4.	.65	3.79	.88
	5.	.59	3.43	1.07
	6.	.59	3.62	.99
	7.	.58	4.16	.72
	8.	.58	3.79	.99
	9.	.72	3.96	.89
Consistency α = .81 SB = .71	10.	.60	3.66	.99
	11.	.63	3.84	.98
	12.	*.39*	3.86	1.10
	13.	*.41*	3.88	.75
	14.	*.49*	3.29	.75
	15. *	*.41*	3.05	.84
	16.	*.47*	3.59	.77
	17.	*.48*	3.09	.87
	18.	.70	3.53	1.01
Adaptability α = .85 SB = .86	19.	.64	3.42	.93
	20.	.72	3.83	.79
	21.	.65	3.71	.79
	22.	*.48*	3.93	.75
	23.	*.47*	3.76	.84
	24. *	*.48*	4.11	.83
	25.	.54	3.79	.80
	26.	.56	3.44	.90
	27.	.55	3.28	.93
Mission *α = .92* SB = .90	28.	.65	4.22	.83
	29.	.69	3.90	1.01
	30.	.74	3.91	1.01
	31.	.72	3.34	.97
	32.	.69	3.71	.93
	33.	.65	3.60	.86
	34.	.78	3.37	.96
	35.	.76	3.98	.83
	36.	.73	3.22	.95

Item-to-total correlations exceeded .50 for three-fourths of the 36 OC items in the survey. Some items showed low levels (≤ .50) of item-to-total correlations. These items were retained because (1) the alpha coefficient for the indexes still reaches a good level of ≥.80, and (2) the items were evaluated to have adequate content validity based on its fit with the definition provided for this index in previous research (Denison, Nieminen, & Kotrba, 2014). A high value of alpha (>.90) suggested redundancies and showed that the test length should be shortened.

The descriptive statistics for the dimensions of organizational culture shoved the existence of balanced organizational cultures – levels of each cultural dimension were about the same (see Table 27).

Table 27. **Descriptive statistics for OC dimensions** (source: own analysis)

Dimension	N		Mean	Std. Deviation
	Valid	Missing		
Involvement	121	0	3.70	.62
Consistency	121	0	3.53	.58
Adaptability	121	0	3.70	.57
Mission	121	0	3.69	.72
Organizational culture	121	0	3.66	.55

It appears that research organizations had involvement-, consistency-, adaptability-, and mission- wise balanced organizational cultures.

3.2.7. Assessment of measurement model on corporate performance (CP)

CP measures' correlation matrix served as a visual test for testing corporate performance measures for data multicollinearity. Result of data multicollinearity test was negative while no correlation coefficients exceeded the limit .80. At the same time, many significant correlations were greater than .30 what allows considering factor analysis appropriate for CP (see Appendixes).

Kaiser-Meyer-Olkin measure of sampling adequacy and Bartlett's test of sphericity indicated correlations among the variables for CP. Resulting MSA value = .87 **(**above .8) indicated that the sampling adequacy is meritorious. Significance level value = .00 (less than .05) of Bartlett's test of sphericity showed that sufficient correlations exist among the tested variables which is an indication to proceed factor analysis (see Table 28).

Table 28. **Test for correlations among variables for CP** (source: own analysis)

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**.87**
Bartlett's Test of Sphericity	Approx. Chi-Square	1016.78
	df	136
	Sig.	**.00**

The scree plot allowed the visualization of Eigenvalues, and helped to indicate the plausible number of corporate performance factor solutions. Resulting scree plot points to the two-factor solution while theoretical model suggest five factors. According to the scree plot, the first five factors would be strong while they have Eigenvalues over one (see Figure 16).

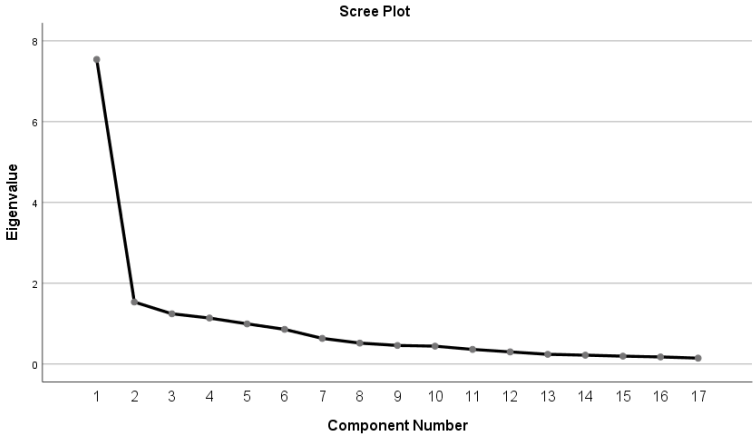

Figure 16. **Scree plot for corporate performance (CP)** (source: own analysis)

Extraction of components of corporate performance was performed using the principal component analysis (see Table 29). While the extracted components should not be orthogonal, factor rotation was Oblimin.

Table 29. **Rotated matrix of principal components for CP** [a] (source: own analysis)

Performance item	Component					
	1	2	3	4	5	6
3.1 Sales	**-.96**					
3.2 Profit margin	**-.95**					
3.3 Revenue growth	**-.68**					
3.4 Customer satisfaction		**.68**				
3.5 Customer retention rate		**.59**				
3.6 Service quality		.41				
3.7 Time to market for new products and services			**.98**			
3.8 Quality of new product development and project management processes			**.85**			
3.9 Lead time				**-.95**		
3.10 Quantity and depth of standardized processes				**-.70**		
3.13 Employee satisfaction survey					**.83**	
3.11 Retention of top employees					**.76**	
3.12 Quality of leadership development					**.64**	
3.16 Investment in R&D						**.82**
3.17 Investment in new market development		.30				**.68**
3.14 Depth and quality of strategic planning		.36				**.59**
3.15 Anticipating and preparing for changes in the external environment						**.56**

Extraction Method: Principal Component Analysis, eigenvalues greater than 0.8. Rotation Method: Oblimin with Kaiser Normalization, delta = .00. Missing values excluded listwise. Loadings sorted by size. Loadings <0.3 are suppressed. Loadings > .50 considered as significant.

a. Rotation converged in 42 iterations.

All loadings except the loading of item 'Service quality' exceeded the value .50. Item 'Service quality' was retained, while it has an adequate content validity based on literature review. No cross-loadings exceeded the value .40. Principal component analysis resulted in extraction of six factors with Eigenvalue of the sixth factor =.80. The measurement model based on the literature review was proposing CP measurement structure, which has five components (financial, customer/market, process, people development, and preparing for the future). However, the data suggests division of the 'process' component into the two components namely the 'product development process' and the 'product delivery process'. This division results the CP

measurement structure composed from six components, which relates to (1) financial, (2) customer/market, (3) product development process, (4) product delivery process, (5) people development, and (6) preparing for the future measures. All six components (factors) were tested on the reliability of scales (see Table 30).

Table 30. **Reliability coeff. and descriptive statistics for CP items** (source: own analysis)

Index	Item	ITTC	Mean	SD
Financial; α = .87	3.1 Sales	.74	3.72	.86
	3.2 Profit margin	.75	3.63	.85
	3.3 Revenue growth	.74	3.66	.81
Customer/market; α = .84	3.4 Customer satisfaction	.74	3.77	.74
	3.5 Customer retention rate	.76	3.71	.73
	3.6 Service quality	.63	3.86	.81
Product development process; α = .87	3.7 Time to market for new products and services	.78	3.54	.86
	3.8 Quality of new product development and project management processes	.78	3.43	.85
Product delivery process; α = .77	3.9 Lead time	.63	3.55	.87
	3.10 Quantity and depth of standardized processes	.63	3.62	.81
People development; α = .70	3.11 Retention of top employees	*.47*	3.52	.81
	3.12 Quality of leadership development	*.49*	3.50	.74
	3.13 Employee satisfaction survey	.60	3.32	.74
Preparing for the future measures; α = .83	3.14 Depth and quality of strategic planning	.60	3.58	.82
	3.15 Anticipating and preparing for changes in the external environment	.68	3.56	.79
	3.16 Investment in R&D	.70	3.72	.90
	3.17 Investment in new market development	.69	3.65	.98

Values of Cronbach's alpha coefficients show that scales for newly created six-factor CP structure are reliable. Item-to-total correlations exceeded .50 for all except two of the 17 CP items in the survey. Items 3.11 'Retention of top employees (=.47) and 3.12 'Quality of leadership development' (=.49) showed medium level of item-to-total correlations. These items were retained because (1) the alpha coefficient for the index itself still reaches acceptable

level of =.70, and (2) the items were evaluated as having adequate content validity based on theoretical list of CP measures.

Factor scores were calculated as summated scales using 'mean' function. Correlation matrix for CP factors show significant correlation between all six factors (see Table 31).

Table 31. **Descriptive statistics and correlation matrix for CP factors** (source: own analysis)

Factors	N		Descriptive stat.		Factor correlations					
	Valid	Missing	Mean	SD	1.	2.	3.	4.	5.	6.
1. Financial	113	8	3.68	.75						
2. Customer/market	111	10	3.77	.66	**.50****					
3. Product development process	109	12	3.49	.81	.43**	**.61****				
4. Product delivery process	111	10	3.59	.76	.36**	**.54****	.46**			
5. People development	112	9	3.44	.61	.35**	.49**	.43**	.42**		
6. Preparing for future	110	11	3.64	.72	**.60****	**.56****	**.57****	**.50****	**.51****	
Overall (cumulative)	113	8	3.61	.54	**.74****	**.80****	**.75****	**.69****	**.69****	**.86****

** Correlation is significant at the 0.01 level (2-tailed).

High correlations marked **bold**

The factor 'preparing for future' highly correlates with all other five factors. Such pattern of the correlation suggests that preparing for future (strategic planning, preparing for changes in environment, investment in R&D, and investment in new market development) is a very important activity for organizations. Financial measures highly correlate with 'customer/market' and 'preparing for future' measures. This correlation suggest that if an organization want a financial success, it should invest into customers, into the market, and into the preparing for future activities.

3.2.8. Resulting measurement framework

The factor analysis suggests several modifications of the initial measurement framework:

1. Instead of two factors, lean methods should have structure of three factors, namely hard, soft, and other lean methods.
2. Two lean principles, namely the 'long-term philosophy' and the 'continuous improvement' should be relocated from the group 'soft principles' to the group 'hard principles'.

3. The measurement of the organizational culture should be based on a system of four cultural dimensions (involvement, consistency, adaptability, and mission) instead of a system of twelve cultural indexes.
4. The measurement of the corporate performance should have the six-item structure (financial, customer /market, product development process, product delivery process, people development, and preparing for future measures) instead of the five-item structure.

This modification results in the 'resulting measuring framework', which shows possible hypothesized relationships between lean practices, the organizational culture, and the corporate performance (see Figure 17).

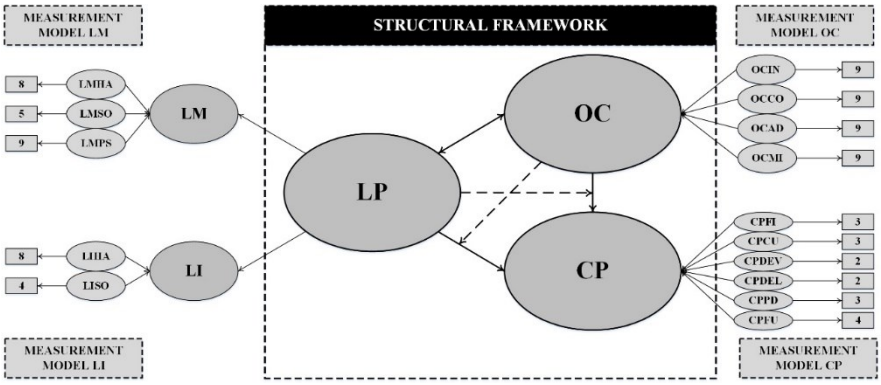

Figure 17. **Resulting measurement framework**
(source: author)

For lean practices (LP), the resulting framework involves second level latent variables namely lean methods (LM) and lean principles (LI). For lean methods, the model involves third level latent variables namely hard (LMHA), soft (LMSO), and problem solving (LMPS) lean methods. For lean principles, the model involves third level latent variables namely hard (LIHA) and soft (LISO) lean principles. For the organizational culture, the model involves second level latent variables involvement (OCIN), consistency (OCCO), adaptability (OCAD), and mission (OCMI). For the corporate performance, the model involves six second level latent variables namely financial (CPFI), customer /market (CPCU), product development process (CPDEV), product delivery process (CPDEL), people development (CPPD), and preparing for future (CPFU). All measures are formative.

Relationships in the resulting structural model visualized by arrows were connected to the set of hypotheses / to the set of research models. Hypotheses

and related research models were the object for testing by the regression analysis.

3.2.9. Assumptions for regression analysis

The regression analysis needs fulfillment of some assumptions. The first assumption in the current research was that both the dependent and independent **variables are metric** (Hair et al., 2014). For a simple regression, all predictor variables and outcome variable must be measured by the interval scale (Čekanavičius & Murauskas, 2014; Field, 2013).

The second assumption was that **the sample size of the current research is large enough**. The hard rule is that sample size for regression should exceed 50 (George & Mallery, 2019). Maintaining power at .80 in multiple regression requires a minimum sample of 50 and preferably 100 observations for most research situations (Hair et al., 2014). The first most common sample size rule of thumb is that you should have 10-15 observations for each predictor in the model (Field, 2013). The second rule is that the minimum ratio should never fall below five observations for each independent variable in the variate and the desired ratio is between 15 to 20 observations for each independent variable in the variate (Hair et al., 2014).

The third assumption was that **predictors have approximately normal distribution**. However, the deviation from normality among the predictor variables, or even the inclusion of a discrete variable can yield good results (George & Mallery, 2019; Murauskas & Cekanavicius, 2014). The visual method for understanding the nature of the variable is to examine the shape of its distribution. The statistical tests for normality are the Shapiro-Wilks test and a modification of the Kolmogorov-Smirnov test. Each calculates the level of significance for the differences from a normal distribution. The graphical P-P plot also allows assessing normality. In the P-P graph, a straight line angled at 45 degrees represents the normal distribution (Hair et al., 2014; Field, 2018).

Assumption of **the linearity** refers to the notion that predicted values fall in a straight line by having a constant unit change of the dependent variable for a constant unit change of the independent variable (Hair et al., 2014). The most common way to assess linearity is to examine scatterplots of the variables and to identify any nonlinear patterns in the data. Of the many types of scatterplots, one format particularly suited to multivariate techniques is the scatterplot matrix. An alternative approach is to run a simple regression analysis and to examine the residuals (Hair et al., 2014).

Assumption of no multicollinearity. The multicollinearity is a phenomenon when any single independent variable is highly correlated with a set of other independent variables. Independent variables are collinear if their correlation coefficient is =1 and there are no collinearity when correlation coefficient =0 (Hair et al., 2014). Presumption for regression is that there is no perfect multicollinearity of the independent variables (predictors). The predictor variables should not correlate too highly (Murauskas & Cekanavicius, 2014; Field, 2018). A method for identifying multicollinearity is to analyze the correlation matrix for predictor variables that correlate very highly (values of correlation coefficient r≥.80 or r≥.90) (Field, 2013). The variance inflation factor (VIF) is another measure for multicollinearity (Čekanavičius & Murauskas, 2014). If the VIF for the predictor is ≥10 then it indicates a multicollinearity problem (Hair et al., 2014; Field, 2018). Stricter rule is that multicollinearity may exist when VIF is ≥4.0 (Garson, 2013; Murauskas & Cekanavicius, 2014). When multicollinearity for the predictor is detected, the multicollinear predictor is a candidate for the elimination from the regression model (Hair et al., 2014).

Assumption that outliers are dealt. Outliers are observations that have a substantial difference between the actual value for the dependent variable and the predicted value (Field, 2013; Hair et al., 2014). The data should not have outliers (Čekanavičius & Murauskas, 2014). A boxplot with confidence intervals illustrates the existence of outliers that would otherwise take more empirical analysis to detect if the graphical method was not employed (Hair et al., 2014). Standardized residuals with an approximate absolute value greater than 3.00 are cause for concern (Field, 2013). Observations having Cook's distance value ≥1.00 means outlier (Čekanavičius & Murauskas, 2014).

The assumption of the **independence of the error terms** (sometimes called as the assumption of absence of correlated errors) means that errors for the variate (residuals) of the individual independent variables 'e' should not be correlated (Čekanavičius & Murauskas, 2014; Hair et al., 2014). The residual is the difference between the observed and predicted values for the dependent variable (Hair et al., 2014). The method for testing this assumption was the Durbin–Watson test, which tests for serial correlations between errors. As a very conservative rule of thumb, values less than 1 or greater than 3 are cause for concern (Field, 2013).

The assumption of **normality of the error term distribution** means that the residuals in the regression model are random, normally distributed variables with a mean =.00 (Field, 2013). The method for residual normality

was a visual check of the histogram of residuals for a distribution approximating the normal distribution. However, this method is difficult in smaller samples and a better method is the use of normal probability P-P plots. Yet another test for residual normality was a Shapiro‑Wilk test where p value ≥.05 shows that residuals are normal (Hair et al., 2014, Murauskas & Cekanavicius, 2014).

The assumption of **homoscedasticity** of the data refers to the notion that dependent variable exhibit equal levels of variance across the range of values of independent (predictor) variables (Hair et al., 2014). Homoscedasticity of the data is desirable (Murauskas & Cekanavicius, 2014; Hair et al., 2014). The common test for the homoscedasticity is the Levene test for homogeneity of variance, which measures the equality of variances for a single pair of variables (Hair et al., 2014). A p value ≥.05 indicates the fulfillment of the requirement for data homoscedasticity. Other tests are the Breusch-Pagan test and the White test. The White test regresses the squared OLS-residuals on all distinct predictors, cross products, squares of predictors, and the intercept. The Breusch-Pagan test tests the null hypothesis that the residuals' variances are unrelated to a set of explanatory variables (Klein, Gerhard, Büchner, Diestel, & Schermelleh-Engel, 2015). However, the White test and the Breusch-Pagan test suffer from low sizes and powers (Li & Yao, 2018). Since the Breusch–Pagan test is sensitive to small sample sizes resulting in deviating from data normality, the current research used the modified Breusch–Pagan (also called Koenker-test) test (Klein et al., 2015) instead.

Assumption of **confirmatory model specification** means that the regression model can employ a confirmatory perspective wherein the researcher specifies the exact set of independent variables to be included into the model. Perhaps the most popular approach to confirmatory approach and the researcher specified variable selection is the stepwise method (Hair et al., 2014). The backward method is proper for exploratory purposes (Field, 2018).

As for objectives of the regression model, the first objective of the regression was to maximize **the overall predictive power** of the independent variables as represented in the variate. The most commonly used measure of predictive accuracy for the regression model is the coefficient of determination (R^2). It ranges from ideal prediction when R^2=1.00 to no prediction when R^2=.00. The most beneficial result of the interpretation of the regression variate is a determination of the relative importance of each independent variable in the prediction of the dependent variable (Hair et al., 2014).

Significant predictive power of regression model was another objective. In multiple regression power refers to the probability of detecting as statistically significant a specific level of R^2 or a regression coefficient at a specified significance level for a specific sample size (Hair et al., 2014). The F-ratio is the ratio of the variation explained by the model to the variation attributable to unsystematic factors. The F-statistics is a tool to test F-ratio. The F-statistic tests the **overall fit of a regression model to a set of observed data**. If F-ratio is small then the ability of the model to predict the observed data is poor, and if F-ratio is large then the ability of the model to predict the observed data is good (Field, 2018).

The fitness of regression model is acceptable when: the coefficient of determination $R^2 \geq .20$; ANOVA $p < .05$; for all independent variables $p < .05$; all VIF ≤ 4; all Cook's values regarding outliers' ≤ 1; all residuals are normally distributed ($p \geq .05$ for Shapiro-Wilk test); the data is homoscedastic and $p \geq .05$ for modified Breusch–Pagan test (Murauskas & Cekanavicius, 2014).

Summarizing, the regression analysis needs fulfillment of some assumptions. In the current research, these assumptions were that covariance-based approach suits for the formatively measured constructs, data is interval, the sample size is large enough, predictors are distributed normally, measured phenomenon is linear, there are no multicollinearity and outliers, data is homoscedastic, error terms are independent, variance of the error terms is constant, and the error term distribution is normal.

3.2.10. Influence of LP on CP: assessment of models

Literature suggest that lean practices (LP) is a predictor variable, and corporate performance (CP) is an outcome variable. This provide possibility to hypothesize a conceptual research model for those two elements (see Figure 18):

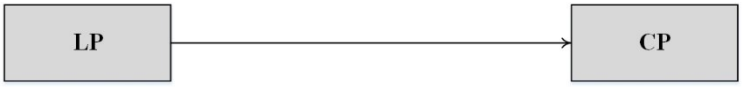

Figure 18. **Conceptual research model for LP and CP**
(source: author)

This conceptual model associates with the hypothesis: 'lean practices are influencing the corporate performance'.

As for influence of individual lean practices, regression analysis would include many independent variables; in such case, the regression as the analysis tool would be to complex. The correlation analysis rather than the regression analysis allows showing links between individual lean practices and performance measures. This research hypothesizes that lower correlation levels associate with lower influence of lean practices on performance measures, and higher correlation levels associate with higher influence of lean practices on performance measures.

Table 32 presents the list of individual lean methods, the level of their implementation (presented as 'mean of implementation'), correlations of each individual lean method and performance measure, and the cumulative influence of an individual lean method on performance measures (presented as 'mean of correlations').

Table 32. **Correlations of individual lean methods and performance** (source: own analysis)

Lean method	*Mean of implementation*	Correlation coefficients						
		Financial	Customer/market	Development process	Delivery process	People development	Preparing for future	Mean of correlations
Policy/strategy deployment (Hoshin)	*2.13*	.21*	.26**	**.33****	**.31****	.22*	**.33****	.28
Proper arrangement (5S)	*3.76*	.13	.25**	.28**	**.32****	.19*	.29**	.24
Information white-boards	*4.03*	.18*	.26**	.16	**.37****	.20*	.27**	.24
Kaizen workshops	*2.98*	.24*	.15	.20*	**.34****	.16	.31**	.23
Visiting actual place (Gemba Walk)	*3.02*	.21*	.27**	.22*	**.34****	.16	.20*	.23
Statistical process charts (SPC)	*2.52*	.13	.16	.24*	**.38****	.20*	.24*	.23
Consensus Decisions (Ringi)	*2.70*	.17	.13	.28**	**.32****	.15	.29**	.22
Reflection after the activity (Hansei)	*1.83*	.08	.20*	.19*	**.30****	.21*	**.35****	.22
Standard operation procedures (SOP)	*3.15*	.10	.20*	.29**	**.35****	.11	.27**	.22
Cross-functional training	*2.48*	.06	.25*	.28**	.23*	.12	**.36****	.22
Error proofing (Poka-Yoke)	*2.26*	.06	.13	.26**	**.36****	.21*	.22*	.21
War room (Obeya)	*1.95*	.22*	.16	.22*	.23*	.09	**.31****	.21
Production Kanban	*2.64*	.10	.24*	.17	.24*	.18	.20*	.19
Total preventive maintenance (TPM)	*3.10*	.07	.22*	.20*	.27**	.11	.24*	.19
Value Stream Mapping (VSM)	*2.28*	.10	.09	.15	**.36****	.22*	.16	.18
Morning meetings (Asaichi)	*4.17*	.24*	.17	.10	.26**	.10	.13	.17
Alert system (Andon)	*1.84*	.18	.07	.10	.18	.27**	.15	.16
Problem solving standard (A3)	*2.80*	.20*	.08	.13	.22*	.10	.21*	.16
Kaizen board	*2.79*	.12	.17	.08	.23*	.09	.23*	.15
Obtaining management support (Nemawashi)	*2.06*	.05	.06	.11	**.30****	.17	.21*	.15
Leader's daily standard work sheets	*2.38*	.08	.00	.13	.17	.14	.16	.11
Root cause analysis ("5 Why?")	*2.95*	.05	-.07	.10	.15	.07	.14	.07

Pearson correlation. Sorted by mean of correlations. Medium level correlations marked **bold**. **. Correlation is significant at the 0.01 level (1-tailed).

*. Correlation is significant at the 0.05 level (1-tailed).

According to the highest mean of correlations, the method 'Policy/strategy deployment (Hoshin)' is the most influential method in regard of impact on various performance measurement groups. It correlates at medium level with performance measures 'Development process', 'Delivery process', and 'Preparing for future' performance. However, the implementation of this important method in the research organizations was relatively low (mean = 2.13). 'Proper arrangement (5S)' and 'Information white-boards' proved as another two important lean methods. Research organizations fairly implemented these methods, and they had a relatively high influence on performance measures, particularly on the measure 'Delivery process'. Interestingly, research organizations actively (mean = 4.17) used the method 'Morning meetings' (Asaichi), although this method correlated relatively low with performance measures.

Table 33 presents the list of individual lean principles, the level of their implementation (presented as 'mean of implementation'), correlations of each individual lean principle and performance measure, and the cumulative influence of an individual lean principle on performance measures (presented as 'mean of correlations').

Table 33. **Correlations of individual lean principles and performance** (source: own analysis)

Lean principle	*Mean of implementation*	Correlation coefficients						
		Financial	Customer/market	Development process	Delivery process	People development	Preparing for future	Mean of correlations
Leaders promoted from within	*3.19*	.20*	.24**	.27**	.28**	**.31****	**.49****	**.30**
Continuous improvement (Kaizen)	*3.82*	.21*	**.33****	**.39****	**.39****	.14	.27**	.29
Long-term philosophy	*2.66*	.20*	.23**	**.32****	**.37****	.15	**.34****	.27
Respect for people and partners	*3.72*	.11	.21*	.26**	**.33****	**.35****	**.32****	.26
Visual management	*3.22*	.17*	**.30****	.28**	**.46****	.10	.27**	.26
Just in time delivery	*2.89*	.11	**.30****	**.34****	**.44****	.13	.19*	.25
Elimination of waste	*3.24*	.11	.28**	.21*	**.47****	.14	.19*	.23
Standardization	*3.50*	.11	.21*	**.33****	**.41****	.08	.25**	.23
Teamwork	*3.62*	.06	.11	.18*	**.33****	.28**	.25**	.20
Effective communication	*3.15*	.05	.00	.18*	**.32****	.21*	.21*	.16
Quality right first time (Jidoka)	*2.90*	.11	.08	.17*	**.35****	.09	.15	.16
Leveling the workload (Heijunka)	*2.60*	-.01	.20*	.18*	.26**	.12	.09	.14

Pearson correlation. Sorted by mean of correlations. Medium level correlations marked **bold**. **. Correlation is significant at the 0.01 level (1-tailed).
*. Correlation is significant at the 0.05 level (1-tailed).

'*Everything rises and falls on leadership!'* (Blanchard & Miller, 2007). According to the highest mean of correlations, the principle 'Leaders promoted from within' is the most influential principle. Research organizations have fairly adopted this principle; it correlates at medium level with performance measures 'People development' and 'Preparing for future'. According to the list of means of correlations, second important principle was 'Continuous improvement' (Kaizen). This principle correlated at medium level with performance measures 'Customer/market', 'Development process', and 'Delivery process'. The principle 'Long-term philosophy' also proved as important. It correlated at medium level with performance measures 'Development process', and 'Delivery process'. However, the adoption of this important principle in research organizations was relatively low. Perhaps, the

relatively low adoption of the principle 'Long-term philosophy' is associated with the reality that '*Lithuanian lean organizations have existed for a relatively short time*' (Serafinas & Ruželė, 2014) to establish long-term business approach. Interestingly, the principle 'Teamwork', though acknowledged in literature as important and adopted pretty well by research organizations, did not show relatively high levels of correlations with performance measures.

A comparison of levels of hypothesized influence of individual lean practices and their implementation levels show that research organizations relatively more implemented/adopted some less influential lean practices (as 'Asaichi' or 'Teamwork'), and relatively less implemented/adopted some more influential lean practices (as 'Hoshin Kanri' or 'Long-term philosophy').

However, 'lean practices' is a construct that has some structural elements. In the same way, a 'corporate performance' is a construct that has some structural elements (see Figure 19).

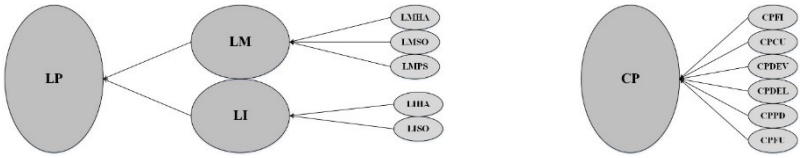

Figure 19. **Constructs for lean practices and corporate performance** (source: author)

Such complex structures of both lean practices (LP) and corporate performance (CP) allows examination of one-to-one, one-to-many, many-to-one, and many-to-many type structural relationships. The first step of relationship analysis (correlation analysis of structural elements) revealed levels of hypothetical influences (see Table 34).

Table 34. **Influence of LP on CP: Pearson correlation coefficients** (source: own analysis)

Structural elements	Corporate performance	Financial	Customer/ market	Development process	Delivery process	People development	Preparing for future
Lean practices	.46**	.22**	.29**	.36**	**.54****	.27**	.43**
Lean methods	.43**	.23**	.26**	.32**	**.50****	.26**	.41**
Lean principles	.44**	.18*	.30**	.39**	**.54****	.26**	.40**
Hard lean methods	.40**	.15	.27**	.33**	.42**	.25**	.38**
Soft lean methods	.33**	.26**	.22*	.17*	.39**	.17*	.30**
PS lean methods	.35**	.20*	.16*	.27**	.42**	.22**	.34**
Hard lean principles	.41**	.18*	.33**	.38**	**.54****	.17*	.34**
Soft lean principles	.39**	.14	.18*	.28**	.39**	.36**	.41**

PS lean methods – problem solving lean methods

**. Correlation is significant at the 0.01 level (1-tailed).

*. Correlation is significant at the 0.05 level (1-tailed).

Weak correlations marked pale. Medium correlations marked normal. Strong correlations marked **bold**.

Influence of lean on corporate performance was analyzed using series of regressions for models with various level of generalization. Twenty-one regression models (see Table 35) and following regression procedures allowed accessing these regression models on both the significance of effect and the influence strength.

Table 35. **Influence of LP on CP: Models for regression** (source: own analysis)

Elements of the model	Corporate perform.	Financial	Customer / market	Devel. processs	Delivery process	People development	Preparing for future
Lean practices	Model 1	Model 4	Model 7	Model 10	Model 13	Model 16	Model 19
Lean methods Lean principles	Model 2	Model 5	Model 8	Model 11	Model 14	Model 17	Model 20
Hard lean methods Soft lean methods PS lean methods Hard lean principles Soft lean principles	Model 3	Model 6	Model 9	Model 12	Model 15	Model 18	Model 21

PS lean methods – problem solving lean methods

Assessment of models regarding impact on overall corporate performance

Model 1: Influence of lean practices on overall corporate performance. Hypothesis: lean practices are influencing overall corporate performance.

The preliminary regression analysis detected no outliers, which exceeded the threshold of three standard deviations. The regression procedure allowed producing the model that met the criteria for $R^2 \geq .20$. The resulting coefficient of determination of the model met threshold value .20 ($R^2 = .20$). The Durbin–Watson test value between one and three (=1.78) showed the absence of correlated errors. The ANOVA p value for F-ratio <.05 (Sig. =.00) and the medium F-ratio (F=28.61) showed that the model explains a significant and medium proportion of the variation. All Cook's distance values (in residual statistics) regarding outliers met the criteria being ≤ 1 (Cook's distance maximum for the model was = .12). Residuals were distributed normally and met the criteria p being ≥.05 for Shapiro-Wilk test (p=.22). Statistical criteria for homoscedasticity p being ≥.05 for modified Breusch–Pagan test (p=.16) was met, see Appendixes. The significance coefficient value for the independent variable met the criteria p being <.05 (p=.00 for lean practices), see Table 36.

Table 36. **Influence of LP on CP: coefficients** [a] (source: own analysis)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	2.62	.19		13.84	.00		
	Lean practices	.34	.06	.45	5.35	.00	1.00	1.00

a. Dependent Variable: Corporate performance

Hypothesis '*lean practices are influencing overall corporate performance*' confirmed. The resulting regression equation for the model is:

Corporate performance = 2.62 + .34 × lean practices

The resulting regression equation allows concluding that lean practices influence overall corporate performance, although the influence is not high (β=.34), and the effect not explained by this model is high (constant =2.62).

Model 2: Influence of lean methods and lean principles on corporate performance. Hypothesis: either lean methods or lean principles are influencing overall corporate performance. All theoretical models did not met the criteria coefficient of determination $R^2 \geq .20$ either the criteria for the significance coefficient value for the independent variable p being <.05. Hypothesis rejected.

Model 3: Influence of hard lean methods, soft lean methods, PS lean methods, hard lean principles, and soft lean principles on corporate performance. Hypothesis: either hard lean methods, soft lean methods, problem solving lean methods, hard lean principles, or soft lean principles are influencing overall corporate performance.

During the preliminary regression analysis, one outlier near the threshold 3 standard deviations (std. residual = 2.59) was removed. The consequent backward and forward regression procedures allowed producing two models that met the criteria for $R^2 \geq .20$. Three independent variables namely hard lean methods, other lean methods, and hard lean principles were removed from the model while they did not met the criteria for the significance coefficient value for the independent variable p being <.05. The resulting coefficient of determination of the model with independent variables soft lean principles, soft lean methods exceeded threshold value .20 (R^2=.24). The Durbin–Watson test value between one and three (=1.98) showed the absence of correlated

errors (see Appendixes). The ANOVA p value for F-ratio <.05 (Sig. =.00) showed that the model explains a significant proportion of the variation. The relatively low value of the F-ratio (F=16.99) showed that the model explains a relatively low proportion of the variation. All Cook's distance values (in residual statistics) regarding outliers met the criteria being ≤ 1 (Cook's distance maximum for the model was = .08). The significance coefficient values for the independent variables met the criteria p being <.05 (p=.00 for soft lean principles and p=.00 for soft lean methods). Both VIF values met the criteria being ≤4 (for both independent variables VIF=1.14), see Table 37.

Table 37. **Influence of LMHA, LMSO, LMPS, LIHA, LISO on CP**[a] (source: own analysis)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
2	(Constant)	2.36	.22		10.88	.00		
	Soft lean principles	.20	.06	.32	3.61	.00	.88	1.14
	Soft lean methods	.16	.05	.27	3.05	.00	.88	1.14

a. Dependent Variable: Corporate performance

Standardized residuals were normally distributed and met the criteria p being ≥.05 for Shapiro-Wilk test (p=.76), see Appendixes. Statistical criteria for homoscedasticity p being ≥.05 for modified Breusch–Pagan test (p=.16) was met. Hypothesis confirmed. The resulting regression equation for the model is:

Corporate performance = 2.36 + .20 × soft lean principles + .16 × soft lean methods

The resulting regression equation allows concluding that both hard lean practices and hard lean principles does not significantly influence the overall corporate performance. In contrast, both soft lean principles and soft lean methods do significantly influence the overall corporate performance (β=.20 for soft lean principles and β=.16 for soft lean methods), and the effect not explained by mentioned lean practices is =2.36. This result shows a high importance of soft lean practices for the corporate success.

Assessment of models regarding impact on financial performance

Model 4: Influence of lean practices on financial performance. Hypothesis: lean practices are influencing financial performance. The generated model did not met the criteria coefficient of determination $R^2 \geq .20$. Hypothesis rejected.

Model 5: Influence of lean methods and lean principles on financial performance. Hypothesis: either lean methods or lean principles are influencing financial performance. The generated models did not met the criteria coefficient of determination $R^2 \geq .20$. Hypothesis rejected.

Model 6: Influence of hard lean methods, soft lean methods, other lean methods, hard lean principles, and soft lean principles on financial performance. Hypothesis: either hard lean methods, soft lean methods, other lean methods, hard lean principles, or soft lean principles are influencing financial performance. The generated models did not met the criteria coefficient of determination $R^2 \geq .20$. Hypothesis rejected.

Assessment of models regarding impact on customer/market performance

Model 7: Influence of lean practices on customer/market performance. Hypothesis: lean practices are influencing customer / market performance. The generated model did not met the criteria coefficient of determination $R^2 \geq .20$. Hypothesis rejected.

Model 8: Influence of lean methods and lean principles on customer/market performance. Hypothesis: either lean methods or lean principles are influencing customer / market performance. The generated models did not met the criteria coefficient of determination $R^2 \geq .20$. Hypothesis rejected.

Model 9: Influence of hard lean methods, soft lean methods, PS lean methods, hard lean principles, and soft lean principles on customer/market performance. Hypothesis: either hard lean methods, soft lean methods, problem solving lean methods, hard lean principles, or soft lean principles are influencing customer / market performance. The generated models did not met the criteria coefficient of determination $R^2 \geq .20$. Hypothesis rejected.

Assessment of models regarding impact on product development process

Model 10: Influence of lean practices on the product development process. Hypothesis: lean practices are influencing product development process. The

generated model did not met the criteria coefficient of determination $R^2 \geq .20$. Hypothesis rejected.

Model 11: Influence of lean methods and lean principles on the product development process. Hypothesis: either lean methods or lean principles are influencing product development process. The generated models did not met the criteria coefficient of determination $R^2 \geq .20$. Hypothesis rejected.

Model 12: Influence of hard lean methods, soft lean methods, PS lean methods, hard lean principles, and soft lean principles on the product development process. Hypothesis: either hard lean methods, soft lean methods, problem solving lean methods, hard lean principles, or soft lean principles are influencing product development process. The generated models did not met the criteria coefficient of determination $R^2 \geq .20$. Hypothesis rejected.

Assessment of models regarding impact on product delivery process

Model 13: Influence of lean practices on the product delivery process. Hypothesis: lean practices are influencing product delivery process.

The preliminary regression analysis detected no outliers, which exceeded the threshold of three standard deviations. The consequent regression procedure allowed producing a model that met the criteria for $R^2 \geq .20$. The coefficient of determination of the model with independent variable lean practices exceeded the threshold value .20 ($R^2 = .29$). The Durbin–Watson test value between one and three (=1.83) showed the absence of correlated errors, see Appendixes. The ANOVA p value for F-ratio <.05 (Sig. =.00) showed that the model explains a significant proportion of the variation. The high value of the F-ratio (F=44.60) showed that the model explains a high proportion of the variation. All Cook's distance values (in residual statistics) regarding outliers met the criteria being ≤ 1 (Cook's distance maximum for the model was = .08). The significance coefficient value of independent variable met the criteria p being <.05 (p=.00 for lean practices), see Table 38.

Table 38. **Influence of LP on CPPD: coefficients** [a] (source: own analysis)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	1.94	.25		7.63	.00		
	Lean practices	.56	.08	.54	6.68	.00	1.00	1.00

a. Dependent Variable: Delivery process (CPPD)

Standardized residuals were distributed normally and met the criteria p being ≥.05 for Shapiro-Wilk test (p=.12), see Appendixes. Statistical criteria for homoscedasticity p being ≥.05 for modified Breusch–Pagan test (p=.18) was met. Hypothesis confirmed. The resulting regression equation for the model is:

Delivery process = 1.94 + .56 × lean practices

The resulting regression equation allows concluding that lean practices do influence the product delivery process performance, the effect of influence β=.56, and the effect not explained by lean practices is =1.94.

Model 14: Influence of lean methods and lean principles on product delivery process. Hypothesis: either lean methods or lean principles are influencing product delivery process.

During the preliminary regression analysis, one outlier near the threshold 3 standard deviations (std. residual =3.02) was removed. The backward regression procedure allowed producing two models that met the criteria for R^2 ≥.20. The independent variable namely lean methods was removed from the model while it did not met the criteria for the significance coefficient value for the independent variable p being <.05. The resulting coefficient of determination of the model with one independent variable lean principles exceeded the threshold value .20 (R^2 =.33). The Durbin–Watson test value between one and three (=1.89) showed the absence of correlated errors, see Appendixes. The ANOVA p value for F-ratio <.05 (Sig. =.00) showed that the model explains a significant proportion of the variation. The very high value of the F-ratio (F=52.62) showed that the model explains a very high proportion of the variation. All Cook's distance values (in residual statistics) regarding outliers met the criteria being ≤ 1 (Cook's distance maximum for the model was = .09). The significance coefficient value of independent variable met the criteria p being <.05 (p=.00 for Soft Lean principles), see Table 39.

Table 39. **Influence of LM and LI on product delivery process**[a] (source: own analysis)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std.	Beta			Tolerance	VI
2	(Constant)	1.85	.25		7.47	.00		
	Lean	.54	.07	.57	7.25	.00	1.00	1.0

a. Dependent Variable: Delivery process

Residuals were normally distributed and met the criteria p being ≥.05 for Shapiro-Wilk test (p=.11), see Appendixes. Statistical criteria for homoscedasticity p being ≥.05 for modified Breusch–Pagan test (p=.12) was met. Hypothesis confirmed. The resulting regression equation for the model is:

Delivery process = 1.85+ .54 × lean principles

The resulting regression equation allows concluding that lean methods do not significantly influence the product delivery process. In contrast, lean principles do significantly influence the product delivery process (β=.54). The effect not explained by lean principles is =1.85. This result shows a high importance of lean principles for the product delivery process.

Model 15: Influence of hard lean methods, soft lean methods, PS lean methods, hard lean principles, and soft lean principles on the product delivery process. Hypothesis: either hard lean methods, soft lean methods, problem solving lean methods, hard lean principles, or soft lean principles are influencing product delivery process.

During the preliminary regression analysis, one outlier exceeding the threshold 3 standard deviations (std. residual =3.33) was removed. The consequent backward and forward regression procedures allowed producing four models that met the criteria for $R^2 \geq .20$. Three independent variables namely hard lean methods, other lean methods, and soft lean principles were removed from the model while they did not met the criteria for the significance coefficient value for the independent variable p being <.05. The resulting coefficient of determination of the model with independent variables soft lean methods and hard lean principles exceeded the threshold value .20 (R^2 =.37). The Durbin–Watson test value between one and three (=1.87) showed the absence of correlated errors, see Appendixes. The ANOVA p value for F-ratio <.05 (Sig. =.00) showed that the model explains a significant proportion of the

variation. The medium value of the F-ratio (F=31.36) showed that the model explains a medium proportion of the variation. All Cook's distance values (in residual statistics) regarding outliers met the criteria being ≤ 1 (Cook's distance maximum for the model was = .10). Both significance coefficient values of independent variables met the criteria p being <.05 (p=.01 for soft lean methods and p=.00 for hard lean principles). Both VIF values met the criteria being ≤4 (for both independent variables VIF=1.21), see Table 40.

Table 40. **Infl. of LMHA, LMSO, LMPS, LIHA, LISO on CPDEL**[a] (source: own analysis)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
4	(Constant)	1.71	.25		6.81	.00		
	Soft lean methods	.19	.07	.24	2.83	.01	.82	1.21
	Hard lean principles	.39	.07	.47	5.53	.00	.82	1.21

a. Dependent Variable: Delivery process

Residuals were normally distributed and met the criteria p being ≥.05 for Shapiro-Wilk test (p=.10). Statistical criteria for homoscedasticity p being ≥.05 for modified Breusch–Pagan test (p=.50) was met. Hypothesis conformed. The resulting regression equation for the model is:

Delivery process = 1.71+ .39 × hard lean principles + .19 × soft lean methods

The resulting regression equation allows concluding that both hard and soft side of lean are important for product delivery process. Particularly, hard lean principles (β=.39) are important. The effect not explained by hard lean principles and soft lean methods is =1.85. This result shows a high importance of lean principles and lesser although significant importance of soft lean methods for the product delivery process.

Assessment of models regarding impact on people development

Model 16: Influence of lean practices on people development. Hypothesis: lean practices are influencing people development. The generated model did not met the criteria coefficient of determination $R^2 \geq .20$. Hypothesis rejected.

Model 17: Influence of lean methods and lean principles on people development. Hypothesis: either lean methods or lean principles are

influencing people development. The generated models did not met the criteria coefficient of determination $R^2 \geq .20$. Hypothesis rejected.

Model 18: Influence of hard lean methods, soft lean methods, PS lean methods, hard lean principles, and soft lean principles on people development. Hypothesis: either hard lean methods, soft lean methods, problem solving lean methods, hard lean principles, or soft lean principles are influencing people development. The generated models did not met the criteria coefficient of determination $R^2 \geq .20$. Hypothesis rejected.

Assessment of models regarding influence on preparing for future

Model 19: Influence of lean practices on preparing for future. Hypothesis: lean practices are influencing preparing for future.

During the preliminary regression analysis, two outliers near the threshold 3 standard deviations (std. residual =3.18 and std. residual =2.87) were removed. The coefficient of determination of the model with independent variable lean practices exceeded the threshold value .20 (R^2 =.20). The Durbin–Watson test value between one and three (=1.70) showed the absence of correlated errors, see Appendixes. The ANOVA p value for F-ratio <.05 (Sig. =.00) showed that the model explains a significant proportion of the variation. The medium value of the F-ratio (F=27.09) showed that the model explains a medium proportion of the variation. All Cook's distance values (in residual statistics) regarding outliers met the criteria being ≤ 1 (Cook's distance maximum for the model was = .09). The significance coefficient value of independent variable met the criteria p being <.05 (p=.00 for Lean practices), see Table 41.

Table 41. **Influence of LP on CPFU: coefficients** [a] (source: own analysis)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	2.47	.24		10.35	.00		
	Lean practices	.41	.08	.45	5.20	.00	1.00	1.00

a. Dependent Variable: Preparing for future

Standardized residuals were distributed normally and met the criteria p being ≥.05 for Shapiro-Wilk test (p=.86), see Appendixes. Statistical criteria for homoscedasticity p being ≥.05 for modified Breusch–Pagan test was not met (p=.02), see Table 42.

Table 42. **Influence of LP on CPFU: modified B-P test** [a,b,c] (source: own analysis)

Chi-Square	df	Sig.
5.13	1.00	.02

1. Dependent variable: Preparing for future

2. Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

3. Predicted values from design: Intercept + LL

Heteroscedasticity of the data was detected. Hypothesis 'lean practices are influencing preparing for future' rejected.

Model 20: Influence of lean methods and lean principles on preparing for future. Hypothesis: Either lean methods or lean principles are influencing preparing for future. The generated models did not met the criteria coefficient of determination $R^2 \geq .20$. Hypothesis rejected.

Model 21: Influence of hard lean methods, soft lean methods, PS lean methods, hard lean principles, and soft lean principles on preparing for future. Hypothesis: hard lean methods, soft lean methods, problem solving lean methods, hard lean principles, or soft lean principles are influencing preparing for future.

During the preliminary regression analysis, one outlier near the threshold 3 standard deviations (std. residual =2.87) was removed. The consequent backward and forward regression procedures allowed producing four models that met the criteria $R^2 \geq .20$. Three independent variables namely soft lean methods, other lean methods, and hard lean principles were removed from the model while they did not met the criteria for the significance coefficient value for the independent variable p being <.05. The resulting coefficient of determination of the model with independent variables soft lean principles, hard lean methods exceeded the threshold value .20 ($R^2 = .20$). The Durbin–Watson test value between one and three (=1.69) showed the absence of correlated errors, see Appendixes. The ANOVA p value for F-ratio <.05 (Sig. =.00) showed that the model explains a significant proportion of the variation. The very low value of the F-ratio (F=13.28) showed that the model explains a very low proportion of the variation. All Cook's distance values (in residual statistics) regarding outliers met the criteria being ≤ 1 (Cook's distance maximum for the model was = .09). Both significance coefficient values of independent variables met the criteria p being <.05 (p=.04 for hard lean

methods and p=.01 for soft lean principles). Both VIF values met the criteria being ≤4 (for both independent variables VIF=1.46), see Table 43.

Table 43. **Infl. of LMHA, LMSO, LMPS, LIHA, LISO on CPFU** [a] (source: own analysis)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
4	(Constant)	2.43	.25		9.64	.00		
	Hard lean methods	.16	.08	.22	2.12	.04	.68	1.46
	Soft lean principles	.23	.08	.28	2.68	.01	.68	1.46

a. Dependent Variable: Preparing for future

Residuals were normally distributed and met the criteria p being ≥.05 for Shapiro-Wilk test (p=.73). Statistical criteria for homoscedasticity p being ≥.05 for modified Breusch–Pagan test (p=.20) was met. Hypothesis confirmed. The resulting regression equation for the model is:

Preparing for future = 2.43 + .23 × soft lean principles + .16 × hard lean methods

The resulting regression equation allows concluding that both soft lean principles and hard lean methods are important for preparing for future. The effect not explained by soft lean principles and hard lean methods is =2.43. This result shows that preparing for future depend on some lean practices although other factors also highly affect the preparing for future performance.

The Table 44 summarizes the assessment of all models and hypotheses testing results regarding the impact of lean practices on corporate performance.

Table 44. **Influence of LP on CP: hypotheses testing results** (source: own analysis)

Model	Hypothesis	Result	Effect
1.	LP is influencing CP	(+)	CP = 2.62 + .34 × LP
2.	Either LM or LI is influencing CP	(-)	
3.	Either LMHA, LMSO, LMPS, LIHA, or LISO is influencing CP	(+)	CP = 2.36 + .20 × LISO + .16 × LMSO
4.	LP is influencing CPFI	(-)	
5.	Either LM or LI is influencing CPFI	(-)	
6.	Either LMHA, LMSO, LMPS, LIHA, or LISO is influencing CPFI	(-)	
7.	LP is influencing CPCU	(-)	
8.	Either LM or LI is influencing CPCU	(-)	
9.	Either LMHA, LMSO, LMPS, LIHA, or LISO is influencing CPCU	(-)	
10.	LP is influencing CPDEV	(-)	
11.	Either LM or LI is influencing CPDEV	(-)	
12.	Either LMHA, LMSO, LMPS, LIHA, or LISO is influencing CPDEV	(-)	
13.	LP is influencing CPDEL	(+)	CPDEL = 1.94 + **.56** × LP
14.	Either LM or LI is influencing CPDEL	(+)	CPDEL = 1.85 + **.54** × LI
15.	Either LMHA, LMSO, LMPS, LIHA, or LISO is influencing CPDEL	(+)	CPDEL = 1.71 + .39 × LIHA + .19 × LMSO
16.	LP is influencing CPPD	(-)	
17.	Either LM or LI is influencing CPPD	(-)	
18.	Either LMHA, LMSO, LMPS, LIHA, or LISO is influencing CPPD	(-)	
19.	LP is influencing CPFU	(-)	
20.	Either LM or LI is influencing CPFU	(-)	
21.	Either LMHA, LMSO, LMPS, LIHA, or LISO is influencing CPFU	(+)	CPFU = 2.43 + .23 × LISO + .16 × LMHA

LP - Lean practices; LM - Lean methods; LI - Lean principles; LMHA – hard lean methods; LMSO – soft lean methods; LMPS – problem solving lean methods; LIHA – hard lean principles; LISO – soft lean principles; CP – corporate performance; CPFI – financial performance; CPCU – customer/market performance; CPDEV - product development process; CPDEL - product delivery process; CPPD - people development; CPFU - preparing for future performance

(-) Hypothesis rejected; (+) Hypothesis confirmed

According to the summarized results, lean practices namely soft lean methods and soft lean principles significantly and positively influence overall corporate performance. Neither financial performance, nor customer / market performance, nor product development process, nor influence people

development was significantly influenced by lean practices. Influence of hard lean methods and soft lean principles on the preparing for future was significant and positive although weak. Lean practices had the biggest positive influence on the product delivery process. The influence of lean practices namely lean principles, soft lean methods, and hard lean principles on product delivery process was significant, positive, and relatively strong.

By lean practices significantly affected areas of the corporate performance are product delivery process, preparing for future results, and the overall (cumulative) corporate performance.

3.2.11. Influence of OC on CP: assessment of models

Literature suggest that organizational culture (OC) is a predictor variable, and corporate performance (CP) is an outcome variable. This provide possibility to hypothesize a conceptual research model for these two elements (see Figure 20):

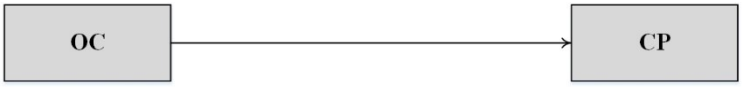

Figure 20. **Conceptual research model for OC and CP**
(source: author)

This conceptual model associates with a hypothesis: 'organizational culture' is influencing the corporate performance'. However, 'organizational culture' is a construct that has some structural elements, and 'corporate performance' is a construct that has some structural elements (see Figure 21).

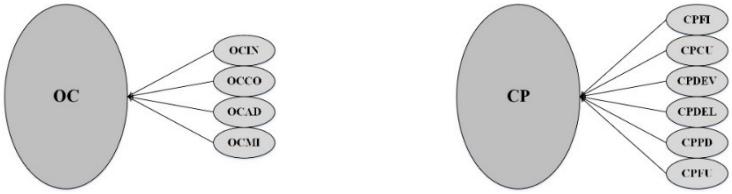

Figure 21. **Structural model for OC and structural model for CP**
(source: author)

Such complex structures of both OC and CP allows examination of one-to-one, one-to-many, many-to-one, and many-to-many type relationships. The first step of relationship analysis (correlation analysis) revealed levels of hypothetical influences (see Table 45).

Table 45. **Correlations of OC and CP** (source: own analysis)

	Corporate performance	Financial	Customer/ market	Development process	Delivery process	People development	Preparing for future
Organizational culture	**.57****	.25**	.42**	.40**	**.50****	.41**	**.61****
Involvement	.47**	.14	.36**	.32**	.43**	.46**	.45**
Consistency	**.53****	.23**	.35**	.34**	.48**	.42**	**.55****
Adaptability	**.54****	.26**	.47**	.39**	.41**	.30**	**.56****
Mission	.49**	.25**	.30**	.36**	.42**	.27**	**.56****

Pearson correlations. ******. Correlation is significant at the 0.01 level (1-tailed).
Weak correlations marked pale. Medium correlations marked normal. Strong correlations marked **bold**.

Influence of organizational culture on corporate performance was analyzed using series of regressions for models with various level of generalization. Fourteen models (see Table 46) and fourteen further regression procedures allowed accessing regression models on both the significance of effect and the impact.

Table 46. **Influence of OC on CP: Models for regression** (source: own analysis)

Structural elements	Corporate performance	Finan-cial	Customer/ market	Developm. process	Delivery process	People developm.	Preparing for future
Organizational culture	Model 22	Model 24	Model 26	Model 28	Model 30	Model 32	Model 34
Involvement Consistency Adaptability Mission	Model 23	Model 25	Model 27	Model 29	Model 31	Model 33	Model 35

Assessment of the OC models regarding influence on overall corporate performance

Model 22: Influence of the organizational culture on the corporate performance. Hypothesis: the organizational culture is influencing the corporate performance.

The preliminary regression analysis detected no outliers, which exceeded the threshold of three standard deviations. The regression procedure allowed producing the model that met the criteria for $R^2 \geq .20$. The resulting coefficient of determination of the model exceeded threshold value .20 ($R^2 = .34$). The

Durbin–Watson test value between one and three (=1.73) showed the absence of correlated errors, see Appendixes. The ANOVA p value for F-ratio <.05 (Sig. =.00) and the high F-ratio (F=56.05) showed that the model explains a significant and very proportion of the variation. All Cook's distance values (in residual statistics) regarding outliers met the criteria being ≤ 1 (Cook's distance maximum for the model was = .08). The significance coefficient value for the independent variable met the criteria p being <.05 (p=.00 for organizational culture), see Table 47.

Table 47. **Influence of OC on CP: coefficients** [a] (source: own analysis)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	1.47	.29		5.08	.00		
	Organizational culture	.58	.08	.58	7.49	.00	1.00	1.00

a. Dependent Variable: Corporate performance

Residuals were normally distributed and met the criteria p being ≥.05 for Shapiro-Wilk test (p=.35), see Appendixes. Statistical criteria for homoscedasticity p being ≥.05 for Breusch–Pagan test (p=.45) was met. Hypothesis 'the organizational culture is influencing the corporate performance' confirmed. The resulting regression equation for the model is:

Corporate performance = 1.47+ .58 × Organizational culture

The resulting regression equation allows concluding that the organizational culture is important factor affecting the overall corporate performance. The effect not explained by soft lean principles and hard lean methods is quite low (=1.47), and the coefficient of the influence is quite high (β=.58). This result shows that the organizational culture is a very important factor for the corporate success.

Model 23: Influence of involvement, consistency, adaptability, and mission on overall corporate performance. Hypothesis: either involvement, consistency, adaptability, or mission is influencing overall corporate performance.

The preliminary regression analysis detected no outliers, which exceeded the threshold of three standard deviations. The regression procedure allowed producing three models that met the criteria for $R^2 \geq .20$. Two independent variables namely Involvement and Mission had the Sig. values >.05 for

standardized B coefficients and were removed. The coefficient of determination of the resulting model exceeded threshold value .20 (R^2 =.34). The Durbin–Watson test value between one and three (=1.78) showed the absence of correlated errors, see Appendixes. The ANOVA p value for F-ratio <.05 (Sig. =.00) and the medium F-ratio (F=28.27) showed that the model explains a significant and medium proportion of the variation. All Cook's distance values (in residual statistics) regarding outliers met the criteria being ≤ 1 (Cook's distance maximum for the model was = .08). The significance coefficient value for the independent variable met the criteria p being <.05 (p=.00 for organizational culture). Both VIF values met the criteria being ≤4 (for both independent variables VIF=1.85), see Table 48.

Table 48. **Influence of cultural dimensions on CP: coefficients** [a] (source: own analysis)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
3	(Constant)	1.39	.30		4.63	.00		
	Consistency	.31	.10	.32	3.07	.00	.54	1.85
	Adaptability	.30	.10	.31	2.97	.00	.54	1.85

a. Dependent Variable: Corporate performance

Residuals were normally distributed and met the criteria p being ≥.05 for Shapiro-Wilk test (p=.32), see Appendixes. Statistical criteria for homoscedasticity p being ≥.05 for modified Breusch–Pagan test (p=.50) was met. Hypothesis 'either involvement, consistency, adaptability, or mission is influencing overall corporate performance' confirmed. The resulting regression equation for the model is:

Corporate performance = 1.39 + .31 × Consistency + .30 × Adaptability

The resulting regression equation allows concluding that the influence of cultural dimensions 'involvement' and 'mission' on the overall corporate performance is not significant. In contrast, the influence of cultural dimensions 'consistency' and 'adaptability' on the overall corporate performance is significant (β=.31 for consistency and β=.30 for adaptability). The effect not explained by consistency and adaptability is quite low (=1.39). This result shows the importance of consistency and adaptability for the corporate success.

Assessment of models regarding influence on financial performance

Model 24: Influence of organizational culture on financial performance. Hypothesis: organizational culture is influencing financial performance. The generated model did not met the criteria coefficient of determination $R^2 \geq .20$. Hypothesis rejected.

Model 25: Influence of Mission, Adaptability, Involvement, and Consistency on financial performance. Hypothesis: either of Mission, Adaptability, Involvement, or Consistency is influencing financial performance. The generated models did not met the criteria coefficient of determination $R^2 \geq .20$. Hypothesis rejected.

Assessment of models regarding influence on customer/market performance

Model 26: Influence of organizational culture on customer/market performance. Hypothesis: organizational culture is influencing customer / market performance. The generated model did not met the criteria coefficient of determination $R^2 \geq .20$. Hypothesis rejected.

Model 27: Influence of mission, adaptability, involvement, and consistency on customer/market performance. Hypothesis: either mission, adaptability, involvement, or consistency is influencing customer / market performance.

The preliminary regression analysis detected no outliers. The regression procedure allowed producing four models that met the criteria for $R^2 \geq .20$. Three independent variables namely Mission, Involvement, and Consistency had the Sig. values >.05 for standardized B coefficients and were removed. The coefficient of determination of the resulting model exceeded threshold value .20 ($R^2 = .22$). The Durbin–Watson test value between one and three (=1.99) showed the absence of correlated errors, see Appendixes. The ANOVA p value for F-ratio <.05 (Sig. =.00) and the medium F-ratio (F=31.57) showed that the model explains a significant and medium proportion of the variation. All Cook's distance values (in residual statistics) regarding outliers met the criteria being ≤ 1 (Cook's distance maximum for the model was = .08). The significance coefficient value for the independent variable met the criteria p being <.05 (p=.00 for Adaptability), see Table 49.

Table 49. **Influence of cultural dimensions on CPCU: coefficients** [a] (source: own analysis)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
4	(Constant)	1.62	.39		4.20	.00		
	Adaptability	.58	.10	.47	5.62	.00	1.00	1.00

a. Dependent Variable: Customer/market

Residuals were normally distributed and met the criteria p being ≥.05 for Shapiro-Wilk test (p=.43), see Appendixes. Statistical criteria for homoscedasticity p being ≥.05 for modified Breusch–Pagan test (p=.21) was met. Hypothesis 'either mission, adaptability, involvement, or consistency is influencing customer / market performance' confirmed. The resulting regression equation for the model is:

$$\text{Customer/market} = 1.62 + .58 \times \text{Adaptability}$$

The resulting regression equation allows concluding that the influence of cultural dimensions 'involvement', 'consistency' and 'mission' on the customer/market performance is not significant. In contrast, the influence of the cultural dimension 'adaptability' on the customer/market performance is significant (β=.58). The effect not explained by adaptability is quite low (=1.62). This result shows the importance of adaptability for the customer/market performance.

Assessment of models regarding influence on the product development process

Model 28: Influence of organizational culture on the product development process. Hypothesis: the organizational culture is influencing product development process. The generated model did not met the criteria coefficient of determination $R^2 \geq .20$. Hypothesis rejected.

Model 29: Influence of mission, adaptability, involvement, and consistency on the product development process. Hypothesis: either mission, adaptability, involvement, or consistency is influencing product development process.

During the preliminary regression analysis, one outlier exceeding the threshold 3 standard deviations (std. residual =3.49) was removed. The regression procedure allowed producing three models that met the criteria for $R^2 \geq .20$. Two independent variables namely Involvement and Consistency had the Sig. values >.05 for standardized B coefficients and were removed. The

coefficient of determination of the resulting model met the threshold value .20 (R^2 =.20). The Durbin–Watson test value between one and three (=1.93) showed the absence of correlated errors, see Appendixes. The ANOVA p value for F-ratio <.05 (Sig. =.00) and the low F-ratio (F=13.12) showed that the model explains a significant albeit low proportion of the variation. All Cook's distance values (in residual statistics) regarding outliers met the criteria being ≤ 1 (Cook's distance maximum for the model was = .17). The significance coefficient value for the independent variable met the criteria p being <.05 (p=.04 for Adaptability and p=.02 for Mission), see Table 50.

Table 50. **Influence of cultural dimensions on CPDEV: coefficients** [a] (source: own analysis)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
3	(Constant)	1.24	.47		2.65	.01		
	Adaptability	.33	.16	.23	2.06	.04	.59	1.69
	Mission	.28	.12	.26	2.29	.02	.59	1.69

a. Dependent Variable: Development process

Residuals did not met the normality criteria p being ≥.05 for Shapiro-Wilk test (p=.03). However, residuals met the normality criteria p being ≥.05 for Kolmogorov-Smirnov test (p=.16), see Appendixes. Statistical criteria for homoscedasticity p being ≥.05 for modified Breusch–Pagan test (p=.18) was met. Hypothesis 'either mission, adaptability, involvement, or consistency is influencing product development process' is confirmed. The resulting regression equation for the model is:

$$\text{Development process} = 1.24 + .33 \times \text{Adaptability} + .28 \times \text{Mission}$$

The resulting regression equation allows concluding that the influence of cultural dimensions 'involvement' and 'consistency' on the product development process is not significant. In contrast, the influence of the cultural dimensions 'adaptability' and 'mission' on the product development process is significant (β=.33 for adaptability and β=.28 for mission). The effect not explained by adaptability is quite low (=1.24). This result shows the importance of adaptability and mission for the product development process.

Assessment of organizational culture models regarding influence on the product delivery process

Model 30: Influence of organizational culture on the product delivery process. Hypothesis: the organizational culture is influencing product delivery process.

The preliminary regression analysis detected no outliers. The regression procedure allowed producing a model that met the criteria for $R^2 \geq .20$. The resulting coefficient of determination of the model exceeded threshold value .20 ($R^2 = .24$). The Durbin–Watson test value between one and three (=1.86) showed the absence of correlated errors, see Appendixes.

The ANOVA p value for F-ratio <.05 (Sig. =.00) and the medium F-ratio (F=34.77) showed that the model explains a significant and medium proportion of the variation. All Cook's distance values (in residual statistics) regarding outliers met the criteria being ≤ 1 (Cook's distance maximum for the model was = .11). The significance coefficient value for the independent variable met the criteria p being <.05 (p=.00 for organizational culture), see Table 51.

Table 51. **Influence of OC on CPDEL: coefficients** [a] (source: own analysis)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.96	.45		2.12	.04		
	Organizational culture	.71	.12	.49	5.90	.00	1.00	1.00

a. Dependent Variable: Delivery process

Residuals were normally distributed and met the criteria p being ≥.05 for Shapiro-Wilk test (p=.75), see Appendixes. Statistical criteria for homoscedasticity p being ≥.05 for modified Breusch–Pagan test (p=.28) was met. Hypothesis 'the organizational culture is influencing product delivery process' is confirmed. The resulting regression equation for the model is:

Delivery process = .96 + .71 × Organizational culture

The resulting regression equation allows concluding that the influence of organizational culture on the product delivery process is significant and high (β=.71). The effect not explained by adaptability is quite low (=.96). This result shows the high importance of the organizational culture for the product delivery process.

Model 31: Influence of mission, adaptability, involvement, and consistency on the product delivery process. Hypothesis: either mission, adaptability, involvement, or consistency is influencing product delivery process.

The preliminary regression analysis detected no outliers. The regression procedure allowed producing four models that met the criteria for $R^2 \geq .20$. Three independent variables namely Mission, Involvement, and Adaptability had the Sig. values >.05 for standardized B coefficients and were removed. The coefficient of determination of the resulting model met the threshold value .20 ($R^2 = .22$). The Durbin–Watson test value between one and three (=1.84) showed the absence of correlated errors, see Appendixes. The ANOVA p value for F-ratio <.05 (Sig. =.00) and the medium level F-ratio (F=31.59) showed that the model explains a significant and medium proportion of the variation. All Cook's distance values (in residual statistics) regarding outliers met the criteria being ≤ 1 (Cook's distance maximum for the model was = .08). The significance coefficient value for the independent variable met the criteria p being <.05 (p=.00 for Consistency), see Table 52.

Table 52. **Influence of cultural dimensions on CPDEL: coefficients** [a] (source: own analysis)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
4	(Constant)	1.30	.41		3.16	.00		
	Consistency	.64	.11	.47	5.62	.00	1.00	1.00

a. Dependent Variable: Delivery process

Residuals met the normality criteria p being ≥.05 for Shapiro-Wilk test (p=.58), see Appendixes. Statistical criteria for homoscedasticity p being ≥.05 for Breusch–Pagan test (p=.64) was met. Hypothesis 'either mission, adaptability, involvement, or consistency is influencing product delivery process' confirmed. The resulting regression equation for the model is:

$$\text{Delivery process} = 1.30 + .64 \times \text{Consistency}$$

The resulting regression equation allows concluding that the influence of cultural dimensions 'involvement', 'adaptability' and 'mission' on the product delivery process is not significant. In contrast, the influence of the cultural dimension 'consistency' on the product development process is significant (β=.64). The effect not explained by adaptability is quite low (=1.30). This result shows the importance of consistency for the product delivery process.

Assessment of models regarding influence on people development

Model 32: Influence of organizational culture on people development. Hypothesis: the organizational culture is influencing the people development.

During the preliminary regression analysis, one outlier exceeding the threshold 3 standard deviations (std. residual =3.21) was removed. The regression procedure allowed producing a model that met the criteria for R^2 ≥.20. The resulting coefficient of determination of the model met the threshold value .20 (R^2 =.20). The Durbin–Watson test value between one and three (=1.76) showed the absence of correlated errors, see Appendixes. The ANOVA p value for F-ratio <.05 (Sig. =.00) and the medium level F-ratio (F=27.67) showed that the model explains a significant and medium proportion of the variation. All Cook's distance values (in residual statistics) regarding outliers met the criteria being ≤ 1 (Cook's distance maximum for the model was = .18). The significance coefficient value for the independent variable met the criteria p being <.05 (p=.00 for organizational culture), see Table 53.

Table 53. **Influence of OC on CPPD: coefficients** [a] (source: own analysis)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	1.55	.36		4.28	.00		
	Organizational culture	.51	.10	.45	5.26	.00	1.00	1.00

a. Dependent Variable: People development

Residuals were normally distributed and met the criteria p being ≥.05 for Shapiro-Wilk test (p=.20), see Appendixes. Statistical criteria for homoscedasticity p being ≥.05 for Breusch–Pagan test (p=.47) was met. Hypothesis 'the organizational culture is influencing the people development' confirmed. The resulting regression equation for the model is:

People development = 1.55+ .51 × Organizational culture

The resulting regression equation allows concluding that the influence of the organizational culture on the people development is significant (β=.51). The effect not explained by adaptability is quite low (=1.55). This result shows the importance of organizational culture for the people development process.

Model 33: Influence of mission, adaptability, involvement, and consistency on people development. Hypothesis: either of mission, adaptability, involvement, or consistency is influencing people development.

The preliminary regression analysis detected no outliers. The regression procedure allowed producing four models that met the criteria for $R^2 \geq .20$. Three independent variables namely Mission, Adaptability, and Consistency had the Sig. values >.05 for standardized B coefficients and were removed. The coefficient of determination of the resulting model exceeded threshold value .20 ($R^2 = .21$). The Durbin–Watson test value between one and three (=1.71) showed the absence of correlated errors (see Appendixes). The ANOVA p value for F-ratio <.05 (Sig. =.00) and the medium F-ratio (F=29.63) showed that the model explains a significant and medium proportion of the variation. All Cook's distance values (in residual statistics) regarding outliers met the criteria being ≤ 1 (Cook's distance maximum for the model was = .08). The significance coefficient value for the independent variable met the criteria p being <.05 (p=.00 for Involvement), see Table 54.

Table 54. **Influence of cultural dimensions on CPPD: coefficients** [a] (source: own analysis)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
4	(Constant)	1.63	.34		4.81	.00		
	Involvement	.49	.09	.46	5.44	.00	1.00	1.00

a. Dependent Variable: People development

Residuals were normally distributed and met the criteria p being ≥.05 for Shapiro-Wilk test (p=.07), see Appendixes. Statistical criteria for homoscedasticity p being ≥.05 for modified Breusch–Pagan test (p=.60) was met. Hypothesis 'either of mission, adaptability, involvement, or consistency is influencing people development' confirmed. The resulting regression equation for the model is:

People development = 1.63+ .49 × Involvement

The resulting regression equation allows concluding that the influence of cultural dimensions 'consistency', 'adaptability' and 'mission' on the people development is not significant. In contrast, the influence of the cultural dimension 'involvement' on the people development is significant (β=.64).

The effect not explained by involvement is quite low (=1.63). This result shows the importance of involvement for the people development.

Assessment of models regarding influence on preparing for future

Model 34: Influence of organizational culture on the preparing for future. Hypothesis: the organizational culture is influencing the preparing for future performance.

The preliminary regression analysis detected no outliers. The regression procedure allowed producing a model that met the criteria for $R^2 \geq .20$. The resulting coefficient of determination of the model exceeded threshold value .20 ($R^2 = .38$). The Durbin–Watson test value between one and three (=2.04) showed the absence of correlated errors, see Appendixes. The ANOVA p value for F-ratio <.05 (Sig. =.00) and the very high F-ratio (F=67.07) showed that the model explains a significant and very high proportion of the variation. All Cook's distance values (in residual statistics) regarding outliers met the criteria being ≤ 1 (Cook's distance maximum for the model was =.11). The significance coefficient value for the independent variable met the criteria p being <.05 (p=.00 for organizational culture), see Table 55.

Table 55. **Influence of OC on CPFU: coefficients** [a] (source: own analysis)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.50	.39		1.29	.20		
	Organizational culture	.85	.10	.62	8.19	.00	1.00	1.00

a. Dependent Variable: Preparing for future

Residuals were normally distributed and met the criteria p being ≥.05 for Shapiro-Wilk test (p=.77), see Appendixes. Statistical criteria for homoscedasticity p being ≥.05 for modified Breusch–Pagan test (p=1.00) was met. Hypothesis 'the organizational culture is influencing the preparing for future performance' confirmed. The resulting regression equation for the model is:

Preparing for future = .50 + .85 × Organizational culture

The resulting regression equation allows concluding that influence of the organizational culture on the preparing for future is significant (β=.64). The effect not explained by involvement is very low (=.50). This result shows that

the organizational culture is a very strong factor defining the future of the organization.

Model 35: Influence of mission, adaptability, involvement, and consistency on the preparing for future. Hypothesis: either mission, adaptability, involvement, or consistency is influencing preparing for future.

The preliminary regression analysis detected no outliers exceeding the threshold value =3.00. The regression procedure allowed producing three models that met the criteria for $R^2 \geq .20$. Two independent variables namely Involvement and Consistency had the Sig. values >.05 for standardized B coefficients and were removed. The coefficient of determination of the resulting model exceeded threshold value .20 ($R^2 = .38$). The Durbin–Watson test value between one and three (=2.04) showed the absence of correlated errors, see Appendixes. The ANOVA p value for F-ratio <.05 (Sig. =.00) and the medium F-ratio (F=33.32) showed that the model explains a significant and medium proportion of the variation. All Cook's distance values (in residual statistics) regarding outliers met the criteria being ≤ 1 (Cook's distance maximum for the model was = .15). The significance coefficient value for the independent variables met the criteria p being <.05 (p=.00 for Adaptability and p=.00 for Mission). Both VIF values met the criteria being ≤4 (for both independent variables VIF=1.69), see Table 56.

Table 56. **Influence of cultural dimensions on CPFU: coefficients** [a] (source: own analysis)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
3	(Constant)	.73	.38		1.93	.06		
	Adaptability	.39	.13	.30	3.01	.00	.59	1.69
	Mission	.39	.10	.39	3.91	.00	.59	1.69

a. Dependent Variable: Preparing for future

Residuals were normally distributed and met the criteria p being ≥.05 for Shapiro-Wilk test (p=.69), see Appendixes. Statistical criteria for homoscedasticity p being ≥.05 for modified Breusch–Pagan test (p=.42) was me. Hypothesis 'either mission, adaptability, involvement, or consistency is influencing preparing for future' confirmed. The resulting regression equation for the model is:

$$\text{Preparing for future} = .73 + .39 \times \text{Adaptability} + .39 \times \text{Mission}$$

The resulting regression equation allows concluding that the influence of cultural dimensions ‘involvement’ and ‘consistency’ on the preparing for future performance is not significant. In contrast, the influence of the cultural dimensions ‘adaptability’ and ‘mission’ on the people development is significant (β=.39 for adaptability and β=.39 for mission). The effect not explained by involvement is quite low (=.73). This result shows that the future of the organization depends on external orientation of the organization and on cultural traits ‘adaptability’ and ‘mission’.

The Table 57 summarizes the assessment of all models and hypotheses testing results regarding the influence of the organizational culture on the corporate performance.

Table 57. **Influence of OC on CP: hypotheses testing results** (source: own analysis)

Model	Hypothesis	Result	Effect
1.	OC is influencing CP	(+)	CP = 1.47 + **.58** × OC
2.	Either OCIN, OCCO, OCAD, or OCMI is influencing CP	(+)	CP = 1.39 + .31 × OCCO + .30 × OCAD
3.	OC is influencing CPFI	(-)	
4.	Either OCIN, OCCO, OCAD, or OCMI is influencing CPFI	(-)	
5.	OC is influencing CPCU	(-)	
6.	Either OCIN, OCCO, OCAD, or OCMI is influencing CPCU	(+)	CPCU = 1.62+ **.58** × OCAD
7.	OC is influencing CPDEV	(-)	
8.	Either OCIN, OCCO, OCAD, or OCMI is influencing CPDEV	(+)	CPDEV = 1.24 + .33 × OCAD+ .28 × OCMI
9.	OC is influencing CPDEL	(+)	CPDEL = .96 + **.71** × OC
10.	Either OCIN, OCCO, OCAD, or OCMI is influencing CPDEL	(+)	CPDEL = 1.30 + **.64** × OCCO
11.	OC is influencing CPPD	(+)	CPPD = 1.55 + **.51** × OC
12.	Either OCIN, OCCO, OCAD, or OCMI is influencing CPPD	(+)	CPPD = 1.63 + .49 × OCIN
13.	OC is influencing CPFU	(+)	CPFU = .50 + **.85** × OC
14.	Either OCIN, OCCO, OCAD, or OCMI is influencing CPFU	(+)	CPFU = .73+ .39 × OCAD + .39 × OCMI

OC – Organizational culture; OCIN – Involvement; OCCO – Consistency; OCAD – Adaptability; OCMI – Mission; CP – corporate performance; CPFI – financial performance; CPCU – customer/market performance; CPDEV - product development process; CPDEL - product delivery process; CPPD - people development; CPFU - preparing for future performance

(-) Hypothesis rejected; (+) Hypothesis confirmed

According to the summarized results, organizational culture and elements of organizational culture significantly and positively influence many aspects of the corporate performance. All corporate performance elements except financial performance are influenced by organizational culture or elements of organizational culture.

3.2.12. Relations between of LP and OC

While according to the literature lean practices and organizational culture influence each other, the appropriate preliminary analysis tool is correlation analysis. Values of correlation coefficients between lean practices and organizational culture show the strength of the mutual influences (see Table 58). Analysis of those values allows considerations, what organizational culture could be associated with weak practicing of lean, and what organizational culture could be associated with strong practicing of lean.

Table 58. **Relations between LP and OC: Pearson correlations** (source: own analysis)

Structural elements	Organizational culture	Involvement	Consistency	Adaptability	Mission
Lean practices	**.56****	**.51****	**.50****	**.55****	.45**
Lean methods	**.51****	.45**	.45**	**.51****	.40**
Lean principles	**.59****	**.54****	**.53****	**.56****	.47**
Hard Lean methods	.46**	.41**	.42**	.48**	.34**
Soft Lean methods	.32**	.32**	.25**	.32**	.25**
Problem solving Lean methods	.44**	.37**	.39**	.42**	.38**
Hard Lean principles	.48**	.40**	.42**	.48**	.40**
Soft Lean principles	**.64****	**.65****	**.59****	**.57****	.48**

**. Correlation is significant at the 0.01 level (2-tailed).
Low correlations marked pale. Medium correlations marked normal. High correlations marked **bold**.

Table of correlations shows that lean practices highly correlates with the strength of the organizational culture and highly correlates with elements of organizational culture namely involvement,consistency, and adaptability. More lean associates with the stronger organizational culture.

Going into the details, hard lean methods, other lean methods, and hard lean principles correlates with organizational culture and cultural elements at medium level. However, the correlation between lean principles, particularly soft lean principles and organizational culture and cultural elements involvement, consistency, and adaptability was high. In stark contrast, the correlation of soft lean methods with organizational culture and cultural elements was low or medium.

The implementation/adoption of lean practices mostly associates with the cultural 'adaptability' trait. In particular, the adoption of lean principles, changes the corporate culture towards the adaptability.

If the culture would be seen as the antecedent of lean practices, the strength of the cultural trait 'adaptability' would help implementing lean practices. If lean practices would be seen as influencing the strength of the organizational culture, soft lean practices would help nurturing the strong organizational culture.

Literature suggest that LP and CP have reciprocal influence on each other. This provide possibility to hypothesize two conceptual research models for the regression analysis (see Figure 22):

Figure 22. **Conceptual models for relationships of LP and OC** (source: author)

Model 36: Influence of lean practices on the organizational culture. Hypothesis: lean practices are influencing the corporate performance.

The preliminary regression analysis detected no outliers, which exceeded the threshold of three standard deviations. The regression procedure allowed producing the model that met the criteria for $R^2 \geq .20$. The resulting coefficient of determination of the model exceeded threshold value .20 ($R^2 = .29$). The Durbin–Watson test value between one and three (=1.72) showed the absence of correlated errors, see Appendixes. The ANOVA p value for F-ratio <.05 (Sig. =.00) and the high F-ratio (F=49.14) showed that the model explains a significant and very proportion of the variation. All Cook's distance values (in residual statistics) regarding outliers met the criteria being ≤ 1 (Cook's distance maximum for the model was = .08). The significance coefficient value for the independent variable met the criteria p being <.05 (p=.00 for Lean practices), see Table 59.

Table 59. **Influence of LP on OC: coefficients** [a] (source: own analysis)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	2.46	.18		13.94	.00		
	Lean practices	.41	.06	.54	7.01	.00	1.00	1.00

a. Dependent Variable: Organizational culture

Residuals were normally distributed and met the criteria p being ≥.05 for Shapiro-Wilk test (p=.99), see Appendixes. Statistical criteria for homoscedasticity p being ≥.05 for Breusch–Pagan test (p=.02) was not met, see Table 60.

Table 60. **Influence of LP on OC: modified B-P test** [a,b,c] (source: own analysis)

Chi-Square	df	Sig.
5.73	1.00	.02

Dependent variable: Organizational culture

Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

Predicted values from design: Intercept + LL

The scatterplot allows ambiguous interpretations regarding the data heteroscedasticity. The form of the scattered data is quite similar the conus (see Figure 23).

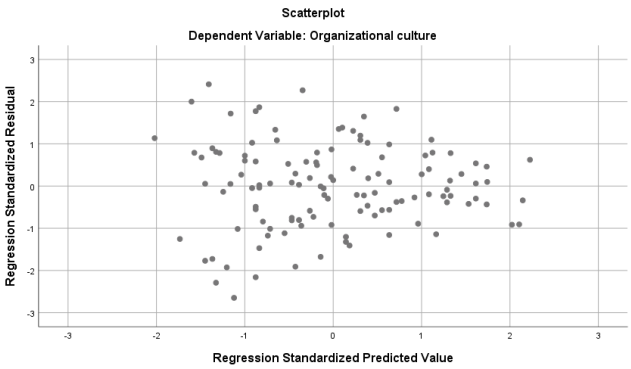

Figure 23. **Influence of LP on OC: scatterplot**
(source: own analysis)

The suitable tool for solving such problems as this (heteroscedasticity-consistent standard error estimation) is the SPSS macro created by A.F. Hayes and named HCREG. This macro (see Appendixes) allows estimating OLS regression models with heteroscedasticity-consistent standard errors using the HC0, HC1, HC2, HC3, and HC4 procedures. HCREG regression procedure results show that heteroscedasticity-consistent SE (HC3) met the criteria for being ≥.05 (SE (HC3) for LP = .06), see Table 61.

Table 61. **Influence of LP on OC: heteroscedasticity test results** (source: own analysis)

	Coeff	SE(HC3)	t	P>|t|
Constant	2.46	.20	12.24	.00
LP	.41	.06	6.82	.00

Hypothesis 'lean practices are influencing the corporate performance' confirmed. The resulting regression equation for the model is:

Organizational culture = 2.46 + .41 × Lean practices

The heteroscedasticity tendencies of the model and the resulting regression equation show that lean practices does not explain a big part of the organizational culture (the constant = 2.46). The proposed model has the possibility for improvement by adding other independent variables.

Model 37: Influence of the organizational culture on lean practices. Hypothesis: the organizational culture is influencing lean practices.

The preliminary regression analysis detected no outliers, which exceeded the threshold of three standard deviations. The regression procedure allowed producing the model that met the criteria for $R^2 \geq .20$. The resulting coefficient of determination of the model exceeded threshold value .20 ($R^2 = .29$). The Durbin–Watson test value between one and three (=1.50) showed the absence of correlated errors, see Appendixes. The ANOVA p value for F-ratio <.05 (Sig. =.00) and the high F-ratio (F=49.14) showed that the model explains a significant and high proportion of the variation. All Cook's distance values (in residual statistics) regarding outliers met the criteria being ≤ 1 (Cook's distance maximum for the model was = .07). The significance coefficient value for the independent variable met the criteria p being <.05 (p=.00 for organizational culture), see Table 62.

Table 62. **Influence of OC on LP: coefficients** [a] (source: own analysis)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.32	.37		.85	.40		
	Organizational culture	.71	.10	.54	7.01	.00	1.00	1.00

a. Dependent Variable: Lean practices

Residuals were normally distributed and met the criteria p being ≥.05 for Shapiro-Wilk test (p=.68), see Appendixes. Statistical criteria for homoscedasticity p being ≥.05 for Breusch–Pagan test (p=.32) was met. According to the HCREG test, the heteroscedasticity-consistent SE (HC3) met the criteria for being ≥.05 (SE(HC3) for OC = .08), see Table 63.

Table 63. **Influence of OC on LP: heteroscedasticity test results** (source: own analysis)

	Coeff	SE(HC)	t	P>|t|
Constant	.32	.28	1.11	.27
OC	.71	.08	8.41	.00

Hypothesis 'the organizational culture is influencing lean practices' confirmed. The resulting regression equation for the model is:

Lean practices = .32 + .71 × Organizational culture

The resulting regression equation shows that organizational culture does a strong influence on lean practices, characterized by high value of the regression coefficient =.71. The Table 64 summarizes hypotheses testing results on reciprocal relationships of lean practices and organizational culture.

Table 64 **Relationships of LP and OC: hypotheses testing summary** (source: own analysis)

Model	Hypothesis	Result	Effect
36.	LP are influencing OC	(+)	OC = 2.46 + .41 × LP
37.	OC is influencing LP	(+)	LP = .32 + .71 × OC

LP – Lean practices; OC – Organizational culture

(-) Hypothesis rejected; (+) Hypothesis confirmed

Hypotheses testing results show that influence of organizational culture on lean practices is stronger than influence of lean practices on organizational culture. High value of a constant in equation (=2.46) proves that organizational culture is highly influenced by other factors that are not included in the model and moderately influenced by lean practices (β=.41). In contrast, lean practices are less influenced by other factors that are not included in the model (value of the constant in equation =.32), but more influenced by organizational culture (β=.71).

3.2.13. Complex model: influence of LP and OC on CP

The presence of three structural elements of the research namely LP, OC, and CP and the theoretical assumption that CP is an outcome variable provide possibility to hypothesize a complex research model between these elements (see Figure 24):

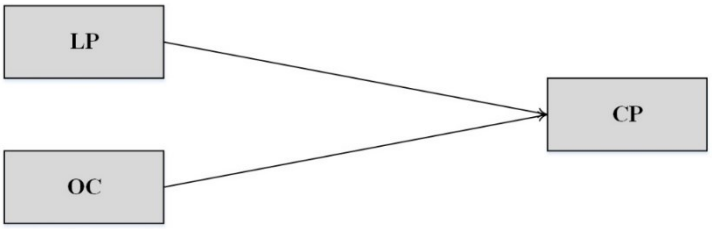

Figure 24. **Complex model for LP and OC influence on CP**
(source: author)

Model 38: Influence of lean practices and the organizational culture on the corporate performance. Hypothesis: both lean practices and organizational culture are influencing the corporate performance.

The regression procedure aimed testing both preconditions for regression and the hypothesis. The preliminary regression analysis detected no outliers. The regression procedure allowed creating a model that met the criteria for R^2 ≥.20. The coefficient of determination of the resulting model exceeded threshold value .20 (R^2 =.36). The Durbin–Watson test value between one and three (=1.76) showed the absence of correlated errors (see Appendixes). The ANOVA p value for F-ratio <.05 (Sig. =.00) and the medium F-ratio (F=31.52) showed that the model explains a significant and medium proportion of the variation. All Cook's distance values (in residual statistics) regarding outliers met the criteria being ≤ 1 (Cook's distance maximum for the model was = .12). The significance coefficient value for the independent variables met the criteria p being <.05 (p=.03 for Lean practices and p=.00 for Organizational culture). Both VIF values met the criteria being ≤4 (for both independent variables VIF=1.40), see Table 65.

Table 65. **Influence of LP and OC on CP: coefficients** [a] (source: own analysis)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	1.43	.28		5.02	.00		
	Lean practices	.15	.07	.20	2.23	.03	.71	1.40
	Organizational culture	.48	.09	.47	5.25	.00	.71	1.40

a. Dependent Variable: Corporate performance

Residuals were normally distributed and met the criteria p being ≥.05 for Shapiro-Wilk test (p=.08), see Appendixes. Statistical criteria for homoscedasticity p being ≥.05 for modified Breusch–Pagan test (p=.03) was not met, see Table 66.

Table 66. **Influence of LP and OC on CP: modified B-P Test** [a,b,c] (source: own analysis)

Chi-Square	df	Sig.
4.61	1.00	.03

a. Dependent variable: Corporate performance

b. Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

c. Predicted values from design: Intercept + LL + OC + LL * OC

While p value for modified Breusch-Pagan test was near the threshold value (.05), White test for heteroscedasticity was performed. Statistical criteria for homoscedasticity p being ≥.05 for White test (p=.46) was met, see Table 67.

Table 67. **Influence of LP and OC on CP: White Test** [a,b,c] (source: own analysis)

Chi-Square	df	Sig.
113.00	112.00	.46

a. Dependent variable: Corporate performance

b. Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

c. Design: Intercept + LL + OC + LL * OC

To solve the heteroscedasticity question, the scatterplot regarding the dependent variable and the standardized residual (see Figure 25) was

analyzed. However, the analysis scatterplot did not provide an unambiguous solution regarding the data heteroscedasticity.

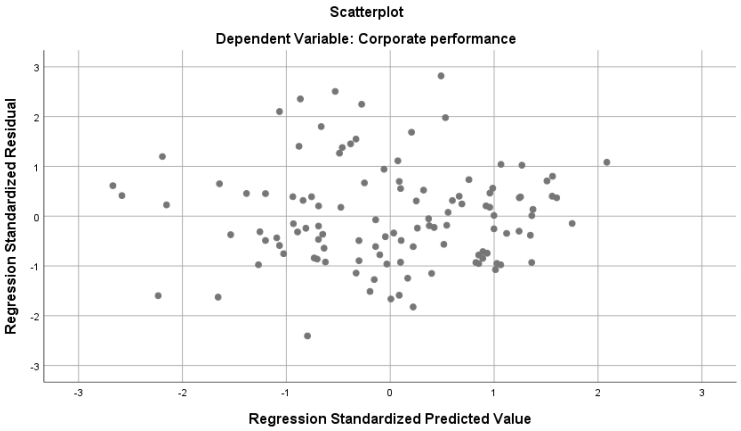

Figure 25. **Influence of LP and OC on CP: scatterplot**
(source: own analysis)

The HCREG macros was the final tool for deciding on the heteroscedasticity question. HCREG regression procedure results show that heteroscedasticity-consistent SE (HC3) for both independent variables is still ≥.05 (SE HC3 = .08 for LP and = .09 for OC) and both p values are ≤.05 (p=.049 for LP and p=.00 for OC), see Table 68.

Table 68. **Influence of LP and OC on CP: heteroscedasticity test**
(source: own analysis)

	Coeff	SE(HC3)	t	P>|t|
Constant	1.43	.26	5.46	.00
LP	.15	.08	1.99	.049
OC	.48	.09	5.33	.00

The model could not be rejected. Hypothesis 'both lean practices and organizational culture are influencing the corporate performance' confirmed. The resulting regression equation for the model is:

Corporate performance = 1.43 + .48 × Organizational culture + .15 × Lean practices

Resulting regression equation shows that both lean practices and organizational culture are influencing the corporate performance, although the

influence of lean practices is barely significant (p=.049). In contrast, the influence of the organizational culture on the corporate performance is quite significant (p=.00) and much stronger than that of lean practices (β=.48 for the organizational culture and β=.15 for lean practices).

Assumptions for moderation. The presence of three structural elements namely LP, OC, and CP and the assumption that CP is an outcome variable provide possibility to hypothesize the moderation effect. A moderation is an effect in which a third independent variable (the moderator variable, W) causes the relationship between an independent variable (X) and a dependent variable (Y) to change, depending on the value of the moderator variable (Hair et al., 2014), see Figure 26.

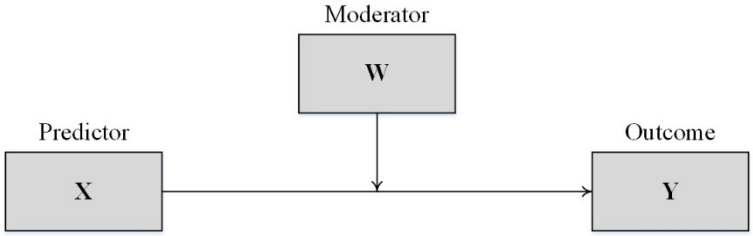

Figure 26. **Conceptual diagram of simple moderation model**
(source: Hayes, 2018; Field, 2018)

The moderated relationship is represented as $Y = i_Y + b_1 \times X + b_2 \times W + b_3 \times X \times W + e_Y$, where i_Y = intercept; $b_1 \times X$ = linear effect of X; $b_2 \times W$ = linear effect of W; $b3 \times X \times W$ = moderator effect of W on X; and e_Y = error variance (Hair et al., 2014; Hayes, 2018; Field, 2018), see Figure 27.

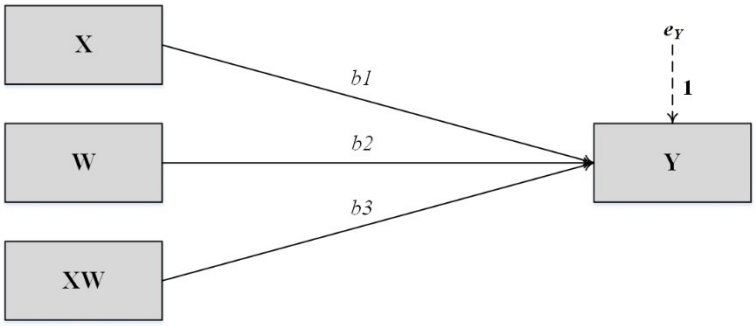

Figure 27. **Statistical diagram of simple moderation**
(source: Hayes, 2018)

A three-step process allows determining whether the moderator effect is significant: (1) estimate the original model without a moderator variable; (2) estimate the moderation model, which includes original variables and a moderator variable; (3) assess the change in R^2: if it is statistically significant, then a significant moderator effect is present. Only the incremental R^2 effect is assessed, not the significance of individual variables (Hair et al., 2014).

The moderation analysis aimed analyzing two models: (1) influence of lean practices on the corporate performance while the organizational culture is a moderator; (2) influence of organizational culture on the corporate performance while the lean practices are a moderator. The calculation of moderation used the PROCESS Procedure for SPSS Version 3.3 Model 1 by Andrew F. Hayes. As suggested for samples ≤250, Davidson-MacKinnon HC3 test was used testing data heteroscedasticity (Long & Ervin, 2000). Procedure aimed to access the preconditions for moderation analysis and the potential presence of a moderator effect.

Model 39: Lean practices influence the corporate performance while the organizational culture is a moderator (see Figure 28). Hypothesis: the organizational culture moderates the influence of lean practices on the corporate performance.

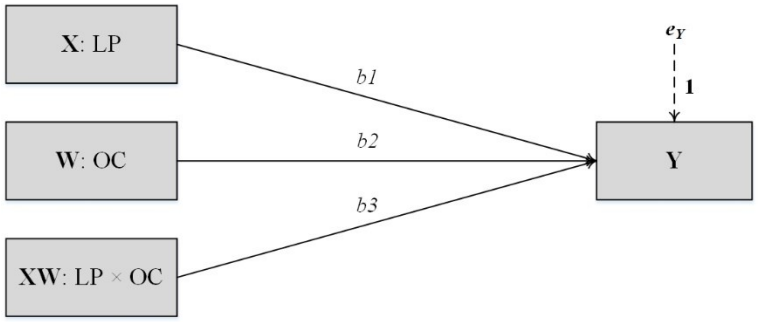

Figure 28. **LP influence on CP moderated by OC: statistical diagram** (source: own analysis)

The calculation of moderation effect used the PROCESS version 3.3 by Andrew F. Hayes. The moderation procedure allowed producing a regression model that met the criteria for $R^2 \geq .20$ ($R^2 = .37$). The ANOVA p value for F-ratio <.05 (Sig. =.00) and the medium F-ratio (F=28.95) showed that the model explains a significant and medium proportion of the variation (see Appendixes). The coefficient analysis shoved the significance and the values

of coefficients. The value of the significance coefficient for predictor LP did not met the criteria for p being ≤.05 (p=.70). The value of the significance coefficient for moderator OC did not met the criteria for p being ≤.05 (p=.52). The value of the significance coefficient (p=.45) for LP x OC did not met the criteria for p being ≤.05 (p=.49). Based on this, the independent variable LP x OC excludes from the regression equation (see Table 69).

Table 69. **LP influence on CP moderated by OC: coefficients[a;b]** (source: own analysis)

	coeff	se(HC3)	t	p	LLCI	ULCI
constant	2.34	1.40	1.67	.10	-.44	5.11
LP	-.21	.53	-.39	.70	-1.26	.85
OC	.24	.37	.65	.52	-.49	.96
Int_1	.09	.13	.69	.49	-.17	.36

a. Int_1 : LP x OC

b. Dependent Variable: Corporate performance

The R^2 change when the independent variable includes in the model is not significant (p=.49). This confirms that the moderation effect is not significant (see Table 70).

Table 70. **LP influence on CP moderated by OC: R^2 change** (source: own analysis)

Test(s) of highest order unconditional interaction(s)

	R^2-chng	F(HC3)	df1	df2	p
X*W	.00	.47	1.00	109.00	.49

A graphical representation of the moderation effect showed that the slopes for different levels of OC are about the same (see Figure 29). It confirms that moderation effect is not significant.

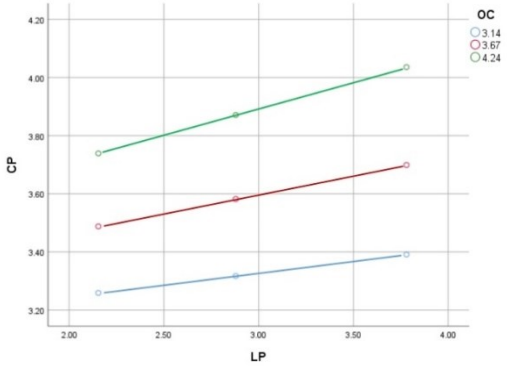

Figure 29. **Graphical representation of moderation effect by OC**
(source: own analysis)

Hypothesis ('*the organizational culture moderates the influence of lean practices on the corporate performance*') rejected. The organizational culture does not significantly changes the influence of lean practices on the corporate performance.

Model 40: Influence of organizational culture on the corporate performance while the lean practices is a moderator (see Figure 30). Hypothesis: lean practices moderate the influence of organizational culture on the corporate performance.

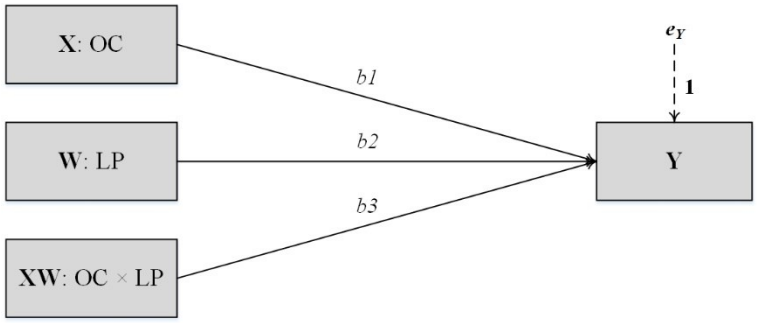

Figure 30. **OC influence on CP moderated by LP: statistical diagram**
(source: author)

The calculation of moderation effect used the PROCESS version 3.3 by Andrew F. Hayes. The moderation procedure allowed producing a regression model that met the criteria for $R^2 \geq .20$ ($R^2 = .37$). The ANOVA p value for F-ratio <.05 (Sig. =.00) and the medium F-ratio (F=28.95) showed that the

model explains a significant and medium proportion of the variation (see Appendixes). The coefficient analysis shoved the significance and the values of coefficients. The value of the significance coefficient for predictor OC did not met the criteria for p being ≤.05 (p=.52). The value of the significance coefficient for moderator LP did not met the criteria for p being ≤.05 (p=.70). The value of the significance coefficient for OC x LP did not met the criteria for p being ≤.05 (p=.49). Based on this, the independent variable OC x LP excludes from the regression equation and the model needs corrections (see Table 71).

Table 71. **OC influence on CP moderated by LP: coefficients** [a;b] (source: own analysis)

	coeff	se(HC3)	t	p	LLCI	ULCI
constant	2.34	1.40	1.67	.10	-.44	5.11
OC	.24	.37	.65	.52	-.49	.96
LL	-.21	.53	-.39	.70	-1.26	.85
Int_1	.09	.13	.69	.49	-.17	.36

a. Int_1 : OC x LP

b. Dependent Variable: Corporate performance

The R^2 change when the independent variable includes in the model is not significant (p=.49). This confirms that the moderation effect is not significant (see Table 72).

Table 72. **OC influence on CP moderated by LP: R^2 change** (source: own analysis)

	R2-chng	F	df1	df2	p
X*W	.00	.57	1.00	109.00	.49

A graphical representation of the moderation effect showed that the slopes for different levels of LP are about the same (see Figure 31). It confirms that moderation effect is not significant.

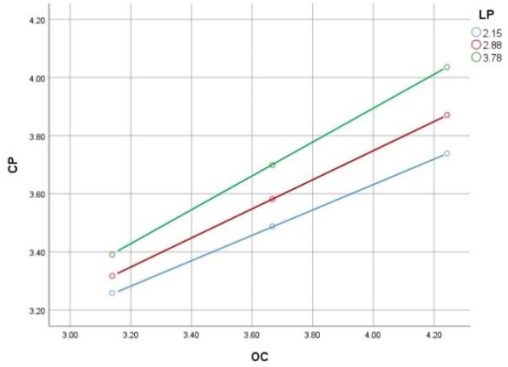

Figure 31. **Graphical representation of moderation effect by LP**
(source: own analysis)

Hypothesis (that '*lean practices moderate the influence of organizational culture on the corporate performance')* rejected. Lean practices does not significantly change the influence of the organizational culture on the corporate performance.

Assumptions for mediation. The presence of three structural elements namely LP, OC, and CP and the assumption that CP is an outcome variable provide possibility to hypothesize a mediation effect. Mediating something means to stand in between two other things and pass on the effect of one to the other (Jose, 2013). The mediation analysis has the goal to establish the extent to which some causal variable influences some outcome variable through one or more mediator variables (Hayes, 2018). A simple mediation model contains a predictor variable (X), a mediator variable (M), and an outcome variable (Y) (Jose, 2013). (M) and (Y) are consequent variables, and (X) and (M) are antecedent variables, with X causally influencing Y and M, and M causally influencing Y (Hayes, 2018), see Figure 32.

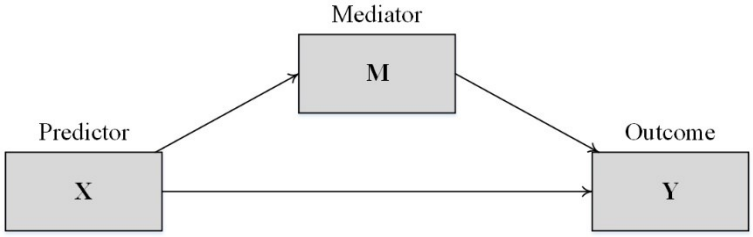

Figure 32. **Conceptual diagram of simple mediation model**
(source: Hayes, 2018; Field, 2018)

Preconditions for mediation analysis are: (1) X is significantly associated with the Y; (2) X is significantly associated with the M; and (3) M is significantly associated with Y when X is also included in the regression equation (Jose, 2013). The effect of an antecedent variable X on some outcome variable Y separates into two paths of influence, direct and indirect. One path leads from X to Y without passing through M is the direct effect of X on Y. The other path from X to Y is the indirect effect of X on Y through M (Hayes, 2018). The X-to-M coefficient is 'a', the M-to-Y coefficient is 'b', and together they define the mediated (or "indirect") effect. The 'c′' represents the X-to-Y relationship after removing the indirect effect that goes through the mediator, and it is termed the direct effect (Jose, 2013), see Figure 33.

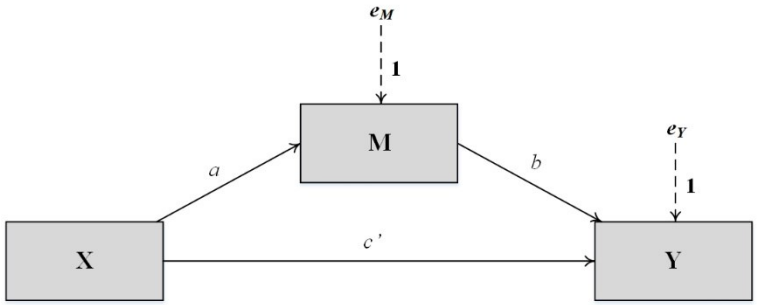

Figure 33. **Statistical diagram of simple mediation**
(source: Hayes, 2018)

In the statistical diagram, 'c'' estimates the direct effect of X on Y, and the product ('a' × 'b') estimates the indirect effect of X on Y through M. This relationship can be rewritten as ('a' × 'b') = 'c' – 'c'', which provides another equation for the indirect effect. A total effect of X on Y is a sum of the direct effect and the indirect effect: 'c'= 'c'' + ('a' ×' b') (Hayes, 2018).

The mediation analysis. The object for the mediation analysis were two models: (1) lean practices influence the corporate performance, while the organizational culture is a mediator; (2) organizational culture influence the corporate performance, while lean practices are a mediator.

The calculation of mediation effects used the PROCESS Procedure for SPSS Version 3.3 Model 4 by Andrew F. Hayes. As suggested for samples ≤250 (Long & Ervin, 2000), Davidson-MacKinnon HC3 test was used for the data homoscedasticity.

Model 41: Lean practices influence the corporate performance; while the organizational culture is a mediator (see Figure 34). Hypothesis: the organizational culture mediates the influence of lean practices on the corporate performance.

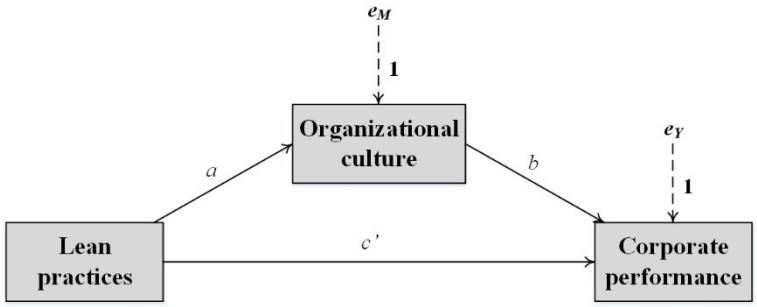

Figure 34. **Statistical diagram: LP influence on CP mediated by OC** (source: author)

Three consequent regression procedures produced three regression models and allowed retrieving values of a, b, and c'. The regression model for 'a' met the criteria for $R^2 \geq .20$ ($R^2 = .29$) and explained a significant proportion of the variation (p=.00). A coefficient 'a' had a value =.39 and was significant (see Table 73).

Table 73. **Results of tests regarding coefficient 'a'** [a] (source: own analysis)

Model Summary						
R	R^2	MSE	F(HC3)	df1	df2	p
.53	.29	.21	43.14	1.00	111.00	.00
Coefficients						
	coeff	se(HC3)	t	p	LLCI	ULCI
constant	2.52	.20	12.57	.00	2.12	2.91
LP	.39	.06	6.57	.00	.28	.51

a. Outcome variable: OC

The regression model for 'b' and 'c'' met the criteria for $R^2 \geq .20$ ($R^2 = .36$) and explained a significant proportion of the variation (p=.00). A coefficient 'b' had a value =.48 and was significant. A coefficient 'c' had a value =.15 and was significant (see Table 74).

Table 74. **Results of tests regarding coefficients b and c' [a]** (source: own analysis)

Model Summary						
R	R^2	MSE	F(HC3)	df1	df2	p
.60	.36	.19	39.37	2.00	110.00	.00
Coefficients						
	coeff	se(HC3)	t	p	LLCI	ULCI
constant	1.43	.26	5.46	.00	.91	1.95
LP	.15	.08	1.99	.05	.00	.30
OC	.48	.09	5.33	.00	.30	.65

a. Outcome variable: CP

The regression model for 'c' met the criteria for $R^2 \geq .20$ ($R^2 = .20$) and explained a significant proportion of the variation (p=.00). A coefficient 'c' for total effect had a value =.34 and was significant (see Table 75).

Table 75. **Results of tests regarding coefficient c [a]** (source: own analysis)

Model Summary						
R	R^2	MSE	F	df1	df2	p
.45	.20	.24	28.61	1.00	111.00	.00
Coefficients						
	coeff	se	t	p	LLCI	ULCI
constant	2.62	.19	13.84	.00	2.25	3.00
LP	.34	.06	5.35	.00	.21	.46

a. Outcome variable: CP

The total effect of the LP on CP was =.34; it was caused by the direct effect =.15 and by the indirect effect =.19 (see Table 76).

Table 76. **Total, direct, and indirect effects of LP on CP [a]** (source: own analysis)

Total effect		se(HC3)	t	p	LLCI	ULCI	c_ps	c_cs
	.34	.07	5.08	.00	.21	.47	.62	.45
Direct effect		se(HC3)	t	p	LLCI	ULCI	c'_ps	c'_cs
	.15	.08	1.99	.05	.00	.30	.28	.20
Indirect effect		BootSE	BootLLCI	BootULCI				
OC	.19	.04	.11	.27				

a. X: Lean practices; Y: Corporate performance

The mediation analysis showed that a mediation effect is partial. A lesser part (44%) of LP influence on CP was direct. A bigger part (56%) of LP influence on CP was indirect mediating effect, through the mediator OC. The lower and upper levels of the confidence intervals showed that indirect effect is clearly significant. Hypothesis 'the *organizational culture mediates the influence of lean practices on the corporate performance*' confirmed. Lean practices influence the corporate performance directly and indirectly, by changing the organizational culture.

Model 42: Organizational culture influence the corporate performance while the Lean practices are a mediator (see Figure 35). Hypothesis: lean practices mediate the influence of the organizational culture on the corporate performance.

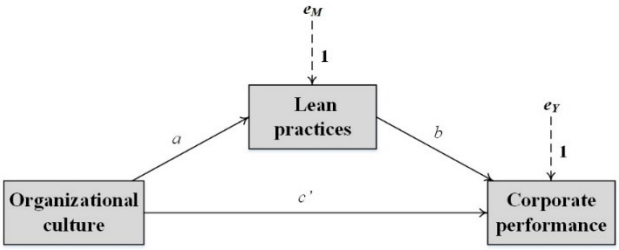

Figure 35. **Statistical diagram: OC influence on CP mediated by LP** (source: author)

A regression procedure allowed calculating values of a, b, and c'. The regression model for 'a' met the criteria for $R^2 \geq .20$ ($R^2 = .29$) and explained a significant proportion of the variation (p=.00). A coefficient 'a' had a value =.72 and was significant (see Table 77).

Table 77. **Results of tests regarding coefficient 'a'** [a] (source: own analysis)

Model Summary						
R	R^2	MSE	F(HC3)	df1	df2	p
.53	.29	.39	62.77	1.00	111.00	.00
Coefficients						
	coeff	se(HC3)	t	p	LLCI	ULCI
constant	.27	.31	.86	.39	-.35	.89
OC	.72	.09	7.92	.00	.54	.90

a. Outcome variable: LP

The regression model for ‘b’ and ‘c’’ met the criteria for $R^2 \geq .20$ ($R^2 = .36$) and explained a significant proportion of the variation (p=.00). A coefficient ‘b’ had a value =.15 and was significant. A coefficient ‘c’’ had a value =.48 and was significant (see Table 78).

Table 78. **Results of tests regarding coefficients b and c’** [a] (source: own analysis)

Model Summary						
R	R^2	MSE	F(HC3)	df1	df2	p
.60	.36	.19	39.37	2.00	110.00	.00
Coefficients						
	coeff	se(HC3)	t	p	LLCI	ULCI
constant	1.43	.26	5.46	.00	.91	1.95
OC	.48	.09	5.33	.00	.30	.65
LL	.15	.08	1.99	.05	.00	.30

a. Outcome variable: CP

The regression model for ‘c’ met the criteria for $R^2 \geq .20$ ($R^2 = .34$) and explained a significant proportion of the variation (p=.00). A coefficient ‘c’ for total effect had a value =.58 and was significant (see Table 79).

Table 79. **Results of tests regarding coefficient c** [a] (source: own analysis)

Model Summary						
R	R^2	MSE	F(HC3)	df1	df2	p
.58	.34	.20	70.73	1.00	111.00	.00
Coefficients						
	coeff	se(HC3)	t	p	LLCI	ULCI
constant	1.47	.26	5.56	.00	.94	1.99
OC	.58	.07	8.41	.00	.45	.72

a. Outcome variable: CP

The total effect of the LP on CP was =.58; it was caused by the direct effect =.48 and by the indirect effect =.11 (see Table 80).

Table 80. **Total, direct, and indirect effects of OC on CP** [a] (source: own analysis)

Total effect	se(HC3)	t	p	LLCI	ULCI	c_ps	c_cs
.58	.07	8.41	.00	.45	.72	1.07	.58
Direct effect	**se(HC3)**	**t**	**p**	**LLCI**	**ULCI**	**c'_ps**	**c'_cs**
.48	.09	5.33	.00	.30	.65	.88	.47
Indirect effect	**BootSE**	**BootLLCI**	**BootULCI**				
LL .11	.06	.01	.23				

a. X: Organizational culture; Y: Corporate performance

The mediation analysis showed that a mediation effect is partial. A very big part (81%) of OC influence on CP is direct. A low part (19%) of LP influence on CP is indirect mediating effect, through a mediator LP. The lower and upper levels of the confidence intervals show that indirect effect is still significant.

Hypothesis '*lean practices mediate the influence of the organizational culture on the corporate performance*' confirmed. The organizational culture influences the corporate performance mostly directly and partly indirectly, by changing lean practices.

Hypotheses testing summary for complex model. The Table 81 presents hypotheses testing summary regarding various modes of impact of lean practices and the organizational culture on the corporate performance.

Table 81. **Complex model: hypotheses testing summary** (source: own analysis)

Model	Hypothesis	Result	Effect
38.	LP or OC influence CP	(+)	CP = 1.43 + .48 × OC + .15 × LP
39.	OC moderates the influence of LP on CP	(-)	
40.	LP moderates the influence of OC on CP	(-)	
41.	OC mediates the influence of LP on CP	(+)	Mediation effect = 56%
42.	LP mediates the influence of OC on CP	(+)	Mediation effect = 19%

LP – Lean practices; OC – Organizational culture; CP – corporate performance

(-) Hypothesis rejected; (+) Hypothesis confirmed

The analysis of the complex model provided several important results. First, both lean practices and an organizational culture have a significant influence on the corporate performance. Second, a moderator analysis

detected that neither lean practices nor an organizational culture are moderators.

Third, one mediation analysis procedure detected that an organizational culture mediates an influence of lean practices on the corporate performance. The regression coefficient =.15 characterizes the direct influence of lean practices on the corporate performance and the regression coefficient =.19 characterizes the indirect influence of lean practices on the corporate performance. The direct effect equals 44% of the total influence and the indirect mediation effect equals 56% of the total influence. Thus, lean practices influence the corporate performance mainly not directly, but by changing an organizational culture.

Another mediation analysis procedure detected that lean practices mediate an influence of organizational culture on the corporate performance. The regression coefficient =.48 characterizes the direct influence of organizational culture on the corporate performance and the regression coefficient =.11 characterizes the indirect influence of organizational culture on the corporate performance. The direct effect equals 81% of the total influence and the indirect mediation effect equals 19% of the total influence. Thus, organizational culture is influencing the corporate performance mainly not by affecting lean practices, but directly.

3.2.14. Summary of key findings

Summary of key findings on lean methods. Factor analysis suggest grouping of lean methods into three groups. Two main groups were categorized as ‘hard lean methods’ and ‘soft lean methods’. The third group, which associates with both hard and soft lean methods and is related to the analysis, decision-making and problem solving, was categorized as ‘problem solving lean methods’ (see Table 82).

Table 82. **Factor based grouping of lean methods (LM)** [a] (source: own analysis)

Category	Methods
Hard lean methods	Total preventive maintenance (TPM) Proper arrangement (5S) Standard operation procedures (SOP) Production Kanban Error proofing (Poka-Yoke) Statistical process charts (SPC) Alert system (Andon) Cross-functional training
Soft lean methods	Morning meetings (Asaichi) Information white-boards Problem solving standard (A3) Kaizen workshops Kaizen board
Problem solving lean methods	Obtaining management support (Nemawashi) Consensus Decisions (Ringi) War room (Obeya) Policy/strategy deployment (Hoshin Kanri) Value Stream Mapping (VSM) Root cause analysis ("5 Why?") Reflection after the activity (Hansei) Visiting actual place (Genchi Genbutsu, Gemba Walk) Leader's daily management standard work sheets

a. Sorted by loadings from high to low

Most rarely used lean methods are soft. This fact suggests that lean in research organizations served mainly as the process improvement tool rather than a holistic managerial system.

Summary of key findings on lean principles. Factor analysis suggest grouping of lean methods into two groups. Such grouping allows categorization of lean principles into 'hard lean principles' and 'soft lean principles' (see Table 83).

Table 83. **Factor based grouping of lean principles (LI)** [a] (source: own analysis)

Category	Methods
Hard lean principles	Just in time delivery, JIT Heijunka Jidoka Elimination of waste Standardization Long-term philosophy Visual management Continuous improvement (Kaizen)
Soft lean principles	Teamwork Respect for people and partners Effective communication Leaders promoted from within

a. Sorted by factor loadings from high to low

Organizations use and categorize lean principles more as hard rather than as soft. Such unbalanced situation suggests that lean serves mainly as the hard process improvement tool rather than the complex managerial system.

Summary of key findings on lean practices. This research defines lean practices as lean methods and lean principles related to both hard and soft side of organization. Systematization of lean principles and lean methods results in a combined matrix of lean practices (see Table 84).

Table 84. **Factor based combined matrix of lean practices** [a] (source: own analysis)

	Hard	Problem solving	Soft
Lean principles	Just in time delivery Heijunka Jidoka Elimination of waste Standardization Long-term philosophy Visual management Continuous improvement		Teamwork Respect Effective communicatio Leaders from within
Lean methods	Total preventive maintenance Proper arrangement (5S) Standard operation procedures Production Kanban Error proofing (Poka-Yoke) Statistical process charts Alert system (Andon) Cross-functional training	Mngm. support (Nemewashi) Consensus Decisions (Ringi) War room (Obeya) Policy deployment (Hoshin) Value Stream Mapping Root cause analysis (5 Why?) Reflect after activity (Hansei) Visiting actual place (Gemba) Leader's standard work sheets	Asaichi meetings Information whiteboards Problem solving (A3) Kaizen workshops Kaizen board

a. Sorted by loadings from high to low

However, lean methods and lean principles are different constructs. The measurement of implementation of lean methods should differ from measurement of adoption of lean principles.

Summary of key findings on organizational culture. For DOCS, Cronbach alpha for three out of twelve second-level latent variables (indexes) namely 'agreement', 'customer focus', and 'organizational learning' was less than .70. Two of these three indexes involve reversed Likert scale, which hypothetically made the data on these indexes less reliable. The reliability of the empirical data for nested structure of Denison organizational culture model was proven as poor. This result suggests that using short 36 items version of DOCS is risky on regard to data reliability.

Cronbach alpha for all four first-level latent variables (categories) namely 'involvement', 'consistency', 'adaptability', and 'mission' was adequate. The empirical data based on 60 items Denison organizational culture model was reliable ($\alpha \geq .80$ for all latent variables). For ensuring the data reliability, the use of 60 items version of DOCS rather than 36 items version of DOCS is suggested.

The descriptive statistics of the dimensions of organizational culture proves organizational cultures of lean organizations are balanced.

Summary of key findings on corporate performance. The results of the factor analysis suggests that a six-element structure of (1) financial, (2) customer/market, (3) product development process, (4) product delivery process, (5) people development, and (6) preparing for the future measures is suitable for measuring the corporate performance (see Table 85).

Table 85. **Factor based six-element measurement structure for CP** [a] (source: own analysis)

Category	Item
Financial (CPFI)	Sales Profit margin Revenue growth
Customer/market (CPCU)	Customer satisfaction Customer retention rate Service quality
Product development process (CPDEV)	Time to market for new products and services Quality of new product development and project and project management processes
Product delivery process (CPDEL)	Lead time Quantity and depth of standardized processes
People development (CPPD)	Employee satisfaction Retention of top employees Quality of leadership development
Preparing for the future (CPFU)	Investment in R&D Investment in new market development Depth and quality of strategic planning Anticipating and preparing for changes in in the external environment

a. Sorted by loadings

While some structural elements involve just two or three indicators, this measurement structure needs to be enhanced by adding some additional indicators (measurement items).

Summary of key findings on influence of LP on CP. Results of 21 regression procedures show strength of influence of various groupings of lean practices on the corporate performance (see Table 86).

Table 86. **Influence of LP on CP: levels of influence** (source: own analysis)

	CP	CPFI	CPCU	CPDEV	CPDEL	CPPD	CPFU
LP	(+)	(-)	(-)	(-)	**(++)**	(-)	(-)
LM	(-)	(-)	(-)	(-)	(-)	(-)	(-)
LI	(-)	(-)	(-)	(-)	**(++)**	(-)	(-)
LMHA	(-)	(-)	(-)	(-)	(-)	(-)	(+)
LMSO	(+)	(-)	(-)	(-)	(+)	(-)	(-)
LMPS	(-)	(-)	(-)	(-)	(-)	(-)	(-)
LIHA	(-)	(-)	(-)	(-)	(+)	(-)	(-)
LISO	(+)	(-)	(-)	(-)	(-)	(-)	(+)

(-) no influence; (+) medium influence; (++) high influence

Lean practices as one bundle were influencing the corporate performance and were strongly influencing delivery process. Lean methods as one bundle did not show significant influence on any group of corporate performance measures. Lean principles were strongly influencing delivery process. Hard lean methods were influencing preparing for future results, soft lean methods were influencing cumulative corporate performance and product delivery performance. Hard lean principles were influencing product delivery performance, soft lean methods were influencing cumulative corporate performance and product delivery performance.

Summary of key findings on influence of OC on CP. Results of 14 regression procedures show how strongly the overall cultural strength of an organization and individual categories of organizational culture influence the corporate performance (see Table 87).

Table 87. **Influence of LP and OC on CP: level of influence** (source: own analysis)

	CP	CPFI	CPCU	CPDEV	CPDEL	CPPD	CPFU
OC	**(++)**	(-)	(-)	(-)	**(++)**	**(++)**	**(++)**
OCIN	(-)	(-)	(-)	(-)	(-)	(+)	(-)
OCCO	(+)	(-)	(-)	(-)	**(++)**	(-)	(-)
OCAD	(+)	(-)	**(++)**	(+)	(-)	(-)	(+)
OCMI	(-)	(-)	(-)	(+)	(-)	(-)	(+)

(-) no influence; (+) medium influence; (++) high influence

Strength of an organizational culture highly influences cumulative organizational performance, product delivery, people development, and preparing for future. Involvement influences people development. Consistency influence cumulative organizational performance and highly influence product delivery. Adaptability influence cumulative organizational performance, product development process, preparing for future, and highly influence customer/market performance. Mission influence product development process.

Summary of key findings on relationships of LP and OC. Strength of organizational culture and three categories of organizational culture namely involvement, consistency, and adaptability highly correlate with soft lean principles. Lean practices have a medium level influence on the organizational culture, although the organizational culture is highly influenced by other organizational factors.

Summary of key findings on relationships of LP and OC on CP

Influence of both LP and OC on CP. Both organizational culture and lean practices does significant influence the corporate performance, although the influence of organizational culture is much higher, as characterized by regression equation $CP = 1.43 + .48 \times OC + .15 \times LP$.

Moderation effect. The organizational culture does not significantly moderate influence of lean practices on the corporate performance, and lean practices do not significantly moderate influence of the organizational culture on the corporate performance.

Mediation effect. The organizational culture significantly mediates the influence of lean practices on the corporate performance. The direct effect of lean practices equals 44% of the total influence and the indirect mediation effect of lean practices equals 56% of the total influence on the corporate performance. Thus, lean practices influence the corporate performance mainly not directly, but by changing the organizational culture.

Lean practices are significantly mediating influence of the organizational culture on the corporate performance. The direct effect of organizational culture equals 81% of the total influence and the indirect mediation effect of organizational culture equals 19% of the total influence on the corporate performance. Thus, organizational culture is influencing the corporate performance mainly not by affecting lean practices, but directly.

3.3. Discussion, practical implications, limitations, and future research

3.3.1. Discussion

Tools vs principles. There is an opinion that organizations tend to use '*easy results-oriented and tools-only approach*' instead of '*principles-led behaviors*' (Hines et al., 2018). This research demonstrated the opposite: investigated lean organizations used lean principles (mean = 3.21) more than lean methods (mean = 2.72).

Hard vs soft. Literature (Bortolotti et al., 2016; Danese et al., 2017; Dorval, Jobin, & Benomar, 2019; Snyder et al., 2016) suggests grouping of lean practices into hard and soft. Technical practices related to production and processes are hard, while practices related to managerial concepts, people, and relations are soft (Bortolotti, Boscari, et al., 2015). Factor analysis of the data on lean methods resulted in the extraction of such factor structure that confirms grouping of lean methods into 'hard lean methods' and 'soft lean methods'. However, lean methods also include the group of 'problem solving lean methods' relating to both the hard and the soft side of lean.

Organizational culture. Literature suggests that the most effective organizations have high levels of all four traits (Denison et al., 2014). Toyota possesses and promotes a balanced culture (Pakdil & Leonard, 2015). The descriptive statistics for the dimensions of the organizational culture showed that lean organizations that participated in this research had balanced cultures.

Corporate performance. The Balanced Scorecard (Kaplan & Norton, 1992) promotes four perspectives of the corporate performance: (1) financial, (2) customer, (3) internal processes, and (4) innovation and learning. The DMP measurement model (Maltz, Shenhar, & Reilly, 2003) distinguishes baseline and firm/sector specific measures/variables. Further, it proposes five categories for baseline variables: (1) financial, (2) customer/market, (3) process, (4) people development, and (5) preparing for the future. The factor analysis of the empirical data in this research suggests six categories of the corporate performance variables: (1) financial, (2) customer/market, (3) product development process, (4) product delivery process, (5) people development, and (6) preparing for the future.

Pervious research suggests that the most important non-financial indices in the ranking order affecting the overall performance are: (1) future; (2) people; and (3) customer indices (Bhasin, 2012). This research confirmed the importance of both future indices (Pearson's r = .86) and customer/market indices (Pearson's r = .80). However, the empirical data showed greater

importance of the product development process (Pearson's r = .75) than of people (Pearson's r = .69).

Influence of lean practices on corporate performance. In this research, a structure of performance measurement involved 'financial', 'customer/market', 'process', 'people development', and 'preparing for the future' measures and a measure of the overall (cumulative) corporate performance.

As to the impact of lean on *financial measures*, some studies reported a positive effect of lean on the financial performance, while other did not find any significant relationship (Fullerton & Wempe, 2009; Losonci & Demeter, 2013a). This research has found that lean practices (methods or principles, hard or soft) have no significant impact on the financial performance.

A few studies reported significant and positive impact of lean on *customer* satisfaction (Sharma et al., 2015; Sohal & Egglestone, 1994); however, no studies reported the influence of lean on the market performance. This research has found that lean practices (methods or principles, hard or soft) have no significant impact on the customer/market performance.

Many studies reported significant and positive impact of lean on the *operational performance* (Fullerton et al., 2014; Moyano-Fuentes & Sacristán-Díaz, 2012; Nawanir et al., 2013; Shah & Ward, 2003). In this study, the factor analysis showed that the operational performance should be analyzed as two separate constructs: the product development performance and product delivery performance. The regression analysis demonstrated that lean practices (methods or principles, hard or soft) had no significant impact on the product development performance. On the contrary, lean practices (in particular, lean principles) had strong influence on the product delivery performance.

Literature (Lacksonen et al., 2010; Liker, 2004; Liker & Hoseus, 2010) insists that *people development* is an important aspect of lean. '*Lean is a system to continuously develop people*' (Ballé et al., 2019). However, there is a lack of empirical studies regarding the people results and people development performance. This research has found that lean practices (methods or principles, hard or soft) had no significant influence on the people development performance.

A few studies on the impact of lean on some aspects of *preparing for the future* performance showed that lean practices helped planning future value streams (Sharma et al., 2015) and had a positive impact on product innovation (Bevilacqua et al., 2017). This research has found that hard lean methods and

soft lean principles, indeed, have significant medium-level influence on preparing for the future performance.

Literature suggests that lean practices have a positive and significant impact on the overall (cumulative) corporate performance (Agus & Hajinoor, 2012; Lander & Liker, 2007; Nawanir et al., 2013; Salhieh & Abdallah, 2019). This research confirmed that lean practices as one bundle and in particular 'soft lean methods' and 'soft lean principles' had significant impact on the overall (cumulative) corporate performance.

Literature (Hines et al., 2018) suggests that the approach based on principles-led behaviors appears to be more successful than the tools-only approach. This research confirmed this notion by showing that lean principles as one bundle highly influenced the performance category 'product delivery process', while lean methods as one bundle had no significant influence on any performance category.

Influence of organizational culture on corporate performance. Literature suggests that the strength of the organizational culture has a positive impact on the (overall) corporate performance (Bititci, 2015; Boyce et al., 2015; Denison et al., 2004; Denison & Mishra, 1995; Nazir & Lone, 2008; Sackmann, 2010; Van der Merwe, 2014). However, no research into the cultural impact on performance analyzed lean organizations. This research shows that lean organizations are no exception and the organizational culture in lean organizations has a very high positive impact on the overall corporate performance. In particular, the strong organizational culture highly influences the performance of the product delivery process, people development, and preparing for the future.

In the same way, research showed that individual categories of the organizational culture (involvement, consistency, adaptability, and mission) influenced various aspects of the corporate performance. Involvement influenced people development performance. Consistency had high impact on the product delivery process and medium impact, on the overall corporate performance. Adaptability had high influence on the customer/market performance and medium influence, on both the product development process performance and the overall corporate performance. The mission had medium effect on the product development process and preparing for the future performance.

Relationships of lean practices and organizational culture. Some studies rely on the approach that lean influences the organizational culture (Hines, 2000; Mann, 2015; Pennington, 2009; S. Shetty et al., 2010). Other studies (Baird et al., 2011; Bhasin, 2011; Erthal & Marques, 2018; Hanson &

Melnyk, 2014; Narasimhan et al., 2012), on the contrary, take the approach that the organizational culture influences implementation of lean practices. According to the third (reciprocal) approach, culture influences lean practices and vice versa – lean practices influence culture (Giorgi et al., 2015; Hozak & Olsen, 2015; Stensaker & Falkenberg, 2007).

This study investigated first two approaches and found that lean practices moderately influenced the organizational culture and that the organizational culture highly influenced the implementation of lean practices. The impact of the organizational culture on lean practices is stronger than the impact of lean practices on the organizational culture. Such result supports the approach that the relationship between lean practices and the organizational culture is reciprocal.

Complex relationships of LP and OC on CP. Literature suggests that: (1) both lean practices and the organizational culture influence performance (Narasimhan et al., 2012); (2) the organizational culture moderates the impact of lean on performance (Iranmanesh et al., 2019; Kull et al., 2014); and (3) lean practices mediate the impact of culture on performance (Hofer et al., 2012; Pakdil & Leonard, 2015).

Other aspects. *Long-term orientation.* The most glaring discordance is seen in the dimension of future orientation, which pertains to long-term planning and working relationships (Wincel and Kull, 2013; Martins et al., 2015). The majority predicted that lean pushes organizations to adopt the long-term philosophy. However, studies (Kull et al., 2014) actually found lean organizations showing lower future orientation than non-lean organizations (Dorval et al., 2019).

This research confirms the existence of the above-mentioned discordance by showing that the principle 'long-term philosophy' is one of the least practiced lean principles (mean = 2.66) and long-term and future-related methods are between least implemented lean methods (mean of Value Stream Mapping = 2.28; mean of Hoshin Kanri = 2.13; mean of Obeya = 1.95).

3.3.2. Practical implications, limitations, and future research

Practical implications. Literature insist that the basis of lean is a long-term-oriented philosophy. However, the research proved that organizations not necessarily followed the long-term philosophy and not necessarily practiced lean methods associated with the long-term philosophy. Supposedly, it means short-term orientation of such organizations. Bearing in mind that future-related lean methods and principles (such as 'Hoshin Kanri', 'Kaizen

workshops', 'long-term philosophy') proved to be the most influential practices, managers need to pay more attention on long-term-related lean principles and methods.

The results of the research suggest that managers should measure six groups of performance: (1) financial, (2) customer/market, (3) product development process, (4) product delivery process, (5) people development, and (6) preparing for the future.

The aim of the implementation of strategic initiatives is not the implementation itself, but improvement of performance. However, research results proved that some lean practices significantly influencing the corporate performance were implemented/adopted to a lesser degree, while other lean practices inconsiderably influencing the corporate performance were implemented/adopted to a higher extent. Supposedly, managers should monitor the effect of implemented lean practices and adjust their implementation according to the impact on performance.

According to the research results, individual lean practices have less influence on some particular performance areas and more influence on other performance areas. For example, 'Hoshin Kanri', 'Hansei', and 'cross-functional training' mostly influence the 'preparing for the future' performance, while 'information white-boards' and 'statistical process charts' are the main determinants of the 'delivery process' performance. Managers need to know exactly what focus areas of improvement are and which lean practices would mostly effect these areas.

The research proves that the stronger organizational culture results in better corporate performance. For managers it means that to achieve the organizational success, they need to strengthen the organizational culture.

Implementation of lean may be associated with the managers' initiative. However, the research shows that lean practices moderately influence the organizational culture and the organizational culture highly affects the implementation of lean practices. This result may mean that although managers are trying to implement the initiative (lean), '*the organization also affects the change initiative through individuals' interpretative responses'* (Stensaker & Falkenberg, 2007) and managers are a weaker side in this process.

The research demonstrated that (1) the direct effect of lean practices on performance amounted to 44% of the total influence, and (2) the indirect effect of lean practices through a mediator 'organizational culture' equaled to 56% of the total influence. This means that lean practices influence the corporate performance mainly not directly but by changing the organizational culture.

In such case, managers should use more culture-related soft lean practices than process-related hard lean practices and use soft lean practices more extensively than hard lean practices. In research organizations, managers followed this approach: the implementation of culture-related soft lean practices exceeded the implementation of process-related hard lean practices (the mean for 'soft lean methods' = 3.35; the mean for 'soft lean principles' = 3.42; the mean for 'hard lean methods' = 2.72; and the mean for 'hard lean principles' = 3.11).

Limitations and delimitations. A limitation of a research is weaknesses in the research methodology, '*a weakness or handicap that potentially limits the validity of the results*' while a delimitation is '*a boundary to which a study was deliberately confined*' (Pyrczak, 2017).

The current study has some limitations. The size of the sample was limited to 121 respondents. The process of empirical data collection involved the use of a single tool – the survey. The research lacks an empirical validation by subject-matter experts. As in many survey studies, an assumption regarding data collection was that respondents had sufficient knowledge to answer the questions, and that respondents answered the questions conscientiously and truthfully. The research was cross-sectional since conducting of a longitudinal study would have been difficult, as this would have required commitment from a high number of lean organizations. The questionnaire provided no detailed description of each scale level. The survey collected opinion-based data, which made the data on the corporate performance subjective. The survey used a non-probability sampling; thus, it is not possible to generalize the findings to all population of lean organizations with any degree of safety.

This study has some delimitations. The survey covered only one country – Lithuania. The survey encompassed only business organizations. The number of questions on both lean practices and corporate performance measures was deliberately reduced due to the already high overall number of questions in the questionnaire.

However, with the above-mentioned limitations and delimitations, the research makes a good empirical addition to the existing literature on lean, the organizational culture and corporate performance.

Directions for future research. This research used a limited number of performance measures. Researchers (Bhasin, 2008; Maltz et al., 2003) have proposed an extended number of performance measures. Empirical investigation on the extended list of performance measures is proposed. Such empirical investigation may give more insight into the proposed six-element structure of measures: (1) financial, (2) customer/market, (3) product

development process, (4) product delivery process, (5) people development, and (6) preparing for the future.

The field still lacks research regarding the impact of lean on people at the individual level. Literature (Liker & Hoseus, 2009, 2010; Rother, 2010) suggests that lean has a high influence on people. However, this research did show that lean practices had no significant influence on people development measures. Further research would identify particular influences and suggest the ways for effective influencing of people during the lean journey.

CONCLUSIONS

1. Lean is a system consisting of lean philosophy and lean practices, and the latter include lean tools (in the current research defined as lean methods) and lean principles. However, the analysis of literature proves that most research does not differentiate between lean methods and lean principles. Instead, it measures and analyses lean practices as one bundle. The current research claims that lean methods differ from lean principles. Lean methods are strict managerial procedures defined and described in a precise way. Lean methods address mainly physical routines at the behavioral level. The implementation of lean methods involves the experimentation phase and possible change (adaption) of these methods according to the current situation. In contrast, lean principles are general guidelines for decision-making. Lean principles focus on mental concepts at the thinking level. Adoption of lean principles does not involve experimentation or the change of some principle. As an opposition to mainstream research, one of the key conclusions of the current research is that lean principles and lean methods lie at different levels of activities and that measurement of implementation of lean methods should differ from measurement of adoption of lean principles.

Consistent with the literature, the current research confirms grouping of lean practices (lean methods and lean principles) into hard process-related practices and soft people/culture-related practices. Further, the factor analysis proves that grouping of both lean methods and lean principles into hard and soft is eligible. However, lean methods also include the group of methods (in the current research defined as 'problem solving lean methods') that are related to both the hard side of lean and the soft side of the organization.

2. Most **cultural research** in the lean setting concentrates on the analysis of cultural typologies and on the effect of cultural typologies on some performance measures. However, there is a lack of research on the analysis of the cultural strength and the effect of the cultural strength on performance in lean settings. Denison Organizational Culture Survey (DOCS) is a prominent tool in cultural studies. It allows measuring the strength of the organizational culture even when single one respondent represents the organization. However, the literature analysis shows that no researchers of organizational cultures have used the DOCS in lean settings. Successful deploying of the DOCS in the current research allows concluding that the DOCS is a proper tool for analyzing the strength as well the typology of the organizational culture in lean settings.

The current research demonstrated that the organizations involved in the research had strong cultures (mean = 3.66), and consistent with literature, it was proven that lean organizations had organizational cultures balanced with regard to involvement, consistency, adaptability and mission.

3. The literature analysis shows that the possibly most popular **performance measurement system** is the Balanced Scorecard (BSC). It organizes measures around four perspectives: (1) financial, (2) customer, (3) internal processes, and (4) innovation and learning. However, some researchers point out that the BSC lacks an important dimension – a human dimension. The dynamic multi-dimensional performance framework (DMP framework) includes the human dimension; this way it extends and improves the BSC. The DMP organizes measures around five perspectives: (1) financial, (2) customer/market, (3) process, (4) people development, and (5) preparing for the future. However, the structure of the DMP lacks thorough empirical examination and validation. Such situation around popular performance measurement systems/frameworks allows concluding that further empirical research in the field of performance measurement is necessary.

The current research did not confirm the 5-factor structure of the DMP and suggested the extension of the structure. The factor analysis in the current research showed that 'process' measures should be divided into 'product development process' and 'product delivery process' measures. Thus, another key conclusion of the current research is that the corporate performance measurement should include six perspectives: (1) 'financial', (2) 'customer/market', (3) 'product development process', (4) 'product delivery process', (5) 'people development' and (6) 'preparing for the future'.

4. The past research on the **influence of lean on performance** mainly concentrates on the influence of various bundles of lean practices on subjectively selected operational (process) or financial performance measures. Several past studies analyzed the influence of various bundles of lean practices on the customer, people, and future performance results. However, excellent operational performance alone may mean nothing for the corporate success. Instead, complex and structured evaluation of the corporate performance is required.

Past research has not examined links of individual lean practices and corporate performance measures. The results of the correlational analysis in the current research show that organizations involved in the research more

extensively implemented/adopted such lean practices that do not most highly influence performance; and less extensively, such lean practices that most highly influence performance. Such discrepancy allows concluding that managers in the organizations involved in the research implemented/adopted lean practices not based on their impact but most likely for the sake of implementation itself.

The current research showed that hard lean practices were positively influencing some performance measures and that soft lean practices were positively influencing other performance measures. The conclusion follows that both hard and soft practices are important for the corporate success. However, the influence of lean principles on one of the performance measures – the product delivery process – was particularly high and positive. The conclusion follows that the adoption of lean principles is more important for the corporate success than the implementation of lean methods.

5. The current research analyzed the **influence of the organizational culture on the corporate performance**. Consistent with the literature, the current research proved that the strength of the organizational culture directly and positively influenced the corporate performance. The strength of the organizational culture particularly affects performance measures 'preparing for the future' and 'product delivery process'.

As to the influence of the cultural typology on the corporate performance, the cultural trait 'adaptability' proved as the most influential in most categories of performance, including 'financial performance', 'customer/market performance', 'product development process' performance, and 'preparing for the future' performance. The cultural trait 'involvement' was the main determinant of 'people development' performance, and the cultural trait 'consistency' was the main determinant of 'product delivery process' performance. Such variety of relations with significant influence allows concluding that the best performance levels require strength of many cultural traits.

6. Lean practices and the organizational culture are related. The current research proved that the relations between lean practices and the organizational culture were not one-directional but reciprocal. The influence of the organizational culture on lean practices resulted as positive and high, while the influence of lean practices on the organizational culture resulted as positive and medium. Thus, the relationship between lean practices and the organizational culture was reciprocal, although the extent of that influence

differed. This allows concluding that the implementation of lean practices affects the organizational culture, and the organizational culture affects lean practices, while lean is a weaker side in this process of mutual influence.

No published empirical research has addressed the question if implementation of lean practices associates with the strength of the organizational culture. Current research allows concluding that the implementation of lean practices positively associates with the strength of the organizational culture.

The correlational analysis showed that the implementation/adoption of lean practices mostly associated with the cultural 'adaptability' trait. The conclusion follows that either lean practices (particularly lean principles) change the corporate culture towards adaptability or high level of the existing adaptability trait allows more effective implementation of lean practices, or both statements are correct.

7. Consistent with the literature, the research on **complex relations between lean practices, organizational culture, and corporate performance** proved that both lean practices and the organizational culture were influencing the corporate performance. The influence of lean practices on the corporate performance was hardly significant. In contrast, the influence of the organizational culture on the corporate performance was significant and much stronger than the influence of lean practices. This allows concluding that strengthening of the organizsational culture is the main key to the corporate success.

The literature suggests that the organizational culture moderates the influence of lean practices on some performance elements. The current research analyzed both lean practices and the organizational culture as moderators and has found that neither lean practices moderate the influence of the organizational culture on the corporate performance nor the organizational culture moderates the influence of lean practices on the corporate performance. This allows concluding that the relationships in lean-culture-performance framework do not involve any moderation effect.

The literature suggests that lean practices mediate the influence of the organizational culture on some performance elements. The current research revealed that lean practices do mediate the influence of the organizational culture on the corporate performance, and the organizational culture does mediate the influence of lean practices on the corporate performance. This allows concluding that the relationships in lean-culture-performance framework do involve mediation effects.

Results of the current research proved that lean practices influenced the corporate performance mainly not directly but by affecting the organizational culture and that the organizational culture was a strong mediator. In contrast, the organizational culture influences the corporate performance mostly directly. Based on this finding, it is concluded that the focus of the implementation of lean practices should be the nourishment of the strong organizational culture rather than efforts directly influencing performance. In such case, the implementation of soft culture-related lean practices would be preferable rather than the implementation of hard process-related lean practices.

REFERENCES

Agus, A., & Hajinoor, M. S. (2012). Lean production supply chain management as driver towards enhancing product quality and business performance: Case study of manufacturing companies in Malaysia. *International Journal of Quality and Reliability Management*, *29*(1), 92–121. https://doi.org/10.1108/02656711211190891

Ahrens, T. (2006). Lean production: Successful implementation of organisational change in operations instead of short term cost reduction efforts. *Lean Alliance*, *49*.

Al-Ashaab, A., Golob, M., Urrutia, U. A., Gourdin, M., Petritsch, C., Summers, M., & El-Nounu, A. (2016). Development and application of lean product development performance measurement tool. *International Journal of Computer Integrated Manufacturing*, *29*(3), 342–354. https://doi.org/10.1080/0951192X.2015.1066858

Al-Najem, M., Djakal, H. N., & Bennet, N. (2012). The role of culture and leadership in lean transformation: a review and assessment model. *International Journal of Lean Thinking*, *3*(1), 120–137.

Alexander, L. A. (2012). *Study of perceived organizational culture and its effect on employee job satisfaction*. Argosy University.

Alvesson, M. (2002). *Understanding Organizational Culture*. SAGE Publications.

Alvesson, M., & Sveningsson, S. (2015). *Changing Organizational Culture*. *Changing Organizational Culture*. https://doi.org/10.4324/9781315688404

Ansari, S. M., Fiss, P. C., & Zajac, E. J. (2010). Made to fit: how practices vary as they diffuse. *Academy of Management Review*, *35*(1), 67–92.

Arlbjørn, J. S., & Freytag, P. V. (2013). Evidence of lean: a review of international peer-reviewed journal articles. *European Business Review*, *25*(2), 174–205.

Arlbjørn, J. S., Freytag, P. V., & de Haas, H. (2011). Service supply Chain management: A survey of lean application in the municipal sector. *International Journal of Physical Distribution and Logistics Management*, *41*(3), 277–295. https://doi.org/10.1108/09600031111123796

Ashkanasy, N. M. (2011). *Organizational Culture and Climate*.

Badurdeen, F., & Gregory, B. (2012). The softer side of Lean. *Industrial Engineer*.

Badurdeen, F., Marksberry, P., Hall, A., & Gregory, B. (2009). No instant prairie: planting lean to grow innovation. *International Journal of Collaborative Enterprise*, *1*(1), 22. https://doi.org/10.1504/ijcent.2009.026454

Badurdeen, F., Wijekoon, K., & Marksberry, P. (2011). An analytical hierarchy process-based tool to evaluate value systems for lean

transformations. *Journal of Manufacturing Technology Management*, *22*(1), 46–65. https://doi.org/10.1108/17410381111099806

Bai, C., Satir, A., & Sarkis, J. (2019). Investing in lean manufacturing practices : an environmental and operational perspective. *International Journal of Production Research*, *57*(4), 1037–1051. https://doi.org/10.1080/00207543.2018.1498986

Baird, K., Hu, K. J., & Reeve, R. (2011). The relationships between organizational culture, total quality management practices and operational performancee. *International Journal of Operations & Production Management*, *31*(7), 789–814. https://doi.org/10.1108/01443571111144850

Ballé, M., Chaize, J., & Jones, D. (2015). Inclusive versus exclusive learning : the secret ingredient to creating a truly "lean" and "learning" culture. *Development and Learning in Organizations: An International Journal*, *29*(1), 20–23. https://doi.org/10.1108/DLO-10-2014-0080

Ballé, M., Chaize, J., & Jones, D. (2019). Lean as a learning system: What do organizations need to do to get the transformational benefits from Toyota's method? *Development and Learning in Organizations: An International Journal*. https://doi.org/10.1108/DLO-11-2018-0147

Banton, M. (2002). *Corporate culture and financial performance*. Nova Southeastern University.

Bateman, N., Hines, P., & Davidson, P. (2014). Wider applications for Lean: An examination of the fundamental principles within public sector organisations. *International Journal of Productivity and Performance Management*, *63*(5), 550–568. https://doi.org/10.1108/IJPPM-04-2013-0067

Bellot, J. (2011). Defining and assessing organizational culture. *Nursing Forum*, *46*(1), 29–37. https://doi.org/10.1111/j.1744-6198.2010.00207.x

Bento, S., & Tontini, G. (2018). Developing an instrument to measure lean manufacturing maturity and its relationship with operational performance. *Total Quality Management & Business Excellence*, 1–19. https://doi.org/10.1080/14783363.2018.1486537

Bevilacqua, M., Ciarapica, F. E., & Sanctis, I. De. (2017). Lean practices implementation and their relationships with operational responsiveness and company performance. *International Journal of Production Research*, *55*(3), 769–794. https://doi.org/10.1080/00207543.2016.1211346

Bhasin, S. (2008). Lean and performance measurement. *Journal of Manufacturing Technology Management*, *19*(5), 670–684. https://doi.org/10.1108/17410380810877311

Bhasin, S. (2011). Performance of organisations treating lean as an ideology. *Business Process Management Journal*, *17*(6), 986–1011. https://doi.org/10.1108/14637151111182729

Bhasin, S. (2012). An appropriate change strategy for lean success. *Management Decision*, *50*(3), 439–458. https://doi.org/10.1108/00251741211216223

Bhasin, S. (2013). Impact of corporate culture on the adoption of the Lean principles, *4*(2008), 118–140. https://doi.org/10.1108/20401461311319329

Bhasin, S., & Burcher, P. (2006). Lean viewed as a philosophy. *Journal of Manufacturing Technology Management*, *17*(1), 56–72. https://doi.org/10.1108/17410380610639506

Bititci, U. S. (2015). *Managing Business Performance*. John Wiley & Sons, Ltd.

Bititci, U. S., Mendibil, K., Nudurupati, S., Garengo, P., & Turner, T. (2006). Dynamics of performance measurement and organisational culture. *International Journal of Operations & Production Management*, *26*(12), 1325–1350. https://doi.org/10.1108/01443570610710579

Blanchard, K., & Miller, M. (2007). *The Secret: What Great Leaders Know and Do*. (J. C. Maxwell, Ed.). Berrett-Koehler Publishers, Inc.

Bortolotti, T., Boscari, S., & Danese, P. (2015). Successful lean implementation: Organizational culture and soft lean practices. *International Journal of Production Economics*, *160*, 182–201. https://doi.org/10.1016/j.ijpe.2014.10.013

Bortolotti, T., Danese, P., & Flynn, B. B. (2016). Is there an ideal organisational culture for lean management ? (pp. 1–9).

Bortolotti, T., Danese, P., Flynn, B. B., & Romano, P. (2015). Leveraging fitness and lean bundles to build the cumulative performance sand cone model. *Intern. Journal of Production Economics*, *162*, 227–241. https://doi.org/10.1016/j.ijpe.2014.09.014

Boyce, A. S., Nieminen, L. R. G., Gillespie, M. A., Ryan, A. M., & Denison, D. R. (2015). Which comes first , organizational culture or performance? A longitudinal study of causal priority with automobile dealerships, *359*(August 2013), 339–359. https://doi.org/10.1002/job

Boyle, T. A., Scherrer-Rathje, M., & Stuart, I. (2011). Learning to be lean: The influence of external information sources in lean improvements. *Journal of Manufacturing Technology Management*, *22*(5), 587–603. https://doi.org/10.1108/17410381111134455

Cameron, K., & Quinn, R. E. (2006). *Diagnosing and Changing Organizational Culture. The Jossey-Bass Business & Management Series*. https://doi.org/10.1111/j.1744-6570.2006.00052_5.x

Canato, A., Ravasi, D., & Phillips, N. W. (2013). Coerced Practice Implementation in Cases of Low Cultural Fit: Cultural Change and Practice Adaptation During the ... *The Academy of Management Journal*, *56*(6), 1724–1753. https://doi.org/10.5465/amj.2011.0093

Carver, D. (Trident U. (2011). *Influences of organizational vision on organizational effectiveness*. Trident University International in.

Retrieved from http://pubsonline.informs.org/doi/abs/10.1287/orsc.6.2.204
Cassell, C., Cunliffe, A. L., & Grandy, G. (2018). *The SAGE Handbook of Qualitative Business and Management Research Methods*. SAGE Publications Ltd.
Čekanavičius, V., & Murauskas, G. (2014). *Taikomoji regresinė analizė socialiniuose tyrimuose*. (M. Radavičius, D. Krapavickaitė, & R. Eidukevičius, Eds.). Vilniaus universiteto leidykla. Retrieved from http://www.lidata.eu/files/mokymai/vadoveliai/TRAST_visa.pdf
Chavez, R., Gimenez, C., Fynes, B., Wiengarten, F., & Yu, W. (2013a). Internal lean practices and operational performance: The contingency perspective of industry clockspeed. *International Journal of Operations & Production Management*, *33*(5), 562–588. https://doi.org/10.1108/01443571311322724
Chavez, R., Gimenez, C., Fynes, B., Wiengarten, F., & Yu, W. (2013b). Internal lean practices and operational performance: The contingency perspective of industry clockspeed. *International Journal of Operations & Production Management*, *33*(5), 562–588. https://doi.org/10.1108/01443571311322724
Chin, V. E. V. W. W., Henseler, J., & Wang, H. (2011). *Handbook of Partial Least Squares*. *Springer-Verlag*. https://doi.org/10.1007/978-3-642-16345-6
Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). Department of Psychology New York University.
Colling, T., & Terry, M. (2010). *Industrial relations: Theory and practice*. (T. Colling & M. Terry, Eds.) (3rd ed.). John Wiley & Sons, Inc.
Dal Pont, G., Furlan, A., & Vinelli, A. (2008). Interrelationships among lean bundles and their effects on operational performance. *Oper Manag Res*, *1*, 150–158. https://doi.org/10.1007/s12063-008-0010-2
Danese, P., Manfe, V., & Romano, P. (2017). A Systematic Literature Review on Recent Lean Research : State-of-the-art and Future Directions. *International Journal OfManagement Reviews*, *00*, 1–27. https://doi.org/10.1111/ijmr.12156
De Toni, A., & Tonchia, S. (2012). Performance measurement systems. *International Journal of Operations & Production Management*, *21*(1/2), 46–71.
Deem, J. W. (2009). *The relationship of organizational culture to Balanced Ccorecard*. *Nova Southeastern University*. Nova Southeastern University.
Denison, D. R., Haaland, S., & Goelzer, P. (2004). Corporate culture and organizational effectiveness: Is Asia different from the rest of the world? *Organizational Dynamics*, *33*(1), 98–109. https://doi.org/10.1016/j.orgdyn.2003.11.008
Denison, D. R., & Mishra, A. K. (1995). Toward a Theory of Organizational

Culture and Effectiveness, *6*(2), 204–223. Retrieved from pubsonline.informs.org/doi/abs/10.../orsc.6.2.204

Denison, D. R., & Neale, W. S. (1999). Denison organizational culture survey: Facilitator guide. *Denison Consulting, LLC*. Denison Consulting, LLC. Retrieved from https://scholar.google.com/scholar?q=Denison+Organizational+Culture+Survey+Facilitator+Guide&btnG=&hl=ar&as_sdt=0%252C5#0#0

Denison, D. R., Nieminen, L., & Kotrba, L. M. (2014). Diagnosing organizational cultures: A conceptual and empirical review of culture effectiveness surveys. *European Journal of Work and Organizational Psychology*, *23*(1), 145–161. https://doi.org/10.1080/1359432X.2012.713173

Detty, R. B., & Yingling, J. C. (2000). Quantifying benefits of conversion to lean manufacturing with discrete event simulation: A case study. *International Journal of Production Research*, *38*(2), 429–445.

Dibia, I. K. (2012). Implementation of the Leadership, People, Process and Outcome Model of Lean using Soft Systems Methodology in Triangulation, (January), 1–203.

Dillman, D. A., Smyth, J. D., & Christian, L. M. (2014). *Internet, phone, mail, and mixed-mode surveys* (4th ed.). Wiley.

Dorval, M., Jobin, M.-H., & Benomar, N. (2019). Lean culture : a comprehensive systematic literature review. *International Journal of Productivity and Performance Management*, *68*(5). https://doi.org/10.1108/IJPPM-03-2018-0087

Duque, D., & Cadavid, L. R. (2007). Lean manufacturing measurement. *Estudios Gerenciales*, *4*(105), 69–83. https://doi.org/10.1016/S0123-5923(07)70026-8

Duque, D. F. M., & Cadavid, L. R. (2013). Lean manufacturing measurement: the relationship between lean activities and lean metrics. *Estudios Gerenciales*, *23*(105), 69–83. https://doi.org/10.1016/s0123-5923(07)70026-8

Erthal, A., & Marques, L. (2018). National culture and organisational culture in lean organisations: a systematic review. *Production Planning & Control*, 1–20. https://doi.org/10.1080/09537287.2018.1455233

Evans, G. L. (2014). A mega review of cultural studies: linking leadership to corporate governance. *Poznana University of Economics Review*, *14*(1), 76–126. Retrieved from https://search-proquest-com.abc.cardiff.ac.uk/docview/1517634854/fulltextPDF/2E1A1F2037974932PQ/1?accountid=9883

Feldman, M. S., & Orlikowski, W. J. (2011). Theorizing Practice and Practicing Theory. *Organization Science*, *22*(5), 1240–1253. https://doi.org/10.1287/orsc.1100.0612

Fey, C. F., & Denison, D. R. (2004). Organizational Culture and Effectiveness: Can American Theory Be Applied in Russia? *Ssrn*, *14*(6),

686–706. https://doi.org/10.2139/ssrn.577141
Field, A. (2013). *Discovering Statistics Using IBM SPSS Statistics*. (J. Seaman, Ed.) (5th ed.). SAGE Publications Ltd.
Fotopoulos, C. B., & Psomas, E. L. (2009). The impact of "soft" and "hard" TQM elements on quality management results. *International Journal of Quality and Reliability Management*, *26*(2), 150–163. https://doi.org/10.1108/02656710910928798
Frigo, M. L. (2003). Performance Measures that Drive the Goal Tenets of Strategy. *Strategic Finance*, (October).
Fullerton, R. R., Kennedy, F. A., & Widener, S. K. (2014). Lean manufacturing and firm performance : The incremental contribution of lean management accounting practices. *Journal of Operations Management*, *32*(7–8), 414–428. https://doi.org/10.1016/j.jom.2014.09.002
Fullerton, R. R., & Wempe, W. F. (2009). Lean manufacturing, non-financial performance measures, and financial performance. *International Journal of Operations & Production*, *Management*(No. 3,), 214–240.
Gaiardelli, P., Resta, B., & Dotti, S. (2018). Exploring the role of human factors in lean management. *International Journal of Lean Six Sigma*. https://doi.org/10.1108/IJLSS-08-2017-0094
Galeazzo, A. (2019). Degree of leanness and lean maturity: exploring the effects on financial performance. *Total Quality Management*, 1–19. https://doi.org/10.1080/14783363.2019.1634469
Gambi, L. D. N., Boer, H., Gerolamo, M. C., Jørgensen, F., & Carpinetti, L. C. R. (2015). The relationship between organizational culture and quality techniques, and its impact on operational performance. *International Journal of Operations and Production Management*, *35*(10), 1460–1484. https://doi.org/10.1108/IJOPM-12-2013-0563
Garcia-Fernandez, J., Martelo-Landroguez, S., Velez-Colon, L., & Cepeda-Carrion, G. (2018). An explanatory and predictive PLS-SEM approach to the relationship between organizational culture , organizational performance and customer loyalty. *Journal of Hospitality and Tourism Technology*. https://doi.org/10.1108/JHTT-09-2017-0100
Garson, G. D. (2013). *Validity and reliability*. Statistical Associates Publishing.
Gelei, A., Losonci, D., & Matyusz, Z. (2015). Lean production and leadership attributes – the case of Hungarian production managers. *Journal of Manufacturing Technology Management*, *26*(4), 477–500. https://doi.org/10.1108/JMTM-05-2013-0059
George, D., & Mallery, P. (2019). *IBM SPSS Statistics 25 Step by Step* (15th ed.). Routledge.
Gillespie, M. A., Denison, D. R., Haaland, S., Smerek, R., & Neale, W. S. (2008). Linking organizational culture and customer satisfaction: Results from two companies in different industries industries. *European*

Journal of Work and Organizational Psychology, *17*(1), 112–132. https://doi.org/10.1080/13594320701560820

Giorgi, S., Lockwood, C., & Glynn, M. A. (2015). The Many Faces of Culture: Making Sense of 30 Years of Research on Culture in Organization Studies. *Academy of Management Annals*, *9*(1), 1–54. https://doi.org/10.1080/19416520.2015.1007645

Hadid, W., & Mansouri, S. A. (2014). The lean-performance relationship in services: A theoretical model. *International Journal of Operations and Production Management*, *34*(6), 750–785. https://doi.org/10.1108/IJOPM-02-2013-0080

Hair, J. F., Black, J. W. C., Babin, B. J., & Anderson, R. E. (2014). *Multivariate Data Analysis* (7th ed.). Pearson Education Limited.

Hallavo, V., Kuula, M., & Putkiranta, A. (2018). Evolution and effect of LEAN bundles: a longitudinal study. *Benchmarking: An International Journal*. https://doi.org/10.1108/BIJ-05-2017-0108

Hanson, J. D., & Melnyk, S. A. (2014). Culture Eats Strategy ... and how to deal with it. *Supply Chain Management Review*, (August), 20–27.

Harbour, J. L. (2011). The three "Ds" of successful performance measurement: Design, data, and display. *Performance Improvement*, *50*(2), 5–12. https://doi.org/10.1002/pfi

Hardcopf, R., & Shah, R. (2014). Lean and performance: impact of organizational culture. In *Academy of Management Annual Meeting Proceedings* (pp. 185–190). https://doi.org/10.5465/AMBPP.2014.275

Hines, P. (2000). How to create and sustain a lean culture. *Training Journal*, (July).

Hines, P., Taylor, D., & Walsh, A. (2018). The Lean journey: have we got it wrong? *Total Quality Management & Business Excellence*, 1–18. https://doi.org/10.1080/14783363.2018.1429258

Hofer, C., Eroglu, C., & Hofer, A. R. (2012). The effect of lean production on financial performance: The mediating role of inventory leanness. *Intern. Journal of Production Economics*, *138*(2), 242–253. https://doi.org/10.1016/j.ijpe.2012.03.025

Hofstede, G., Hofstede, G. J., & Minkov, M. (2010). *Cultures and Organizations: Software of the mind*. *Cultures and Organizations*. https://doi.org/10.1007/s11569-007-0005-8

Holmemo, M. D., Rolfsen, M., & Ingvaldsen, J. A. (2018). Total Quality Management & Business Excellence Lean thinking : outside-in , bottom-up ? The paradox of contemporary soft lean and consultant-driven lean implementation. *Total Quality Management & Business Excellence*, *29*(1–2), 148–160. https://doi.org/10.1080/14783363.2016.1171705

Hooper, D. (2012). *Exploratory Factor Analysis*. (H. Chen, Ed.), *Dublin Institute of Technology*. Oak Tree Press.

House, R. J. (2004). *Culture, Leadership, and Organizations: The GLOBE study of 62 societies*. SAGE Publications, Inc.

Hozak, K., & Olsen, E. O. (2015). Lean psychology and the theories of "Thinking, Fast and Slow." *International Journal of Lean Six Sigma*, *6*(3), 206–225. https://doi.org/10.1108/IJLSS-10-2014-0030

Hwang, G., Han, S., Jun, S., & Park, J. (2014). Operational Performance Metrics in Manufacturing Process: Based on SCOR Model and RFID Technology. *International Journal of Innovation, Management and Technology*, *5*(1). https://doi.org/10.7763/ijimt.2014.v5.485

Imre, N., Jenei, I., & Losonci, D. (2011). *What is lean culture – and how to measure it?*

Inamizu, N., Fukuzawa, M., Fujimoto, T., Shintaku, J., & Suzuki, N. (2014). Group leaders and teamwork in the over-lean production system. *Journal of Organizational Change Management*, *27*(2), 188–205. https://doi.org/10.1108/JOCM-08-2012-0122

Ingelsson, P., & Mårtensson, A. (2014). Measuring the importance and practices of Lean values. *TQM Journal*, *26*(5), 463–474. https://doi.org/10.1108/TQM-07-2012-0047

Iranmanesh, M., Zailani, S., Hyun, S. S., Ali, M. H., & Kim, K. (2019). Impact of Lean Manufacturing Practices on Firms ' Sustainable Performance : Lean Culture as a Moderator. *Sustainability*, *11*. https://doi.org/10.3390/su11041112

Jacobs, M. (2014). *Cultural Impact on Lean Six Sigma and Corporate Success*. Technische Universität Dresden. https://doi.org/10.1007/978-3-658-07340-4

Jardioui, M., Garengo, P., & El Alami, S. (2019). How organizational culture influences performance measurement systems in SMEs. *International Journal of Productivity and Performance Management*. https://doi.org/10.1108/IJPPM-10-2018-0363

Jasti, N. V. K., & Kodali, R. (2015). Lean production: Literature review and trends. *International Journal of Production Research*, *53*(3), 867–885. https://doi.org/10.1080/00207543.2014.937508

Jose, P. E. (2013). *Doing Statistical Mediation and Moderation*. (D. A. Kenny & T. D. Little, Eds.). The Guilford Press.

Jung, T., Scott, T., Davies, H. T. O., Bower, P., Whalley, D., McNally, R., & Mannion, R. (2009). Instruments for Exploring Organizational Culture: A Review of the Literature. *Public Administration Review*, (1).

Kaplan, R. S., & Norton, D. P. (1992). The Balanced Scorecard : Measures That Drive Performance - Harvard Business R ... The Balanced Scorecard : Measures That Drive Performance The Balanced Scorecard : Measures That Drive Performance - Harvard Business R ... *HARVARD BUSINESS REVIEW January–February*, *January-Fe*, 71–79.

Karim, A., & Arif-Uz-Zaman, K. (2013). A methodology for effective implementation of lean strategies and its performance evaluation in manufacturing organizations. *Business Process Management Journal*, *19*(1), 169–196. https://doi.org/10.1108/14637151311294912

Kataria, A., Rastogi, R., & Garg, P. (2013). Organizational Effectiveness as a Function of Employee Engagement. *South Asian Journal of Management*, *20*(4), 56–73. Retrieved from http://search.proquest.com.hodges.idm.oclc.org/abicomplete/docview/1519059074/EA3C7DD093004A65PQ/1?accountid=40795

Klein, A. G., Gerhard, C., Büchner, R. D., Diestel, S., & Schermelleh-Engel, K. (2015). The Detection of Heteroscedasticity in Regression Models for Psychological Data. *Psychological Test and Assessment Modeling*, *58*(4), 542–568.

Knapp, S. (2015). Lean Six Sigma implementation and organizational culture. *International Journal of Health Care Quality Assurance*, *28*(8), 855–863. https://doi.org/10.1108/IJHCQA-06-2015-0079

Kotrba, L. M., Gillespie, M. A., Schmidt, A. M., Smerek, R. E., Ritchie, S. A., & Denison, D. R. (2012). Do consistent corporate cultures have better business performance ? Exploring the interaction effects. *Human Relations*, *65*(2), 241 –262. https://doi.org/10.1177/0018726711426352

Kull, T. J., Yan, T., Liu, Z., & Wacker, J. G. (2014). Int . J . Production Economics The moderation of lean manufacturing effectiveness by dimensions of national culture : Testing practice-culture congruence hypotheses. *Intern. Journal of Production Economics*, *153*, 1–12. https://doi.org/10.1016/j.ijpe.2014.03.015

Lacksonen, T., Rathinam, B., Pakdil, F., & Gülel, D. (2010). Cultural Issues in Implementing Lean Production. In A. Johnson & J. Miller (Eds.), *Proceedings of the 2010 Industrial Engineering Research Conference*.

Lander, E., & Liker, J. K. (2007). The Toyota Production System and art: Making highly customized and creative products the Toyota way. *International Journal of Production Research*, *45*(16), 3681–3698. https://doi.org/10.1080/00207540701223519

Lean Enterprise Institute, I. (2008). *Lean Lexicon*. (C. Marchwinski, J. Shook, & A. Schroeder, Eds.) (4th ed.). The Lean Enterprise Institute, Inc. Retrieved from http://www.lean.org/lexicon/muda-mura-muri

Levy, P., & Lemeshow, S. (2008). *Sampling of Populations: Methods and Applications*. *John Wiley & Sons, Inc.* A JOHN WILEY & SONS, INC., PUBLICATION. https://doi.org/10.2307/1271120

Li, Z., & Yao, J. (2018). Testing for Heteroscedasticity in High-dimensional Regressions. *Econometrics and Statistics*. https://doi.org/10.1016/j.ecosta.2018.01.001

Liker, J. K. (2004). *The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer*. *McGraw-Hill*.

Liker, J. K., & Hoseus, M. (2009). *Корпоративная культура Toyota*.

Liker, J. K., & Hoseus, M. (2010). Human Resource development in Toyota culture. *International Journal of Human Resources Development and Management*, (January 2010). https://doi.org/10.1504/IJHRDM.2010.029445

Liker, J. K., & Morgan, J. M. (2006). The Toyota Way in Services: The Case of Lean Product Development. *Academy of Management Perspectives*, *20*(2), 5–20. https://doi.org/10.5465/amp.2006.20591002

Long, J. S., & Ervin, L. (2000). Using heteroscedasticity-consistent standard errors in the linear regression model. *The American Statistician, 54*, 217–224.

Losonci, D., & Demeter, K. (2013a). Lean production and business performance : international empirical results. *An International Business Journal*, *23*(3), 218–233. https://doi.org/10.1108/10595421311319816

Losonci, D., & Demeter, K. (2013b). Lean production and business performance : international empirical results. *An International Business Journal*, *23*(3), 218–233. https://doi.org/10.1108/10595421311319816

Losonci, D., Kása, R., Demeter, K., Heidrich, B., & Jenei, I. (2017). The impact of shop floor culture and subculture on lean production practices. *International Journal of Operations & Production Management*, *37*(2), 205–225. https://doi.org/10.1108/IJOPM-11-2014-0524

Lozeau, D., Langley, A., & Denis, J. (2002). The corruption of managerial techniques by organizations, *55*(200205), 537–564.

Lyons, A. C., Vidamour, K., Jain, R., & Sutherland, M. (2013). Developing an understanding of lean thinking in process industries. *Production Planning and Control*, *24*(6), 475–494. https://doi.org/10.1080/09537287.2011.633576

Mackelprang, A. W., & Nair, A. (2010). Relationship between just-in-time manufacturing practices and performance : A meta-analytic investigation. *Journal of Operations Management*, *28*(4), 283–302. https://doi.org/10.1016/j.jom.2009.10.002

Malmbrandt, M., & Åhlström, P. (2013). An instrument for assessing lean service adoption. *International Journal of Operations and Production Management*, *33*(9), 1131–1165. https://doi.org/10.1108/IJOPM-05-2011-0175

Maltz, A. C. (2000). *Defining and Measuring Organizational Success: A Multi-dimensional Framework*. STEVENS INSTITUTE OF TECHNOLOGY.

Maltz, A. C., Shenhar, A. J., & Reilly, R. R. (2003). Beyond the Balanced Scorecard: *Long Range Planning*, *36*(2), 187–204. https://doi.org/10.1016/s0024-6301(02)00165-6

Mann, D. (2009). The missing link: Lean leadership. *Frontiers of Health Services Management*, *26*(1), 15–26. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/19791484

Mann, D. (2015). *Creating a Lean Culture: Tools to Sustain Lean Conversations* (3rd ed.). Boca Raton: CRC Press.

Marr, B., & Neely, A. (2003). Automating the balanced scorecard – selection criteria to identify appropriate software applications. *Measuring Business Excellence*, *7*(3), 29–36.

https://doi.org/10.1108/13683040310496480
Matsui, Y. (2007). An empirical analysis of just-in-time production in Japanese manufacturing companies. *International Journal of Production Economics*, *108*(1–2), 153–164. https://doi.org/10.1016/j.ijpe.2006.12.035
Minkov, M., & Hofstede, G. (2011). The evolution of Hofstede's doctrine. *Cross Cultural Management: An International Journal*, *18*(1), 10–20. https://doi.org/10.1108/13527601111104269
Moyano-Fuentes, J., & Sacristán-Díaz, M. (2012). Learning on lean: A review of thinking and research. *International Journal of Operations and Production Management*, *32*(5), 551–582. https://doi.org/10.1108/01443571211226498
Murphy, P. J., Cooke, R. A., & Lopez, Y. (2013). Firm culture and performance: Intensity's effects and limits. *Management Decision*, *51*(3), 661–679. https://doi.org/10.1108/00251741311309715
Murti, Y. (2009). *Sustaining Lean in New Zealand Manufacturing Organisations*. Massey University, Palmerston North, New Zealand.
Naor, M., Linderman, K., & Schroeder, R. (2010). The globalization of operations in Eastern and Western countries: Unpacking the relationship between national and organizational culture and its impact on manufacturing performance. *Journal of Operations Management*, *28*(3), 194–205. https://doi.org/10.1016/j.jom.2009.11.001
Narasimhan, R., Kull, T. J., & Nahm, A. (2012). Alternative relationships among integrative beliefs , time-based manufacturing and performance. *International Journal of Operations & Production Management*, *32*(4), 496–524. https://doi.org/10.1108/01443571211223112
Narayanamurthy, G., & Gurumurthy, A. (2016). Leanness assessment: a literature review. *International Journal of Operations and Production Management*, *36*(10), 1115–1160. https://doi.org/10.1108/IJOPM-01-2015-0003
Nathan, P. E. (2014). *The Oxford Handbook of Organizational Climate and Culture*. (B. Schneider & K. M. Barbera, Eds.). Oxford University Press.
Nawanir, G., Kong, L., Siti, T., & Othman, N. (2013). Impact of lean practices on operations performance and business performance Some evidence from Indonesian companies. *Journal of Manufacturing Technology Management*, *24*(7), 1019–1050. https://doi.org/10.1108/JMTM-03-2012-0027
Nazir, N. A., & Lone, M. A. (2008). Validation of Denison's model of organisational culture and effectiveness in the indian context. *The Journal OfBusiness Perspective*, *12*(1).
Negrão, L. L. L., Filho, M. G., & Marodin, G. (2017). The Management of Operations Lean practices and their effect on performance: a literature review. *Production Planning & Control*, *28*(1), 33–56. https://doi.org/10.1080/09537287.2016.1231853

Olsen, E. O. (2004). *Lean manufacturing management: the relationship between practice and firm level financial performance*. *ProQuest Information and Learning Company*. Ohio State University. Retrieved from http://onlinelibrary.wiley.com/doi/10.1002/cbdv.200490137/abstract

Pakdil, F., & Leonard, K. M. (2015). The effect of organizational culture on implementing and sustaining lean processes. *Journal of Manufacturing Technology Management*, *26*(5), 725–743. https://doi.org/10.1108/JMTM-08-2013-0112

Panwar, A., Nepal, B. P., Jain, R., & Rathore, A. P. S. (2015). On the adoption of lean manufacturing principles in process industries. *Production Planning and Control*, *26*(7), 564–587. https://doi.org/10.1080/09537287.2014.936532

Parker, C. (2004). Performance measurement. *Work Study*, *49*(2), 63–66. https://doi.org/10.1108/00438020010311197

Paro, P. E. P., & Gerolamo, M. C. (2015). Diagnosing and understanding the ideal Lean Culture – based on the 14 principles of the Toyota Way. *Global Journal on Humanites & Social Sciences*, *2*(2), 50–59. Retrieved from http://www.world-education-center.org/index.php/pntsbs

Paro, P. E. P., & Gerolamo, M. C. (2017). Organizational culture for lean programs. *Journal of Organizational Change Management*, *30*(4), 584–598. https://doi.org/10.1108/JOCM-02-2016-0039

Patten, M. L., & Newhart, M. (2017). *Understanding Research Methods*. Routledge.

Pennington, R. G. (2009). Yes , but how ? Nine tips for building a culture focused on results , relationships , and accountability. *Industrial and Commercial Training*, *41*(3), 146–150. https://doi.org/10.1108/00197850910950943

Prajogo, D. I., & McDermott, C. M. (2005). The relationship between total quality management practices and organizational culture. *International Journal of Operations & Production Management*, *25*(11), 1101–1122. https://doi.org/10.1108/01443570510626916

Prajogo, D. I., & McDermott, C. M. (2011). The relationship between multidimensional organizational culture and performance. *International Journal of Operations & Production Management*, *31*(7), 712–735. https://doi.org/10.1108/01443571111144823

Pyrczak, F. (2017). *Writing Empirical Research Reports*. (R. R. Bruce, Ed.) (8th ed.). Routledge.

Rother, M. (2010). *Toyota Kata*. New York: McGraw-Hill Companies.

Ruželė, D., & Serafinas, D. (2015). Preconditions and critical success factors of Lean management innovations in Lithuania's wood sector enterprises. *Current Issues of Business and Law*, *10*, 130–156. https://doi.org/10.5200/1822-9530.2015.08

Sackmann, S. A. (2010). *Assessment, Evaluation, Improvement: Success*

through Corporate Culture. (C. Raffel, Ed.). Bertelsmann Stiftung.
Salhieh, L., & Abdallah, A. A. (2019). A two-way causal chain between lean management practices and lean values. *International Journal of Productivity and Performance Management*, *68*(5), 997–1016. https://doi.org/10.1108/IJPPM-08-2018-0289
Sarstedt, M., & Mooi, E. (2019). *A Concise Guide to Market Research: The Process, Data, and Methods Using IBM SPSS Statistics* (3rd ed.). Springer Texts in Business and Economics. https://doi.org/10.1007/978-3-662-56707-4
Saunders, M., Lewis, P., & Thornhill, A. (2016). *Research Methods for Business Students, 7th. Ed. Pitman Publishing imprint*. Pearson Education Limited.
Saurin, T. A., Marodin, G. A., & Ribeiro, J. L. D. (2011). A framework for assessing the use of lean production practices in manufacturing cells. *International Journal of Production Research*, *49*(11), 3211–3230. https://doi.org/10.1080/00207543.2010.482567
Sawner, T. E. (2000). *An Empirical Investigation of the Relationship between Organizational Culture and Organizational Performance in a Large Public Sector Organization*.
Schein, E. H. (2010). *Organizational Culture and Leadership* (4th ed.). A Wiley Imprint.
Seddon, J. (2005). *Freedom from Command & Control: Rethinking Management for Lean Service*. Productivity Press.
Serafinas, D., & Ruželė, D. (2014). Evolution of organizations in the context of total quality management. *International Business: Innovations, Psychology, Economics*, *1*(8), 42–65.
Shah, R., & Ward, P. T. (2003). Lean manufacturing: context, practice bundles, and performance. *Journal of Operations Management*, *21*, 129–149.
Shah, R., & Ward, P. T. (2007). Defining and developing measures of lean production. *Journal of Operations Management*, *25*(4), 785–805. https://doi.org/10.1016/j.jom.2007.01.019
Shang, G., & Sui Pheng, L. (2013). The adoption of Toyota Way principles in large Chinese construction firms. *Journal of Technology Management in China*, *7*(3), 291–316. https://doi.org/10.1108/17468771311325185
Sharma, V., Dixit, A. R., & Qadri, M. A. (2015). Impact of lean practices on performance measures in context to Indian machine tool industry. *Journal of Manufacturing Technology Management*, *26*(8), 1218–1242. https://doi.org/10.1108/JMTM-11-2014-0118
Shaughnessy, J. J., Zechmeister, E. B., & Zechmeister, J. S. (2015). *Research Methods in Psychology* (10th ed.). McGraw-Hill Education.
Shetty, D., Ali, A., & Cummings, R. (2010). Survey-based spreadsheet model on lean implementation. *International Journal of Lean Six Sigma*, *1*(4), 2040–4166. https://doi.org/10.1108/20401461011096087

Shetty, S., Componation, P., Gholston, S., & Utley, D. (2010). Assessing the extent of Lean Implementation in an Organization. In *IIE Annual Conference. Proceedings* (pp. 1–6). Retrieved from http://search.proquest.com.ezp.waldenulibrary.org/abicomplete/docview/733014400/D1EA90514244757PQ/3?accountid=14872

Shook, J. (2010). How to Change a Culture : Lessons From NUMMI. *MIT Sloan Management Review*, *51*(2), 63–68.

Sinha, N., & Matharu, M. (2019). A Comprehensive Insight into Lean Management : Literature Review and Trends. *Journal of Industrial Engineering and Management*, *12*(2), 302–317. https://doi.org/10.3926/jiem.2885

Sisson, J., & Elshennawy, A. (2015). Achieving success with Lean: An analysis of key factors in Lean transformation at Toyota and beyond. *International Journal of Lean Six Sigma*, *6*(3), 263–280. https://doi.org/10.1108/IJLSS-07-2014-0024

Skarphedinsson, G., & Gudlaugsson, T. (2013). Psychometric Properties of the Icelandic Version of the Denison Organizational Culture Survey. *International Journal of Business and Social Science*, *4*(4). https://doi.org/10.30845/ijbss

Snyder, K., Ingelsson, P., & Bäckström, I. (2016). Enhancing the study of Lean transformation through organizational culture analysis. *International Journal of Quality and Service Sciences*, *8*(3). https://doi.org/10.1108/IJQSS-04-2016-0027

Sohal, A. S., & Egglestone, A. (1994). Lean Production: Experience among Australian Organizations. *Journal of Operations & Production Management*, *14*(11), 35–51. https://doi.org/10.1108/01443579410068639

Soliman, M., Saurin, T. A., & Anzanello, M. J. (2018). International Journal of Production Economics The impacts of lean production on the complexity of socio-technical systems. *International Journal of Production Economics*, *197*, 342–357. https://doi.org/10.1016/j.ijpe.2018.01.024

Star, S., Russ-Eft, D., Braverman, M. T., & Levine, R. (2016). Performance Measurement and Performance Indicators: A Literature Review and a Proposed Model for Practical Adoption. *Human Resource Development Review*, *15*(2), 151 –181. https://doi.org/10.1177/1534484316636220

Stensaker, I., & Falkenberg, J. (2007). Making sense of different responses to corporate change. *Human Relations*, *60*(1), 137–177. https://doi.org/10.1177/0018726707075287

Stone, K. B. (2010). *Relationships between organizational performance and change factors and manufacturing firms' leanness. Dissertation Abstracts International Section A: Humanities and Social Sciences*. Colorado State University. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=psyh&AN=20

11-99070-454&site=ehost-live
Stone, K. B. (2012). Four decades of lean: A systematic literature review. *International Journal of Lean Six Sigma*, *3*(2), 112–132. https://doi.org/10.1108/20401461211243702
Sustainability Data Book. (2016). *Toyota Motor Corporation*. Retrieved from http://www.toyota-global.com/sustainability/report/sr/
Tangen, S. (2005). Analysing the requirements of performance measurement systems. *Measuring Business Excellence*, *9*(4), 46–54. https://doi.org/10.1108/13683040510634835
Testani, M., & Ramakrishnan, S. (2013). Leader-centric Hoshin Planning: A Systemic Approach for Sustaining an Enterprise-wide Lean Transformation. In A. Krishnamurthy & W. K. V. Chan (Eds.), *Proceedings of the 2013 Industrial and Systems Engineering Research Conference* (pp. 1006–1014).
The Economist. (2003). *Numbers Guide. The Essentials of Business Numeracy* (5th ed.). Profile Books Ltd.
The Shingo prize for operational excellence. (2016). Utah State University.
Thomas, A. J., Antony, J., Francis, M., & Fisher, R. (2015). A comparative study of Lean implementation in higher and further education institutions in the UK. *International Journal of Quality & Reliability Management*, *32*(9), 982–996. https://doi.org/10.1108/JFM-03-2013-0017
Trompenaars, F., & Woolliams, P. (2003). *Business across cultures*. Capstone Publishing Ltd.
Tung, A., Baird, K., & Schoch, H. P. (2011). Factors influencing the effectiveness of performance measurement systems. *International Journal of Operations & Production Management, 31*(12), 1287–1310. https://doi.org/10.1108/01443571111187457
Van der Merwe, K. (2014). The Development of a Lean Culture Diagnostic Tool. *South African Journal of Industrial Engineering*.
Voyt, D. D. (2011). *Identifying total rewards systems and organizational culture type using the competing values framework*. *ProQuest Dissertations and Theses*. Capella University. Retrieved from http://libaccess.mcmaster.ca/login?url=http://search.proquest.com/docview/866632303?accountid=12347%5Cnhttp://sfx.scholarsportal.info/mcmaster?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:dissertation&genre=dissertations+&+theses&sid=ProQ:ABI/INFO
Wiengarten, F., Gimenez, C., Fynes, B., & Ferdows, K. (2015). Exploring the importance of cultural collectivism on the efficacy of lean practices taking an organisational and national perspective. *International Journal of Operations and Production Management*, *35*(3), 370–391. https://doi.org/10.1108/IJOPM-09-2012-0357
Woehl, J. H. (2011). How leadership styles reflect on lean manufacturing

practices and culture. *ProQuest Dissertations and Theses*, (August), 149-n/a. Retrieved from http://search.proquest.com/docview/894429006?accountid=14553%5Cnhttp://openurl.library.uiuc.edu/sfxlcl3?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:dissertation&genre=dissertations+&+theses&sid=ProQ:ProQuest+Dissertations+&+Theses+Full+Text&atit

Womack, J. P., Jones, D. T., & Roos, D. (1990). *The machine that changed the world*.

Xenikou, A., & Simosi, M. (2006). Organizational culture and transformational leadership as predictors of business unit performance. *Journal of Managerial Psychology*, *21*(6), 566–579. https://doi.org/10.1108/02683940610684409

Yadav, N., & Sagar, M. (2013). Performance measurement and management frameworks Research trends of the last two decades. *Business Process Management Journal*, *19*(6), 947–971. https://doi.org/10.1108/BPMJ-01-2013-0003

Yadav, R. K., Mittal, M. L., & Jain, R. (2018). Adoption of lean principles in software development projects. *International Journal of Lean Six Sigma*. https://doi.org/10.1108/IJLSS-03-2018-0031

You, C. L. K., Coulthard, M., & Petkovic-Lazarevic, S. (2010). Changing corporate culture to improve business performance: case of the Australian automobile industry. *Journal of Global Strategic Management*, *07*, 53–63.

APPENDIXES

Appendix 1. **Research Questionnaire in English**

Dear Respondent,

this research is carried out on a basis of doctoral studies in Vilnius University and has the aim to assess the impact of Lean tools on both organizational culture and on corporate performance. Research subjects are organizations, which are implementing Lean. Population of the research are business lean organizations in Lithuania. Results of the research will allow to assess effectiveness of Lean tools.

Answering will take approximately 15 minutes. Please check these boxes of the questionnaire that are most relevant to your opinion. Try to answer the questions as honestly as possible. Respondents of this research remain anonymous, the particular information you'll provide will not be disclosed to third parties. The responses will be processed and analyzed only in a generalized form and for scientific purposes only.

Please send your answers to the e-mail darius.ruzele@ef.vu.lt or by mail to: room 704, Saulėtekio al 9, II building, LT-10222 Vilnius. We hope for your help and understanding. **Thank you in advance for your contribution to the science!**

Darius Ruželė, lecturer at Vilnius University
tel. +370 687 11544

Please rate the level your organization implements the *Lean method*: 1- does not implement; 2- experimental; 3- repeatable; 4- established; 5- culturally ingrained.

Lean tool	**1**	**2**	**3**	**4**	**5**
1. Proper arrangement (5S)	☐	☐	☐	☐	☐
2. Value stream mapping (VSM)	☐	☐	☐	☐	☐
3. Production Kanban	☐	☐	☐	☐	☐
4. Problem solving standard (A3)	☐	☐	☐	☐	☐
5. Root cause analysis ("5 Why?")	☐	☐	☐	☐	☐
6. Total preventive maintenance (TPM)	☐	☐	☐	☐	☐
7. Error proofing (Poka-Yoke)	☐	☐	☐	☐	☐
8. Alert system (Andon)	☐	☐	☐	☐	☐
9. Statistical process charts (SPC)	☐	☐	☐	☐	☐
10. Standard operation procedures (SOP)	☐	☐	☐	☐	☐
11. Information boards	☐	☐	☐	☐	☐

12. Improvement events (Kaizen workshops)	☐	☐	☐	☐	☐
13. Leader's daily management standard work sheets	☐	☐	☐	☐	☐
14. Visiting actual place (Genchi Gembutsu)	☐	☐	☐	☐	☐
15. The suggestion system (Kaizen board)	☐	☐	☐	☐	☐
16. Morning meetings (Asaichi)	☐	☐	☐	☐	☐
17. Cross-functional training	☐	☐	☐	☐	☐
18. Reflection after the activity (Hansei)	☐	☐	☐	☐	☐
19. Policy/strategy deployment (Hoshin Kanri)	☐	☐	☐	☐	☐
20. War room (Obeya)	☐	☐	☐	☐	☐
21. Obtaining management support (Nemawashi)	☐	☐	☐	☐	☐
22. Consensus decisions (Ringi decision making)	☐	☐	☐	☐	☐
Other Lean tool (please name the tool):	☐	☐	☐	☐	☐

Please rate the level your organization purposefully implements the *principle*: 1- no adoption; 2- little adoption; 3- some adoption; 4- extensive adoption; 5- complete adoption of the principle.

Lean principle	**1**	**2**	**3**	**4**	**5**
1. Elimination of waste	☐	☐	☐	☐	☐
2. Just in time delivery (JIT)	☐	☐	☐	☐	☐
3. Standardization of processes and materials	☐	☐	☐	☐	☐
4. Visual management	☐	☐	☐	☐	☐
5. Getting quality right first time (Jidoka)	☐	☐	☐	☐	☐
6. Leveling the workload (Heijunka)	☐	☐	☐	☐	☐
7. Long-term philosophy	☐	☐	☐	☐	☐
8. Continuous improvement (Kaizen)	☐	☐	☐	☐	☐
9. Leaders promoted from within	☐	☐	☐	☐	☐
10. Respect for people and partners	☐	☐	☐	☐	☐
11. Teamwork	☐	☐	☐	☐	☐
12. Effective communication	☐	☐	☐	☐	☐

Please rate your agreement with following statements about the organization you work at: 1—strongly disagree, 2—disagree, 3—neutral, 4—agree, and 5—strongly agree.

Organizational culture	**1**	**2**	**3**	**4**	**5**
1. Decisions are usually made at the level where the best information is available	☐	☐	☐	☐	☐
2. Information is widely shared so that everyone can get the information he or she needs when it's needed	☐	☐	☐	☐	☐

3.	Everyone believes that he or she can have a positive impact	☐	☐	☐	☐	☐
4.	Working in this organization is like being part of a team	☐	☐	☐	☐	☐
5.	This organization relies on horizontal control and coordination to get work done, rather than hierarchy	☐	☐	☐	☐	☐
6.	Teams are the primary building blocks of this organization	☐	☐	☐	☐	☐
7.	This organization is constantly improving compared with its competitors in many dimensions	☐	☐	☐	☐	☐
8.	This organization continuous invests in the skills of employees	☐	☐	☐	☐	☐
9.	The capability of people in this organization is viewed as an important source of competitive advantage	☐	☐	☐	☐	☐
10.	The leaders and managers follow the guidelines that they set for the rest of the organization	☐	☐	☐	☐	☐
11.	There is a clear and consistent set of values in this organization that governs the way we do business	☐	☐	☐	☐	☐
12.	This organization has an ethical code that guides our behaviour and tells us right from wrong	☐	☐	☐	☐	☐
13.	When disagreements occur, we work hard to achieve solutions that benefit both parties in the disagreement	☐	☐	☐	☐	☐
14.	It is easy to reach consensus, even on difficult issues	☐	☐	☐	☐	☐
15.	We often have trouble reaching agreement on key issues ‘	☐	☐	☐	☐	☐
16.	People from different organizational units still share a common perspective	☐	☐	☐	☐	☐
17.	It is easy to coordinate projects across functional units in this organization	☐	☐	☐	☐	☐
18.	There is good alignment of goals across levels of this organization	☐	☐	☐	☐	☐
19.	This organization is very responsive and changes easily	☐	☐	☐	☐	☐
20.	This organization responds well to competitors and other changes in the environment	☐	☐	☐	☐	☐
21.	This organization continually adopts new and improved ways to do work	☐	☐	☐	☐	☐
22.	Customer comments and recommendations often lead to changes in this organization	☐	☐	☐	☐	☐
23.	Customer input directly influences our decisions	☐	☐	☐	☐	☐
24.	The interests of the final customer often get ignored in our decisions ‘	☐	☐	☐	☐	☐
25.	We view failure as an opportunity for learning and improvement	☐	☐	☐	☐	☐

26. This organization encourages and rewards those who take risk	☐	☐	☐	☐	☐
27. We make certain that we coordinate our actions and efforts between different units	☐	☐	☐	☐	☐
28. This organization has long-term purpose and direction	☐	☐	☐	☐	☐
29. This organization has a clear mission that gives meaning and direction to our work	☐	☐	☐	☐	☐
30. This organization has a clear strategy for the future	☐	☐	☐	☐	☐
31. There is widespread agreement about goals of this organization	☐	☐	☐	☐	☐
32. Leaders of this organization set goals that are ambitious, but realistic	☐	☐	☐	☐	☐
33. The leadership has clearly stated the objectives we are trying to meet	☐	☐	☐	☐	☐
34. We have a shared vision of what this organization will be like in the future	☐	☐	☐	☐	☐
35. Leaders of this organization have a long-term orientation	☐	☐	☐	☐	☐
36. Our vision creates excitement and motivation for our employees	☐	☐	☐	☐	☐

Please indicate your opinion about how your organization compares to its competitors in the same industry, in your market: 1—poor or low, 2—below average, 3—average or equal to the competition, 4—better than average, and 5—superior to competition

Corporate performance	**1**	**2**	**3**	**4**	**5**
1. Sale numbers	☐	☐	☐	☐	☐
2. Profit margin	☐	☐	☐	☐	☐
3. Revenue growth	☐	☐	☐	☐	☐
4. Customer satisfaction	☐	☐	☐	☐	☐
5. Customer retention rate	☐	☐	☐	☐	☐
6. Service quality	☐	☐	☐	☐	☐
7. Time to market for new products and services	☐	☐	☐	☐	☐
8. Quality of new product development and project management processes	☐	☐	☐	☐	☐
9. Product lead time	☐	☐	☐	☐	☐
10. Quantity and depth of standardized processes	☐	☐	☐	☐	☐
11. Retention of top employees	☐	☐	☐	☐	☐
12. Quality of leadership development	☐	☐	☐	☐	☐
13. Employee satisfaction level	☐	☐	☐	☐	☐

14. Depth and quality of strategic planning	☐	☐	☐	☐	☐
15. Anticipating and preparing for changes in the external environment	☐	☐	☐	☐	☐
16. Investment in R&D	☐	☐	☐	☐	☐
17. Investment in new market development	☐	☐	☐	☐	☐

1. For how long are you working for the company (please write down number of years): _____
2. Your position is (please check one of the boxes):
   1. ☐ manager or supervisor
   2. ☐ worker or employee
   3. ☐ other (please write down)
3. For how long are you acknowledged with Lean principles and tools (number of years): _____
4. What is the number of employees in your organization (please check one of the boxes):
   1. ☐ 1 - 49
   2. ☐ 50 - 249
   3. ☐ 250 and more
5. For how long your organization is implementing Lean tools (please write down number of years): _____
6. Which sector your organization operates in (please check one or few boxes)?
   1. ☐ high volume manufacturing
   2. ☐ low volume manufacturing
   3. ☐ service
   4. ☐ other (please write down) _____
7. Please name other less known Lithuanian organizations that are implementing Lean tools _____

If you would like to be informed about the results of the survey, *please indicate your e-mail address* so that we can send summarized results for you (this e-mail address will not be used for any other purpose): _____

Please send the completed questionnaire by e-mail darius.ruzele@evaf.vu.lt or by mail to room 704, Saulėtekio al 9, II building, LT-10222 Vilnius. **Thank you for your answers!**

Appendix 2. **Research Questionnaire in Lithuanian**

Gerbiamas respondente, laba diena.

Esu Vilniaus universiteto Ekonomikos ir verslo administravimo fakulteto lektorius (dėstau apie Lean) bei doktorantas, daktaro disertacijos pagrindu atlieku tyrimą, kurio *tikslas yra gauti ir apibendrintu pavidalu įmonėms pateikti informaciją apie **Lean** įtaką darbuotojų mąstymui bei veiklos rezultatams*.

Atsakymai į tyrimo anketos klausimus vienam respondentui užims apie 15-ka minučių. Į anketos klausimus prašomi atsakyti 3-5 respondentai iš skirtingų organizacijos lygmenų (vadovai ir darbuotojai).

Užpildytus anketos klausimynus (žr. prisegtą bylą) siųsti el. paštu darius.ruzele@evaf.vu.lt. Anketą galima užpildyti ir elektroninėje erdvėje, prisijungus pagal nuorodą https://apklausa.lt/f/lean-itaka-darbuotoju-mastymui-ir-imoniu-veiklos-rezultatams-7q21tln.fullpage.

Tyrimas yra anoniminis – konkreti įmonė, respondentas bei pateikta individuali informacija apie įmonę nėra atskleidžiama, tačiau esant jūsų pageidavimui, jūs galite gauti *apibendrintus* tyrimo rezultatus.

Ačiū už Jūsų pozityvią nuostatą sudalyvauti šiame tyrime!

lektorius, doktorantas Darius Ruželė
Tel. +370 687 11544

Įvertinkite, kiek įmonėje yra taikomas Lean metodas: 1- netaikomas; 2- eksperimentuojama; 3- taikomas retkarčiais; 4- taikomas nuolat; 5- taikymas yra tapęs įpročiu.

Lean metodas	**1**	**2**	**3**	**4**	**5**
1. Tinkamas darbo vietos sutvarkymas *(5S)*	☐	☐	☐	☐	☐
2. Vertės srauto modeliavimas *(Value stream mapping, VSM)*	☐	☐	☐	☐	☐
3. Produkcijos Kanbanai *(manufacturing Kanban)*	☐	☐	☐	☐	☐
4. Problemų sprendimo standartas A3	☐	☐	☐	☐	☐
5. Giluminių priežasčių analizė "5 Kodėl" *(5 Why?)*	☐	☐	☐	☐	☐
6. Prevencinė įrengimų priežiūra *(Total preventive maintenance, TPM)*	☐	☐	☐	☐	☐
7. Klaidų prevencija Poka-Yoke *(Error proofing)*	☐	☐	☐	☐	☐
8. Įspėjimų sistema Andon *(Alert system)*	☐	☐	☐	☐	☐

9. Statistiniai kokybės valdymo grafikai *(statistical control charts)*	☐	☐	☐	☐	☐
10. Standartinės operacijų procedūros SOP (*Standard operation procedures*)	☐	☐	☐	☐	☐
11. Informacijos lentos *(Information boards)*	☐	☐	☐	☐	☐
12. Kaizen renginiai *(Kaizen workshops)*	☐	☐	☐	☐	☐
13. Kasdieninių standartinių vadovo darbų sąrašas	☐	☐	☐	☐	☐
14. Ėjimas į vertės kūrimo vietą *(Genchi Genbutsu, Gemba Walk)*	☐	☐	☐	☐	☐
15. Pagerinimo pasiūlymų sistema *(Kaizen lenta)*	☐	☐	☐	☐	☐
16. Rytmetiniai darbuotojų susirinkimai *(Asaichi meetings)*	☐	☐	☐	☐	☐
17. Tarp-funkciniai darbuotojų mokymai *(Cross-functional training)*	☐	☐	☐	☐	☐
18. Apmąstymas po veiklos atlikimo *(Hansei)*	☐	☐	☐	☐	☐
19. Politikos ir strategijos išskleidimas *(Hoshin Kanri)*	☐	☐	☐	☐	☐
20. Diskusijų kambarys *(War room Obeya)*	☐	☐	☐	☐	☐
21. Vadovų pritarimo užsitikrinimas *(Nemawashi)*	☐	☐	☐	☐	☐
22. Bendru sutarimu priimami sprendimai *(consensus decisions, Ringi)*	☐	☐	☐	☐	☐
Kiti Lean metodai (įvardinkite metodą): _____	☐	☐	☐	☐	☐

Įvertinkite, kiek įmonėje yra taikomas *Lean principas*: 1- netaikomas; 2- taikomas retai; 3- taikomas reguliariai; 4- taikomas nuolat; 5- taikomas visuomet.

Lean principas	**1**	**2**	**3**	**4**	**5**
1. Švaistymų eliminavimas *(Elimination of waste)*	☐	☐	☐	☐	☐
2. Pristatymas "kaip tik laiku" *(Just in time delivery, JIT)*	☐	☐	☐	☐	☐
3. Procesų ir resursų standartizavimas	☐	☐	☐	☐	☐
4. Vizuali vadyba	☐	☐	☐	☐	☐
5. Kokybiška produkcija iš pirmo karto *(Jidoka)*	☐	☐	☐	☐	☐
6. Darbo krūvio subalansavimas *(Heijunka)*	☐	☐	☐	☐	☐
7. Ilgo laikotarpio verslo filosofija *(Long-term philosophy)*	☐	☐	☐	☐	☐
8. Nuolatinis gerinimas *(Kaizen)*	☐	☐	☐	☐	☐

9. Vadovų ugdymas įmonės viduje *(Leaders promoted from within)*	☐	☐	☐	☐	☐
10. Pagarba darbuotojams ir partneriams *(Respect for people and partners)*	☐	☐	☐	☐	☐
11. Komandinis darbas *(Teamwork)*	☐	☐	☐	☐	☐
12. Veiksmingas informacijos perdavimas	☐	☐	☐	☐	☐

Įvertinkite, kiek sutinkate su teiginiais apie įmonę, kurioje jūs dirbate: 1—visiškai nesutinku, 2—nesutinku, 3—nei nesutinku, nei sutinku, 4—sutinku, 5—visiškai sutinku.

Įmonės kultūra	**1**	**2**	**3**	**4**	**5**
1. Sprendimai priimami tame lygmenyje, kuriame yra reikiama informacija	☐	☐	☐	☐	☐
2. Plačiai dalijamasi informacija, reikiamą informaciją kiekvienas gali gauti laiku	☐	☐	☐	☐	☐
3. Kiekvienas tiki, kad jis gali padaryti teigiamą įtaką	☐	☐	☐	☐	☐
4. Darbas įmonėje yra lyg buvimas komandos dalimi	☐	☐	☐	☐	☐
5. Įmonė remiasi ne hierarchija, bet horizontalia kontrole ir koordinavimu	☐	☐	☐	☐	☐
6. Pagrindiniai įmonės struktūriniai vienetai yra komandos	☐	☐	☐	☐	☐
7. Įmonė nuolat tobulėja įvairiose srityse	☐	☐	☐	☐	☐
8. Įmonė nuolat investuoja į darbuotojų žinias ir įgūdžius	☐	☐	☐	☐	☐
9. Darbuotojų kompetencijos laikomos svarbiu konkurencinio pranašumo veiksniu	☐	☐	☐	☐	☐
10. Vadovai patys vadovaujasi gairėmis, kurias jie nustato įmonės darbuotojams	☐	☐	☐	☐	☐
11. Įmonė yra aiškiai apibrėžusi vertybes, kuriomis yra nuosekliai remiamasi	☐	☐	☐	☐	☐
12. Įmonė turi etikos kodeksą, kuris apibrėžia elgsenos darbe gaires	☐	☐	☐	☐	☐
13. Nesutarimų atveju yra ieškoma abi puses tenkinančių sprendimų	☐	☐	☐	☐	☐
14. Yra paprasta pasiekti konsensusą net ir sudėtingais atvejais	☐	☐	☐	☐	☐
15. Dažnai susiduriama su sunkumais, ieškant sutarimo svarbiausiais klausimais‘	☐	☐	☐	☐	☐
16. Veiklos kryptis yra ta pati net ir skirtinguose padaliniuose	☐	☐	☐	☐	☐

17. Nėra sunku koordinuoti projektus su įvairių įmonės padalinių darbuotojais	☐	☐	☐	☐	☐
18. Įmonės tikslai yra suderinti visuose vadovų/darbuotojų lygmenyse	☐	☐	☐	☐	☐
19. Įmonė yra jautri aplinkai ir lengvai keičiasi	☐	☐	☐	☐	☐
20. Įmonė reaguoja į konkurentų veiksmus ir kitus pokyčius verslo aplinkoje	☐	☐	☐	☐	☐
21. Įmonė nuolat pritaiko naujus ir geresnius darbo metodus	☐	☐	☐	☐	☐
22. Vartotojų pastabos ir rekomendacijos iššaukia pokyčius įmonės veikloje	☐	☐	☐	☐	☐
23. Vartotojų nuomonė daro tiesioginę įtaką priimant sprendimus	☐	☐	☐	☐	☐
24. Galutinio vartotojo nuomonė dažnai ignoruojama priimant sprendimus‘	☐	☐	☐	☐	☐
25. Klaidos yra interpretuojamos, kaip galimybės mokytis ir gerinti veiklą	☐	☐	☐	☐	☐
26. Įmonė skatina darbuotojus, kurie prisiima riziką ir atsakomybę	☐	☐	☐	☐	☐
27. Veiksmai tarp skirtingų padalinių yra užtikrintai koordinuojami	☐	☐	☐	☐	☐
28. Įmonė turi ilgalaikius tikslus ir ilgalaikę kryptį	☐	☐	☐	☐	☐
29. Įmonė turi misiją, kuri nukreipia ir įprasmina mūsų darbą	☐	☐	☐	☐	☐
30. Įmonė turi aiškią ateities strategiją	☐	☐	☐	☐	☐
31. Visi darbuotojai sutaria dėl įmonės tikslų	☐	☐	☐	☐	☐
32. Įmonės vadovai iškelia ambicingus, bet realius tikslus	☐	☐	☐	☐	☐
33. Vadovai aiškiai apibrėžia uždavinius, kuriuos siekiama įvykdyti	☐	☐	☐	☐	☐
34. Įmonės darbuotojai turi bendrą viziją, kokia įmonė turėtų būti ateityje	☐	☐	☐	☐	☐
35. Įmonės vadovai orientuojasi į ilgalaikius tikslus	☐	☐	☐	☐	☐
36. Įmonės vizija sužadina ir motyvuoja darbuotojus	☐	☐	☐	☐	☐

Įmonės rezultatus *palyginkite su konkurentų rezultatais* jūsų rinkoje: 1- daug blogiau nei konkurentai; 2-blogiau; 3-apylygiai; 4- geriau; 5- daug geriau nei konkurentai.

Įmonės veiklos rezultatai	**1**	**2**	**3**	**4**	**5**

1. Pardavimų apimtis	☐	☐	☐	☐	☐
2. Pelningumas	☐	☐	☐	☐	☐
3. Pajamų augimas	☐	☐	☐	☐	☐
4. Vartotojų pasitenkinimas	☐	☐	☐	☐	☐
5. Vartotojų išlaikymas	☐	☐	☐	☐	☐
6. Paslaugų kokybė	☐	☐	☐	☐	☐
7. Naujų produktų kūrimo trukmė nuo idėjos iki pardavimo	☐	☐	☐	☐	☐
8. Naujų produktų kūrimo ir projektų valdymo procesų kokybė	☐	☐	☐	☐	☐
9. Proceso laikas nuo žaliavos (pradžios) iki galutinio produkto *(lead time)*	☐	☐	☐	☐	☐
10. Procesų standartizavimo apimtis ir detalumas	☐	☐	☐	☐	☐
11. Pagrindinių darbuotojų išlaikymas	☐	☐	☐	☐	☐
12. Vadovų ugdymo kokybė	☐	☐	☐	☐	☐
13. Darbuotojų pasitenkinimo laipsnis	☐	☐	☐	☐	☐
14. Strateginio planavimo detalumas ir kokybė	☐	☐	☐	☐	☐
15. Pokyčių verslo aplinkoje tyrimas ir pasirengimas pokyčiams	☐	☐	☐	☐	☐
16. Investicijos į naujų produktų ir/ar paslaugų kūrimą	☐	☐	☐	☐	☐
17. Investicijos į naujų rinkų kūrimą ir vystymą	☐	☐	☐	☐	☐

1. Kiek laiko dirbate šioje įmonėje (įrašykite metų skaičių): _____
2. Jūsų pareigos (pažymėkite vieną iš laukelių):
    1. ☐ vadovas
    2. ☐ darbuotojas
    3. ☐ kita (įrašykite) _____
3. Kaip seniai jūs pats taikote Lean principus ir/ar metodus (įrašykite metų skaičių): _____
4. Koks yra įmonės darbuotojų skaičius (pažymėkite vieną iš laukelių):
    1. ☐ 1 - 49
    2. ☐ 50 - 249
    3. ☐ 250 ir daugiau
5. Kiek laiko įmonė taiko Lean įrankius? (įrašykite metų skaičių): _____
6. Kokiame sektoriuje veikia įmonė (pažymėkite vieną arba keletą laukelių):
    1. ☐ masinė gamyba
    2. ☐ vienetinė gamyba

3. ☐ paslaugos
4. ☐ kitas sektorius (įrašykite) _____

7. Kokios kitos mažiau žinomos Lietuvos įmonės taiko Lean (įvardinkite keletą) _____
8. Jei norite gauti apibendrintus apklausos rezultatus, nurodykite el. pašto adresą: _____

Užpildytus anketos klausimynus siųsti el. paštu darius.ruzele@evaf.vu.lt arba paštu LT-10222 Vilnius, Saulėtekio al 9., II rūmai, 704 kab. Anketą galima užpildyti ir elektroninėje erdvėje, prisijungus pagal nuorodą https://apklausa.lt/f/lean-itaka-darbuotoju-mastymui-ir-imoniu-veiklos-rezultatams-7q21tln.fullpage

Ačiū už Jūsų indėlį į šį tyrimą!

Appendix 3. **Introductory letter in English**

Dear lean practitioner,

I am lecturer from Vilnius University faculty of Economics and Business Administration. Currently I am researching the impact of Lean on employees and on corporate performance. The aim of the study is to gather information and share it in generalized form with companies. *I invite your company to participate in this research.*

Research is anonymous, respondents and particular companies will be not disclosed. *After the research you will be provided with generalized results which could help you to decide on politics regarding implementation of Lean tools in your company.*

Answers to the survey questionnaire will take about 15 minutes for one respondent. 3-5 questions from different levels of the organization (managers and staff) are requested in the questionnaire. Complete questionnaires (see attached file) by e-mail darius.ruzele@evaf.vu.lt . You can also fill out the questionnaire online: https://apklausa.lt/f/lean-itaka-darbuotojus-mastymui-ir-imoniuveiklos-rezultatams-7q21tln.fullpage .

Thank you in advance!

Appendix 4. **Introductory letter in Lithuanian**

Laba diena.

Kaip kalbėjome telefonu, esu Vilniaus universiteto Ekonomikos ir verslo administravimo fakulteto lektorius (studentams dėstau apie Lean), daktaro disertacijos pagrindu atlieku tyrimą, kurio *tikslas yra išsiaiškinti konkrečių Lean metodų taikymo naudą įmonėms bei įtaką darbuotojams bei apibendrintais rezultatais pasidalinti su įmonėmis. Kviečiu ir jus sudalyvauti šiame tyrime apie Lean.*

Atsakymai į tyrimo anketos klausimus vienam respondentui užims apie 15-ka minučių. Į anketos klausimus prašomi atsakyti 2-3 respondentai iš skirtingų organizacijos lygmenų (vadovas ir darbuotojai). Tyrimas yra anoniminis – konkreti įmonė, respondentas bei pateikta individuali informacija apie įmonę nėra atskleidžiama. Užpildytus anketos klausimynus (žr. prisegtą bylą) siųsti el. paštu darius.ruzele@evaf.vu.lt. Anketą galima užpildyti ir elektroninėje erdvėje, prisijungus pagal nuorodą https://apklausa.lt/f/lean-itaka-darbuotoju-mastymui-ir-imoniu-veiklos-rezultatams-7q21tln.fullpage

Šiame tyrime jau sudalyvavo apie 120 Lean ekspertų/koordinatorių/darbuotojų iš apie 70 Lietuvos Lean įmonių. Jums užpildžius anketas, apibendrintus rezultatus gausite keletos dienų bėgyje.

Ačiū už Jūsų pozityvią nuostatą sudalyvauti šiame tyrime!

Appendix 5. **Questionnaire items of the resulting measurement model**

Element	Index	Items
LM	LMHA	Proper arrangement (5S), Standard operation procedures (SOP), Total preventive maintenance (TPM), Production Kanban, Statistical process charts (SPC), Cross-functional training, Error proofing (Poka-Yoke), Alert system (Andon)
	LMSO	Morning meetings (Asaichi), information white-boards, Kaizen workshops, problem solving standard (A3), Kaizen board
	LMPS	Visiting actual place (Gemba Walk), root cause analysis ("5 Why?"), consensus Decisions (Ringi), Leader's daily management standard work sheets, Value Stream Mapping (VSM), policy/strategy deployment (Hoshin Kanri), obtaining management support (Nemawashi), war room (Obeya), reflection after the activity (Hansei)
LI	LIHA	Continuous improvement (Kaizen), standardization, elimination of waste, visual management, Jidoka, Just in time delivery, long-term philosophy, Heijunka
	LISO	Respect for people and partners, teamwork, leaders promoted from within, effective communication
OC	Involvement	1. Decisions are usually made at the level where the best information is available. 2. Information is widely shared so that everyone can get the information he or she needs when it's needed. 3. Everyone believes that he or she can have a positive impact. 4. Working in this organization is like being part of a team. 5. This organization relies on horizontal control and coordination to get work done, rather than hierarchy. 6. Teams are the primary building blocks of this organization. 7. This organization is constantly improving compared with its competitors in many dimensions. 8. This organization continuous invests in the skills of employees. 9. The capability of people in this organization is viewed as an important source of competitive advantage.
	Consistency	10. The leaders and managers follow the guidelines that they set for the rest of the organization. 11. There is a clear and consistent set of values in this organization that governs the way we do business. 12. This organization has an ethical code that guides our behaviour and tells us right from wrong 13. When disagreements occur, we work hard to achieve solutions that benefit both parties in the disagreement. 14. It is easy to reach consensus, even on difficult issues. 15. We often have trouble reaching agreement on key issues * 16. People from different organizational units still share a common perspective. 17. It is easy to coordinate projects across functional units

		in this organization. 18. There is good alignment of goals across levels of this organization.
	Adaptability	19. This organization is very responsive and changes easily. 20. This organization responds well to competitors and other changes in the environment. 21. This organization continually adopts new and improved ways to do work 22. Customer comments and recommendations often lead to changes in this organization. 23. Customer input directly influences our decisions. 24. The interests of the final customer often get ignored in our decisions * 25. We view failure as an opportunity for learning and improvement. 26. This organization encourages and rewards those who take risk. 27. We make certain that we coordinate our actions and efforts between units.
	Mission	28. This organization has long-term purpose and direction. 29. This organization has a clear mission that gives meaning and direction to our work. 30. This organization has a clear strategy for the future. 31. There is widespread agreement about goals of this organization. 32. Leaders of this organization set goals that are ambitious, but realistic. 33. The leadership has clearly stated the objectives we are trying to meet. 34. We have a shared vision of what this organization will be like in the future. 35. Leaders of this organization have a long-term orientation. 36. Our vision creates excitement and motivation for our employees
CP	Financial	Sales, profit margin, Revenue growth
	Customer/ market	Customer satisfaction, customer retention rate, service quality
	Development process	Time to market for new products and services, quality of new product development and project …
	Delivery process	Lead time, quantity and depth of standardized processes
	People development	Retention of top employees, quality of leadership development, employee satisfaction survey
	Preparing for future	Depth and quality of strategic planning, anticipating and preparing for changes in …, investment in R&D, investment in new market development

Appendix 6. **Item correlation matrixes for LM, LI, and CP**

Item correlation matrix for LM

Lean methods	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	1.10	1.11	1.12	1.13	1.14	1.15	1.16	1.17	1.18	1.19	1.20	1.21	1.22
1.1 Proper arrangement (5S)																						
1.2 Value Stream Mapping (VSM)	.10																					
1.3 Production Kanban	.49**	.22*																				
1.4 Problem solving standard (A3)	.26**	.22*	.09																			
1.5 Root cause analysis ("5 Why?")	.13	.16	.12	.36**																		
1.6 Total preventive maintenance (TPM)	.62**	.04	.47**	.23*	.16																	
1.7 Error proofing (Poka-Yoke)	.45**	.38**	.44**	.24**	.29**	.50**																
1.8 Alert system (Andon)	.33**	.27**	.31**	.09	.29**	.29**	.47**															
1.9 Statistical process charts (SPC)	.38**	.21*	.38**	.33**	.16	.40**	.44**	.41**														
1.10 Standard operation procedures (SOP)	.31**	.39**	.38**	.10	.13	.46**	.59**	.33**	.43**													
1.11 Information white-boards	.35**	.24**	.20*	.33**	.18*	.25**	.16	.17	.31**	.26**												
1.12 Kaizen workshops	.40**	.19*	.25**	.44**	.23*	.17	.27**	.16	.27**	.12	.48**											
1.13 Leader's daily management standard work sheets	.24**	.19*	.12	.12	.18	.17	.29**	.24**	.28**	.21*	.29**	.22*										
1.14 Visiting actual place (Gemba Walk)	.22*	.41**	.33**	.15	.16	.15	.30**	.21*	.33**	.16	.14	.38**	.12									
1.15 Kaizen board	.32**	.22*	.28**	.45**	.23*	.35**	.31**	.22*	.25**	.31**	.38**	.38**	.18	.20*								
1.16 Morning meetings (Asaichi)	.17	.09	.10	.39**	.24**	.13	.07	.14	.14	.02	.55**	.33**	.05	.15	.28**							
1.17 Cross-functional training	.24**	.17	.27**	.17	.23*	.35**	.27**	.27**	.30**	.46**	.33**	.35**	.04	.20*	.31**	.12						
1.18 Reflection after the activity (Hansei)	.24**	.34**	.30**	.13	.19*	.36**	.45**	.26**	.28**	.41**	.30**	.21*	.38**	.35**	.28**	.17	.44**					
1.19 Policy/strategy deployment (Hoshin Kanri)	.22*	.31**	.39**	.21*	.38**	.29**	.43**	.37**	.35**	.32**	.17	.30**	.23*	.32**	.15	.14	.45**	.46**				
1.20 War room (Obeya)	.26**	.31**	.33**	.29**	.31**	.28**	.44**	.29**	.31**	.34**	.29**	.31**	.31**	.35**	.28**	.17	.34**	.55**	.50**			
1.21 Obtaining management support (Nemawashi)	.15	.40**	.29**	.24**	.32**	.16	.42**	.15	.30**	.34**	.12	.28**	.33**	.35**	.25**	.04	.26**	.43**	.53**	.52**		
1.22 Consensus Decisions (Ringi)	.13	.25**	.29**	.19*	.40**	.23*	.48**	.28**	.39**	.35**	.14	.24**	.29**	.26**	.13	.04	.34**	.44**	.59**	.49**	.68**	

N = 121. ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

Item correlation matrix for LI

Lean principles	1.23	1.24	1.25	1.26	1.27	1.28	1.29	1.30	1.31	1.32	1.33	1.34
1.23 Elimination of waste												
1.24 Just in time delivery, JIT	.58**											
1.25 Standardization	.49**	.58**										
1.26 Visual management	.52**	.53**	.54**									
1.27 Jidoka	.46**	.56**	.51**	.49**								
1.28 Heijunka	.42**	.49**	.47**	.41**	.56**							
1.29 Long-term philosophy	.40**	.42**	.55**	.29**	.48**	.62**						
1.30 Continuous improvement (Kaizen)	.47**	.33**	.29**	.34**	.24**	.30**	.41**					
1.31 Leaders promoted from within	.32**	.29**	.38**	.33**	.25**	.28**	.46**	.50**				
1.32 Respect for people and partners	.39**	.22*	.32**	.32**	.32**	.29**	.31**	.34**	.45**			
1.33 Teamwork	.16	.27**	.40**	.37**	.29**	.26**	.30**	.22*	.39**	.61**		
1.34 Effective communication	.39**	.37**	.58**	.41**	.49**	.39**	.41**	.26**	.38**	.58**	.64**	

N = 121. ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

Item correlation matrix for CP

Corporate performance measures	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	3.1	3.11	3.12	3.13	3.14	3.15	3.16	3.17
3.1 Sales																	
3.2 Profit margin	.69**																
3.3 Revenue growth	.67**	.69**															
3.4 Customer satisfaction	.34**	.27**	.47**														
3.5 Customer retention rate	.46**	.38**	.57**	.76**													
3.6 Service quality	.36**	.29**	.38**	.58**	.60**												
3.7 Time to market for new products and services	.29**	.24*	.44**	.43**	.51**	.49**											
3.8 Quality of new product development…	.37**	.33**	.49**	.42**	.57**	.57**	.78**										
3.9 Lead time	.18	.20*	.25**	.27**	.39**	.38**	.28**	.43**									
3.10 Quantity and depth of standardized processes	.34**	.34**	.41**	.44**	.55**	.56**	.36**	.51**	.63**								
3.11 Retention of top employees	.14	.10	.25**	.34**	.26**	.40**	.31**	.29**	.25**	.38**							
3.12 Quality of leadership development	.33**	.31**	.28**	.33**	.34**	.32**	.29**	.38**	.27**	.44**	.32**						
3.13 Employee satisfaction survey	.19*	.20*	.39**	.42**	.33**	.38**	.32**	.34**	.08	.37**	.49**	.51**					
3.14 Depth and quality of strategic planning	.32**	.37**	.46**	.27**	.32**	.28**	.37**	.46**	.27**	.42**	.14	.50**	.34**				
3.15 Anticipating and preparing for changes…	.43**	.41**	.58**	.32**	.42**	.30**	.43**	.42**	.32**	.41**	.21*	.42**	.33**	.64**			
3.16 Investment in R&D	.37**	.37**	.49**	.39**	.52**	.38**	.37**	.46**	.26**	.51**	.21*	.39**	.29**	.50**	.50**		
3.17 Investment in new market development	.38**	.38**	.60**	.49**	.63**	.47**	.51**	.51**	.26**	.50**	.28**	.41**	.44**	.43**	.57**	.72**	

**. Correlation is significant at the 0.01 level (2-tailed).

Appendix 7. **Influence of LP on CP: analysis tables**

Influence of LP on CP: Model summary [b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.45[a]	.20	.20	.49	1.78

a. Predictors: (Constant), Lean practices

b. Dependent Variable: Corporate performance

Influence of LP on CP: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.78	1.00	6.78	28.61	.00[b]
	Residual	26.30	111.00	.24		
	Total	33.08	112.00			

a. Dependent Variable: Corporate performance

b. Predictors: (Constant), Lean practices

Influence of LP on CP: tests of normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.07	113.00	.20	.98	113.00	.22

a. Lilliefors Significance Correction

Influence of LP on CP: modified B-P test for heteroscedasticity [a,b,c]

Chi-Square	df	Sig.
1.97	1.00	.16

a. Dependent variable: Corporate performance

b. Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

c. Predicted values from design: Intercept + LL

Influence of LMHA, LMSO, LMPS, LIHA, and LISO on CP[c]

Model	R	R	Adjusted R	Std. Error of the	Durbin-
1	.42[a]	.17	.17	.49	
2	.49[b]	.24	.22	.47	1.98

a. Predictors: (Constant), Soft lean principles

b. Predictors: (Constant), Soft lean principles, Soft lean methods

c. Dependent Variable: Corporate performance

Influence of LMHA, LMSO, LMPS, LIHA, and LISO on CP: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
2	Regression	7.60	2.00	3.80	16.99	.00[c]
	Residual	24.38	109.00	.22		
	Total	31.98	111.00			

a. Dependent Variable: Corporate performance

c. Predictors: (Constant), Soft lean principles, Soft lean methods

Influence of LMHA, LMSO, LMPS, LIHA, and LISO on CP: normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.07	112.00	.20*	.99	112.00	.76

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Influence of LP on CP: modified B-P test heteroscedasticity [a,b,c]

Chi-Square	df	Sig.
1.77	1.00	.18

a. Dependent variable: Corporate performance

b. Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

c. Predicted values from design: Intercept + LMSO + LISO + LMSO * LISO

Influence of LP on product delivery process: Model summary [a;b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.54[a]	.29	.28	.64	1.83

a. Predictors: (Constant), lean practices

b. Dependent Variable: Delivery process

Influence of LP on product delivery process: ANOVA [a;b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	18.42	1.00	18.42	44.60	.00[b]
	Residual	45.02	109.00	.41		
	Total	63.44	110.00			

a. Dependent Variable: Delivery process

b. Predictors: (Constant), lean practices

Influence of LP on product delivery process: tests of normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.11	111.00	.00	.98	111.00	.22

a. Lilliefors Significance Correction

Influence of LP on CP: modified B-P test heteroscedasticity [a,b,c]

Chi-Square	df	Sig.
1.38	1.00	.24

1. Dependent variable: Delivery process

2. Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

3. Predicted values from design: Intercept + LL

Influence of LM and LI on product delivery process: Model summary[c]

Model	R	R	Adjusted R	Std. Error of the	Durbin-
1	.58[a]	.34	.32	.61	
2	.57[b]	.33	.32	.62	1.89

a. Predictors: (Constant), lean principles, lean methods

b. Predictors: (Constant), lean principles

c. Dependent Variable: Delivery process

Influence of LM and LI on product delivery process: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
2	Regression	19.95	1.00	19.95	52.62	.00[c]
	Residual	40.95	108.00	.38		
	Total	60.90	109.00			

a. Dependent Variable: Delivery process

c. Predictors: (Constant), lean principles

Influence of LM and LI on product delivery process: tests of normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.09	110.00	.05	.98	110.00	.11

a. Lilliefors Significance Correction

Influence of LM and LI on CPDEL: modified B-P test heteroskedasc [a,b,c]

Chi-Square	df	Sig.
2.47	1.00	.12

a. Dependent variable: Delivery process

b. Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

c. Predicted values from design: Intercept + LI

Influence of LMHA, LMSO, LMPS, LIHA, LISO on CPDEL: Model[e]

Model	R	R Square	Adjusted R	Std. Error of the	Durbin-
1	.62[a]	.38	.35	.60	
2	.62[b]	.38	.36	.60	
3	.61[c]	.37	.36	.60	
4	.61[d]	.37	.36	.60	1.87

a. Predictors: (constant), soft lean principles, soft lean methods, hard lean methods, problem solving lean methods, hard lean principles

b. Predictors: (constant), soft lean principles, soft lean methods, problem solving lean methods, hard lean principles

c. Predictors: (constant), soft lean principles, soft lean methods, hard lean principles

d. Predictors: (constant), soft lean methods, hard lean principles

e. Dependent variable: delivery process

Influence of LMHA, LMSO, LMPS, LIHA, LISO on CPDEL: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
4	Regression	22.50	2.00	11.25	31.36	.00[e]
	Residual	38.40	107.00	.36		
	Total	60.90	109.00			

a. Dependent Variable: Delivery process

e. Predictors: (Constant), Soft lean methods, Hard lean principles

Influence of LMHA, LMSO, LMPS, LIHA, LISO on CPDEL: normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.10	110	.01	.98	110	.10

a. Lilliefors Significance Correction

Influence of LMHA, LMSO, LMPS, LIHA and LISO on CPDEL: modified Breusch-Pagan Test for heteroskedasticity [a,b,c]

Chi-Square	df	Sig.
.45	1.00	.50

1. Dependent variable: Delivery process

2. Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

3. Predicted values from design: Intercept + LMSO + LIHA + LMSO * LIHA

Influence of LP on CPFU: Model summary [a;b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.45[a]	.20	.20	.61	1.70

a. Predictors: (Constant), Lean practices

b. Dependent Variable: Preparing for future

Influence of LP on CPFU: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9.94	1.00	9.94	27.09	.00[b]
	Residual	38.89	106.00	.37		
	Total	48.82	107.00			

a. Dependent Variable: Preparing for future

b. Predictors: (Constant), Lean practices

Influence of LP on CPFU: tests of normality [a]

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.05	108.00	.20*	.99	108.00	.86

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Infl. of LMHA, LMSO, LMPS, LIHA, LISO on CPFU: Model [a;b;c;d;e]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.46[a]	.21	.17	.63	
2	.46[b]	.21	.18	.62	
3	.46[c]	.21	.19	.62	
4	.45[d]	.20	.19	.62	1.69

a. Predictors: (constant), soft lean principles, soft lean methods, hard lean methods, problem solving lean methods, hard lean principles

b. Predictors: (constant), soft lean principles, soft lean methods, hard lean methods, problem solving lean methods

c. Predictors: (constant), soft lean principles, soft lean methods, hard lean methods

d. Predictors: (constant), soft lean principles, hard lean methods

e. Dependent variable: preparing for future

Influence of LMHA, LMSO, LMPS, LIHA, LISO on CPFU: ANOVA [a;e]

Model		Sum of Squares	df	Mean Square	F	Sig.
4	Regression	10.34	2.00	5.17	13.28	.00[e]
	Residual	41.25	106.00	.39		
	Total	51.59	108.00			

a. Dependent Variable: Preparing for future

e. Predictors: (Constant), Soft lean principles, Hard lean methods

Influence of LMHA, LMSO, LMPS, LIHA, LISO on CPFU: normality [a]

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.05	109.00	.20*	.99	109.00	.73

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Influence of LMHA, LMSO, LMPS, LIHA and LISO on CPFU: Modified B-P test for heteroskedasticity[a,b,c]

Chi-Square	df	Sig.
1.62	1.00	.20

a. Dependent variable: Preparing for future

b. Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

c. Predicted values from design: Intercept + LMHA + LISO + LMHA * LISO

Appendix 8. **Influence of OC on CP: analysis tables**

Influence of OC on CP: Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.58[a]	.34	.33	.44	1.73

a. Predictors: (Constant), Organizational culture

b. Dependent Variable: Corporate performance

Influence of OC on CP: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	11.10	1.00	11.10	56.05	.00[b]
	Residual	21.98	111.00	.20		
	Total	33.08	112.00			

a. Dependent Variable: Corporate performance

b. Predictors: (Constant), Organizational culture

Influence of OC on CP: tests of normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.07	113.00	.20*	.99	113.00	.35

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Influence of OC on CP: modified B-P test for Heteroskedasticity[a,b,c]

Chi-Square	df	Sig.
.56	1.00	.45

a. Dependent variable: Corporate performance

b. Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

c. Predicted values from design: Intercept + OC

Influence of cultural dimensions on CP: Model Summary[d]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.59[a]	.34	.32	.45	
2	.59[b]	.34	.32	.45	
3	.58[c]	.34	.33	.45	1.78

a. Predictors: (Constant), Mission, Adaptability, Involvement, Consistency

b. Predictors: (Constant), Mission, Adaptability, Consistency

c. Predictors: (Constant), Adaptability, Consistency

Influence of cultural dimensions on CP: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
3	Regression	11.23	2.00	5.61	28.27	.00[d]
	Residual	21.85	110.00	.20		
	Total	33.08	112.00			

a. Dependent Variable: Corporate performance

d. Predictors: (Constant), Adaptability, Consistency

Influence of cultural dimensions on CP: tests of normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.06	113.00	.200[*]	.99	113.00	.32

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Influence of cultural dimensions on CP: modified B-P test for Heteroskedasticity[a,b,c]

Chi-Square	df	Sig.
.46	1.00	.50

a. Dependent variable: Corporate performance

b. Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

c. Predicted values from design: Intercept + OCCO + OCAD + OCCO * OCAD

Influence of cultural dimensions on CPCU: Model Summary[e]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.48[a]	.23	.20	.59	
2	.48[b]	.23	.21	.59	
3	.48[c]	.23	.22	.59	
4	.47[d]	.22	.22	.59	1.99

a. Predictors: (Constant), Mission, Adaptability, Involvement, Consistency

b. Predictors: (Constant), Mission, Adaptability, Involvement

c. Predictors: (Constant), Adaptability, Involvement

d. Predictors: (Constant), Adaptability

e. Dependent Variable: Customer/market

Influence of cultural dimensions on CPCU: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
4	Regression	10.89	1.00	10.89	31.57	.00[e]
	Residual	37.59	109.00	.34		
	Total	48.48	110.00			

a. Dependent Variable: Customer/market

e. Predictors: (Constant), Adaptability

Influence of cultural dimensions on CPCU: tests of normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.07	111.00	.20[*]	.99	111.00	.43

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Influence of cultural dimensions on CPCU: modified B-P test [a,b,c]

(Source: own analysis)

Chi-Square	df	Sig.
1.59	1.00	.21

a. Dependent variable: Customer/market

b. Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

c. Predicted values from design: Intercept + OCAD

Influence of cultural dimensions on CPDEV: Model Summary[d]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.45[a]	.21	.17	.70	
2	.45[b]	.20	.18	.70	
3	.45[c]	.20	.18	.70	1.93

a. Predictors: (Constant), Mission, Adaptability, Involvement, Consistency

b. Predictors: (Constant), Mission, Adaptability, Consistency

c. Predictors: (Constant), Mission, Adaptability

d. Dependent Variable: Development process

Influence of cultural dimensions on CPDEV: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
3	Regression	12.80	2.00	6.40	13.12	.00[d]
	Residual	51.19	105.00	.49		
	Total	63.99	107.00			

a. Dependent Variable: Development process

b. Predictors: (Constant), Mission, Adaptability, Involvement, Consistency

c. Predictors: (Constant), Mission, Adaptability, Consistency

d. Predictors: (Constant), Mission, Adaptability

Influence of cultural dimensions on CPDEV: tests of normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.08	108.00	.16	.97	108.00	.03

a. Lilliefors Significance Correction

Influence of cultural dimensions on CPDEV: modified B-P test [a,b,c]

Chi-Square	df	Sig.
1.83	1.00	.18

a. Dependent variable: Development process

b. Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

c. Predicted values from design: Intercept + OCAD + OCMI + OCAD * OCMI

Influence of OC on CPDEL: Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.49[a]	.24	.23	.66	1.86

a. Predictors: (Constant), Organizational culture

b. Dependent Variable: Delivery process

Influence of OC on CPDEL: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15.34	1.00	15.34	34.77	.00[b]
	Residual	48.09	109.00	.44		
	Total	63.44	110.00			

a. Dependent Variable: Delivery process

b. Predictors: (Constant), Organizational culture

Influence of OC on CPDEL: tests of normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.06	111.00	.20*	.99	111.00	.75

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Influence of OC on CPDEL: modified B-P test for Heteroskedasticity[a,b,c]

Chi-Square	df	Sig.
1.15	1.00	.28

a. Dependent variable: Delivery process

b. Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

c. Predicted values from design: Intercept + OC

Influence of cultural dimensions on CPDEL: Model Summary[e]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.50[a]	.25	.22	.67	
2	.50[b]	.25	.23	.67	
3	.49[c]	.24	.23	.67	
4	.47[d]	.22	.22	.67	1.84

a. Predictors: (Constant), Mission, Involvement, Adaptability, Consistency

b. Predictors: (Constant), Involvement, Adaptability, Consistency

c. Predictors: (Constant), Adaptability, Consistency

d. Predictors: (Constant), Consistency

e. Dependent Variable: Delivery process

Influence of cultural dimensions on CPDEL: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
4	Regression	14.25	1.00	14.25	31.59	.00[e]
	Residual	49.18	109.00	.45		
	Total	63.44	110.00			

a. Dependent Variable: Delivery process

e. Predictors: (Constant), Consistency

Influence of cultural dimensions on CPDEL: tests of normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.05	111.00	.20[*]	.99	111.00	.58

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Influence of cultural dimensions on CPDEL: modified B-P Test [a,b,c]

Chi-Square	df	Sig.
.24	1.00	.62

a. Dependent variable: Delivery process

b. Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

c. Predicted values from design: Intercept + OCCO

Influence of OC on CPPD: Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.45[a]	.20	.20	.53	1.76

a. Predictors: (Constant), Organizational culture

b. Dependent Variable: People development

Influence of OC on CPPD: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.79	1.00	7.79	27.67	.00[b]
	Residual	30.69	109.00	.28		
	Total	38.48	110.00			

a. Dependent Variable: People development

b. Predictors: (Constant), Organizational culture

Influence of OC on CPPD: Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.05	111.00	.20*	.98	111.00	.20

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Influence of OC on CPPD: Modified B-P Test for Heteroskedasticity[a,b,c]

Chi-Square	df	Sig.
.53	1.00	.47

a. Dependent variable: People development

b. Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

c. Predicted values from design: Intercept + OC

Influence of cultural dimensions on CPPD: Model Summary[e]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.50[a]	.25	.22	.54	
2	.50[b]	.25	.23	.53	
3	.48[c]	.23	.22	.54	
4	.46[d]	.21	.21	.54	1.71

a. Predictors: (Constant), Mission, Adaptability, Involvement, Consistency

b. Predictors: (Constant), Mission, Involvement, Consistency

c. Predictors: (Constant), Involvement, Consistency

d. Predictors: (Constant), Involvement

e. Dependent Variable: People development

Influence of cultural dimensions on CPPD: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
4	Regression	8.69	1.00	8.69	29.63	.00[e]
	Residual	32.24	110.00	.29		
	Total	40.93	111.00			

a. Dependent Variable: People development

e. Predictors: (Constant), Involvement

Influence of cultural dimensions on CPPD: tests of normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.09	112.00	.02	.98	112.00	.07

a. Lilliefors Significance Correction

Influence of cultural dimensions on CPPD: Modified B-P Test [a,b,c]

Chi-Square	df	Sig.
.28	1.00	.60

a. Dependent variable: People development

b. Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

c. Predicted values from design: Intercept + OCIN

Influence of OC on CPFU: Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.62[a]	.38	.38	.57	2.04

a. Predictors: (Constant), Organizational culture

b. Dependent Variable: Preparing for future

Influence of OC on CPFU: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	21.53	1.00	21.53	67.07	.00[b]
	Residual	34.66	108.00	.32		
	Total	56.19	109.00			

a. Dependent Variable: Preparing for future

b. Predictors: (Constant), Organizational culture

Influence of OC on CPFU: tests of normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.05	110.00	.20*	.99	110.00	.77

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Influence of OC on CPFU: Modified B-P test for Heteroskedasticity[a,b,c]

Chi-Square	df	Sig.
.00	1.00	1.00

a. Dependent variable: Preparing for future

b. Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

c. Predicted values from design: Intercept + OC

Influence of cultural dimensions on CPFU: Model summary[d]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.63[a]	.39	.37	.57	
2	.63[b]	.39	.38	.57	
3	.62[c]	.38	.37	.57	2.04

a. Predictors: (Constant), Mission, Involvement, Adaptability, Consistency

b. Predictors: (Constant), Mission, Adaptability, Consistency

c. Predictors: (Constant), Mission, Adaptability

d. Dependent Variable: Preparing for future

Influence of cultural dimensions on CPFU: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
3	Regression	21.57	2.00	10.78	33.32	.00[d]
	Residual	34.63	107.00	.32		
	Total	56.19	109.00			

a. Dependent Variable: Preparing for future

d. Predictors: (Constant), Mission, Adaptability

Influence of cultural dimensions on CPFU: tests of normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.07	110.00	.20*	.99	110.00	.69

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Influence of cultural dimensions on CPFU: modified B-P test [a,b,c]

Chi-Square	df	Sig.
.64	1.00	.42

a. Dependent variable: Preparing for future

b. Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

c. Predicted values from design: Intercept + OCAD + OCMI + OCAD * OCMI

Appendix 9. **Relations of LP and OC: analysis tables**

Influence of LP on OC: Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.54[a]	.29	.29	.47	1.72

a. Predictors: (Constant), Lean practices

b. Dependent Variable: Organizational culture

Influence of LP on OC: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.67	1.00	10.67	49.14	.00[b]
	Residual	25.84	119.00	.22		
	Total	36.52	120.00			

a. Dependent Variable: Organizational culture

b. Predictors: (Constant), Lean practices

Influence of LP on OC: tests of normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.03	121.00	.20*	1.00	121.00	.99

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Influence of OC on LP: Model summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.54[a]	.29	.29	.61	1.50

a. Predictors: (Constant), Organizational culture

b. Dependent Variable: Lean practices

Influence of OC on LP: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	18.19	1.00	18.19	49.14	.00[b]
	Residual	44.06	119.00	.37		
	Total	62.25	120.00			

a. Dependent Variable: Lean practices

b. Predictors: (Constant), Organizational culture

Influence of OC on LP: tests of normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.04	121.00	.20*	.99	121.00	.68

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Influence of OC on LP: modified B-P test for heteroskedasticity[a,b,c]

Chi-Square	df	Sig.
1.00	1.00	.32

Dependent variable: Lean practices

Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

Predicted values from design: Intercept + OC

Appendix 10. **Complex LP, OC, and CP framework: analysis tables**

Influence of LP and OC on CP: Model summary [a;b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.60[a]	.36	.35	.44	1.76

a. Predictors: (Constant), Organizational culture, Lean practices

b. Dependent Variable: Corporate performance

Influence of LP and OC on CP: ANOVA [a;b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	12.05	2.00	6.02	31.52	.00[b]
	Residual	21.03	110.00	.19		
	Total	33.08	112.00			

a. Dependent Variable: Corporate performance

b. Predictors: (Constant), Organizational culture, Lean practices

Influence of LP and OC on CP: tests of normality [a]

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.07	113.00	.20*	.98	113.00	.08

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

LP influence on CP moderated by OC: Model summary [a;b;c]

Model	R	R Square	MSE	F	df1	df2	p
1	.61	.37	.19	28.95	3.00	109.00	.00

a. Predictors: (Constant), Lean practices

b. Moderator: Organizational culture

c. Dependent Variable: Corporate performance

OC influence on CP moderated by LP: Model summary [a;b;c]

Model	R	R^2	MSE	F(HC3)	df1	df2	p
1	.61	.37	.19	28.95	3.00	109.00	.00

a. Predictors: (Constant), Organizational culture

b. Moderator: Lean practices

c. Dependent Variable: Corporate performance

Appendix 11. **HCREG macro for estimating OLS regression models with heteroscedasticity-consistent standard errors.**

Source: http://afhayes.com/spss-sas-and-mplus-macros-and-code.html

HCREG macro:

```
* Encoding: UTF-8.
DEFINE hcreg (dv =!charend ('/')/iv =!charend ('/')
        /test = !charend('/') !default (0)
        /const = !charend('/') !default(1)
        /method = !charend ('/') !default (3)
        /covmat = !charend('/') !default(0)).
PRESERVE.
set length = none.
SET MXLOOP = 100000000.
MATRIX.
GET x/file = */variables = !dv !iv/names = dv/missing = omit.
compute y=x(:,1).
compute x=x(:,2:ncol(x)).
compute iv5 = x.
compute pr = ncol(x).
compute n = nrow(x).
compute L = ident(pr).
compute tss=cssq(y)-(((csum(y)&**2)/n)*(!const <> 0)).
do if (!const = 0).
  compute iv = t(dv(1,2:ncol(dv))).
  compute df2 = n-pr.
else.
  compute iv = t({"Constant", dv(1,2:ncol(dv))}).
  compute con = make(n,1,1).
  compute x={con,x}.
  compute df2 = n-pr-1.
  compute L1 = make(1,pr,0).
  compute L = {L1;L}.
end if.
compute dv=dv(1,1).
compute b = inv(t(x)*x)*t(x)*y.
compute k = nrow(b).
compute invXtX = inv(t(x)*x).
compute h = x(:,1).
loop i=1 to n.
  compute h(i,1)= x(i,:)*invXtX*t(x(i,:)).
end loop.
```

```
compute resid = (y-(x*b)).
compute mse = csum(resid&**2)/(n-ncol(x)).
compute pred = x*b.
compute ess= cssq(resid).
 do if (!method = 2 or !method = 3).
  loop i=1 to k.
    compute x(:,i) = (resid&/(1-h)&**(1/(4-!method)))&*x(:,i).
  end loop.
 end if.
 do if (!method = 0 or !method = 1).
  loop i=1 to k.
    compute x(:,i) = resid&*x(:,i).
  end loop.
 end if.
 do if (!method = 5).
   loop i=1 to k.
    compute x(:,i) = sqrt(mse)&*x(:,i).
  end loop.
 end if.
do if (!method = 4).
 compute mn = make(n,2,4).
 compute pr3 = n-df2.
 compute mn(:,2) = (n*h)/pr3.
 compute ex=rmin(mn).
  loop i=1 to k.
    compute x(:,i) = (resid&/(1-h)&**(ex/2))&*x(:,i).
  end loop.
 end if.
compute hc = invXtX*t(x)*x*invXtX.
do if (!method = 1).
  compute hc = (n/(n-k))&*hc.
end if.
compute F = (t(t(L)*b)*inv(t(L)*hc*L)*((t(L)*b)))/pr.
compute pf = 1-fcdf(f,pr,df2).
compute r2 = (tss-ess)/tss.
compute pf = {r2,f,pr,df2,pf}.
do if (!method <> 5).
print !method/title = "HC Method"/format F1.0.
end if.
print dv/title = "Criterion Variable"/format A8.
print pf/title = "Model Fit:"/clabels = "R-sq" "F" "df1" "df2" "p"/format F10.4.
compute sebhc = sqrt(diag(hc)).
```

```
compute te = b&/sebhc.
compute p = 2*(1-tcdf(abs(te), n-nrow(b))).
compute oput = {b,sebhc, te, p}.
do if (!method <> 5).
print oput/title = 'Heteroscedasticity-Consistent Regression Results'/clabels
      = "Coeff" "SE(HC)" "t" "P>|t|"/rnames = iv/format f10.4.
else if (!method = 5).
print oput/title = 'OLS Regression Results Assuming Homoscedasticity'/clabels
      = "Coeff" "SE" "t" "P>|t|"/rnames = iv/format f10.4.
end if.
compute iv2 = t(iv).
do if (!covmat = 1).
print hc/title = 'Covariance Matrix of Parameter Estimates'/cnames =
     iv/rnames = iv2/format f10.4.
end if.
do if (!test > 0 and !test < pr).
 compute L2 = make(pr-!test+!const,!test,0).
 compute L = {L2;L((pr+1-!test+!const):(pr+!const),(pr-!test+1):(pr))}.
 compute F = (t(t(L)*b)*inv(t(L)*hc*L)*((t(L)*b)))/!test.
 compute pf = 1-fcdf(f,!test,df2).
 compute pf = {f,!test,df2,pf}.
 print pf/title = "Setwise Hypothesis Test"
   /clabels = "F" "df1" "df2" "p"/format F10.4.
 compute iv = t(iv((pr+1-!test+!const):(pr+!const),1)).
 print iv/title = "Variables in Set:"/format A8.
end if.
END MATRIX.
RESTORE.
!ENDDEFINE.
```

HCREG macro launch for dependent CP and independent LP and OC:

```
* Encoding: UTF-8.
HCREG dv = CP
/iv = LP OC
/const = 1
/method = 3
* method 3 uses HC3 heteroscedasticity consistent interference by Davidson-
Mackinnon
/covmat = 1
/test = 1
```

LIST OF PUBLICATIONS

1. Ruželė, D. & Serafinas, D. (2015). Preconditions and critical success factors of Lean management innovations in Lithuania's wood sector enterprises. *Current Issues of Business and Law*, p. 109-130. Doi: 10.5200/1822-9530.2015.08
2. Serafinas, D. & Ruželė, D. (2014). Evolution of Organizations in the Context of Total Quality Management. *International business: innovations, psychology, economics.* Vol. 5, No. 1 (8), p. 42–65.
3. Serafinas, D. & Ruželė, D. (2014). Evolution of Lean Organizations. *Management of Organizations: Systematic Research*. Issue 69, p. 119-136. Doi: 10.7220/MOSR.1392.1142.2014.69.8
4. Ruželė, D. (2014). Survival of Organizations in Context of Globalization. Proceedings of conference 'Harmony of business and science', Vilnius' cooperation college, 29 May 2014, p. 1-14.
5. Ruželė, D. (2013). Influence of managerial tools Lean and Six Sigma on evolution of organizations. Proceedings of conference "Insights of young scholars in economics and management", Scientific Society of Students (SMD), p.199-209. Vilnius: Vilnius University Publishing.

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