Assessing the Effect of Organisational Culture on Lean Technical Practices in Jordanian Manufacturing Firms

By

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Abstract

Lean manufacturing is one of the most developing manufacturing philosophies through which firms can minimise waste in the production process. Implementing lean practices successfully enables firms to lower unit costs of production and maximise value to the customer, which in turn helps them to increase their competitive edge over rivals. The emerging literature considers organisational culture as a necessary intangible source for achieving a competitive advantage for companies, and to have a critical role in the success or failure of lean practices implementation.

The aim of this thesis is to investigate the effect of organisational culture on lean technical practices in the manufacturing firms in Jordan. More specifically, four conceptual models have been developed in the current study highlighting the effect of each type of organisational culture on lean technical practices implementation. In addition, more emphasis was on understanding the mechanism through which customers' involvement, employees' involvement and suppliers' involvement affect the relationship between organisational culture and lean technical practices. Thus, the four conceptual models bring to light the potential intervening role of the human lean practices in the organisational culture/ lean technical practices association.

After identifying and reviewing the relevant literature, the socio-technical system theory, contingency theory and RBV are adopted to develop the conceptual models and associated hypotheses. A Structural Equation Modelling (SEM) techniques have been adopted to analyse a dataset of over 200 manufacturing firms in Jordan, collected by using a self-administered survey.

The findings of this study indicate that the hierarchical culture has the highest substantial positive effect on lean technical practices followed by developmental culture, group culture and rational culture respectively. In addition, it is found that each type of organisational culture (group, developmental, hierarchical and rational) affects positively lean human practices (customers' involvement, employees' involvement and suppliers' involvement) in different statistical levels. For example, all types of organisational culture affect suppliers' involvement more than customers' involvement and employees' involvement respectively. Moreover, it is found that customers' involvement and suppliers' involvement have the highest positive effect on lean technical practices in the rational culture and the least positive effect in the hierarchical culture. Furthermore, it is found that the positive effect of each type of organisational culture on lean technical practices is partially mediated by customers' involvement and partially mediated by suppliers’ involvement. The highest significant mediating effect of customers' involvement and suppliers’ involvement lies in the rational culture/ lean technical practices link whereas the lowest significant mediating effect of customers' involvement and suppliers’ involvement lies is in the hierarchical culture/ lean technical practices link. Finally, it is found that employees’ involvement does not mediate the relationship between organisational culture and lean technical practices. These findings provide new evidence from Jordan to support the hypotheses that the organisational culture can act as a crucial pre-condition for lean technical practices to be fully effective. Additionally, the findings reinforce the notion that emphasizing the human side of lean especially for customers' involvement and suppliers' involvement can promote the effectiveness of lean implementation.

The current study contributes to the current literature at two levels. First, at the theoretical level, this study develops multiple conceptual models which crosses two streams of literature mainly, organisational culture literature and lean manufacturing literature with a focus on the human side of lean. Unlike previous studies, the models integrate the direct effect of organisational culture on lean technical practices and the intervening role of lean human practices due to which the organisational culture is assumed to have also an indirect effect on lean technical practices. Furthermore, employing a powerful statistical technique (Analysis of Moment Structure-SEM) provides more credibility to the results reported in this study. Second, at the empirical level, this study is conducted in the Jordanian context. As such, this study is one of the first, to our knowledge, that examines the effect of organisational culture on lean technical practices, as well as having examined the mechanism of how each type of organisational culture affects lean technical practices using empirical survey data from this context.

Keywords: Lean Technical Practices, Lean Human Practices, Organisational Culture, Competing Values Framework, Jordanian Manufacturing Firms, Structural Equation Modelling, Confirmatory Factor Analysis.

Dedication

To

My source of inspiration

&

My hope of future

Maryam & Sa'ed

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“I can do all things through Christ who strengthens me” Philippians 4:13

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As I read back over this acknowledgement, I realize that I have accomplished more in life than I ever thought possible.

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List of Abbreviations

ADF	Asymptotically distribution free
AGFI	Adjusted Goodness-Of-Fit Index
AMOS	Analysis moment of structures
AVE	Average variance extracted
β	Standardised Beta coefficient
CFA	Confirmatory factor analysis
CFI	Comparative fit index
CMIN	minimum discrepancy
CR	Composite reliability
CVF	Competing value framework
DF	Degrees of freedom
FDI	Foreign direct investment
GDP	Gross domestic product
GLS	Generalised least Square
GFI	goodness-of-fit index
GOF	Goodness of fit
HRM	Human resource management
ICT	Information and communications technology
IFI	Incremental Fit Index
IMF	International monetary fund
ISIC	International standards and industrial categories
JIEC	Jordan industrial estate corporation
JIT	Just in time
JOD	Jordanian dinar
MLE	Maximum likelihood estimation
MIT	Massachusetts Institute of Technology
NUMMI	New united motor manufacturing incorporation
NFI	Normed Fit Index
OCP	Organisational culture profile
OLS	Ordinary least square
PNFI	Parsimony Normed Fit Index
QIZs	Qualified industrial zones

RBV	Resource based view
RMSEA	Root mean square of approximation
SEM	Structural equation modelling
SMEs	Small and medium sized enterprises
SRMS	Standardised root mean residual
SPC	Statistical process control
SPSS	Statistical package of the social sciences
TLI	Tucker-Lewis Index
TPM	Total productive maintenance
TPS	Toyota production system
TQM	Total quality management
ULE	Unweighted least square
VSM	Value stream mapping
WLS	Weighted least square

CHAPTER ONE: Introduction

1.1 Chapter Introduction

Due to global competition and market dynamics, manufacturing firms all over the world are under tremendous pressure to decrease their costs and increase the quality level of their businesses. There are many strategies adopted by organisations to achieve these goals. Lean manufacturing is one of the most powerful strategies that is implemented successfully by many companies in different sectors (Dentz et al., 2009, Green et al., 2010, Hallgren and Olhager, 2009, Hunter et al., 2004, Piercy and Rich, 2009, Powell et al., 2013, Rashid et al., 2010, Wong et al., 2009) and has achieved significant benefits, such as optimising costs, shortening lead times, lowering inventories, improving quality, improving profitability and improving customer service (Abdulmalek and Rajgopal, 2007, Bhasin, 2008, Dahlgaard and Dahlgaard, 1999, Melton, 2005).The success of the firms that adopted lean practices has led to increased interest in lean implementation. Lean manufacturing is presently considered as a way of thinking that can be applied universally to change business practices (Womack and Jones, 2010).The lean concept has been described as a "system for the absolute elimination of waste"(Womack and Jones, 2010). Along with the elimination of waste, respect for humans and culture are considered equally important factors for lean implementation. This is confirmed by many works (Badurdeen et al., 2011, Bhasin, 2012, Hines et al., 2011, Womack and Jones, 2010, Liker and Hoseus, 2008).

However, there are also many companies that are struggling to adopt and implement lean systems effectively. Different statistics present some facts about the success rate in lean implementation. For example, based on a survey conducted by Industry Week on 433 US manufacturing firms, 74 per cent of respondents admit that they have not achieve good progress with lean implementations (Pay, 2008). According to Katz (2008) only 5 per cent of senior executives rate their lean journey as extremely effective. Moreover, Bhasin and Burcher (2006) argue that only less than 10 per cent of UK organisations have achieved successful implementation of lean manufacturing philosophy. In reality, many organisations are unable to adopt lean manufacturing because this transformation is a long journey full of challenges and barriers (Ahmad, 2013, Čiarnienė and Vienažindienė, 2012). One of the top barriers for lean implementation is inappropriate organisational culture (Bhasin, 2012, Bortolotti et al., 2015, Hines et al., 2011, Hogan, 2009, Liker and Hoseus, 2008). The success of an organisation in both the local and international markets depends heavily on the culture of the specific organisation (Sohal and Egglestone, 1994).

The organisational culture is the prevailing ideology that people carry in their minds; it transmits a sense of identity to employees and provides nonverbal guidelines for how to get along in the organisation (Cameron and Quinn, 2011). The organisational culture is characterised by its observable artefacts, espoused values, and basic assumptions (Schein, 2010). The emerging literature (Ahmad, 2013, Badurdeen et al., 2011, Saad et al., 2006, Sarhan and Fox, 2013, Taleghani, 2010) highlights the critical role of organizational culture in the success or failure of lean practices and considers the organisational culture to have a significant influence on the implementation of lean practices. Lean manufacturing can be a complex subject and is susceptible to failed implementations because too often firms concentrate on the tools and methodologies of lean and the necessary change in the organisational culture is ignored (Aberdeen Group, 2015). The creation of a supportive organisational culture is an essential critical factor for lean implementation (Saad et al., 2006).

In spite of the increasing movement towards recognition of the great impact of organisational culture on the success or failure of lean manufacturing implementation (Ahmad, 2013, Atkinson, 2010, Bhasin, 2012, Bortolotti et al., 2015, Hogan, 2009, Liker and Hoseus, 2008, Mann, 2014, Mi Dahlgaard-Park and Dahlgaard, 2006, Pakdil and Leonard, 2015, Sarhan and Fox, 2013, Wong, 2007) ,there is still a lack of empirical studies addressing the effect of organisational culture on lean manufacturing implementation.

On the one hand, numerous studies about lean manufacturing focus on the technical side of lean and ignore the cultural and human side (Chavez et al., 2015, Demeter and Matyusz, 2011, Hodge et al., 2011, Hofer et al., 2012, Serrano Lasa et al., 2008, Yang et al., 2011). On the other hand, few empirical studies focus on the cultural and human issues in lean implementation (Ahmad, 2013, Atkinson, 2010, Badurdeen et al., 2011, Saad et al., 2006, Sarhan and Fox, 2013, Taleghani, 2010). Therefore, this research is motivated by: (1) the importance of cultural issues in implementing lean practices in the manufacturing sector; (2) uncovering and understanding the role of different types of organisational culture in implementing lean technical practices; (3) identifying the role of human factors such as customers' involvement, employees' involvement and suppliers' involvement in the implementation of lean technical practices and (4) understanding the mechanism through which customers' involvement, employees' involvement and suppliers' involvement affect the relationship organisational culture and lean technical practices.

1.2 Background and Study's Rationale

Every company has to invest in manufacturing management programmes, methods and technologies in order to remain competitive (Demeter and Matyusz, 2011). One very popular investment choice is lean manufacturing (Demeter and Matyusz, 2011). Lean manufacturing is a powerful managerial approach widely recognised as developing the overall operational performance of a company (Shah and Ward, 2003). Organisations implement lean approach hoping to achieve greater efficiency, to eliminate wasting resources and to gain a competitive advantage (Deshmukh et al., 2010, López-Fresno, 2014). Some sources of waste that should be eliminated by organisations are overproduction, faulty products, sub-optimised processes, unnecessary waiting, movement or transportation and excess inventory (Demeter and Matyusz, 2011). Lean manufacturing includes productivity with the least amount of waste, continuous improvement flow, good quality systems and empowered workers (Taj and Morosan, 2011). Furthermore, lean manufacturing involves identifying and eliminating non-value-adding activities in design, production, supply chain management and customer relationship management (Al-Tahat and Jalham, 2015). The lean manufacturing system consists of several social and technical practices, including customer focus, pull production, quality development, total productive maintenance (TPM) , continuous improvement, worker empowerment and supplier development (Demeter and Matyusz, 2011).

The concept of lean manufacturing is accepted by a growing number of companies and applied widely not only in the manufacturing field, such as in the automobile industry where it originated (Womack et al., 1990), but most researchers now focus on studying its application in different specific industries in order to increase the companies' improvement and be more responsive to customer demands (Bhamu and Singh Sangwan, 2014). These industries include textiles (Boyle and Scherrer-Rathje, 2009, Hodge et al., 2011), construction (Yu et al., 2009, Dentz et al., 2009), food (Rashid et al., 2010), electronics (Wong et al., 2009, Shen and Han, 2006, Doolen and Hacker, 2005) as well as services (Piercy and Rich, 2009, Villa, 2010). Moreover, the lean manufacturing concept has been examined by many authors to investigate its effect on different managerial and business aspects such as operational performance (Furlan et al., 2011, Taj and Morosan, 2011, Nawanir et al., 2013, Rahman et al., 2010), financial performance (Hofer et al., 2012, Jayaram et al., 2008, Yang et al., 2011), or environmental performance (Demeter and Matyusz, 2011, Yang et al., 2011). Other authors have discussed the barriers of implementing lean, such as Sarhan and Fox (2013) and Bhasin (2012) while others have assessed the benefits gained from lean implementation, such as Singh et al. (2010).

In spite of the previous studies in the field of lean manufacturing approach and the large number of companies around the world who tried to establish a lean manufacturing system to remain alive and thrive in the competitive global environment, it seems that just a few cases have achieved progress in this area (Behrouzi and Wong, 2011). In reality, many organisations are unable to change themselves toward lean manufacturing because this transformation is a long journey which is full of many challenges and barriers (Ahmad, 2013, Čiarnienė and Vienažindienė, 2012).

With reference to lean barriers, the literature suggests that often firms fail to view lean as a continuous and never-ending process (Atkinson, 2010, Bhasin, 2012, Saurin et al., 2011). Often lean is viewed as a means for eliminating waste, whereas it must be more about waste reduction (Sim and Rogers, 2008). Operations management scholars have discussed several causes of this lack of success, such as the complexity of lean implementation (Lander and Liker, 2007), the existence of contingency factors which affect negatively on lean implementation (Bortolotti et al., 2013) and the lack of attention paid to social factors such as human resources (Agarwal et al., 2013) and the organisational culture (Atkinson, 2010). The human factors and the organisational culture will be the focus of the current study. With respect to the organisational culture, based on a survey conducted by Aberdeen Group (2004), it has been found that the first challenge towards the adoption of lean strategy is the significant culture of the organisation (Jones and Aberdeen Group, 2004). An empirical study for Bhasin (2012) reviewed findings from 68 sets of managers and 7 case studies. It found the second most serious barrier to the low numbers of successful lean implementations is inappropriate organisational culture. Toyota Corporation in Japan, giving a clear indication that it has a unique blend of Japanese culture, has developed lean manufacturing. Lean implementation in any organisation is successful when there is an acceptance of change in the organisation's culture (Rathinam and Balu, 2010)

The Organisational culture represents the shared values, beliefs, assumptions, and ways of doing things which influence people's minds and behaviours in the organisation (Schermerhorn, 2014). One of the most reliable and popular approaches for measuring the organisational culture is the competing value framework (CVF). This framework combines all the different patterns of shared values and principles that define an organisation's culture (Prajogo and McDermott, 2011). The CVF includes four cultural types. These types are group, developmental, hierarchical and rational. The group culture considers the organisation as a big family in which the managers motivate, help, encourage and cooperate with their subordinates to develop the subordinates' skills (Chung et al., 2010, Naor et al., 2014, Zu et al., 2010). The developmental culture concentrates on an organisation's desire to grow in its activities in different ways (Cameron and Quinn, 2011, Naor et al., 2014). It strives to be a leader in the market through introducing new products to satisfy customers (Chung et al., 2010). The hierarchical culture depends on stability and control (Quinn and Spreitzer, 1991). All employees in the hierarchical culture are working according to specific rules and processes and are rewarded according to their hierarchical levels (Chung et al., 2010, Zu et al., 2010). The rational culture is considered competitive and values what the company can achieve in the market (Naor et al., 2014). Its core values are competitiveness, productivity and profitability (Cameron and Quinn, 2011).

Recent literature (Ahmad, 2013, Atkinson, 2010, Bhasin, 2012, Bortolotti et al., 2015, Hogan, 2009, Liker and Hoseus, 2008, Mann, 2014, Mi Dahlgaard-Park and Dahlgaard, 2006, Pakdil and Leonard, 2015, Sarhan and Fox, 2013, Wong, 2007) has investigated the critical role of organisational culture in the success or failure of lean practices, but until now there has been a lack of empirical work that has examined the effect of different types of organisational cultures using the competing value CVF on lean manufacturing practices.

It is noted in the previous studies on organisational culture / lean manufacturing relationship that some authors (Ahmad, 2013, Badurdeen et al., 2011, Saad et al., 2006, Sarhan and Fox, 2013, Taleghani, 2010) have discussed the significant role of organisational culture on lean practices just through conceptual and theoretical methodologies. Others have discussed the importance of organisational culture in implementing lean practices through developing a theoretical model without putting it into practice (Ahmad, 2013, Mi Dahlgaard-Park and Dahlgaard, 2006, Pakdil and Leonard, 2015, Taleghani, 2010). A limited number of authors have empirically examined the effect of organisational culture on lean manufacturing practices but through using different measures and models of organisational culture such as Hofstede's (2011) model of organisational culture (Bortolotti et al., 2015, Naor et al., 2010) .

To develop the previous research, the current thesis is motivated to investigate empirically the effect of organisational culture using the competing values framework (CVF) on lean manufacturing practices, aiming to explore which type(s) is considered the ideal for implementing lean practices in the manufacturing firms.

Another important issue in lean implementation is the role of human factors. Lean is viewed as an integrated socio-technical system which aims to minimise waste by continuously reducing or minimising supplier, customer, and internal variability (Shah and Ward, 2003). This definition confirms that the human side in lean manufacturing has an important implication equal to the technical side. It is observed that most studies have addressed all lean practices as one variable to examine its effect on other variables (Al Hasan and Zu'bi, 2014, Al-Nsour et al., 2012, Alsmadi et al., 2012, Chavez et al., 2013, Demeter and Matyusz, 2011, Fullerton and Wempe, 2009, Ghosh, 2012, Hofer et al., 2012, Jayaram et al., 2008, Ramaswamy, 2006). Few research papers have made an explicit distinction between lean human practices and lean technical practices to examine the effect of the former on the latter. Furthermore, there is a lack of studies investigating the role of lean human practices in the relationship between the organisational culture and lean technical practices. Therefore, the current thesis is also motivated to investigate the role of lean human practices in the effective implementation of lean technical practices. The organisational culture and lean human practices represent a critical area of research in lean manufacturing because of the following:

First: Some scholars have pointed to the culture of the organisation as the cause of the poor implementation of lean practices (Atkinson, 2010, Liker, 2004, Liker and Franz, 2011, Liker and Rother, 2011, Sim and Rogers, 2008) and based on this assumption, the relationship between organisational culture and some bundles of lean manufacturing have been empirically studied, such as total quality management (TQM) (Baird et al., 2011, Naor et al., 2008, Prajogo and McDermott, 2005, Zu et al., 2010) and JIT (Yasin et al., 2003). The limitation of the previous research in this area is linked to the narrow set of organisational culture dimensions and lean manufacturing practices. In-depth understanding of the role of organisational culture in implementing lean practices in the manufacturing firms is required.

Second: As few researchers have studied organisational culture as an antecedent of lean manufacturing practices, other scholars (Narasimhan et al., 2012, Wincel and Kull, 2013) have advanced arguments for more complex relationships between organisational culture and lean manufacturing practices, thus making an investigation using intervening variables more appropriate. Lean manufacturing is considered an interrelated system of human and technical practices (Shah and Ward, 2007), and in line with Shah and Ward's (2007) definition and few previous studies (Prajogo and McDermott, 2005, Rahman and Bullock, 2005), lean practices are referred to both soft or human, which are concerned with people and relations, and hard or technical which focus on techniques and tools. Human factors are critical for sustaining performance in the long run, even though organisations sometimes do not give equal importance to human and technical tools, instead concentrating on technical tools only (Liker and Rother, 2011). Based on this gap in knowledge, this thesis is motivated to be one of the first studies, to our knowledge, which proposes three lean human practices (customers' involvement, employees' involvement and suppliers' involvement) as mediating intervening variables to examine their effect on the relationship between organisational culture and lean technical practices.

1.3 Key Analytical Issues

Based on the previous gaps, the problems with lean effectiveness are identified primarily in the focus of its tools, techniques and processes rather than the required strategic level of thinking. The lean iceberg explains this view (Hines et al., 2008). The lean iceberg describes that lean techniques and tools can be seen on the surface; they are easily grasped and visible when visiting a lean organisation. These are above the waterline and are relatively easy to implement but are not sufficient for the effective implementation of lean philosophy. To implement lean practices effectively, organisations have to look below the surface of the lean iceberg. The critical aspects below the surface are the behaviours, beliefs, assumptions and culture. Those aspects focus on the human and cultural factors that are considered necessary to sustain and eventually drive a successful lean organisation. Human and cultural factors are missed in lean implementations. Therefore, this study strives to investigate the effect of the hidden part of lean (organisational culture) on the visible part of lean (lean technical practices). This study will address three main critical analytical issues as follows:

First: Investigating the effect of different types of organisational culture using the CVF on lean technical practices implementation. This issue focuses on analysing quantitatively, using Structural Equation Modelling (SEM), the extent of effect for each type of organisational culture (group, developmental, hierarchical, rational) on lean technical practices implementation in the Jordanian manufacturing firms. This issue aims is to explore the ideal type(s) of organisational culture to implement the technical practices of lean manufacturing.

Second: Exploring and understanding quantitatively how the effect of organisational culture on lean technical practices occurs. Thus, this study will investigate the mediating role of lean human practices in the organisational culture/ lean technical practices relationship. Lean human practices used in the current study include: (1) employees' involvement, (2) customers' involvement and (3) suppliers' involvement. This issue will provide detailed analysis using a Bootstrapped test in SEM and a Sobel statistical test to examine to what extent each lean human practice (e.g. customers' involvement) mediates the relationship between organisational culture and lean technical practices.

Third: Investigating quantitatively using multi-group analysis in SEM, the moderating role of two contextual factors (firm age and firm size) in the relationship between organisational culture and lean technical practices.

1.4 The Context of Study

The different operational approaches such as lean manufacturing and TQM were initiated in Japan and received a high level of attention from manufacturing firms in Western countries (Zu'bi, 2015), especially in the UK and USA (Bhamu and Singh Sangwan, 2014). As for developing countries, TQM is still the most popular and well-known Japanese management philosophy (Zu'bi, 2015). Despite globalisation, the implementation of lean manufacturing has not occurred at the same level in different countries in the world. The the first implementation of lean principles started in Toyota's automobile company in Japan, then in the US, and Europe followed by some of the Asian countries such as China, India and Thailand. Arab countries in the Middle East have lagged behind in the lean journey. One of these countries is Jordan. The severe competitive situation that moved towards a global basis has forced many Jordanian manufacturing firms to adopt innovative operational practices, such as lean systems, to remain competitive (Zu'bi, 2015).

Jordan has been suffering the last few years from accumulative local economic challenges such as financial deficit, public debt poverty and unemployment and low growth rates (Jordan's Economic Outlook Report, 2015). The main challenge in Jordan's economy today is the unstable environment of the region and the unrest in the neighbouring countries. The burdens on Jordan's economy increased with the Syrian refugee crisis, the cost of which on the under-resourced country is estimated at over five billion Jordanian dinars for the period 2011-2014 (Jordan's Economic Outlook Report, 2015). Despite these challenges, the human resources in Jordan are well educated and the national culture is very open to Western cultures; the country has advanced technology and thus the potential to be one of the most successful countries in the world. Thus, from the researcher's perspective, helping Jordanian managers to adopt the appropriate organisational culture to implement lean practices is a necessity in the current circumstances in Jordan. Lean practices aim to produce more outputs through less resources, and the Jordanian context needs to save resources and minimise waste through adopting lean practices. Jordan is a newly-emerging industrial market in which the industries are still in the early stages in terms of competing with other world-class industries (Central Intelligence Agency, 2016). Therefore, lean manufacturing can be regarded as an ideal response to the current challenges that Jordanian manufacturing firms face, to remain competitive in the local market and to try to compete in the regional and global markets (Zu'bi, 2015).

The current thesis focuses on the manufacturing firms in Jordan because the manufacturing sector is highly dependent on the lean concept. In fact, it was one of the pioneers of lean manufacturing starting from Toyota's lean production in the 1940s. Lean practices in manufacturing firms has become a leader and an innovative strategy for improvement; Lean is considered an essential part of a manufacturing endeavour (Pearce and Pons, 2013). The industrial sector in Jordan is the second greatest generator of gross domestic product after the services sector, at 29.9 per cent. The industrial production growth rate reached about 3.6 percent in 2015 (Central Intelligence Agency, 2016).

Despite the limited number of empirical studies that have been conducted in Jordan in the field of lean manufacturing, there are no research papers that investigate the effect of organisational culture on lean practices in the Jordanian context. The number of studies conducted in the field of lean manufacturing in Jordan is few and constrained to specific industrial sectors, such as food or garments industries. For example, Smadi (2012) has examined the extent of applying lean supply practices in the garments manufacturing companies in Jordan. The study has found that this industry has adopted the lean supply practices with a high degree of success in all aspects, except for supplier development. Al Hasan and Zu'bi (2014) have examined the relationship between lean manufacturing dimensions and radical product innovation in the Jordanian pharmaceutical sector. It has been found that continuous improvement and waste minimisation practices have no significant impact on radical product innovation, while lean job characteristics and employees' involvement have positive significant impact on radical product innovation. Zu'bi (2015) has investigated the effects of four internal lean practices on flexibility performance. The results show that the internal lean practices positively and significantly affect flexibility performance. In a study for AL-Tahat and Bwaliez (2015), the relationship between the workforce management system and lean production was statistically investigated in 10 Jordanian manufacturing sectors. The results show that the selected sample of Jordanian firms can be described as 'very good' implementers for lean production practices.

In the light of the proceeding discussion, It is noted that there is a lack of studies conducted in the Jordanian context about the effect of organisational culture on lean manufacturing practices. This gap in knowledge is a prime motive for conducting this thesis in this context.

1.5 Research Aim

This study aims to examine the effect of organisational culture on lean technical practices as well as to investigate the mediating role of lean human practices represented by customers' involvement, employees' involvement and suppliers' involvement in organisational culture/ lean technical practices relationship.

1.6 Research Objectives

In light of the research aim, the objectives of the study are as follows:

1- To examine the effect of organisational culture (group culture, developmental culture, hierarchical culture and rational culture) on lean technical practices implementation.

2- To explore the type(s) of organisational culture that best fit(s) with implementing lean technical practices.

3- To examine the effect of organisational culture (group culture, developmental culture, hierarchical culture and rational culture) on lean human practices (customers' involvement, employees' involvement and suppliers' involvement).

4- To examine the effect of lean human practices (customers' involvement, employees' involvement and suppliers' involvement) on lean technical practices implementation.

5- To examine the mediating effect of customers' involvement, employees' involvement and suppliers' involvement on the relationship between organisational culture (group culture, developmental culture, hierarchical culture and rational culture) and lean technical practices.

6- To examine the moderating effect of firm size and firm age on the relationship between organisational culture (group culture, developmental culture, hierarchical culture and rational culture) and lean technical practices.

1.7 Research Questions

This study seeks to answer the following research questions:

1. To what extent does organisational culture (group culture, developmental culture, hierarchical culture and rational culture) affect lean technical practices implementation?
2. What is/ are the best type(s) of organisational culture that best fit(s) with implementing lean technical practices in the Jordanian manufacturing firms?
3. To what extent does organisational culture (group culture, developmental culture, hierarchical culture and rational culture) affect lean human practices (customers' involvement, employees' involvement and suppliers' involvement)?
4. To what extent do lean human practices (customers' involvement, employees' involvement and suppliers' involvement) affect lean technical practices implementation?
5. How do lean human practices (customers' involvement, employees' involvement and suppliers' involvement) mediate the relationship between each type of organisational culture (group culture, developmental culture, hierarchical culture and rational culture) and lean technical practices?
6. Do firm size and firmF age moderate the relationship between each type of organisational culture (group culture, developmental culture, hierarchical culture and rational culture) and lean technical practices?

1.8 Research Significance: Contributions and Implications

The significance of the current study is revealed through the theoretical and empirical contributions. These contributions can be summarised as follows:

First: Unlike most prior empirical research about the relationship between organisational culture and lean manufacturing practices, this study applies four conceptual models to capture the effect of each type of organisational culture individually on lean manufacturing practices implementation. Furthermore, this study applies the multi-dimensional view of lean concept to capture the effect of organisational culture on the various practices of lean manufacturing (human practices and technical practices), rather than focusing on a limited number of practices. Thus, the research findings expect to provide a more comprehensive understanding of the role of each cultural type in affecting lean human and technical practices in the manufacturing firms in Jordan. This becomes fundamental in the light of the scarcity of studies on an organisational culture/ lean manufacturing relationship in developing countries in general and Jordan in particular.

Second: The current study distinctively brings the empirical effect of lean human practices (customers' involvement, employees' involvement and suppliers' involvement) into four conceptual models to gain a better understanding of the mechanism of organisational culture/ lean technical practices relationship. To the researcher's knowledge, the originality of this study lies in the simultaneous examination of four competing scenarios with multiple mediators (customers' involvement, employees' involvement and suppliers' involvement). Therefore, the empirical findings expect to provide unique insights into the mechanism by which customers' involvement, employees' involvement and suppliers' involvement mediate the organisational culture/ lean technical practices relationship.

Given the lack of empirical evidence on lean manufacturing practices in developing countries such as Jordan, this study will be of substantial practical significance for current and prospective manufacturing firms in Jordan. The conceptual four models introduced and tested in the current study could be very helpful for practitioners seeking the ideal type of organisational culture to implement lean technical practices effectively in the manufacturing firms in Jordan. Furthermore, the specific findings of this study can provide insights on how lean human practices can be employed to enhance better implementation of lean technical practices. This, in turn, can largely contribute to enhancing the operational performance of the manufacturing firms and gaining the competitive edge in the marketplace.

1.9 Thesis Structure

This thesis is structured and organised into eleven chapters as follows:

Chapter One: Introduction

The first chapter presents an introduction to the topic. It clarifies the study's background and rationale. The gaps are identified. The key analytical issues are listed and identified. A background about the context of study is presented. The research aim, objectives and questions are defined clearly. This chapter also summarises the significance of this study and its expected contributions and implications.

Chapter Two: Literature Review

This chapter is intended to provide a review of the relevant literature on the two main interests of this thesis: organisational culture and lean manufacturing. The chapter begins with a detailed overview of lean manufacturing. This domain includes the various definitions of lean concept and the multi-dimensionality of it with other managerial concepts. Then, providing a literature review about lean principles, benefits, and practices. Previous studies are provided to understand how these practices are used in the manufacturing firms. Then, this domain ends with presenting a summary of different contexts in which lean manufacturing is implemented by shedding light on the Jordanian context, which represents the context of the current study. The second domain presents an overview of organisational culture; its definitions, levels and its approaches. A focus is given to the CVF, which is used in the current study. Previous studies are presented about how the CVF is used with different managerial approaches. The last domain presents the previous studies addressing the relationship between organisational culture and lean manufacturing practices. This chapter ends with identifying the main gaps in knowledge. The gaps show that there is lack of empirical studies that have been done to examine the effect of organisational culture on lean practices in the in the Jordanian manufacturing firms. In addition, there is lack of studies that have tested the mediating effect of lean human practices (customers' involvement, employees' involvement and suppliers' involvement) on the relationship between organisational culture and lean technical practices. Furthermore, few studies have examined the moderating effect of firm size and age on organisational culture/ lean technical practices relationship.

Chapter Three: Development of Hypotheses and Conceptual Models

This chapter explores the research focus of this thesis, which includes its conceptual models and presents the research hypotheses as well as its theoretical and empirical support from previous studies. Four conceptual models are developed in this chapter; each one is linked to just one type of organisational culture. Twelve hypotheses are proposed in each conceptual model. Ten of them focus on investigating the direct and indirect effect of organisational culture on lean technical practices through customer's involvement, employees' involvement and suppliers' involvement. The other two hypotheses test the moderating effect of firm age and size on the relationship between organisational culture and lean technical practices. Totally, forty-eight hypotheses are developed in the current thesis to achieve the main aim of this thesis.

Chapter Four: An Overview of the Jordanian Context

The purpose of this chapter is to present an overview of Jordan where the empirical work is carried out. The chapter briefly describes the country in terms of its history, geography, people, culture, and economic situation. Additionally, it presents a review of the manufacturing firms in Jordan with a focus on the target population of the current thesis from which the sample is drawn.

Chapter Five: Research Methodology

This chapter outlines the research methodology adopted in the current study. More specifically, explanation of the two main research paradigms (positivism versus interpretivism) is provided along with the rationale behind the adoption of the positivism paradigm. In addition, discussion of the different research approaches (deductive versus inductive) and research strategies is presented accompanied by justification of the choices made in adopting the deductive approach and the cross-sectional survey strategy. Moreover, comparison of the different data collection methods is provided with shedding the light on the survey-based research methodology, which is adopted to analyse the collected primary data. The various steps of developing the questionnaire are reported. This chapter also identifies the research context, population and the sample from which the data have been collected. This is accompanied by detailed description of the study variables measured and process of administering the questionnaire instrument. Finally, a description of the statistical techniques and a justification for choosing SEM as the appropriate statistical analysis technique is provided along with clarification of the main aspects and estimates of SEM.

Chapter Six: Descriptive Analysis

This chapter presents the results of the descriptive data analysis. It represents a general picture of the demographic profile of the survey respondents and provides the results of the descriptive analysis of responses in the questionnaire items.

Chapter Seven: Measurement Models Evaluation Using CFA

The purpose of this chapter is assessing the validity and the reliability of the data. The chapter presents the statistical procedures of the data preparation and screening including treatment of missing data, detection of outliers, and normality of data. Then the measurement models are validated using Confirmatory Factor Analysis.

Chapter Eight: Testing the Direct and Indirect Effect of Organisational Culture on Lean Technical Practices Using SEM

This chapter aims to test the hypothesised relationships between the study constructs using SEM. The results of evaluating the overall fit of the proposed models are reported. In addition, the results of testing the direct and mediated relationships between the study constructs are represented subsequently.

Chapter Nine: Testing the Role of Moderation in the Organisational Culture/ Lean Technical Practices Relationship Using Multi-Group Analysis

The purpose of this chapter is examining the moderating effect of firm age and firm size on the relationships between organisational culture and lean technical practices. A multi-group analysis technique is adopted in moderation tests using AMOS (Analysis Moment of Structures) version 22.

Chapter Ten: Discussion of the Findings

The purpose of this chapter is discussing the research findings in the light of the results from previous studies. The chapter shows and explains the level of match and difference between the findings of this study and those emerging from the previous studies.

Chapter Eleven: Conclusions, Contributions and Limitations

This final chapter presents the conclusions drawn from this study in relation to each research question. It also highlights the study's contributions to theory and practice, its limitations and areas of future research.

1.10 Chapter Summary

The purpose of this chapter is to introduce the focus of the thesis. Firstly, gaps in the knowledge and the motivations for the research are indicated, followed by introducing the key analytical issues and the context of the study. The research aim, objectives and questions are then stated. Subsequently, the significance of this thesis and its expected contributions are presented in brief. The structure of the thesis, along with the purpose of each chapter is outlined at the end of this chapter. The next chapter will present a comprehensive review of the existing literature.

CHAPTER TWO: Literature Review

2.1 Introduction

This chapter aims to present a critical review of the relevant literature about lean manufacturing and organisational culture. Moreover, a critical evaluation of the previous studies is undertaken, to enhance understanding of the impact of organisational culture on lean manufacturing practices. Based on the previous literature, this chapter presents the main gaps in knowledge that will be filled in this study.

This review is divided into five sections. The second section provides an overview of lean manufacturing. It discusses the origin of lean manufacturing, its different definitions, its principles, lean wastes and lean benefits. In addition, the main practices of lean manufacturing are identified, explained and listed according to previous empirical research. To connect the literature with the current context of this study, the end of this section presents evidence about the applicability of lean manufacturing in different geographical regions and highlighting the previous studies, which have been conducted in a Jordanian context.

The third section presents an overview of organisational culture and includes three subsections. It focuses on defining organisational culture, presenting examples of some popular measures used to assess the organisational culture. In addition, it discusses the importance of the CVF and how has been used in previous research. In section four, the literature review about the link between organisational culture and lean manufacturing is discussed through presenting empirical and non-empirical research about the organisational culture/ lean manufacturing relationship. This section is important to help position the current study within the body of literature and provide a background for understanding the next chapter, which is devoted to presenting the conceptual models and hypotheses. The fifth section summarises three main gaps that have been observed from theory and past research about lean manufacturing and organisational culture. Finally, the sixth section presents a summary for the current chapter.

2.2 An Overview of Lean Manufacturing

Every company has to invest in manufacturing management programmes, methods and technologies in order to remain competitive in the market (Demeter and Matyusz, 2011). One very popular investment choice nowadays is in lean manufacturing philosophy (Demeter and Matyusz, 2011). The focus of this section is to present an overview about lean manufacturing and define the main constructs of lean manufacturing, which are adopted in the current study and form the basis in building the conceptual models in chapter 3. This section is divided into eight subsections. The first two subsections (2.2.1 and 2.2.2) present the origin of lean manufacturing and its various definitions and meanings. The third subsection (2.2.3) presents main lean principles. The fourth subsection (2.2.4) explains the benefits of implementing the lean system. The fifth subsection (2.2.5) presents lean manufacturing practices, which are considered the main constructs, used in the current study. These constructs are divided into two subsections; lean technical practices and lean human practices. The sixth subsection (2.2.6) lists lean manufacturing practices in previous studies, then the seventh subsection discusses how lean has been applied in different regions around the world in (2.2.7). At the end of this section, the previous studies about lean manufacturing philosophy in the Jordanian context are presented in (2.2.8).

2.2.1 Origin of Lean Manufacturing Concept

Although there are instances of rigorous process thinking in manufacturing all the way back to the Arsenal in Venice in the 1450s, the first person to truly integrate an entire production process was Henry Ford[1](Lean Enterprise Institute, 2016a). Ford called his innovative system in designing cars *mass production*. The key to mass production was not the moving or continuous assembly line. Rather it was the complete and consistent interchange ability and the simplicity of attaching them to each other (Womack et al., 1990). The public grasped this in the dramatic form of the moving assembly line, but from the standpoint of the manufacturing engineer the breakthroughs actually went much further (Lean Enterprise Institute, 2016a).

1: One of America's foremost industrialists. Born on July 30, 1863. He created the Ford Model T car in 1908 and went on to develop the assembly line mode of production, which revolutionised the industry. As a result, Ford sold millions of cars and became a world-famous company head(Biography Website, 2016).

Ford took all the factors of a manufacturing system including workers, machines, tools, techniques, and products. All of them were arranged in a continuous system for manufacturing the Model T automobile. Ford was so successful and he quickly became one of the world's richest men. In 1913, Ford was considered by many to be the first practitioner of JIT[2] and lean manufacturing. Ford's success inspired many others to copy his methods but most of those who copied did not understand the fundamentals. Ford assembly lines were often employed for products and processes that were unsuitable for them. When the world began to change, the Ford system began to break down and Ford refused to change the system. For example, Ford production relied on a labour force that was so desperate for money and jobs that workers would sacrifice their dignity and self-esteem. The prosperity of the 1920s and the advent of labour unions produced conflict with the Ford system. Product proliferation also put strains on the Ford system. Annual model changes, multiple colours, and options did not fit well in Ford factories (Lee, 2016).

In the early 1920s, at General Motors' Alfred Sloan took a more pragmatic approach (Womack et al., 1990). He developed business and manufacturing strategies for managing very large enterprises and dealing with variety. By the mid-1930s, General Motors had passed Ford in domination of the automotive market. Yet, many elements of Ford production were sound, even in the new age. Ford methods were a deciding factor in the allied victory of World War II (Lee, 2016). The allied victory and the massive quantities of material behind it caught the attention of Japanese industrialists. They studied American production methods with attention to Ford practices and the Statistical Quality Control practices of Ishikawa, Edwards Deming, and Joseph Juran (Lee, 2016).

2: is described as "only the necessary products, at the necessary time, in the necessary quantity". JIT philosophy is associated with three constructs: total quality, people involvement, and JIT manufacturing techniques. Programs associated with JIT include "elimination of waste and full utilization of people, equipment, materials, and parts". JIT is a comprehensive approach to continuous manufacturing improvement based on the notion of eliminating all waste in the manufacturing process. JIT is based on the notion of eliminating waste through simplification of manufacturing processes such as elimination of excess inventories and overly large lot sizes, which cause unnecessarily long customer cycle times (Shah and Ward, 2007).

In 1950 and after World War II, Kiichiro Toyoda, Taiichi Ohno and Shigeo Shingo recognised that a series of simple innovations could make it more possible to provide both continuity in process flow and a wide variety in product offerings. Therefore, they revisited Ford's original thinking, and invented the Toyota production system (TPS) (Lean Enterprise Institute, 2016a). This system shifted the focus of the manufacturing engineer from individual machines and their utilisation, to the flow of the product through the total process. Toyota Motor Company confirmed that by right-sizing machines for the actual volume needed, introducing self-monitoring machines to ensure quality, lining the machines up in process sequence, pioneering quick setups so each machine could make small volumes of many part numbers, and having each process step notify the previous step of its current needs for materials. This way led to obtain low cost, high variety, high quality and very rapid throughput[3] times to respond to changing customer desires. In addition, information management could be made much simpler and more accurate (Lean Enterprise Institute Website, 2016).

All of this took place between about 1950 and 1975. To some extent, it spread to other Japanese companies. When the productivity and quality gains became evident to the outside world, American executives travelled to Japan to study it (Lee, 2016). They brought back, mostly, the superficial aspects like Kanban cards and quality circles. Most early attempts to emulate Toyota failed because they were not integrated into a complete system and because few understood the underlying principles (Lee, 2016).

In 1985, the American government funded a study at the Massachusetts Institute of Technology (MIT) called "the International Motor Vehicle Program" (Womack et al., 1990). The aim of this study was explaining why Japanese automakers were more productive and their products have better quality at competitive prices. The study was conducted by a graduate student named John Krafcik, who had been an engineer at New United Motor Manufacturing Inc.(NUMMI) (Emiliani, 2006). This study used for the first time the term 'lean' to describe the TPS and how it achieved better results while consuming less resources compared to mass production (Emiliani, 2006, Womack et al., 1990). Therefore, the term 'lean' was first introduced to describe a production system that uses fewer resources compared to traditional manufacturing methods such as mass production (Papadopoulou and Özbayrak, 2005).

3:is the rate at which units move through a production process (Heizer and Render, 2013).

The results of MIT's study have been published in a popular book called *"The Machine that Changed the World*" for James Womack, Dan Jones and Daniel Roos in 1990 (Womack et al., 1990). The authors state in their book that lean production means using less of everything such as half the human effort in the firm, half of the manufacturing space, half the investment in tools, and half the engineering hours to develop a new product in half the time.

Based on the previous discussion, it is clear that the term 'lean production ‘or 'lean manufacturing' was coined to describe the Toyota's lean production system in Japan, which is the basis for its success and showed the advantages of a lean system over the mass production system (Hines et al., 2004). Thus, the production system in Toyota's car company which is known today as the TPS is considered the origin for lean manufacturing (Ghosh, 2012, Hines et al., 2004).

2.2.2 Various Definitions of Lean manufacturing

2.2.2.1 What is Lean manufacturing?

Numerous different definitions and descriptions of lean are found in the literature review. Mi Dahlgaard-Park and Pettersen (2009) argue that there is no agreement on a definition of lean manufacturing and there is a different view of points on which characteristics should be linked with the concept. This section presents a compilation of the various definitions of lean manufacturing chronologically since 1990 due to the popularity of lean concept after the seminal work *The Machine that Changed the World* (Womack et al., 1990) was published. Womack et al. (1990) define lean as a dynamic process of change driven by a systematic set of principles (subsection 2.2.3) and best practices in order to achieve continuous improvement.Womack and Jones (1994) define lean as an alternative integrated production model because it includes unique tools, methods and strategies in product development, supply chain management and operations management into a coherent whole. Liker (1997) and Blackstone and Cox (1998) define lean as a philosophy focuses on the minimisation of the amount of all the resources used in the different activities in the enterprise, including the waste of work-in-progress and finished items inventories. Howell (1999) argues that lean is a new way to design and make things differentiated from mass and craft forms of production by the objectives and techniques applied on the shop floor, in design and along supply chains.

In line with Liker (1997) and Blackstone and Cox (1998) definitions, Wu et al. (2000) view lean as a philosophy focuses on delivering the highest quality product on time and at the lowest cost. Cooney (2002) takes a broad view about the lean concept through defining lean as a production concept that encompasses the whole manufacturing chain from product design and development, through manufacturing and distribution. Shah and Ward (2003) emphasise the human factors in lean concept and they consider lean as an approach to delivering the upmost value to the customer by eliminating waste through process and human design elements. Shah and Ward's (2003) definition is the first one that takes into consideration the human side of the lean concept. Rothstein (2004) defines lean in line with Shah and Ward's 2003 definition in that lean is a broad production paradigm including an array of manufacturing systems containing technical and human practices, such as JIT, inventory systems, teamwork, multi-tasking workers, employee involvement and policies for ensuring product quality throughout the production process. MacBryde et al. (2006) and De Treville and Antonakis (2006) consider lean as an integrated manufacturing system intended to maximise capacity utilisation and minimise buffering inventories through decreasing system variability.

Shah and Ward (2007) define lean manufacturing in line with their previous definition (Shah and Ward, 2003) through concentrating on the human as well as the technical aspects of lean concept; they define lean as an *integrated socio-technical system* which aims to eliminate waste by continuously reducing or minimising supplier , customer, and internal variability. Holweg (2007) agrees with Shah and Ward's (2007) definition in that lean extends the scope of the TPS philosophy by providing an enterprise-wide term that draws together many technical and human constructs, such as product development process, supplier management process, customer management process, and policy focusing process.

In line with Shah and Ward (2003), Holweg (2007), and Shah and Ward (2007) definitions, Womack and Jones (2010) view lean as much more than a technique, but also as a new way of thinking that leads to a new work environment in which all people are involved in the continuous improvement process. Furthermore, Taj and Morosan (2011) consider lean manufacturing as *a multi-dimensional concept* which includes productivity with the least amount of waste, continuous improvement flow, good quality systems and well-trained and empowered workers that have a positive impact on operational performance. Antony et al. (2012) confirms Womack and Jones's (1990) lean definition in considering lean new way of thinking, which includes the integration of vision, culture, and strategy to serve the customer with high quality, low cost and short delivery times. Lean manufacturing is viewed as a model where the persons assume a role of thinkers and their involvement promotes the continuous improvement and gives companies the flexibility they need to face the market demands and environment changes of today and tomorrow (Putnik et al., 2012).

Heizer and Render (2013) define lean similarly to Liker (1997) and Blackstone and Cox (1998) definitions with more emphasis on the benefits of lean. They define lean as a philosophy that concentrates on a continuous improvement in order to remove waste. If lean philosophy is implemented in the proper way, this will lead to sustainable competitive advantage resulting in increasing profits. Hasle et al. (2012) supports the definition by Shah and Ward (2007) where lean is described as a socio-technical system that can be analysed through its practice and more emphasis on the human side as well, where lean should be understood as more than waste reduction. Bortolotti et al. (2015) confirm the definitions of Shah and Ward (2007) and Hasle et al. (2012) that lean manufacturing is a managerial approach for improving processes based on a complex system of interrelated socio-technical practices. The definitions of Shah and Ward (2003, 2007), Antony et al. (2012) and Putnik et al. (2012), Hasle et al. (2012) and Bortolotti et al. (2015) confirm the importance of people in the lean concept.

From the above definitions it is clear that there is a multiplicity of descriptions and terms used to define the lean manufacturing concept (Shah and Ward, 2007). Lean is a process (Womack et al., 1990), a model (Putnik et al., 2012, Womack and Jones, 1994), a philosophy (Blackstone and Cox, 1998, Heizer and Render, 2013, Liker, 1997, Wu et al., 2000), a set of tools and techniques (Green et al., 2010), a set of principles (Womack et al., 1990), an approach (Bortolotti et al., 2015), a programme (Hallgren and Olhager, 2009), a system or integrated system (Hopp and Spearman, 2004, Shah and Ward, 2007, Vinodh and Joy, 2012, Womack and Jones, 1996, De Treville and Antonakis, 2006), a concept (Cooney, 2002, Taj and Morosan, 2011), a systematic way (Howell, 1999, López-Fresno, 2014), a production paradigm (Rothstein, 2004) and a way of thinking (Antony et al., 2012, Womack and Jones, 2010).

For the purpose of the current study, the definitions of Shah and Ward (2003, 2007), Antony et al. (2012) and Putnik et al. (2012), Hasle et al. (2012) and Bortolotti et al. (2015) are adopted. The rationale behind adopting these definitions that they set lean in a new direction towards both a philosophy and a set of tools and techniques, where management of both technical and social systems are emphasised as keys to effectively manage variability in supply, processing time, and demand time. The current study adopts the socio-technical system theory in considering lean as *an integrated socio-technical system*, which involves both human and technical practices. The researcher believes that the integration between the technical and human practices of lean will lead to achieving the competitive edge in the market. The socio-technical system theory will be discussed later in subsection 3.2.1.

2.2.2.2 Multi-Dimensionality of the Lean Concept

The increasing interest in the lean manufacturing concept has led to a strong debate in the literature on what other managerial approaches are like lean manufacturing. Lean can be found in literature and practice with other similar terms such as JIT, continuous improvement (CI), TQM[4] and world class manufacturing[5] (Mi Dahlgaard-Park and Dahlgaard, 2006). Shah and Ward (2003) argue that lean manufacturing as an integrated system consists of highly inter-related factors and a wide variety of management practices that can be classified into four bundles or categories: JIT, TQM, (TPM)[6] and human resource management (HRM)[7].

4: is an integrated management philosophy and set of practices that emphasises continuous improvement, meeting customer requirements, reducing rework, long range thinking, increased employee involvement and teamwork, process redesign, competitive benchmarking, team-based problem solving, constant measurement of results, and closer relationships with suppliers). TQM is an approach to management that can be characterised by its principles, practices and techniques. Its three principles are customer focus, continuous improvement, and teamwork (Shah and Ward, 2007).

5: is a collection of concepts, which set standard for production and manufacturing for another organisation to follow. Japanese manufacturing is credited with the pioneer in concept of world- class manufacturing. One of the important principles which drive world-class manufacturing is the implementation of JIT and lean management that lead to reduction in wastage thereby reduction in cost (Yamashina, 2000).

6: see subsection 2.2.5.1

7: is the process of hiring and developing employees so that they become more valuable to the organisation. It includes conducting job analyses, planning personnel needs, recruiting the right person for the job, orienting and training, managing wages and salaries, providing benefits and incentives., evaluating performance, resolving disputes, and communicating with all employees at all levels. (Business Dictionary Website, 2016).

In the same manner, some researchers believe that the lean system is just an extended model of the well-known Japanese system, JIT (Fullerton and Wempe, 2009).On one hand, Alagaraja (2014) supports the notion that lean system is a developed version of TQM. Similarly, Mi Dahlgaard-Park and Dahlgaard (2006) have reviewed the relevant literature related to lean, TQM, and six sigma and emphasise that lean has the same origin as TQM and its practices should be viewed as supportive to the aim of TQM rather than as an alternative. Contrasting the above-mentioned findings, Mi Dahlgaard-Park and Pettersen (2009) report that lean system is significantly different from its closest relative, TQM, leading to the conclusion that the lean system is a management concept on its own.

Comm and Mathaisel (2000) and Radnor and Boaden (2008) state that when lean philosophy broken into individual parts, it is not new, but as a holistic approach it can be considered as a new system. Moreover, a number of authors have discussed the similarities and differences between lean and other similar managerial philosophies such as TPS, TQM, six sigma, and JIT (Heizer and Render, 2013, Mi Dahlgaard-Park et al., 2006, Mi Dahlgaard-Park and Dahlgaard, 2006, Anvari et al., 2011). For example, Heizer and Render (2013) compare between JIT, TPS and lean operations. They consider the three terms are similar because they are all approaches to continuous improvement that lead to excellent operations. At the same time, they argue that there are some differences among the three terms..

JIT is an approach of continuous improvement and problem solving through emphasising on reducing inventory. TPS focuses on employee learning and empowerment in an assembly line environment, whereas Lean operations eliminate waste through continuous improvement and focus on exactly understanding and satisfying customers' wants. However, Heizer and Render (2013) conclude that in practice, there is a small difference and the terms can be used interchangeably.

Six sigma, as with lean and TQM, has been on a journey. Six sigma is a method for improving processes through statistical means; it was originally developed at Motorola. Although TQM methods play a big part in six sigma, it is said that six sigma extends further, including vision and goal and moving in the direction of perfection. As a concept, it includes the customer, the process, and the employee. In basic terms, six sigma takes what is important to a customer, in regards to quality, and measures it against acceptable limits. From this the degree of quality is determined, a product of process stability or control. Measurements are compared to the normal distribution (Antony, 2011, Nave, 2002, Tennant, 2001). Mi Dahlgaard-Park et al. (2006) argue that six sigma and lean are excellent guides, which could be used one by one or combined together with the values in TQM, reducing waste, which is a significant part of TQM but under the banner of poor-quality costs (Mi Dahlgaard-Park and Pettersen, 2009).

Lean and agile[8] manufacturing are also described as two distinct manufacturing philosophies with different objectives. Lean generally emphasises minimisation of waste and agile system aims to be more flexible and adoptive to changes in the external environment and thus has the potential to use more resources (Christopher and Towill, 2000). In spite of the differences in the end goal, some researchers present lean and agile as two strategies that are two mutually supportive in the organisation (Katayama and Bennett, 1999, Naylor et al., 1999, Robertson and Jones, 1999). Hallgren and Olhager (2009) argue that both lean and agile philosophies significantly affect quality performance, delivery speed, and delivery reliability.

Based on the previous discussion, lean manufacturing concept is multidimensional and has similarities and differences with other managerial approaches. Whereas six sigma and TQM focus on maintaining and improving the quality of products, the lean concept concentrates on minimising waste in production to generate flow of value, with the pull of that value from the customer. This is the distinct power and uniqueness of lean that lies in the researcher's point of view. However, the current study adopts the arguments of Shah and Ward (2003) that lean is a comprehensive and multidimensional concept that comprises four bundles: TQM, JIT, HRM and TPM. This means that those bundles work together as tools to reinforce the implementation of lean. Moreover, this study confirms the view of Heizer and Render (2013) that JIT, TPS and the lean concept are similar because they are all approaches to continuous improvement that lead to world-class operations. This study confirms the multidimensional definition of the lean concept and its match with all the previous mentioned approaches. Lean and the other approaches are interdependent and complementary approaches. All of them are developed to deliver the maximum value to customers and enhance the performance of

8: The ability of an organisation to thrive in the competitive environment of continuous and unanticipated change and to respond quickly to rapidly changing markets driven by customer based valuing of products and services (Christian et al., 2001).

the system. From a strategic point of view, any concept that provides customer value can be in line with a lean concept (Bhamu and Singh Sangwan, 2014).

2.2.2.3 What is Waste in Lean Manufacturing?

Any organisation, whether service or product oriented, has processes, and those processes consist of different activities. These activities from a customer's perspective either add value or do not add any value to the product or service (Womack and Jones, 2010). Waste is lean's concept with the greatest focus (Mi Dahlgaard-Park and Dahlgaard, 2006). Lean means "manufacturing without waste" and most companies waste 70 percent-90 per cent of their available resources. Even the best lean manufacturers probably waste 30 per cent (Lee, 2007). According to Abdulmalek and Rajgopal (2007) the processes of transforming raw material into finished goods are the result of three activities:

1-Value–added activities: Womack and Jones (2003) state that these activities directly result in the accrual of value in the eyes of the end customer so that this type is considered necessary regarding the perceived quality of final offering, for example, converting the iron ore into cars, forging raw materials, and painting a car body.(Mishra et al., 2016).

2-Necessary non-value-added activities: these activities add cost and create no value so that they can be removed (Womack and Jones, 2003). These activities do not make a product more valuable but are necessary under the current operating circumstances. Such waste is difficult to remove immediately and must be targeted for longer-term change. For example, walking long distances to pick up parts, or unpacking vendor boxes. These can be removed by changing the current layout of a line or organising vendor items to be delivered unpacked (Mishra et al., 2016).

3-Unnecessary non-value-added activities: These include all the activities that the customer believes are not valuable in a product, and are not necessary under the current conditions. These activities are pure waste and should be targeted for immediate removal. Examples include waiting time, stacking of products and double transfers (Mishra et al., 2016).

Rich et al. (2006) have identified seven common types of waste as follows: 'Overproduction' where a big number of units are made in batches and dumped into end goods or work in process. 'Unnecessary inventory', which comes because of overproduction in which inventory is simply held awaiting an order in the assumption that future orders will come later. 'Inappropriate processing', which results from using complex machines to produce simple items that can be produced through using simpler or less costly techniques. 'Unnecessary Transportation', which is related to the movement of materials in the factory from receiving the materials until shipment. 'Unnecessary Delay', which is concerned with the simple 'dwelling' time, as products are ready to be converted, but sits waiting. 'Unnecessary Defects', which results from producing several units which need to be reworked or scrapped. Finally, 'Unnecessary Motion', which happens when the production process is weakly designed and operators, engage in stressful activities to handle materials.

Rawabdeh (2005), categorises the seven types of waste into three main categories, which are: human, machine and materials. The human group includes motion, waiting and overproduction. The machine group consists of processing waste, and the material group includes transportation, inventory and defects. Rawabdeh (2005) argues that all types of wastes are interdependent and each one has an effect on the others and is affected by others. MacBryde et al. (2006) adds an eighth type of waste, which is knowledge. This means that the human resources are not confident about the best way to do tasks. Knowledge waste is termed as skills waste, which means the waste of untapped human potential through the weak use and application of the talents and skills of the people employed in the process (Jones and Robinson, 2012) .

2.2.3 Principles of Lean Manufacturing

Lean manufacturing emphasises that removing waste from the production system can be achieved by following five main steps (Womack and Jones, 2010). These main principles are considered as a roadmap or steps to become lean. The five principles are illustrated in figure 2.1 and they are:

1- *Specify value*: The key question to understand this principle is to ask "If I were the customer what would I be willing to pay for it?"(Jones and Robinson, 2012).Value should be defined from the ultimate customers' perspectives, and it is only meaningful for one specific product. In some situations, firms have problems in defining value because it has different meanings in the eyes of engineers who try to refine every single detail in the product, which sometimes leads to a waste because the customer does not care about the over-engineered solutions. In some other cases, the shareholders and top management aim to achieve quick financial results and define the value in a way that may not fit the desires of customers (Womack and Jones, 2010). Therefore, specifying value is a critical principle in lean thinking and is the first thing companies should define if they want to begin in the lean journey. Womack and Jones (2010) argue that " lean thinking must start with a conscious attempt to precisely define value in terms of specific products with specific capabilities offered at specific prices through a dialogue with specific customers". The core idea in lean concept is to maximise customer value while minimising waste, because lean simply means creating more value for customers with fewer resources. A lean organisation understands customer value and focuses its key processes to continuously increase it. The end goal for any lean organisation is to provide perfect value to the customer through a perfect value creation process that has zero waste (Lean Enterprise Institute, 2016b).

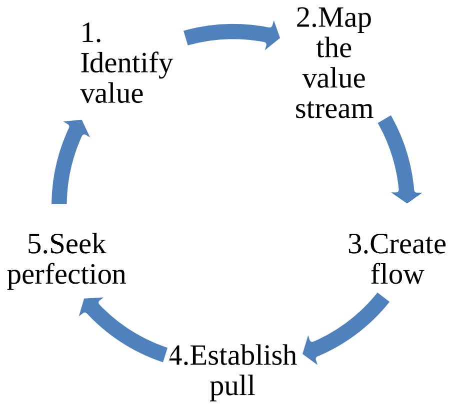
2- *Map the value stream:* The aim of this principle is to identify the steps in the production process that are required to deliver value to the customer (Jones and Robinson, 2012). A value stream illustrates the flow of materials through the manufacturing process from the customer's point of view (Cassell et al., 2006). A value stream mapping (VSM) is a specific model applied to a specific operation (Robinson et al., 2012). Managers usually design a map for the value stream to understand how to add value in the flow of material and information through the entire production process, including the supply chain. VSM takes into consideration not only the process but also the managerial decisions and information systems that support the process (Heizer and Render, 2013). Womack and Jones (2010) explain three critical management tasks required to identify the value stream. First, "problem solving task" which runs from concept through detailed design and engineering to production launch; second, "information management task" running from order receiving through accurate scheduling to delivery; third, " physical transformation task" proceeding from raw materials to a finished product available to the customer. If much of waste is removed from the operation by reorganisation and restructuring of the process, then a much faster throughput can be achieved without the unnecessary waiting time.

3- *Create flow*: This principle is concerned with getting value to flow through the value stream without interruption and waiting (Jones and Robinson, 2012). To achieve a continuous flow in the production process, Womack and Jones (2003) suggest that firms must: focus on the whole value stream from raw material to end customer; remove obstructions to the continuous flow from each department; and apply specific work practices and tools to eradicate backflows that cause stoppages.

4- *Establish pull*: The argument of Womack and Jones (2010) behind the fourth principle is that the company must design, schedule and make exactly what the end customer wants just when the customer wants it. The "pull" concept means that nothing should be produced until the customer needs it. In other words, the end customer must be the leader of the value stream (Antony et al., 2012, Singh et al., 2010). This principle aims to reduce dramatically the time required to move from concept to market, sale to delivery and resources to the customers. Womack and Jones (2003, p.24) clarify pull principle as the following "it is a revolutionary achievement; it is because the ability to design, schedule and make exactly what the customer wants just when the customer wants. It means you can throw away the sales forecast and simply make what customers tell you they need. That is, you can let the customer pull the product from you as needed rather than pushing products often unwanted onto the customer". Pull is a vital part of lean manufacturing as it ensures that no element enters the operation unless an order is attached to it (Jones and Robinson, 2012) .

5- *Seek perfection*: The last principle means that there is no end to the process of reducing effort, time, cost and errors**.** Customer value is not static so manufacturing firms continually seek to provide increased levels of value, whether this is in terms of cost, quality, and/or delivery (Jones and Robinson, 2012). Womack and Jones (2003) argue that in a lean system, anybody can observe everything and so it is not difficult to discover better ways to create value. The last principle is like the Japanese philosophy 'Kaizen' that means continuous improvement through incremental change. Kaizen has been linked to lean production because both of them are concerned with the systematic improvement of processes and products through incremental innovation (Jones and Robinson, 2012).

Figure 2-1 Five Lean Principles



Source: Lean Enterprise Institute (2016)

To understand what is wasteful in a system; lean manufacturing prescribes it as key to first understand what adds value to the end customer. Starting with a product, the organisation should define what is valuable to their customers. Then identify and map the value stream to explain visually what needs to be done to reach perfection. A value stream map as a tool points to what steps should be improved on next for that product. It may indicate the need to completely restructure a set of steps or improve one operation. VSM is used to identify the waste in the steps of the process and remove the non-value-added activities to reach perfection for that process. (Hines et al., 2011, Rother and Shook, 2003, Womack and Jones, 2010). Developing flow is the third prescribed step for forming a lean system. Single-piece flow, as seen with an ideal JIT production system, possesses no waste in the form of inventory and overproduction. This is ideal for a lean system because lean manufacturing depends on lining up steps one after the other to produce flow from one operation to another. Once flow is achieved, pull can be implemented. Pull is a mechanism of initiating production in a lean system. Pull in its essence links the process of production to the customer directly and it is a mechanism by which JIT flow is achieved. Ideal lean manufacturing happens only when the customer calls for it, pulling value from the system in the form of the desired product. In this way, overproduction is eliminated. If the process is perfected when the customer demands it or pulls value, in the form of a product, it flows to them at the rate they require it (Hines et al., 2011, Rother and Shook, 2003, Womack and Jones, 2010).

2.2.4 Benefits of Lean Manufacturing Implementation

Based on the different and multidimensional definitions of lean which was discussed earlier in subsections 2.2.2.1 and 2.2.2.2, many researchers agree that lean implementation results in many benefits for the organisation. Sohal and Egglestone (1994) argue that companies which have adopted lean production concepts can typically design, manufacture, and distribute products in less than half the time taken by other companies. Womack et al (1990, p.13) confirm Sohal's argument when they argue that "lean uses less of everything compared to mass production, half the human effort in the factory, half the manufacturing space, half the investment in tools, half the engineering hours to develop a new product in half the time. Also it requires keeping far less than half the needed inventory on site, results in many fewer defects, and produces a greater and ever growing variety of products". Heizer and Render (2013) identify three main benefits of implementing lean practices: eliminating waste, eliminating variability and improving throughput. Bhasin and Burcher (2006) claim that maybe a reduction in waste of 40 per cent will occur if organisations implement lean practices. In addition, one important benefit for lean implementation is the reduction of lead-time between the beginning of any process and the completion of that process. Lead time is considered an important issue to gain the flexibility and response to market demand (Deshmukh et al., 2010).

Jayaram et al. (2008) state that lean leads to reduction in lot sizes, reduction in inventories, improved quality, greater process yields, increased productivity, increased flexibility, reduced space requirements, decreased manufacturing costs, reduced lead times, and increased problem solving skills. Furthermore, Bhasin (2008) lists about eleven benefits for lean as the following: shorter cycle time, shorter lead times, lower work in process (WIP), faster response time, lower costs, higher production flexibility, higher quality, better customer service, greater revenues, higher throughput and more profits.

López-Fresno (2014) explains the contribution of lean manufacturing to the overall business excellence as follows:

1. Lean system facilitates a cultural change through bringing the top management together into the operational level.

2. Lean produces a visible and fast improvement through facilitating the sense of achievement, sense of belonging and reinforcing employees' motivation.
3. Lean implies all workers in continuous improvement because lean is a *friendly methodology* useful to achieve operational excellence that leads to overall excellence.

Singh et al. (2010) provide an in-depth case study of how lean has been implemented to a specific production facility and the benefits gained through lean implementation. It has been found after comparing the current and future state of production that lean implementation led to 83.14 per cent reduction in lead time, 12.62 per cent reduction in processing time, 89.47 per cent reduction in work in process inventory, 30 per cent reduction in manpower requirement and 42.86 per cent increase in productivity per operator.

Based on the previous discussion, it can be concluded that lean implementation leads to achieving a competitive edge in the market through reducing costs, improving quality, increasing customer service and customer satisfaction, reducing inventory, reducing cycle time and lead time (Bhasin, 2008, Deshmukh et al., 2010, Heizer and Render, 2013, Jayaram et al., 2008, Melton, 2005, Rizzardo and Brooks, 2003).

2.2.5 Main Lean Manufacturing Practices

Practices in lean manufacturing are termed in similar meanings such as measures (Shah and Ward, 2007), building blocks (Kilpatrick, 2003), issues (Deshmukh et al., 2010), areas (Wang and Taj, 2005) or dimensions (Antony et al., 2012, Ghosh, 2012). Lean exists at two main levels: strategic and operational. At the strategic one, lean helps to recognise customer value and identify the value stream. At the operational level, it is a bundle of practices and tools leading to the minimisation of waste and force continuous improvement (Anvari and Moghimi, 2011, Demeter and Matyusz, 2011, Hines et al., 2004).

For the current study, it was decided to divide lean practices into two categories; the first one discusses the main technical practices of lean, which rely on using tools and technical methods. The second part discusses the main lean human practices, which refer to both internal human practices such as employees’ involvement, and external human practices such as suppliers' involvement and customers' involvement. It must be mentioned that the list of lean practices is not complete. This study focuses on defining the practices that will be used in the conceptual models of the current study and help the researcher to achieve the objectives of the study.

2.2.5.1 Main Lean Technical Practices

According to Shah and Ward (2007), the five main technical practices of lean are:

1-Pull System: This is a standard practice of lean. It is a system that 'pulls' a unit to where it is needed, just as it is needed. The pull concept is used both within the immediate production process and with suppliers. By pulling raw materials through the system just as it is needed, waste and inventory are removed. Therefore, clutter is decreased, problems become clear, and continuous improvement is emphasised. Push systems are contradictory of lean because push systems dump orders on the next downstream station workstation, regardless of timeliness and resource availability. Pulling resources through the manufacturing process as it is required rather than in a 'push' mode usually lowers cost and improves schedule performance, enhancing customer satisfaction (Heizer and Render, 2013).

A pull system uses specific techniques, such as Kanban (Shah and Ward, 2007). Jones and Robinson (2012) define Kanban as 'kan' meaning visual and 'ban' meaning card. A classic signalling method is the basis for the pull planning process. Heizer and Render (2013) confirm that a Kanban card is the authorisation for the next container of material to be produced. Usually, a Kanban signal exists for each container of units to be obtained. An order for the container is then initiated by each Kanban and 'pulled' from the producing department or supplier. A sequence of Kanban 'pulls' the material through the factory. Nowadays the system has been justified in different plants so that even though it is called a Kanban, the card itself does not exist. In some cases, an empty spot or position on the floor is a good indication that the next container is required. Cassell et al. (2006) argue that Kanban uses cards to signal a need to produce or transport a container of raw materials or partially finished products to the next stage in the production process. Sun (2011) adds that a Kanban control system depends on different visual signals, such as control cards, empty squares on the floor or a shelf, or coloured golf balls to control the withdrawal and replacement of resources during manufacturing.

Kanban send urgent signs for workers to do specific tasks immediately, such as starting production of a certain product.

A pull system has many benefits, such as reduction of work in process and scheduling complexities (Antony et al., 2012). In the past Toyota faced a serious problem when the US market refused its new brand in the 1950s.The solution was to improve quality through applying total quality control using a Kanban system. As a result, Toyota became much more competitive and increased its market share (Mi Dahlgaard-Park and Dahlgaard, 2006).

2-Continuous Flow: This is the hardest lean concept, which most clearly conflicts with a mass production system. Flow is concerned with processes, people and culture, therefore, this principle requires to understand the linkages of events and activities delivering value to the customer (Melton, 2005). Continuous flow is created by determining the value from the customers' perspectives and moving machines and people together (Dennis, 2002). Flow principle focuses on reducing the management or coordination costs through following small production runs and dealing with a smaller number of suppliers to facilitate coordination (Rahman et al., 2010). Continuous flow can be developed through the implementation of work cells, which is a technique, to arrange operations in a cell with one piece flow and better use of workers and equipment (Kilpatrick, 2003). Liker (2004) argues that continuous flow is at the heart of the lean concept that shortens the elapsed time from raw resources to finished products and, hence, leads to the best quality, lowest cost, and shortest delivery time.

3-Statistical Process Control (SPC): This is a system-monitoring tool which has been introduced into the general manufacturing industry for monitoring process performance and product quality and to observe the general process variation, exhibited in a few process variables (Kruger and Xie, 2012). SPC is a very useful tool to be used in promoting and maintaining the health of a commercial and industrial company (Wetherill and Brown, 1991). SPC relies on the application of statistical techniques to ensure that processes meet standards because all processes are subject to a specific extent of variability (Heizer and Render, 2013). In this respect, managers must distinguish between two causes for variation: the natural or common variations which happen as part of the manufacturing process and tend to stay within a specific tolerance. The other type of variations is the significant or special variations in which managers should intervene to severe and sudden shifts, which exceed acceptable standards of tolerance and actively seek out the causes of such variations. In a machine environment, this philosophy is central to the concept of SPC (Rich, 2001). Walter Shewhart developed in the 1920s a simple and powerful tool to separate the two causes of variation called the control chart. The control chart is a visual presentation of process data over time **(**Heizer and Render, 2013)**.** SPC philosophy involves the whole organisation, starting from the supply chain management to the product life cycle (Kruger and Xie, 2012). Presently, SPC is considered an important internal lean practice in the lean manufacturing context (Shah and Ward, 2003).

4- TPM: A common denominator of all excellent production systems such as the lean system is the integrated role and importance of the maintenance department as an equal partner in the factory. This recognition of the importance of correct maintenance rules with satisfying customers' desires permitted the development of proactive strategies to improve the management of maintenance itself. These strategies have typically led to the adoption of a philosophy termed 'Total Productive Maintenance' which is known as TPM (Rich, 2001). Historically firms would repair a machine once it had broken down or during the planned annual factory closure. This mainly reactive approach led to disruption in manufacturing as machinery failed or had to run slowly. The TPM concept combines TQM philosophy with a strategic view of maintenance from process and equipment design to preventive maintenance. It involves reducing variability through autonomous maintenance and excellent maintenance activities (Heizer and Render, 2013). TPM is a philosophy and system, which has both visible elements and an invisible management control system, which focuses on the radical and continuous improvement activities within the organisation. TPM is compulsory for firms seeking to exploit the full capabilities of the manufacturing system (Rich, 2001). TPM is an integral part of the demands of Japanese factory systems such as Toyota, Nissan and Honda. Also, it is incorporated in the concepts of lean production (Womack and Jones, 1996). According to Jones and Robinson (2012), a typical TPM programme has seven steps as follows:

1- Initial deep cleaning, to discover equipment defects or problems that have not previously been found.

2- Development of procedures and tools aimed at preventing these defects from happening, such as moving the machine to make it easier to repair.
3- Establishing standards for cleaning, lubricating, and maintaining each type of machine and training staff up to these standards.
4- Establishing general inspection rules and schedules.
5- Developing employee autonomy to run an inspection.
6- Orderliness and tidiness become the norm.
7- Full autonomous maintenance.

5- Set-up Time Reduction: set-up time means the period required to prepare a machine, process or system for it to be ready to function or accept a job (Shah and Ward, 2003). The essence of lean manufacturing is to compress the time from the receipt of a customer order all the way through to receipt of payment. This will result in increased productivity, reduced costs, improved quality and increased customer satisfaction (Rizzardo and Brooks, 2003).

Furthermore, set-up time reduction is an effective lean technique that allows the flexibility of manufacturing without slowing the production process or creating more costs related to non-value-added steps. Set-up time is governed by the need to being able to change over a certain activity to producing a different item in the most efficient way (Antony et al., 2012). Reducing set-up times leads to a higher return on investment by maximising the machine's productive time (Sun, 2011). Short set-up times make the production of small lot sizes economically feasible, so that the producing of items can completely correlate its production rate with the demand rate and respond as soon as possible when demand changes (Jayaram et al., 2008).

2.2.5.2 Main Lean Human Practices

According to Shah and Ward (2007), the three main human practices of lean are:

1-Customers' Involvement: Lean production can be thought of as the result of a well-run operations management function, which understands what the customer wants and ensures customer input and feedback. Lean practices aim to identify customer value by analysing all the activities needed to produce the product and then optimising the whole process from the customer's perspective (Heizer and Render, 2013). Lean thinking starts with the customer and the definition of value (Womack and Jones, 2003). Therefore, without a deep understanding about what the customer values, organisations cannot move forward. The challenge for the producer is designing product's features based on customers' values propositions (Melton, 2005). By clearly defining value for a specific product from the customer's point of view, all the non-value activities can be eliminated (Čiarnienė and Vienažindienė, 2012).

In lean production history, the matter of dealing with the customer began in the 1930s in the Toyota motor sales company when Eiji Toyoda and his marketing expert began thinking about the link between the production system and the customer. They believed that the variety available from lean system would be far too trivial if the lean producer could not develop what the customer wanted. Therefore, they developed a new programme called "aggressive selling" in which they can build a long-term relation between the assembler, the dealer and the buyer by building the dealer into the production process and the buyer into the product development process. This programme led Toyota to stop creating cars in advance for unknown buyers and changed to a build-to-order system in which the dealer was the first step in the Kanban system, sending orders for presold cars to the factory for delivery to specific customers in two to three weeks. In this case, the dealer had to work closely with the factory to sequence orders in a way the factory could accommodate. The system also incorporated the buyer into the product development process and in a very direct way. Toyota went directly to its existing customers in planning new products. Established customers were treated as members of the 'Toyota family', and brand loyalty became a salient feature of Toyota's lean production system (Womack et al., 1990). Closer customer relationships are defined as a company's ability to both determine and meet its customers' requirements. The firm that is close to the customer is better able to synchronise or match its products with its customers' needs and expectations (Jayaram et al., 2008).

2-Employees' Involvement: This is the extent to which workers are motivated to participate in continuous improvement and problem solving activities (Fullerton and Wempe, 2009). Employees are the key element in lean manufacturing because they are the ones who solve problems and improve the production process (Sujatha and Rao, 2013). Heizer and Render (2013) argue that allowing employees to participate in every step of the production process is very critical issue. They argue that the job is to create machines and processes that produce the desired quality and those who understand the weaknesses of the system best do this with a high degree of involvement. Those dealing with the system daily understand it better than anyone else does.

One of the three core components of TPS, which represents the origin of lean system, is respect for people. TPS engages the mental as well as physical capabilities of workers in the challenging activities of improving operations. Employees are empowered to stop machines and processes when quality problems occur. This means that the tasks that have usually been assigned to staff are shifted to employees. Toyota recognises that workers know more about their tasks than anyone else does. Thus, Toyota respects employees by providing them with the opportunity to enrich both their work and their lives (Heizer and Render, 2013).

Employees' involvement enhances the feeling of perceived control and competence. On the one hand, employees’ feeling of perceived control promotes the use of specific lean technical practices, such as pull systems. Empowered workers have the authority to stop the production line when defective items are manufactured and keep it shut down until the root cause of the problem is determined and solved. Employees, who work downstream, control inventory in the system by requesting items as and when they are needed from employees upstream. This task is the essence of pull production (Raja, 2011). On the other hand, employees' feeling of perceived competence motivates using different lean technical practices such as set-up time reduction and TPM. Empowered workers have the right training to decrease the set-up times needed when moving from one operation to the other through practice and making specific fixtures that convert internal set-ups to external set-ups. Empowered employees have the training to perform basic equipment maintenance work such as inspection or cleaning which are considered elements in TPM (Raja, 2011).

3-Suppliers' Involvement

Integrating good relationships with suppliers is an important issue, which ensures continuous flow of right quantities of material at the right time. Working and sharing ideas and suggestions with the supplier will eliminate wastes in inventories and improve the quality (Sharma et al., 2011). Antony et al. (2012) claim that a lean system is an integrated activity in supply chain management. Hence, organisations should be able to connect its internal functions within a firm with the external activities of suppliers to compete successfully in the market. According to Shah and Ward (2007), the suppliers' most related lean practices are:

(a)Supplier Feedback: This focuses on providing continuous feedback to suppliers about the quality and delivery performance (Shah and Ward, 2007).

(b) JIT Delivery: JIT provides a powerful strategy for improving operations. With JIT, materials arrive where they are needed only when they are needed. When good resources do not reach by suppliers just as needed a 'problem' has been determined. This is the reason JIT is so powerful, because of its focus on solving problems. By eliminating waste and delay, JIT decreases inventory and reduces variability and waste. Every moment material is held, a step that adds value should be happening (Heizer and Render, 2013). JIT delivery is an important lean practice because it ensures that suppliers deliver the right quantity of resources at the right time in the right location (Shah and Ward, 2007). Suppliers represent a critical factor for the success of lean manufacturing so it is important to encourage suppliers to create JIT production capabilities in addition to JIT delivery in order to support long term competitiveness (Sujatha and Rao, 2013). Soare (2012) confirms that JIT is a system by which the needed resources are available exactly when they are required, in the necessary quantity, thereby reducing waste and improving efficiency. Lean firms form cooperative supplier relationships, sharing product design and cost reduction suggestions in addition to ensuring the on-time delivery of high quality materials (Conti et al., 2006).

(c) Suppliers' Development: This represents activities designed to develop relationships with suppliers to get their collaboration (Jabbour et al., 2013). Developing suppliers is a critical lean practice that helps suppliers to participate and give new ideas to improve the production process (Shah and Ward, 2007). Suppliers' development may include everything from training, to engineering and production help, to procedures for information transfer. The aim of suppliers' development is to help the buyer to make sure the supplier has an appreciation of quality requirements, product features, schedules and delivery and procurement policies (Heizer and Render, 2013). Many firms to help bring a supplier's performance up to speed, most notably in the domain of quality, use suppliers' development. For suppliers who are deficient with respect to quality, buying firms institute quality certification programmes to educate potential suppliers concerning quality, to train them to use SPC, and to work closely with them to implement quality procedures. For example, Xerox Corp. spends annually $500,000 to offer customised training to its suppliers in areas such as TQM and JIT manufacturing (Jayaram et al., 2008).Table 2.1 summarises the lean technical and human practices.

Table 2-1 Lean Technical and Human Practices Used in this Study

Main Practices	Lean constructs	Description
Technical Related	Pull	Specific system uses special techniques such as Kanban to facilitate JIT production
	Flow	Establishing mechanisms to facilitate the continuous flow of products
	SPC	Ensuring that each production process will supply zero defect units to the following production process
	Set-up time reduction	Reducing process downtime between product changeovers
	TPM	Addressing equipment downtime through the regular maintenance of equipment to achieve a high degree of equipment availability
Suppliers' Related	Suppliers' feedback	The organisation should provide continuous feedback on quality and delivery performance to their suppliers.
	JIT Delivery	Ensuring that suppliers deliver the right quantity of materials at the right time in the right place.
	Suppliers' involvement	Providing training and development for suppliers so they can participate in the continuous improvement process.
Customers Related	Customers' involvement	The organisation should focus on involving customers in the production process to satisfy their needs.
Employees Related	Employees' involvement	Employees should have an important role in problem solving through cross-functional teams and self-directed teams.

Source: Shah and Ward (2007)

2.2.6 Lean Manufacturing Practices in Previous Research

There is a large body of literature that has investigated lean practices in the manufacturing operations. For this study, this subsection presents different lean practices that have been used in the most cited studies during the last 17 years (from 2000 to 2016) in different geographical regions. The aim of this subsection is understand how lean practices have been used in previous research and for what purpose. Therefore, it will be easy to show how the current study will contribute to research.

In a study for Martínez Sánchez and Pérez Pérez (2001), a set of lean practices have been developed to evaluate the progress in implementing lean systems. The study uses six lean practices adopted from Karlsson and Åhlström (1996). The six lean practices are; elimination of waste, continuous improvement, JIT production and delivery, multifunctional teams, integration of suppliers and flexible information systems. They connected the lean practices to some specific indicators related to performance, which they assumed should be applied in a balanced scorecard approach. The responses of 41 firms have been collected through an email survey**.** In this study, the researchers tried to be more accurate in implementing lean practices to be adopted in the company's performance indicators. An important result in this study was that the average use and the degree of importance of most lean practices was significantly greater in the large companies than in small and medium-sized companies. In addition, this study suggests that lean survey should be tailored to specific industries. This study has used a small sample size and it focuses just on analysing which lean production indicators are most used to evaluate the firm's improvements in their production systems.

Soriano-Meier and Forrester (2002) also used the lean practices of Karlsson and Åhlström (1996) and developed a methodology to measure the degree of leanness of firms. The practices of lean are elimination of waste, continuous improvement, zero defects, JIT deliveries, pull of raw materials, multifunctional teams, decentralisation, integration of functions and vertical information systems. The respondents were asked to fill in two questionnaires. 30 firms in the UK ceramic tableware industry completed the survey. After conducting a regression analysis, it was found that the degree of leanness is the most important variable to measure performance of the company and companies are considered lean if the mean value of the degree of leanness is above average. This study focuses on a small sample size and on just one industrial sector. In addition, it does not take into consideration the role of organisational culture in the degree of leanness in this industry.

Shah and Ward (2003) examined the impact of three contextual factors; the company's size, age and unionisation and the likelihood of applying lean practices in 1,748 firms in the USA using a quantitative survey. They identified in their study four bundles for lean: JIT, TQM, TPM, and HRM. They have correlated these bundles to measure six items related to the operational performance. These items are lead-time, unit-manufacturing cost, and five-year changes in manufacturing cycle time, scrap and rework costs, labour productivity and first pass yield. It was found that all lean bundles have a significant positive effect on performance and explain about 23 per cent of the variation in operational performance after accounting for the effects of industry and contextual factors. Additionally, it was found that the firm's size has the most influence on lean practices implementation compared to the plant's age and unionisation. This study is one of the first, to our knowledge, that applies synergistic bundles of lean practices concurrently to make a substantial contribution to operational performance but it does not consider any precondition before applying lean bundles such as the culture of the organisation.

Doolen and Hacker (2005) developed an instrument to evaluate the implementation level of lean practices in an organisation including electronic manufacturers. It was found that while electronic manufacturers have implemented different lean practices, the level of implementation varies and may be because of economic, operational or organisational factors. The study is exploratory and aimed at illustrating how the instrument they developed can be used to understand the factors that might contribute to the implementation of lean practices in one industrial sector.

Shah and Ward (2007) conducted a literature review using a historical perspective to define the main elements of lean manufacturing. Based on their review of theory, they developed a new instrument to measure the different elements of lean by using two stages of empirical analysis and data from a large sample of manufacturing firms in the USA. The new instrument was validated through using confirmatory factor analysis. The empirical measurement instrument has been considered useful for researchers who are interested in conducting survey research related to lean manufacturing systems. The instrument includes ten lean practices grouped into three categories. The first category is supplier related practices and includes supplier feedback, JIT delivery and supplier development. The second category is customer related practices, which includes customer involvement. The third category is internal related practices and includes pull, flow, set-up time, SPC, and TPM. This study suggests that every factor of the ten factors of lean manufacturing is an important contributor and that none should be removed. Despite the importance of this study, it does not mention any thing about the effect of organisational culture on lean manufacturing factors.

Taj (2008) has used an assessment tool to evaluate the current state of lean manufacturing in 65 manufacturing firms in China. This assessment tool has been adopted from Lee (2004)and includes nine main practices or areas: inventory, the team approach, process, maintenance, layout and handling, suppliers, set-up, quality and scheduling/control. It has been found that the petroleum industry is the first among all industries, followed by computer and electronics industries. This study depends on a small sample size and it aims simply to evaluate the level of lean implementation among different manufacturing sectors.

Jayaram et al. (2008) investigated the relationship between suppliers and customers with lean strategy and financial performance in 150 independently owned first tier suppliers to General Motors, Ford and Daimler-Chrysler. This study assumes that lean strategy should begin after developing good relationships with suppliers and customers. The authors identified two dimensions for lean strategy, lean manufacturing and lean product design. The lean manufacturing practices are JIT, setup time reduction, and cellular manufacturing. The major findings in this study are the positive relationships between relationship building and lean design, relationship building and lean manufacturing, and lean design with financial performance. The study suggests that a lean strategy must be created before building relationships with suppliers and customers. This study is an original one because it sheds light on the importance of lean human practices such as suppliers and customers' relationships to evaluate their effect on lean manufacturing, but unfortunately, this study does not describe what type of lean strategy should precede building relationships with customers and suppliers.

Fullerton and Wempe (2009) examined the moderating and the mediating effect of non-financial manufacturing performance on the relationship between lean manufacturing and profit in 121 US manufacturing firms. The lean manufacturing practices in this study are set-up reduction, cellular manufacturing and quality improvement. It was found in this study that all lean practices have varied direct effects on profitability, and also that the utilisation of non-financial measures has a significant effect on profitability, while the use of non-financial measures such as delivery time, rework, scrap, inventory turnover and labour productivity mediate the relationship between lean manufacturing and financial performance. This study is a unique one because it aims to examine how the utilisation of non-financial performance affects the lean manufacturing-financial performance relationship. At the same time, this study does not address the effect of organisational culture as a non-financial factor on the implementation level of lean practices.

Rahman et al. (2010) examined the impact of lean practices on operational performance in Thailand. This study uses three practices for lean: JIT, waste minimisation and flow management. The responding firms were categorised into small and medium sized enterprises (SMEs) and large firms based on size and Thai-owned, foreign-owned and joint venture firms based on ownership. The multiple regression models were used to investigate the effects of three lean constructs on operational performance in different categories of firms. The results indicate that all three lean constructs are significantly related to operational performance. JIT has a higher level of significance in large firms compared to SMEs, whereas for waste minimisation there is a higher level of significance for SMEs compared to lean firms. Flow management has a much lower level of significance for both SMEs and large firms. With respect to ownership, JIT is highly significant to operational performance for all three ownership groups (Thai, foreign and joint venture). This study provides insights into the adoption of lean practices in an Asian context and, using survey data as opposed to case studies, also provides further evidence that lean practices are significant in enhancing operational performance. However, it does not discuss the role of organisational culture in implementing lean practices.

Nordin et al. (2010) examined the extent of lean implementation in 60 Malaysian automotive manufacturing firms and the drivers and barriers that affect lean implementation. The six lean practices in this study are process and equipment, manufacturing planning and control, human resource management, supplier relationship and customer relationship. The findings show that most of the respondent firms are classified as in-transition towards lean manufacturing implementation. These in-transition firms have moderate mean values for each of the five lean manufacturing practice categories. It was also found that these firms pay more attention to and invest more resources in internal areas, such as firms' operation and management, compared to external relationships with suppliers and customers. The main barriers to lean implementation are the lack of understanding of lean concepts and employees' attitudes. This paper does not discuss any relationship between lean practices and other human or cultural factors.

Demeter and Matyusz (2011) investigated the effect of three contingency variables, which are production system, order type and product type of inventories with lean environment. In addition, this study aims to show how lean practices affect the inventory levels. The lean manufacturing practices that were used in this study are the same four bundles used by Shah and Ward (2003), which are TQM, JIT, TPM and HRM. The cluster and correlation analyses were conducted with separate manufacturers based on the extent of their leanness and to examine the effect of contingencies. The results of this study show that different types of inventories are sensitive to different contingency factors. For example, there is a relationship between the process and inventories, while there is no correlation between the product type and inventories. This study concentrates on the relationship between lean manufacturing and inventory levels without discussing the effect of organisational culture in this relationship.

Yang et al. (2011) explored the relationship between lean practices, environmental management and business performance in 309 international manufacturing firms. The lean constructs in the study are JIT flow, quality management and employee involvement. The findings suggest that prior lean manufacturing experiences are positively related to environmental management practices. Environmental management practices alone are negatively related to market and financial performance. However, improved environmental performance substantially decreases the negative effect of environmental management practices on market and financial performance. The paper provides empirical evidence with large sample size that environmental management practices become an important mediating variable to resolve the conflicts between lean manufacturing and environmental performance. At the same time this paper does not discuss any human or cultural factors that can affect lean practice implementation such as organisational culture.

Hofer et al. (2012) have investigated the relationship between lean production and financial performance in US manufacturing industries with a focus on the role of inventory leanness. The lean constructs in this study are also adopted from Shah and Ward (2007). The authors divided lean manufacturing practices into external lean practices (supplier feedback, supplier JIT, supplier development and customer involvement) and internal lean practices (pull system, continuous flow, setup time reduction, SPC, employee's involvement and TPM). Based on an analysis of a combination of survey and secondary data, the effect of lean production on financial performance is found to be partially mediated by inventory leanness. In addition, there is strong evidence that the concurrent implementation of internally focused and externally focused lean practices yields higher performance benefits than selective lean production implementation. Therefore, this study contributes to the theory of lean production by providing insights into the mediated and moderated effects of lean production on inventory leanness and financial performance, but it does not consider the effect of organisational culture of as an important factor on the implementation level of internal and external lean practices.

Alsmadi et al. (2012) have examined the differences between manufacturing and service firms with respect to lean implementation in UK firms. The ten lean practices in this study are adopted also from Shah and Ward's (2007) study. The results confirm that service firms are interested in the soft practices of lean, such as people and customer involvement, while they are found underperforming in manufacturing-related practices such as TPM, set-up time and supplier feedback. Moreover, the results show a positive relationship between lean practices and firm performance in both sectors, while the degree of effect on performance was found to be identical between the two sectors. This study focused on lean implementation in a developed country without considering the effect of soft side of lean practices on the hard or technical lean practices.

Vinodh and Joy (2012) analysed lean manufacturing practices in 60 small and medium enterprises in India to identify the critical success factors for lean implementation. The authors developed a conceptual model that includes five practices for lean, which are management responsibility leanness, manufacturing management leanness, technology leanness, and workforce leanness and manufacturing strategy. They found that all practices are correlated with each other and help to improve the organisational performance. This study relied on a small sample size without considering any correlations between the organisational culture and the five mentioned lean practices.

Ghosh (2012) examined the existing situation of lean adoption in 79 Indian manufacturing firms and its effect on operational performance. The lean practices used in this study are supply performance; focus on customer needs, using pull system, set-up time reduction, TPM, SPC and cross-departmental problem solving. The results show that the operational metrics have improved on all dimensions such as high productivity, reduced lead-time, reduced inventory and space requirement. This study addresses the relationship between lean practices and operational outcomes in a developing country, but the sample size is considered small and the effect of organisational culture on lean practices has not been discussed at all.

Nawanir et al. (2013) investigated the relationship between lean practices, operations performance and business performance in 139 Indonesian manufacturing companies. The lean practices in this study are flexible resources, cellular layouts, pull system, small lot production, quick setups, a uniform production level, quality at the source, TPM, and supplier networks. It was found that all lean practices have a positive impact on both types of performance and that the operational performance partially mediates the relationship between lean practices and business performance. This study examined the link between lean practices and two types of performance, but without addressing the role of the cultural or human factors in this link.

Chavez et al. (2013) have examined the effect of internal lean factors on different dimensions of operational performance in 228 manufacturing firms in Ireland. In addition, the study assessed the role of industry clock speed in this relationship. The internal lean practices used in this study are set-up time reduction and JIT. The study has found that lean factors have a positive effect on quality, delivery, cost and flexibility, and the industry clock-speed moderates this relationship. This study relies on just a limited number of lean practices to examine their effect on operational performance. It also ignores the human practices of lean to evaluate their effect on operational performance.

Kull et al. (2014) developed moderation hypotheses based on the congruence between dimensions of national culture and lean manufacturing practices. Data was collected from more than 1,400 facilities in 24 countries. The lean practices in this study are cellular manufacturing, process redesign, JIT, throughput-time reduction, set-up time reduction, SPC and waste reduction. It was found that lean manufacturing is most effective in countries that value high uncertainty avoidance, low assertiveness, low future orientation and low performance orientation. This paper moves beyond descriptive accounts of lean manufacturing tools, practices, and behaviours by showing what specific cultural values are incongruent with lean practices. This study shows the key cultural dimensions that are useful in predicting the effectiveness of lean manufacturing. The limitation of this study is that it only addresses the technical practices of lean without considering the human practices. Furthermore, this study focuses on the national culture and not the organisational culture.

Khanchanapong et al. (2014) investigated the unique and complementary effects of manufacturing technologies and lean practices on operational performance of manufacturing firms. Their data was collected from 186 manufacturing plants in Thailand. The practices of lean in the study are production flow management, customer focus, process management, supplier management and workforce management. The findings found that both manufacturing technologies and lean practices have unique effects on a range of operational performance factors such as quality and lead-time. In addition, it was found that both organisational resources have synergistic impacts on those operational dimensions. This study did not use comprehensive measurements of lean practices or investigate the complementary effects of organisational culture and human practices of lean on lean technical practices.

Chavez et al. (2015) study investigates the linkages between supplier partnership and customer relationship and internal lean practices. Furthermore, this study investigates the linkages from internal lean practices to operational performance and organisational performance, and assesses the contingency perspective of these relationships with respect to technological turbulence. The study is based on a questionnaire sent to 228 manufacturing companies in the Republic of Ireland. The lean practices used in this study are JIT and set-up time. The results show the importance of supply chain relationships, especially through supplier partnership and customer relationship, in that they are positively related to internal lean practices. In addition to this, the study finds that internal lean practices are positively linked to operational and organisational performance. This study also adds to the understanding of the situations under which internal lean practices affect performance, in that technological turbulence was found to have negatively moderated associations between internal lean practices, operational performance and organisational performance. This study is one of the few empirical studies that investigates the link between customers, suppliers and internal lean practices. Despite its originality, this study used just two internal lean practices and did not consider the role of organisational culture.

Zahraee (2016) has identified the effective practices and tools of lean manufacturing implementation in Iranian manufacturing firms. The lean manufacturing practices in this study are process and equipment, manufacturing planning and control, human resources, supplier relationship and customer relationship. The results indicate that all lean practices are significant practices in lean manufacturing in Iranian manufacturing firms. This paper is from the very limited number of studies that have been conducted in Iran regarding the implementation of lean thinking. Despite that, this study aims to assess the level of lean practices without considering the organisational culture. Table 2.2 summarises the previous studies in this subsection.

Based on the previous discussion, different lean practices have been used in empirical studies. Some studies concentrate more on the technical practices of lean (Chavez et al., 2013, Fullerton and Wempe, 2009, Jayaram et al., 2008, Rahman et al., 2010). Some other studies combined the technical and human practices of lean together in order to evaluate the level of its implementation or to investigate its impact on other factors (Doolen and Hacker, 2005, Ghosh, 2012, Nordin et al., 2010, Taj, 2008). In this thesis, all lean practices as they are described in Shah and Ward's (2007) instrument are adopted. The selected lean practices are identified in subsection 2.2.6. The rationale behind choosing Shah and Ward's (2007) lean practices in the current study is the following:

1- The chosen lean practices have been empirically validated using confirmatory factor analysis (Shah and Ward, 2007). Shah and Ward (2007) identified a key set of measurement items by charting the linkages between measurement instruments that have been used in previous literature, and used a rigorous, two step empirical method by collecting data from a large set of manufacturing lean companies. Thus, they conclude that ten factors provide support to the multidimensional and integrated nature of lean production system.

2- The selected lean practices are more comprehensive than other measures observed in literature as it reflects the lean landscape more broadly by including both internal and external dimensions. Some previous studies have adopted only a specific or a narrow sub-group of lean practices (Chavez et al., 2013, Yang et al., 2011).

3- The chosen lean practices are the best for achieving the aim of this study. The aim is to investigate the mediating role of lean human practices in the relationship between organisational culture and lean technical practices. Thus, the aim of the study requires employing both technical and human practices of lean. Shah and Ward's (2007) instrument is considered appropriate to be used in the current study because it combines both types of practices.

Table 2-2 Summary on Key Studies Addressed Lean Manufacturing Practices

Author	Year	Country	Lean practices	Main finding in the study
Martínez Sánchez and Pérez Pérez	2001	Spain	Elimination of waste Continuous improvement JIT production and delivery Multifunctional teams Integration of suppliers Flexible information systems	The average use and the degree of importance of most lean practices are significantly greater in the large companies than in small and medium-sized companies.
Soriano-Meier and Forrester	2002	UK	Elimination of waste Continuous improvement Zero defects JIT deliveries Pull of raw materials Multifunctional teams Decentralisation Integration of functions Vertical information systems.	The degree of leanness is the most important variable to measure performance of the company and companies are considered lean if the mean value of degree of leanness and degree of commitment are above average.
Shah and Ward	2003	USA	JIT TQM TPM HRM	The firm size has the most influence on lean practices implementation compared to the plant's age and unionisation. In addition, all lean bundles have a significant positive effect on performance and explain about 23per cent of the variation in operational performance after accounting for the effects of industry and contextual factors.
Doolen and Hacker	2005	USA	Manufacturing processes and equipment Shop floor management New product development Supplier Relationships Customer Relationships Workforce Management	While electronic manufacturers have implemented a wide range of lean practices, the level of lean implementation varies and may be related to different factors.

Shah and Ward	2007	USA	Supplier feedback JIT delivery Developing suppliers Involved customers Pull, Flow, Low set-up time Controlled processes TPM Involved employees	Developing an operational measure of lean production that can be used as a framework, including both internal and external dimensions of lean
Taj	2008	China	Inventory, The team approach, Process, maintenance, layout and handling, Suppliers, Set-up time, Quality management, Scheduling/control.	The assessment shows that the petroleum industry is the leader among all industries, followed by computer and electronics industries.
Jayaram et al.	2008	USA	JIT manufacturing Cellular Manufacturing Set-up time Reduction	After statistically examining the relationship between suppliers and customers with two sides of lean strategy: lean manufacturing and lean design, it has been found positive relationships exist between variables.
Fullerton and Wempe	2009	USA	Set-up time reduction Cellular manufacturing Quality improvement	Providing a proof that utilisation of non-financial performance measures moderates the relationship between lean practices and financial performance.
Rahmanet al.	2010	Thailand	JIT Waste elimination Flow management.	All lean constructs positively enhance the operational performance.
Yang et al.	2011	International	JIT flow Quality Management Employee involvement	All lean practices are positively related to environmental management practices.

Nordin et al.	2011	Malaysia	Process and equipment Manufacturing planning and control HRM Supplier Relationship Customer Relationship	The Malaysian firms are in transition towards lean practices implementation and the main barrier of its implementation is the lack of understanding of lean concepts.
Hofer et al.	2012	USA	Supplier feedback, Supplier Development, JIT, Customer involvement, Pull, Flow, Set-up reduction, SPC, Employee involvement, TPM	The impact of lean practices implementation on financial performance is partially mediated by inventory leanness.
Alsmadi et al.	2012	UK	Supplier feedback JTT delivery Developing suppliers Involved customers Pull, Flow, Low set-up time Controlled processes TPM Involved employees.	Both manufacturing and non-manufacturing sectors are identical with respect to lean implementation and there is a positive relationship between lean practices and firm's performance.
Vinodh and Joy	2012	India	Management responsibility Manufacturing management Technology Workforce Manufacturing strategy	All practices are correlated with each other and help to improve the organisational performance.
Nawanir et al.	2013	Indonesia	Flexible resources, Cellular layout, Pull System, Small lot production, Quick set-ups, Uniform production level, Quality at the source, TPM, Supplier networks.	All lean factors have positive impact on both operational performance and business performance.

Ghosh	2013	India	Supply Performance Focus on customers' needs Implementing pull system Set-up time reduction TPM SPC Cross Departmental Problem Solving	The Indian plants are at an advanced level of lean practices implementation and have achieved positive operational performance by implementing lean.
Chavez et al.	2013	Ireland	Set-up Reduction JIT	There is a positive relationship between internal lean practices and operational performance. In addition, the environmental dynamism influences this relationship.
Kull et al.	2014	International	Cellular manufacturing Process redesign JIT Throughput time reduction Set-up time reduction SPC Waste reduction	The countries who find lean manufacturing more effective will value ways to avoid uncertainty in a cooperative manner. In addition, the countries, which value long-term, future planning and concrete performance achievements will struggle with implementing lean manufacturing.
Khanchanapong et al	2014	Thailand	Production flow management Customer focus Process management Supplier management Workforce management	Both manufacturing technologies and lean practices have significant impacts on most operational performance dimensions such as quality, lead-time and cost.
Chavez et al.	2015	Ireland	JIT Set-up time	Supplier partnership and customer relationship are positively related to internal lean practices. As well as, the internal lean practices are positively linked to operational and organisational performance.
Zahraee	2016	Iran	Process and equipment Manufacturing Planning and control Human resources Supplier Relationship Customer relationship	All lean practices used in this study are considered significant practices in lean manufacturing in Iranian manufacturing firms.

2.2.7 Applicability of Lean manufacturing in Different Contexts

The pioneers of lean, Womack and Jones (2003), claim that lean is spreading rapidly to all regions of the world, and the lean enterprise is the solution for competing in the global market. A study has been done by Li (2007), around how the concept of lean, has been disseminated throughout the world; the researcher refers to 40 empirical articles from 1993 to 2007. The results of the study found that the UK and USA are the two countries applying the lean concept most, and those following from highest to lowest are: Japan, France, Sweden, Spain, Mexico, China, Singapore, Australia, Netherlands, Ireland, Canada, Germany. In addition, it has been found that Turkey, Germany, India, South Africa and the Far East are the countries applying lean concept least.

In another recent study conducted by Bhamu and Singh Sangwan (2014), 209 research papers about lean manufacturing between 1988 and 2012 are reviewed. The results of this study found that authors from the USA and UK publish half of the papers. Indian authors published also 13 per cent of the papers and most of these studies are conducted empirically in the Indian automotive industry. Additionally, there are authors from many European countries such as Spain, Sweden and Australia. Few studies have been conducted in China, Italy, Malaysia, Taiwan, Brazil, Canada, Netherlands, Denmark, Hungary, Greece, Norway, Belgium, Germany and Korea. The number of studies in each of the abovementioned countries ranges from two to seven. Surprisingly, the number of studies published in Japan is just two. One of the reasons for this may be that the Japanese prefer the term Toyota production system over lean manufacturing.

According to Li (2007) and Bhamu and Singh Sangwan (2014), the automotive industry is the most popular sector for applying lean concepts smoothly. Successful experiences from Toyota inspire other automotive manufacturers to follow this paradigm. However, the lean implementation began in the automobile sector and soon its application was adopted by other different industries (Bhamu and Singh Sangwan, 2014). For instance, the high-tech industry is the second most popular sector that applied lean practices. This sector includes computer, electronics, and telecommunications (Hallgren and Olhager, 2009, Wong et al., 2009). Other industries include the textile industry (Comm and Mathaisel, 2005), the tile industry (Bonavia and Marin, 2006), the construction industry (Wang et al., 2005, Yu et al., 2009), the steel industry (Dhandapani et al., 2004), the food industry (Al-Nsour et al., 2012, Rashid et al., 2010), the medical and pharmaceutical products (Chowdary and George, 2011), the chemical and plastics industry (Serrano Lasa et al., 2008) and the furniture industry (Hunter et al., 2004). The service sector is another industry that has implemented lean practices. This sector includes financial services (Bortolotti and Romano, 2012) and human health (Atkinson and Mukaetova-Ladinska, 2012). Lean manufacturing can be applied easily, but based on contingency theory there is no one good solution to meet greater performance, and that the context of operations is of the utmost importance (Shah and Ward, 2003). Contingency theory will be discussed later in chapter three (subsection 3.2.2).

Bhamu and Singh Sangwan (2014) conclude in their paper that the demographic representation of authors proves that the lean manufacturing concept and its application has spread all over the world. When Toyota began expanding outside of Japan, many believed that its Eastern culture was more conducive to high quality manufacturing and that Western countries, especially the USA, would not be able to apply the TPS. Toyota provided evidence that its approaches could work everywhere and became a global manufacturer (Naor et al., 2010). Therefore, it is not strange to shed the light on lean manufacturing practices in Jordan, which represents an emerging economy in the Middle East. The current study will take into consideration all the manufacturing sectors in Jordan to generalise the results for all manufacturing sectors, not just for a limited number of sectors. The next subsection presents the main studies conducted in Jordan to understand to what extent lean concept has been studied in that region.

2.2.8 Lean Manufacturing in the Jordanian Context

The severe competitive situation that moved towards a global basis has forced many manufacturing firms in the developing countries such as Jordan to adopt innovative operational practices, such as lean systems, to remain competitive (Zu'bi, 2015). Womack and Jones (1990, p.9) argue that "we believe that the fundamental ideas of lean production are universal – applicable anywhere by anyone – and that many non-Japanese companies have already learnt this".

In a review of literature about lean manufacturing in the Jordanian context, it has been found that the studies in this country are recent in date and few in number. This subsection gives a good summary about the most recent and important studies that have been conducted in Jordan because it represents the field of the current study. More information will be provided about Jordan and the status of the manufacturing Jordanian industry in chapter 4. According to Smadi (2012) study, the extent of applying lean supply practices in the garments manufacturing companies in Jordan has been explored. The author selects five lean practices and all of them represent lean supply concept. These practices are supplier feedback, JIT delivery, supplier development, customer involvement, and facilitation of JIT production. A survey questionnaire has been used for data collection by employees who occupy managerial positions in the garments sector. It has been found that the garments industry in Jordan adopts the lean supply practices with a high degree at all aspects, except for supplier development, which was given an average rating.

Al-Nsour et al. (2012) explored the extent of implementing the lean production concept and its effect on the competitive advantage. Four lean practices were used in the study. These are JIT, set-up time reduction, cellular layout and TPM. Data was collected from 43 companies specialising in fast food moving consumer goods. The statistical analysis of the study has shown that lean manufacturing practices have a positive significant impact on the competitive advantage of the food-manufacturing firms specialising in fast moving consumer goods. In addition, it has been found that no differences occurred on the effect of lean production on the competitive advantage due to the demographic variables.

Al-Tahat and Jalham (2015) used SEM to examine the impact of lean production on lean-based quality and productivity performance. The model in this study involved eight lean practices. Some of these practices are variability reduction, visual control, and quality at the source, Kaizen, root cause analysis and TQM. The data was collected from 300 Jordanian manufacturing firms. The results of the study provide strong evidence that all the considered lean practices have a positive significant effect on lean-based quality and productivity improvement.

In a recent study for Al Hasan and Zu'bi (2014) in the Jordanian pharmaceutical sector, the relationship between lean manufacturing dimensions and radical product innovation has been assessed. The lean practices entail continuous improvement, waste minimisation, lean job characteristics and employee involvement. They used a survey-based questionnaire to collect data from ten pharmaceutical companies and multiple regression analysis was conducted to achieve the objective of the study. It has been found that continuous improvement and waste minimisation practices have no significant effect on radical product innovation, while the other two practices, lean job characteristics and employees' involvement, have a positive significant effect on radical product innovation. Moreover, it has been found that employee involvement has the highest positive effect on radical product innovation. This study is from the first studies highlighting the role of the human side of lean in radical innovation.

In another recent study for Zu'bi (2015), an investigation of the effect of internal lean practices on flexibility performance has been examined. In addition, the study has examined the moderating effect of environmental dynamism. The lean practices in this study are set-up time reduction, continuous improvement, synchronisation of operations, and pull system. A survey questionnaire has been used to collect data from 157 manufacturing firms from different industry types. The hierarchical regression analysis, which has been used in the study, revealed that lean practices positively and significantly affect flexibility performance. The synchronisation of operations has the greatest positive effect followed by pull system and continuous improvement. Additionally, it has been found that the environmental dynamism positively and significantly moderated the relationship between synchronisation of operations and flexibility performance.

In an action research for Arafeh (2015), the six sigma methodology has been adopted to systematically apply lean manufacturing concepts and tools in order to improve productivity in a local Jordanian company specialising in the manufacturing of safety and fire resistance metal doors and windows. The implementation includes the use of different quality and lean manufacturing tools, such as value added flow charts and Pareto diagrams. Throughout the various project phases, a reduction in the production cycle time had occurred. In addition, the study helps in eliminating the non-value-added activities in different processes, and the percentage of defective doors dropped from 100 per cent to 15 per cent.

In a study for AL-Tahat and Bwaliez (2015), the relationship between workforce management system and lean production has been statistically investigated in ten Jordanian manufacturing sectors. The results show that the selected sample of firms can be described as 'very good' implementers for lean production practices. The best implementation level has been achieved by the construction sector and the worst by the engineering industries sector.

Al-jawazneh (2015) has studied the impact of internal lean dimensions on the manufacturing based quality of food processing firms in Jordan. The internal lean practices in this study are: pull system, continuous flow, set-up time reduction, TPM, SPC, and employee involvement. A survey questionnaire has been used to collect data from people who work in the production unit. It has been found that the internal lean dimensions have a positive significant effect on the manufacturing based quality represented by many dimensions such as lower food products processing, conforming to high quality standards and lower defects rate. This positive effect helps the selected sample of companies in delivering the products on time and the optimisation of the utilisation of their manufacturing resources, such as machines and equipment, raw materials, and labour force.

Based on the previous literature about lean manufacturing in Jordan, it is concluded that most studies are too recent and just focus on investigating the impact of lean manufacturing as an independent variable on other factors considered as dependent variables such as competitive advantage (Al-Nsour et al., 2012), productivity performance (Al-Tahat and Jalham, 2015), radical product innovation(Al Hasan and Zu'bi, 2014) or flexibility performance (Zu'bi, 2015). No previous studies in Jordan have investigated the effect of organisational culture on lean manufacturing practices. Therefore, this is the first study in a Jordanian context that examines the effect of organisational culture on lean technical practices, as well as explaining the mechanism of how the organisation culture affects lean technical practices through the utilisation of the human side of lean.

2.3 An Overview of Organisational Culture

Despite the importance of organisational culture and its study, one major challenge is still existent about what exactly organisational culture is and how it should be studied (Jackson, 2011). Culture may usefully be compared to an iceberg in which people can only observe the small part that lies above the water's surface. The most difficult to identify is the deeply embedded values and beliefs that represent the core culture of a group (Davison and Martinsons, 2003). This subsection provides a review of literature on organisational culture and its measures with a focus on the CVF, which is adopted in the current study, and how it has been used in previous research.

2.3.1 What is an Organisational Culture?

The term 'culture' has its origin within social anthropology and has been primarily used in a holistic way to explain the traits of human beings that are passed from one period to the other (Karimi and Kadir, 2012). Schein (2010) defines culture as both a '*here and now'* dynamic phenomena and a coercive background structure that affects us in different ways. Although there are many definitions for organisational culture, it has been considered as holistic and socially constructed (Demir et al., 2011). Some managers and organisational researchers use culture to describe the norms and behaviours that organisations develop around their handling of individuals (Schein, 2010). One of the popular definitions of organisational culture is Schein’s (2010, p.18) definition. He defines culture as "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".

Quinn and Robert (2011) define the organisational culture as a representative approach for "how things are going here". It reflects the dominant ideology that people carry inside their minds. It transfers a sense of identity to employees, provides non-verbal guidelines for how to behave in the organisation, and it helps stabilise the social system. Strode et al. (2009) define the organisational culture as a shared belief system that penetrates the whole organisation or a subunit and eventually affects the actions of people and work groups. Schermerhorn (2014) describes the organisational culture through two levels: the observable culture and the core culture. The observable culture is visible and anyone can see and hear when walking around an organisation as a visitor, a customer or an employee. The observable culture can be learned by employees in a number of ways, described by Robbins and Coulter (2016) and Schermerhorn (2014) as follows:

1- Stories/ Heroes: These Usually include a narrative of significant events or people, including, for example, the organisation's founders, rule breaking, reactions to past errors, etc. Such stories are told and retold among members to help in transferring what is important and give examples that individuals can learn from.

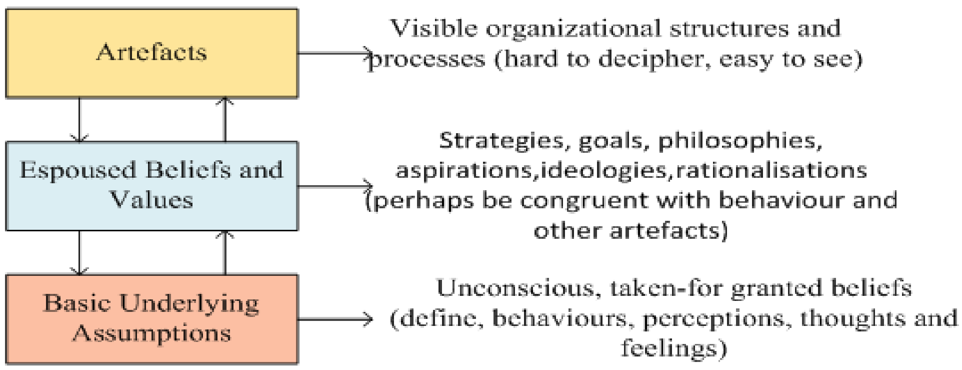
2- Rituals: These are repetitive sequences of activities that express and emphasise the essential values and goals of the organisation. Rituals are represented by the ceremonies and meetings to celebrate important occasions.

3- Material artefacts and symbols: These are nonverbal expressions that demonstrate the power of material symbols or artefacts in creating an organisation's personality and to communicate important themes of organisational life. Examples include the layout of an organisation's facilities, dress of employees, types of cars offered to top managers, the size of offices, and the extra benefits offered to people such as employee fitness centres or health club memberships.

4- Language: This is considered as a common denominator that bonds members because many organisations use language as a method to identify and unite members of a culture. By learning this language, individuals attest to their acceptance of the culture and their willingness to help preserve it.

The second and deeper level of organisational culture is the core culture. It includes the underlying assumptions and beliefs that shape and guide members’ actions, and contributes to the elements of observable culture just described. Similarly, according to Schein (2010) there are three levels for the organisational culture as illustrated in figure 2.2.

Figure 2-2 Three Levels of Organisational Culture



Source: Schein (2010, p.24)

As shown in figure 2.2, the three levels range from the very tangible public demonstrations that people can see and feel, to the unconscious basic values and assumptions, which are the essence of culture. In between these levels are different adopted values, norms and rules of behaviour that individuals use as a method of representing the culture to themselves and others (Schein, 2010).

Based on the previous discussion, it is apparent that the organisational culture has been described as the shared values, principles, traditions and ways of doing things that influence the way the organisational members behave and that differentiate the organisation from other organisations. The organisational culture has two main levels: the core level(Schermerhorn, 2014), which is described by Schein (2010) as the basic underlying beliefs, feelings, perceptions and thoughts, and the observable level or artefacts (Schermerhorn, 2014, Schein, 2010) which is visible and tangible for anyone inside or outside the organisation.

2.3.2 Measuring Organisational Culture

Many researchers (Denison and Spreitzer, 1991, O'Reilly et al., 1991, Quinn and Robert, 2011, Quinn and Spreitzer, 1991, Schein, 2010, Hofstede, 2011) have studied organisational culture in different perspectives and developed different measures and dimensions to describe organisational culture. Because of the many different measurements to organisational culture, this subsection aims to describe the most popular approaches and frameworks for measuring organisational culture as have been found from the literature review.

According to the Hofstede (2011) model, there are six dimensions representing the culture of any organisation. These dimensions are **process-oriented vs results oriented**, **employee oriented vs job oriented**, **and parochial vs professional**, **open system vs closed system**, **loose control vs tight control**, **and normative vs pragmatic**. These dimensions are illustrated and defined in table 2.3.

Table 2-3 Hofstede's Framework for Measuring Organisational Culture

Dimension	Description
Process oriented vs results oriented	Process oriented culture is governed by technical and bureaucratic routines whereas results oriented culture is led by a common concern for outcomes.
Employee oriented vs job oriented	Employee-oriented culture assumes a big responsibility for the members' well-being, while job-oriented culture assumes responsibility for employees' job performance only and nothing more.
Parochial vs professional	The parochial members derive their identity from the organisation for which they work, while the professional people identify primarily with their profession.
Open system vs closed system	Refers to the familiar internal and external way of communication, and to the ease with which outsiders and newcomers are admitted.
Loose control vs tight control	Deals with the degree of formality and punctuation within the organisation.
Normative vs pragmatic	Describes the flexible or rigid dominant way of dealing with the external environment especially with customers.

Source:(Hofstede, 2011)

Another classification for organisational culture is called an Organisational Culture Profile (OCP) which was developed by O'Reilly, Chatman, and Caldwell (O'Reilly et al., 1991). OCP includes seven dimensions as follows: innovation, outcome orientation, and respect for people, team orientation, stability, aggressiveness, and attention to detail. These dimensions have a range from low to high. Describing an organisation based on these seven dimensions offers a composite picture of the organisation's culture. In many organisations, one cultural dimension is often emphasised more than the others and significantly forms the organisation's personality and the way organisational members act (Robbins and Coulter, 2016).

Moreover, Denison (1990) identifies four basic views of organisational culture as shown in table 2.4.

Table 2-4 The Four Propositions of Organisational Culture

	Stability/ control	**Change/ flexibility**
Internal	Consistency	Involvement/participation
External	Mission	Adaptability

Source: Baker (2002, p.5)

The four views are explained into four distinct propositions (Baker, 2002). These are:

- The consistency proposition: proposes that the shared beliefs and values among the organisational participants will motivate internal coordination and promote meaning and a sense of identification on the part of its members.
- The mission proposition: assumes that a shared sense of purpose, direction, and strategy can coordinate and drive organisational members to achieve collective goals.
- The involvement/participation proposition: assumes that involvement and participation will contribute to a sense of responsibility and ownership and, hence, organisational commitment and loyalty.
- The adaptability proposition: proposes that norms and beliefs that enhance an organisation's ability to receive, interpret, and translate signals from the environment into internal organisational and behavioural changes will promote its survival, growth and development

The four propositions focus on different aspects of culture. The first two ideas focus on stability, while the second two allow for change. The first and third types focus on internal organisational dynamics while the second and fourth types addressing the relation of the organisation to its external environment (Baker, 2002).

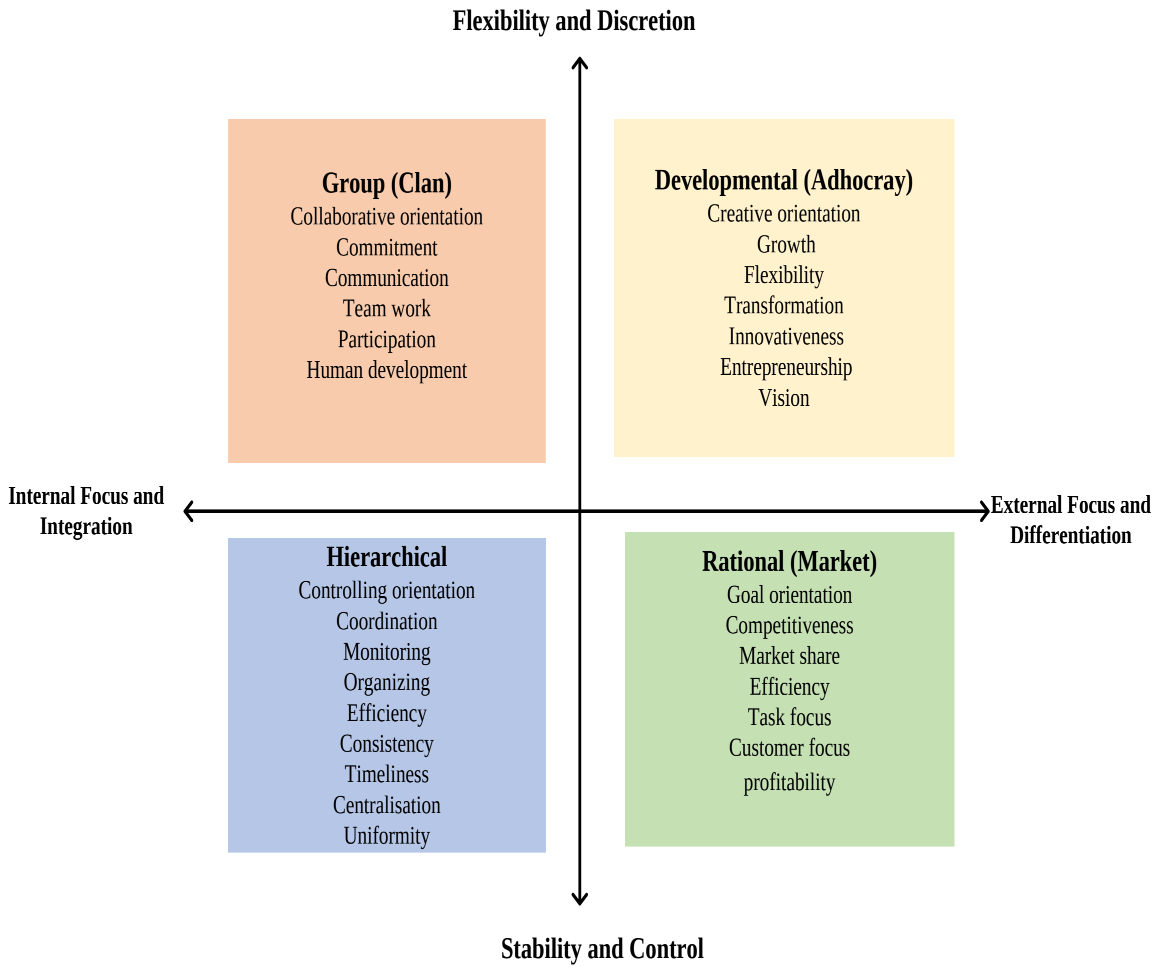
The last approach for measuring organisational culture is the CVF. This framework was created originally by Quinn and Rohrbaugh (1983) with the idea of identifying the values that organisational members held as valuable to organisational effectiveness. Relying on the work of Quinn and Rohrbaugh (1983), Quinn and Spreitzer (1991) developed a more specific model for classifying organisational culture types and called this model 'competing value framework'. In this framework, they identify two main assumptions as follows:

(1) An organisation's culture would be represented by a profile in the two- dimensional area rather than a single point. This means that a high rate on one dimension does not eliminate a high rate at the other end.

(2) An effective organisation will present some level of balance between the four different cultural types.

CVF has been built on two dimensions as shown in figure 2.3. The first dimension is a flexibility-control dimension. This dimension represents the extent to which the organisation focuses on change and stability. The second dimension represents an internal-external dimension and it examines to what extent the organisation focuses on the internal practices and the external environment (Cameron and Quinn, 2011).

Figure 2-3 The Competing Value Framework



Source: Cameron and Quinn (2011, p.53), Pakdil and Leonard (2015, p.728).

As shown in figure 2.3, together these two dimensions form four quadrants, each representing a specific type of organisational culture with a distinct set of characteristics. The four cultural types are:

1-Group or clan culture: Cameron and Quinn (2011) describe the organisation in this type as a big family in which the managers motivate, help, encourage and cooperate with their subordinates to develop their skills. The work environment depends on trust, teamwork and participation. Organisations characterised by this type help to decrease the functional barriers among all organisational members (Naor et al., 2010, Zu et al., 2010).

2-Developmental or Adhocracy culture: This type concentrates on an organisation's desire to grow in its activities in different ways, such as innovation and creativity (Zu et al., 2011). Organisations characterised by this type strive to be a leader in the market through introducing new products to satisfy customers. Therefore, the employees are rewarded according to their creativity (Chung et al., 2010).

3-Hierarchical Culture: this type depends on stability and control. It is related to the bureaucratic firms (Quinn and Rohrbaugh, 1983). All employees who work in organisations characterised by this type rely on specific rules and processes to perform their tasks. Its main goal is to keep the successful operations and efficiency in production. Also, the employees are rewarded according to their hierarchical levels (Chung et al., 2010, Zu et al., 2011).

4-Rational or market culture: This is a competitive type, which values what the company can achieve in the market. It places an emphasis on productivity, performance, and achieving goals. Organisations characterised by this type place a great importance on efficient planning and tight control of production, aiming to achieve high productivity and gain competitive advantage (Denison and Spreitzer, 1991).

2.3.2.1 Rationale behind using the CVF in the Current Study

The CVF model of organisational culture has been adopted in the current study for the following reasons:

First: The contrasting values captured under CVF provide a logic reason for choosing this model of organisational culture over other models. In this study, the dimensions of flexibility and control are critical to test whether the underlying cultures are required for the successful implementation of lean practices.

Second: CVF integrates the majority of organisational culture dimensions offered in theory (Yu and Wu, 2009).

Third: Many authors had verified the reliability and validity of the CVF in their previous empirical studies (Duygulu and Özeren, 2009, Howard, 1998). Therefore, it is believed that using a reliable and valid instrument in this study is a strong reason for adopting it.

Fourth: It is one of the most significant and extensively used models for developing the profile of an organisation's culture in an accurate and simple way (Cameron and Quinn, 2011).

Fifth: CVF has been used in previous empirical studies in the operations management field. Many authors have adopted the CVF in different fields of operations management (Haffar et al., 2013, Karimi and Kadir, 2012, Prajogo and McDermott, 2005, Prajogo and McDermott, 2011, Strode et al., 2009, Zu et al., 2011). Examples of some recent studies will be discussed in the next subsection.

2.3.3 Competing Value Framework in Previous Studies

This subsection aims to present how the CVF has been used in the field of operations management and manufacturing firms during the period 2003-2014.

Lund (2003) used the CVF to examine the impact of organisational culture on job satisfaction in manufacturing and non-manufacturing firms in the USA. It has been found that clan (group) and adhocracy (developmental) cultures are positively correlated with job satisfaction while the market (rational) and hierarchy cultures are both negatively associated with job satisfaction.

Cheng and Liu (2007) used the CVF to explore the ideal cultural type in the construction firms in Hong Kong to implement TQM concept successfully. They concluded that the ideal organisational culture for quality management depends on different dimensions. For instance, the hierarchical culture is best for leadership, organisation glue and criteria of success, while the rational culture is best for the strategic focus and the clan or developmental culture is best for workforce management.

In a study for Strode et al. (2009), the authors have adopted the CVF to explore the impact of organisational culture on the usage of agile method techniques. Based on multi- case study of nine projects, they found that specific organisational cultural factors correlate with the effective use of an agile method. Some of these factors are the existence of innovative, entrepreneurial and risk taking leadership, in addition to the loyalty, commitment and mutual trust between organisational members.

Zu et al. (2011) used the CVF to investigate the effect of cultural profile on quality management (TQM) and six sigma's implementations in manufacturing firms in China. They found that the cultural profile is a unique factor to show the difference between organisations with respect to TQM and six sigma's implementations. In addition, they been found that companies in the different cultural profiles show significantly different degrees of TQM and six sigma's implementation. Prajogo and McDermott (2011) used the CVF in manufacturing and non-manufacturing firms in Australia to investigate the relationship between the four cultural dimensions of the CVF and four types of performance: product quality, process quality, product innovation and process innovation. They found that the developmental culture is the strongest predictor among the four cultural types, as it shows relationships with product quality, product innovation and process innovation.

Karimi and Kadir (2012) conducted a study in the oil industry in Iran using the CVF to investigate the relationship between organisational culture and the implementation of quality management practices. They found that the rational culture and group culture have a significant positive impact on both hard and soft quality management practices. In the same field, Haffar et al. (2013) used the CVF to examine the impact of organisational culture on TQM implementation in the manufacturing firms in Syria. They found that the healthiest cultures in TQM are the adhocracy (developmental) and the group culture.

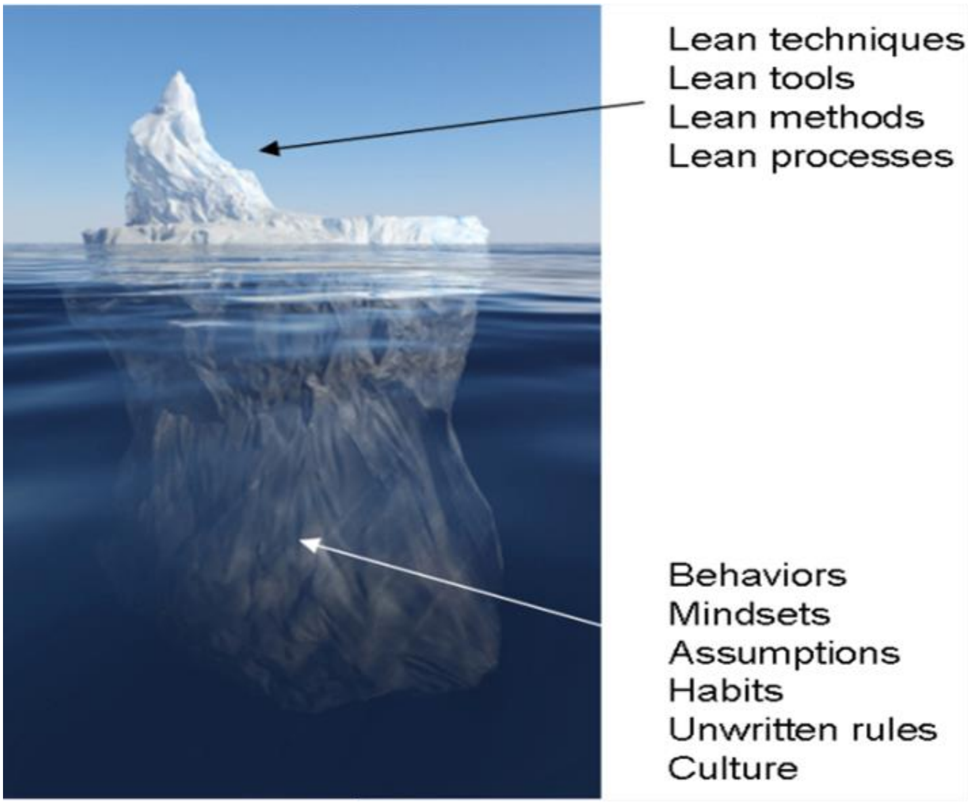
Finally, in an international study, the CVF was adopted by Naor et al. (2014) to investigate the relationship between organisational culture and organisational effectiveness dimensions in 238 manufacturing firms in eight countries. They found that different cultural types are significant in East and West regions based on the effectiveness element prioritised by the firm.

From the discussion of the previous studies, it can be concluded that the CVF has been used with different managerial practices, such as TQM (Karimi and Kadir, 2012, Prajogo and McDermott, 2011, Zu et al., 2011), organisational effectiveness (Naor et al., 2014) and job satisfaction (Lund, 2003). Few studies have used the CVF in the context of lean manufacturing (Bortolotti et al., 2015, Hardcopf and Shah, 2014, Pakdil and Leonard, 2015). These studies will be explained in the next section, 2.4.

2.4 Organisational Culture and Lean Manufacturing

Hines et al. (2011) argue that applying lean is best illustrated by an analogy with an iceberg as shown in figure 2.4.

Figure 2- 4 Lean Iceberg Model



Source: Miller (2011)

The important part is not what is seen, it is generally what people do not see that is more important (Hines et al., 2011). Miller (2011) explains the iceberg saying that lean methods, tools and techniques such as Kanban, TPM, standard work and so forth are what lie above the water within a firm trying to implement lean practices. What lies below the water line are those invisible behaviours, assumptions and beliefs, and unwritten 'how we do things' that make up the culture of an organisation. Miller (2011) adds that lean implementations fail when we fail to look under the water and address these behaviours and mind-sets. This view is consistent with the three levels of organisational culture for Schein (2010) which are illustrated in figure 2.2, in that organisational culture starts from the deeply unconscious basic values and assumptions which are the essence of culture to the very tangible artefacts that people can see and feel. Moreover, Hines et al. (2011) confirm that the way through the lean iceberg is not always smooth and the way a firm takes depends on its organisational characteristics such as *its culture.*

Based on the definition of Shah and Ward (2007), who define lean manufacturing as an *integrated socio-technical system* that aims to eliminate waste by continuously reducing or minimising supplier, customer, and internal variability, it can be argued that the technical practices of lean represent the visible aspects of organisational culture. This refers to the use of tools and techniques that can be implemented as part of lean. When it comes to the human practices of lean, this represents more the hidden and core aspects of organisational culture. Schein (2010) confirms that organisational culture is even more important today than it was in the past. Increased competition, globalisation, mergers, acquisitions, alliances, and different human developments have developed a greater need for increasing efficiency, quality, and speed of designing, manufacturing and delivering products, and the ability to successfully introduce new technologies, such as lean philosophy. Therefore, focusing on culture in organisations is one of the basic fields in research (Karimi and Kadir, 2012).

Wong (2007) argues that during the implementation of lean manufacturing, there is an urgent need for cultural adaptation. Lean cannot exist in a firm where the culture is against it. Also, the organisational culture is a prerequisite for the success of lean implementation (Bhasin and Burcher, 2006). The transformation process to lean manufacturing needs a lot of work and participation at all organisational levels, introduction of new principles not only on the shop floor level but also in the organisational culture (Papadopoulou and Özbayrak, 2005). In the next subsection, the focus is devoted to the limited number of previous studies which link organisational culture with lean manufacturing during the period 2006-2015, because it is observed in literature that this topic appeared more clearly just ten years ago.

The relationship between lean manufacturing implementation and organisational culture is very sensitive because different countries have different traditions, labour density, degrees of development, industrialisation, education, land prices and other issues. Companies should take these issues into consideration when implementing lean manufacturing (Bhamu and Singh Sangwan, 2014). Cultural support for lean implementation is recommended as a precursor to the application of lean practices (Chen and Meng, 2010, Perez et al., 2010).

The creation of a supportive organisational culture is the essential basis for lean implementation and the organisational culture is considered one of the critical factors for the success of lean manufacturing adoption (Saad et al., 2006). Mi Dahlgaard-Park and Dahlgaard (2006) discussed in a conceptual paper the main concepts behind lean production, such as six sigma quality and TQM. They conclude that there is too much concentration on training people in how to use the tools and techniques of lean, but at the same time, too little focus is given to understanding the human side and how to build the right company culture.

Bhasin and Burcher (2006) developed a literature analysis about "lean viewed as a philosophy". This is one of the few studies with a holistic approach to lean. The authors tried to combine lean practices with a lean culture. In their conclusion, they argue that the right culture is needed to implement lean, and list at least ten cultural values for implementing lean philosophy, some of these values are:

1. Making decisions at the lowest levels in the organisation.
2. Clarity of vision; a guide of what the organisation believes it will look like once the transformation is complete.
3. Ensuring that there is a strategy of change.
4. Developing supplier relationships based on mutual trust and commitment.
5. Nurturing a learning environment.
6. Systematically and continuously focusing on the customer.
7. Promoting lean leadership at all levels.
8. Making a conscientious effort to maximise stability in a changing environment.

This study is one of the most important studies addressed the importance of organisational culture in lean implementation through giving many suggestions. Despite its importance, it could not identify a specific type of organisational culture as ideal for implementing lean practices.

According to Taleghani (2010), it is not only necessary to implement most of the technical tools for a lean manufacturing system, but the *organisational culture* should also change. This study shows that the lack of comprehensive and suitable lean knowledge related to probable problems within the companies by the managers, direction, gap and a lack of recognition of lean culture in the whole organisation cause the failures within lean implementations. Additionally, some managers try to enhance the implementation by some of the lean tools and mostly try to only implement 'continuous improvement' and explicitly forget another basic lean principle: respect for people. This study sheds light on the importance of the organisational culture in lean implementation but without giving any empirical solutions.

Badurdeen et al. (2011) developed a survey tool to compare what employees say about their cultural values in their lean organisations. They created a hierarchical framework of explicit values and behaviour. These values are based on the Toyota Way (TW) as an indirect means to evaluate the culture and value system required for lean transformations. The authors relied on two main constructs or pillars of the Toyota Way. The first pillar is continuous improvement (hard side) and the second one is respect for people (the soft side). It has been found that the ideal culture for successful lean transformation is hard to specify because each organisation has its specific values and may be not easy to access, as well as the fact that the problem in implementing lean is not in the techniques used but in the cultural characteristics of forms. The preliminary results of this study suggest that there should be more examination about the relationship between cultural type, explicit values and successful lean implementation.

In the same manner, Čiarnienė and Vienažindienė (2012) recommended that firms should create an appropriate corporate culture along with lean manufacturing initiatives, in order to increase the effectiveness of lean solutions. This paper simply presents a conceptual model for lean implementation process and confirms that lean implementation requires the establishment of an organisational culture that makes the process possible. This culture will ensure that employees feel empowered and have the necessary tools to gain product and process ownership, focused team work and autonomy in the development of solutions and process improvements.

Sarhan and Fox (2013) study sought to identify and assess the possible barriers to the successful implementation of lean practices. Based on an extensive literature review, followed by a statistical analysis of data gained from a questionnaire survey, which targeted practitioners in the UK construction industry, several barriers were identified as key. They found that the organisational culture is from the key top barriers that hinder the successful implementation of lean in the UK. Ahmad (2013) provides in his conceptual paper a clear overview about culture in lean manufacturing. The author has developed a lean culture framework but without testing it empirically. At the end of his paper, he calls for further study to prove the validity of cultural impact on lean transformation.

Hardcopf and Shah (2014) assessed the role of organisational culture in realising performance benefits from lean. The authors developed a moderation model to test the role of four organisational cultures as represented in the CVF, and to test the role of cultural ambidexterity, on the ability of lean to deliver manufacturing performance benefits, as measured by cost, quality, delivery and flexibility. They found that lean's significant and positive effect on cost performance is robust to organisational culture. Furthermore, they found that lean's effect on delivery performance is also robust to organisation culture, except for an overly rational culture. In addition, it was found that lean's effect on quality and flexibility is dependent upon having a developmental culture. An important observation made is that the developmental culture is the most supportive of lean. Finally, they found that the cultural ambidexterity, such as an ability to manifest multiple different cultures under different circumstances, does not moderate the lean-performance relationship.

A recent investigation for Bortolotti et al. (2015) aimed to examine whether the firms that successfully implement lean manufacturing are characterised by a specific organisational culture profile and extensively adopt soft lean practices. Data were analysed from a High-Performance Manufacturing (HPM) project dataset using a multi-group approach. The results have found that a specific organisational culture profile characterises successful lean firms. The successful lean firms show higher institutional collectivism, future orientation, a human orientation, and a lower level of assertiveness. In addition, the successful lean firms use soft lean practices, such as small group problem solving, employee training, supplier partnerships and customer involvement more extensively than unsuccessful lean firms. This paper is one of the few studies that correlate the organisational culture with both hard and soft practices of lean manufacturing. This study confirms that to succeed in lean implementation, it is necessary to go beyond lean hard practices by adopting soft practices and nurturing the development of an appropriate organisational culture.

Finally, Pakdil and Leonard (2015) developed a conceptual model that discusses the relationship between organisational culture and lean processes. They have identified theoretically the various cultural dimensions and their purported effect on lean implementation and sustainability. This study only provides a brief discussion of lean processes in relation to organisational culture that leads to different hypotheses identifying the various cultural dimensions and their effect on lean implementation. A model of this interaction is developed and still needs empirical analysis. A summary of the previous key studies addressing organisational culture and lean manufacturing relationship is provided in table 2.5

Table 2-5 Key Studies addressed Organisational Culture/ Lean Manufacturing Relationship

Author	Year	Methodology	Main conclusion regarding organisational culture/ lean manufacturing link
Saad et al.	2006	Empirical	The organisational culture is one of the most critical success factors for the successful adoption of lean.
Bhasin and Burcher	2006	Conceptual	The right culture is needed to implement lean,
Mi Dahlgaard-Park and Dahlgaard	2006	Conceptual	Too much attention is given to training people how to use lean tools, but too little focus is given in how to build the right company culture for lean implementation.
Taleghani	2010	Historical review	One of the major problems companies face in applying lean is lack of recognition of the lean culture in the organisation.
Badurdeen et al.	2011	Empirical	The relationship between cultural type explicit values and successful lean implementation needs more investigation.
Sarhan and Fox	2013	Empirical	The cultural barriers are from the top barriers that hinder the progress towards successful lean implementation.
Čiarnienė & Vienažindienė	2012	Conceptual	Firms should create an appropriate corporate culture along with lean manufacturing initiatives to increase the effectiveness of lean solutions.
Ahmad	2013	Conceptual	More attention should be given of the culture in lean manufacturing studies.
Hardcopf and Shah	2014	Empirical	Lean’s significant and positive effect on cost performance is robust to organisational culture. Further, it was found that lean’s impact on delivery performance is also robust to organisation culture, except for an overly rational culture.
Bortolotti et al.	2015	Empirical	A specific organisational culture profile characterises successful lean firms. They show higher institutional collectivism, future orientation, a human orientation, and a lower level of assertiveness.
Pakdil and Leonard	2015	Conceptual	Developing a conceptual model discusses the relationship between organisational culture and lean processes.

2.5 Gaps in Literature

Based on the literature review discussed in this chapter, three main gaps are observed as follows:

Based on the literature review discussed in this chapter, three main gaps are observed as follows:

Gap 1: Many authors have focused on assessing the level of lean practices implementation in different contexts (Martínez Sánchez and Pérez Pérez, 2001, Nordin et al., 2010, Taj, 2008, Ghosh, 2012). Also, most authors (Chavez et al., 2013, Fullerton and Wempe, 2009, Hofer et al., 2012, Nawanir et al., 2013, Rahman et al., 2010, Shah and Ward, 2003, Taj and Morosan, 2011, Yang et al., 2011, Demeter and Matyusz, 2011, Furlan et al., 2011) have examined the effect of lean manufacturing on many types of organisational performance, such as operational performance (Furlan et al., 2011, Taj and Morosan, 2011, Nawanir et al., 2013, Rahman et al., 2010), financial performance (Hofer et al., 2012, Jayaram et al., 2008, Yang et al., 2011) and environmental performance (Demeter and Matyusz, 2011, Yang et al., 2011). Some authors discussed the barriers of implementing lean (Nordin et al.,2010) or the benefits gained from lean implementation (Singh et al., 2010). It is observed that a small number of studies (Bhasin and Burcher, 2006, Wong, 2007) examine the effect of organisational culture on lean practices implementation. Recent literature (Ahmad, 2013, Badurdeen et al., 2011, Saad et al., 2006, Sarhan and Fox, 2013, Taleghani, 2010) argues the critical role of organisational culture in the success of lean practices in theoretical methods more than empirical studies.

Some authors have discussed the importance of organisational culture to implement lean successfully through reviewing the literature or developing a theoretical framework without putting it into practice (Ahmad, 2013, Mi Dahlgaard-Park and Dahlgaard, 2006, Pakdil and Leonard, 2015, Taleghani, 2010). The small number of authors who empirically examined the effect of organisational culture on lean have used different measures and models of organisational culture, such as Hofstede's model dimensions of organisational culture (Bortolotti et al., 2015, Naor et al., 2010) . Until now, the impact of cultural characteristics of the organisation on lean manufacturing using the CVF have not been conducted empirically. It is believed that companies must create a specific type of organisational culture that fits with lean principles and values. Therefore, there is an urgent need to investigate the cultural characteristics in lean manufacturing through new empirical studies using different cultural models.

Gap 2: It is observed that most studies have addressed lean practices without differentiating the nature of these practices. In other words, they combined technical and human practices of lean together in order to assess their level of implementation in a specific context or to investigate their impact on other variables (Al Hasan and Zu'bi, 2014, Al-Nsour et al., 2012, Alsmadi et al., 2012, Chavez et al., 2013, Demeter and Matyusz, 2011, Fullerton and Wempe, 2009, Ghosh, 2012, Hofer et al., 2012, Jayaram et al., 2008, Ramaswamy, 2006). No studies have tried to separate lean manufacturing practices into two categories: lean technical practices and lean human practices to examine the effect of the former on the latter. For example, no studies have tried to examine the effect of customers' involvement or suppliers' development on the successful use of lean technical practices. Therefore, in this thesis, the organisational culture and human practices of lean will be proposed as antecedents for the successful implementation of lean technical practices. The current study is one of the first studies, to our knowledge, that examines the mediating impact of lean human practices on the relationship between organisational culture and lean technical practices.

Gap 3: It is observed that most studies have been conducted in developed countries such as the UK and USA, and some have been conducted in developing countries such as India, Malaysia, Indonesia, etc. (Bhamu and Singh Sangwan (2014). A limited number of studies have been carried out in the Middle Eastern countries such as Jordan. That limited number have concentrated on examining the impact of lean manufacturing on competitive advantage (Al-Nsour et al., 2012), productivity performance (Al-Tahat and Jalham, 2015), radical product innovation (Al Hasan and Zu'bi, 2014) or flexibility performance (Zu'bi, 2015). No studies have been conducted in Jordan about the effect of organisational culture on lean manufacturing. Conducting an empirical research in a developing Arab country such as Jordan is considered a new contribution to research.

2.6 Chapter Summary

In today's competitive and changing business world, the lean manufacturing philosophy has been adopted in many different countries in many different forms to improve a firm's efficiency and effectiveness. Despite the many previous studies published on lean in the manufacturing sector, few empirical studies exist in the literature examining the relationship between the organisational culture and lean practices. Lean manufacturing is not a set of tools an organisation can implement in isolation and expect perfect results; it is a socio-technical approach, which must take into consideration the organisational culture. It is important to investigate the cultural characteristics that reinforce lean implementation success. It is apparent after reviewing the literature that increasing attention should be given to the impact of organisational culture on the success or failure of lean manufacturing.

This chapter aims to present an in-depth literature review regarding three domains. The first domain presents an overview of lean manufacturing. Overall, lean manufacturing can be defined as 'an integrated socio-technical system which aims to eliminate waste'. Seven main types of waste should be eliminated by organisations to be lean. These are overproduction, unnecessary inventory, inappropriate processing, unnecessary transportation, unnecessary delay, unnecessary defects and unnecessary motion. In addition, there are five principles that should be followed by organisations to be lean. The five principles are specifying value, mapping the value stream, creating flow, establishing pull and seeking perfection. Lean implementation leads to many benefits such as optimising costs, quality, customer service, reduced work in process, reduced inventory, cycle time reduction, lead-time reduction and improved customer satisfaction. Eight main lean practices are adopted in the current study and are defined in this chapter. Five of them are technical practices: pull system, continuous flow, set-up time reduction, SPC and TPM. The other three practices are related to the human side. They are customer involvement, employees' involvement, and suppliers' involvement. The chapter also provides examples about how lean manufacturing practices have been explored in previous studies in many countries. A specific concentration is given to Jordan because it represents the context of the current study.

The second domain presents an overview of organisational culture. Organisational 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. Examples of models are provided to measure organisational culture, such as the six dimensions of Hofstede's model, the four hypotheses of organisational culture, and the CVF. More concentration is given to the latter model because it is adopted in the current study. The CVF includes four types of organisational culture: group, developmental, hierarchical and rational. The chapter provides examples about how the CVF has been used in previous studies in operations management. In addition, this chapter provides a discussion linking the organisational culture with lean manufacturing. Previous studies are presented in the chapter to show the critical role of organisational culture in lean manufacturing and the gaps in knowledge.

The end of this chapter provides three main gaps that are observed from literature review. The gaps show that there are not enough empirical studies that have been done to examine the effect of organisational culture on the implementation of lean practices in the manufacturing sector and especially in the Jordanian manufacturing context. More testing is required on the ideal cultural characteristics to implement lean manufacturing successfully. In addition, there is lack of empirical studies that have tested the mediating role of lean human practices in the relationship between organisational culture and lean technical practices. Furthermore, few studies have examined the moderating role of firm size and age in the relationship between organisational culture and lean technical practices. The next chapter will highlight the main gaps in depth through presenting the conceptual models and hypotheses of the thesis.

CHAPTER THREE: Development of Hypotheses and Conceptual Models

3.1 Introduction

This chapter aims to present the argument about the effect of each type of organisational culture on lean technical practices and the argument of the mediating role of human lean practices in the relationship between each type of organisational culture and lean technical practices. It will also examine the moderating role of firm age and size in the relationship between each type of organisational culture and lean technical practices. Based on literature review and previous studies, four conceptual models have been developed, each conceptual model is linked to one type of organisational culture. Twelve hypotheses are proposed in each conceptual model. All conceptual models have the same constructs. The only difference in the models is the name of the organizational culture's type. Each conceptual model has been numbered and named based on the type of organisational culture.

This chapter is divided into four sections; the second section presents the theoretical foundation of the research. The third section introduces research hypotheses as well as presenting the relevant support from the findings of previous studies. In addition, the four conceptual models are illustrated in this section. A chapter summary is also provided at the end of this chapter in section four.

3.2 The Theoretical Foundation of the Research:

The literature on lean manufacturing and organisational culture as discussed earlier in chapter two represents multiple perspectives stemming from the multidimensionality of lean manufacturing concept and the different measures of organisational culture.

3.2.1 Socio-technical System Theory:

The socio-technical system theory was developed at Tavistock Institute of Human Relations in London as a result of the labour unrest and the disappointing productivity in the British coal mines, and then was reported on through a series of research papers written by Eric Trist and his colleagues (Trist and Bamforth, 1951, Trist, 1981, Dankbaar, 1997). This theory assumes that organisations consist of two separate but interdependent systems: a technical system and a social system (Trist, 1981). The technical system encompasses how things are done. It consists of equipment, tools, techniques, methods, procedures, technology and knowledge used by organisational members to acquire inputs and transform them into outputs (Smith and Carayon, 1995, Trist, 1981, Trist and Bamforth, 1951, Wilson, 2000). The social system comprises people's attitudes, values, beliefs and relationships. The argument behind this theory is that greater reliance on the technical system as a response to changes in the environment can be more effective if it is accompanied by a corresponding consideration on the social system (Fox, 1995, Huber and Brown, 1991, Trist and Bamforth, 1951). Despite that each system can be described as a stand-alone system, the social system follows the principles of human sciences such as sociology and psychology. Whereas, the technical system follows the laws of natural sciences such as physics and mathematics, the two systems are correlated and the optimal performance of an organisation can only be obtained by the joint optimisation of technical and social systems together (Manz and Stewart, 1997, Trist, 1981, Zu, 2009, Baba and Mejabi, 1997).

Socio-technical system theory frames organisations as biological entities, part of an open system that interacts with the external environment. The scientific management approach focused on technical systems and work standards but the socio-technical theory recognises the importance of the social system that includes communication networks and organisational culture (Pasmore, 1988). Pasmore (1988) argues that organisations are natural socio-technical systems in that they are "made up of people (the social system) using tools, techniques and knowledge (the technical system) to produce goods or services valued by customers (who are part of the external environment). How well the social and technical systems are designed with respect to one another and with respect to the demands of the external market determines how effective the organisation will be... The structuring and integrating of human activities around various technologies affects the types of inputs into the organisation, the nature of the transformation processes, and the outputs of the system that determines the effectiveness and efficiency of the utilisation of the technology". The alignment between social and technical systems determines the effectiveness of an organisation. The optimisation of technical systems without regard to social systems as in scientific management is counterproductive (Pasmore, 1988).

Based on socio-technical system theory, the paradigm of lean manufacturing calls for the integration of the human and technological practices (Paez et al., 2004). For instance, Lewis (2000) differentiates between lean production as an outcome, which is influenced by external conditions from suppliers or customers, and lean production as a process, which includes improvement of flow of materials and information, focus on customer pull, and a commitment to continuous improvement enabled by the continuous development of people. Lewis's (2000) framework combines the capability of the workers with the major objectives of lean production. Das and Jayaram (2007) have adopted the socio-technical perspective to examine the synergy between four lean technical practices (i.e. Kanban, group technology, JIT supply, TPM) and three human resources practices (i.e. cross-trained employees, operator teams, decentralized decision-making). Based on data from 322 manufacturing firms, the authors have confirmed the expected synergy between the two sets of practices on operational performance. Furthermore, Dabhilkar and Åhlström (2013) have examined the synergy between a set of technical lean practices and a set of human resource practices by employing data from 127 manufacturing firms. The results support a full mediation of human resources' effect on operational performance by the set of lean technical practices. In this line, a few other empirical studies including Shah and Ward (2003) and Shah and Ward (2007) found in the lean literature and explained earlier in subsection 2.2.6 confirm the importance of considering the lean manufacturing concept as a socio-technical system. Shah and Ward's (2003, 2007) arguments that lean manufacturing is a configuration of practices/tools taken as a whole and the relationships among practices are neither explicit nor precise in terms of linearity or causality.

The current study adopts the socio-technical system theory through considering lean manufacturing as a socio-technical system in which the technical and human practices should be engaged together in the production process to achieve competitive advantage in the marketplace. The importance of socio-technical theory to the current study stems from classifying lean practices into lean human practices and lean technical practices as illustrated earlier in lean literature in subsections 2.2.5.1 and 2.2.5.2. The socio-technical system is adopted as a theoretical foundation to investigate the effect of human and cultural factors on lean technical practices. This study views lean practices as a socio-technical system but differs than the previous two mentioned studies (Shah and Ward, 2003, Shah and Ward, 2007) in proposing causality between lean practices, believing that the effective implementation of lean technical practices should be supported and facilitated by lean human practices, as well as both lean human and technical practices should be preceded by the appropriate organizational culture.

3.2.2 Contingency theory

The contingency theory is a critical approach that has contributed significantly to different research fields such as operations management (Chavez et al., 2013, Demeter and Matyusz, 2011, Jayaram et al., 2010, Rashidirad et al., 2013, Sila, 2007, Zhang et al., 2012). Contingency theory adopts the premise that any organisational, managerial and operational system cannot be equally applicable and/or effective in all contexts and environments (Drazin and Van de Ven, 1985). Therefore, a specific context can be more conducive for a specific system than other contexts, which positions the concept of fit at the heart of contingency theory (Drazin and Van de Ven, 1985). Generally, contingency theory argues that there is no theory or method can be applied in all situations (Flynn et al., 2010). This means, that there is no one best way to design an organisation. The environment that an organisation works within forms its structures and activities, and this suggests that organisations should match their structures and activities to their environment, to maximize performance. Both customers and suppliers are important human factors in lean manufacturing (Shah and Ward, 2007) and in the same time represent important part in a manufacturer's environment (Flynn et al., 2010). Therefore, it is believed based on the contingency theory that the manufacturing firms in Jordan have a specific environment and culture match with the effective implementation of lean technical practices. Furthermore, the type of organisational culture that could be ideal in the Jordanian context could not be the same in other contexts.

When implementing lean practices, the contingency theory holds that organizations adopt their structures in order to keep up with changing contextual factors such as firm' size (Punnakitikashem et al., 2009). Contingency theory was adopted in lean management by different authors such as Shah and Ward (2003), Demeter and Matyusz (2011), and Chavez et al. (2013). These few empirical studies are explained earlier in lean literature (subsection 2.2.6). For example, Shah and Ward (2003) have examined the effects of two contextual factors (firm size and age) on the likelihood of implementing lean manufacturing practices that are key facets of lean production in USA manufacturing firms.

Venkatraman (1989) has highlighted the moderation and mediation perspectives within the contingency theory. Each of these perspectives will be presented below.

3.2.2.1 The Mediation Perspective

The mediation perspective represents a case where the relationship between a predictor and a criterion variable can be either completely or partially explained by a third variable called "mediator" (Frazier et al., 2004). The mediation perspective will be essentially used in this study to support the theoretical argument in relation to the proposed mediating effect of three human lean practices (customers' involvement, employees' involvement and suppliers' involvement) on organisational culture/ lean technical practices relationship. More specifically, by adopting the mediation perspective, the conceptual models, which are developed in this thesis, examine the indirect effect of each type of organisational culture on lean technical practices through three proposed mediators: customers' involvement, employees' involvement and suppliers' involvement. The mediation perspective will be explained later in subsection 8.3.1.

3.2.2.2 The Moderation Perspective

The moderation perspective within contingency theory implies that a relationship between one independent variable and one dependent variable is dependent on the level of a third variable called "moderator" (Frazier et al., 2004, Venkatraman, 1989). The moderator can either moderate the form or strength of the proposed relationship where understanding the type of moderation is critical to determine the appropriate statistical analysis needed to detect it (Frazier et al., 2004, Venkatraman, 1989). Based on the moderation perspective in contingency theory, the current study examines the moderating effects of firm size and age on the direct effect of organisational culture on lean technical practices in the context of Jordanian manufacturing firms. Depending on the theoretical argument, a moderation form can be relied on along with the appropriate statistical analysis to test it. The moderation perspective will be explained later in section 9.1.

3.2.3 Resource-Based View (RBV)

The specific contribution of RBV lies in the fundamental principle that long-term competitive advantage lies primarily in firms creating bundles of strategic resources that competitors find difficult to substitute or imitate without great effort (Lewis et al., 2010). The emergence of the RBV as an organisational theory indicates that organisational resources are important, redirecting managerial attention inside the organisation (Naor et al., 2014). The RBV argues that business organisations, even within the same industry and the same operational environment, are heterogeneous in their resource bundles and capabilities and this heterogeneity may be long-lasting and imperfectly mobile (Khanchanapong et al., 2014, Naor et al., 2014, Barney, 1991). To achieve a competitive advantage, the resources of the firm must be valuable (i.e. they allow the firm to exploit opportunities or neutralize threats relative to competitors) and rare (i.e. in relatively short supply). For this advantage to be sustainable, the firm's resources must also be imperfectly imitable (i.e. difficult to replicate because of causal ambiguity, social complexity, and/or specific historical circumstances), and non-substitutable (Barney, 1991).

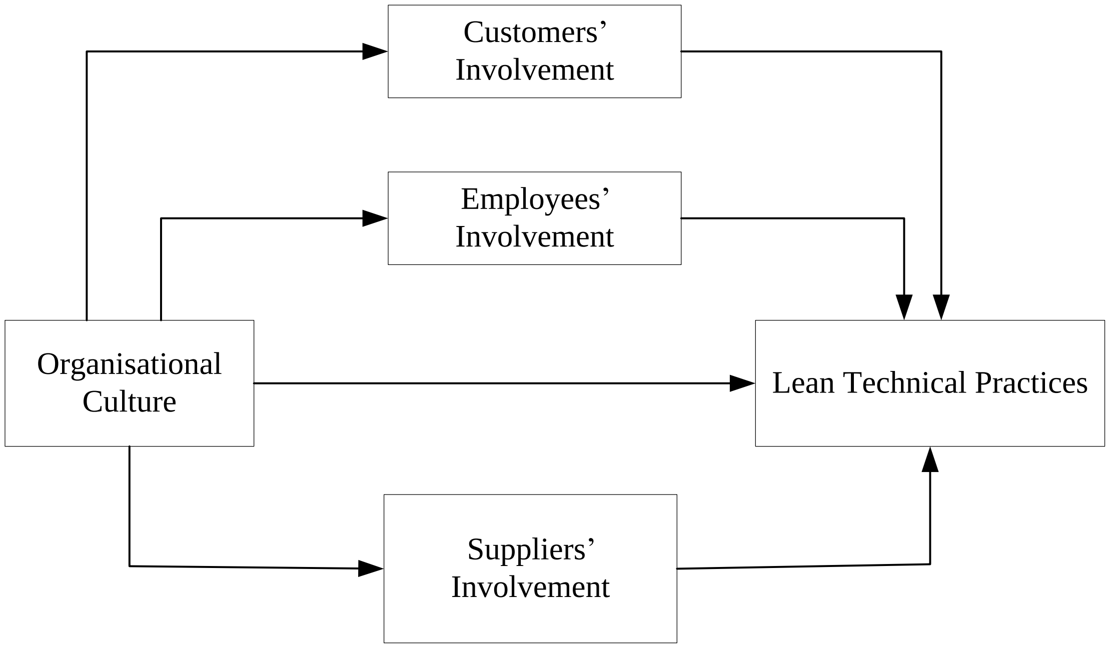
In RBV, resources represent the inputs into the production process, while the capability is the capacity for a bundle of resources to perform some task or activity (Grant, 1991). Capabilities involve for instance, complex patterns of coordination between people (Grant, 1991). The ability of an organisation to achieve coordination and cooperation within groups of workers is a key component in the relationship between resources and capabilities (Grant, 1991, Naor et al., 2014). This requires that an organisation motivates and socialise its members in a manner conducive to the development of smooth-functioning routines (Grant, 1991). The organisation's style, values and traditions are critical encouragements to the cooperation and commitment to its members (Grant, 1991). The organisational culture is considered as intangible capabilities for the firm to achieve a competitive advantage (Naor et al., 2014). This study is in line with other few scholars who empirically confirm that the organisational cultural characteristics can be valuable source of advantage for the firm (Barney, 1986, Power et al., 2010, Naor et al., 2014, Zheng et al., 2010).

The RBV has been used in operations management in previous studies (Hult et al., 2007, Cao and Zhang, 2011, Naor et al., 2014, Khanchanapong et al., 2014). For example, Hult et al. (2007) have built on the RBV to examine the effect of culture of competitiveness and knowledge development on supply chain performance in varied market turbulence conditions. They consider, based on the RBV, that a culture of competitiveness functions as an intangible strategic resource that can be developed by interaction and cooperation among supply chain members and provide competitive advantage and improving performance. They used a sample of 201 manufacturing firms and found that the interaction between a culture of competitiveness and knowledge development has a positive association with performance. Based on the RBV, this study aims to examine the effect of each type of organisational culture on lean technical practices. It is believed that the organisational culture is a source of sustained competitive advantage (Barney, 1991), and the embeddedness of the characteristics of specific cultural type to implement lean technical practices allow firms to focus on their unique and intangible core competencies, which lead to improve the level of lean implementation and in turn achieving a competitive advantage in the market**.**

3.3 Research Hypotheses and Conceptual Models

The three perspectives (socio-technical system theory, contingency theory, and RBV), discussed earlier in section 3.2, form the basis for developing the main variables of the research model as illustrated in figure 3.1. The socio-technical system theory motivates the empirical focus of examining the effect of organisational culture (social factors) on lean technical practices (technical factors) believing that the optimal performance of any firm can only be obtained by the joint interaction between the social and technical systems together (Manz and Stewart, 1997, Trist, 1981, Zu, 2009, Baba and Mejabi, 1997). In addition, the contingency theory, using the mediation perspective, motivates the empirical focus to examine the indirect effect of organisational culture on lean technical practices through three lean human practices (customers' involvement, employees' involvement and suppliers' involvement). Finally, based on the RBV, it is believed that the organisational culture is a critical success factor and an important antecedent for implementing lean technical practices which in turn, it could be a source of sustained competitive advantage (Barney, 1991).

Figure 3-1 Synoptic View of the Research Model



The following subsections outline the conceptual models of the current study in more details for the different types of culture. Each subsection will present the research hypotheses and the conceptual model for each type of organizational culture.

3.3.1The Effect of Group Culture on Lean Technical Practices

The first type in the CVF is group culture. It focuses on flexibility and internal maintenance through concentrating on strong personal relationships, mutual trust, mutual support, and participation of all organisational members (Cameron and Quinn, 2011, Karimi and Kadir, 2012, Yu and Wu, 2009, Zu et al., 2011). All these traits are consistent with the requirements of lean. For example, Cassell et al. (2006) argue that lean technical practices such as JIT and setup time reduction require employees to share ideas and communicate together to solve problems. Sharing suggestions and communication are important beliefs in group culture.Prajogo and McDermott (2005) have explored the relationship between TQM practices and organisational culture with the purpose of identifying the specific culture for the successful implementation of TQM practices. This study found that the group culture is the most dominant among the other types and is significantly and positively related to all practices of TQM, either the hard practices such as process management and information and analysis or the soft ones such as leadership, people management and customer focus. Haffar et al. (2013) have examined the effect of organisational culture on the implementation of TQM practices in the Syrian manufacturing firms. It has been found that all TQM practices have the highest coefficients of correlation with the group culture. Similarly, in a study for Karimi and Kadir (2012) in the Iran oil industry, the effect of organisational culture has been examined on TQM practices and it has been found that group culture has a significant positive effect on the hard side of quality management practices. In another study for Prajogo and McDermott (2011), it has been found that group culture is associated with both process quality and process innovation. The authors suggest that the values of teamwork and empowerment play important roles in ensuring the success of process improvement as well as implementation of new process technologies. Also, Zu et al. (2010) have concluded in their study that group culture is an important culture type for most practices in TQM/six sigma implementation. The results of their study have shown that group culture has a positive effect on the technical side of quality practices such as product design, process management, six sigma structured improvement procedures and six-sigma focus on metrics.

Implementing lean technical processes relies heavily on groups, including continuous quality improvement, decision making and consensus building. Lean implementation is a programme driven by employees’ involvement (Pakdil and Leonard, 2015). In successful lean implementation, employees develop systems through collaboration, suggestion system and group decision-making. One of the important principles in the group culture is employees’ empowerment (Naor et al., 2008). In lean manufacturing implementation, the empowerment of employees is important because it allows workers to incorporate quality in the product or service, as well as to stop the machines immediately when an error has occurred for correction on the spot (Shook, 2010). Kull et al. (2014) argue that a strong group culture produces a positive impact on lean manufacturing's effectiveness because group culture’s values emphasises employees' tasks and obligations in their companies, which will increase employees' responsibilities to lean manufacturing practices. In a case of cellular manufacturing as a lean practice for small business,Yauch and Steudel (2002) have identified that responsibility avoidance is a strong barrier for companies in using cellular manufacturing. The employees who work in group culture will be more willing to share information within their organisations, expend more effort on performing tasks and provide higher quality products to satisfy the customers, all of which facilitates the true implementation of lean manufacturing (Kull et al., 2014). A lack of cooperation within the facility slows efforts toward set up reduction and disrupting continuous flow (Kull et al., 2014). Accordingly, the following hypothesis is proposed:

H1: Group Culture has a positive effect on lean technical practices implementation.

3.3.2 The Effect of Group Culture on Lean Human Practices

As discussed earlier in chapter two (subsection 2.2.5.2), lean human practices are customers' involvement, employees' involvement and suppliers' involvement. It is preferred to begin discussing the effect of group culture on the internal lean human practice, which is employees' involvement, before moving on to the external lean human practices, which are customers' involvement and suppliers' involvement.

Generally, lean human practices rely on employees' commitment and involvement (De Treville and Antonakis, 2006) which are implied in the values of group culture (Cameron and Quinn, 2011). The successful implementation of quality programmes such as lean system requires building teamwork within and/or cross functions, providing employees with appropriate training, involving them in decision making, rewarding them for quality performance and establishing the communications to create awareness of organisational goals for continuous improvement (Flynn et al., 1994, Kaynak, 2003, Lee and Choi, 2006, Zu et al., 2010). The aforementioned requirements are the core of group culture values which rely on employees’ involvement, participation and collaboration (Cameron and Quinn, 2011).

In the same manner, group culture encourages the involvement of suppliers and customers in organisational activities (Naor et al., 2008). Both customers and suppliers are outside the boundaries of the organisation, but they are the key parties in the whole supply chain (Zu et al., 2010, Flynn et al., 1994). As discussed in subsection 2.2.3, the first principle in lean manufacturing focuses on specifying value according to customer's perspective. This means that the organisation needs to consider its customers' viewpoints to identify their needs and to get feedback on the quality level of products (Womack and Jones, 2010). Group culture allows customers to be involved effectively regarding quality, product design and information exchange to obtain reliable and fast feedback on the quality levels of products (Flynn et al., 1994, Zu et al., 2010). In addition, a close relationship with suppliers means selecting suppliers based on quality, requesting supplier certification, involving suppliers in product design and process improvement, exchanging information about supplier quality and keeping a limited number of suppliers to develop long-term relations based on constructive collaboration (Kaynak, 2003, Zu et al., 2010).Thus, the strong relationships with customers and suppliers are based on commitment, cooperation and communication and all of these factors are basics in group culture values (Naor et al., 2008).

In organisations emphasising group culture, they would apply its values in trust, commitment and open communication to their relationship with its customers and suppliers (Zu et al., 2010). Karimi and Kadir (2012) have investigated the relationship between four types of organisational culture based on the CVF and two types of TQM: soft and hard types. It has been found that group culture has a significant positive effect not just on the hard side of quality management practices but also on the soft side. The soft side includes the human factors such as customer focus and employee empowerment. Finally, Zu et al. (2010) have investigated how the organisational culture influences the implementation of different practices incorporated in the recent six sigma approach as well as those associated with TQM. It has been found that group culture is an important cultural type for most practices in TQM/six sigma implementation; three of these practices are related to human practices such as supplier relationships and workforce management. Based on the previous discussion, the following hypotheses are proposed:

H2a: Group Culture has a positive effect on customers' involvement.

H2b: Group Culture has a positive effect on employees' involvement.

H2c: Group Culture has a positive effect on suppliers' involvement.

3.3.3 The Effect of Lean Human Practices on Lean Technical Practices in Group Culture

Regarding the effect of employees' involvement on lean technical practices, Womack and Jones (2003) argue that in lean implementation, all employees should be motivated to solve problems to reach perfection. Perfection means that everyone can see everything and so it is easy to discover better ways to improve processes and to create value. Hence, the perfect implementation of lean requires building teamwork, employees' involvement and empowerment. Employees' involvement and empowerment let workers use either a single technical practice or a combination of several technical practices to make improvement in product or process design, participate in problem solving activities, manage quality control responsibilities, maintain production levels and schedule equipment maintenance. Organisations that encourage employees' involvement by enhancing their feeling of perceived control and perceived competence will usually see an increase implementation of lean technical practices (Raja, 2011). Cheng and Liu (2007) have investigated the relationship between organisational culture and quality management in the construction industry in Hong Kong. It has been found that management of employees especially in the group culture had a significant positive effect on implementing quality management practices.

Successful teamwork practices, which are an important dimension in group culture (Cameron and Quinn, 2011), lead to increasing employees knowledge of their jobs and the consistency of their efforts, which in turn results in many technical improvements, such as reduced errors, improved quality and the effective use of statistical analyses in manufacturing (Sadikoglu and Zehir, 2010). Quality circles help to make employees feel they are valued, respected and important. Their participation in decision making and problem solving solicits their ideas for improving processes in manufacturing (Rahman and Bullock, 2005). Furthermore, Shah and Ward (2007) consider customers' involvement and suppliers' involvement as two major practices in lean manufacturing. Organisations should keep a close relationship with them through involving them in different issues, such as product design (Kaynak, 2003). Giving priority to customers' real needs and keeping close contact with customers to identify their requirements continuously will lead to reductions in defective items (Sadikoglu and Zehir, 2010). Furthermore, successful buyer-supplier relationships improve information sharing which leads to improving technical processes and quality performance of buyer and supplier (Yang et al., 2009).

Rahman and Bullock (2005) have investigated the direct impact of soft quality management on the diffusion of hard quality practices in Australian manufacturing firms. It has been found that all soft quality practices, namely workforce commitment, customer focus, use of teams and cooperative supplier relations have a significant positive impact on hard quality practices, such as use of JIT approach, technology utilisation and continuous improvement. Therefore, the following hypotheses are proposed.

H3a: Customers' involvement in group culture has a positive effect on lean technical practices implementation.

H3b: Employees' involvement in group culture has a positive effect on lean technical practices implementation.

H3c: Suppliers' involvement in group culture has a positive effect on lean technical practices implementation.

All the proposed hypotheses from subsection 3.3.1 to 3.3.3 are illustrated in figure 3.2.

3.3.4 The Mediating Role of Lean Human Practices in the Relationship between Group Culture and Lean Technical Practices.

Any organisation characterised as having a group culture is a very friendly place for humans to work because people share a lot of themselves. It is like an extended family. The leaders are mentors and perhaps even parent examples. The organisation is held together by loyalty and commitment. As well as this, the organisation emphasises the long-term benefit of human resource development and attaches big importance to cohesion and morale (Cameron and Quinn, 2011, Naor et al., 2008, Zu et al., 2010).

Based on the arguments in subsections 3.3.2 and 3.3.3, the values of group culture that focuses on employees' involvement and participation are considered facilitators for implementing lean technical practices successfully. A good example of the last statement is Toyota culture. Toyota has a main principle in its work, which is called 'respect of people'. Respect of people is a hallmark of successful lean implementation and the idea of 'them versus us' does not exist (Dennis, 2002). Based on the socio-technical theory, the focus on the technical side without a parallel focus on people has been cited as one of the reasons that lean implementation often fails when transferred to firms in different countries (Liker and Franz, 2011). Employees' involvement plays an important role in group culture/ lean technical practice relationship because it allows employees to use different technical practices in order make improvements.

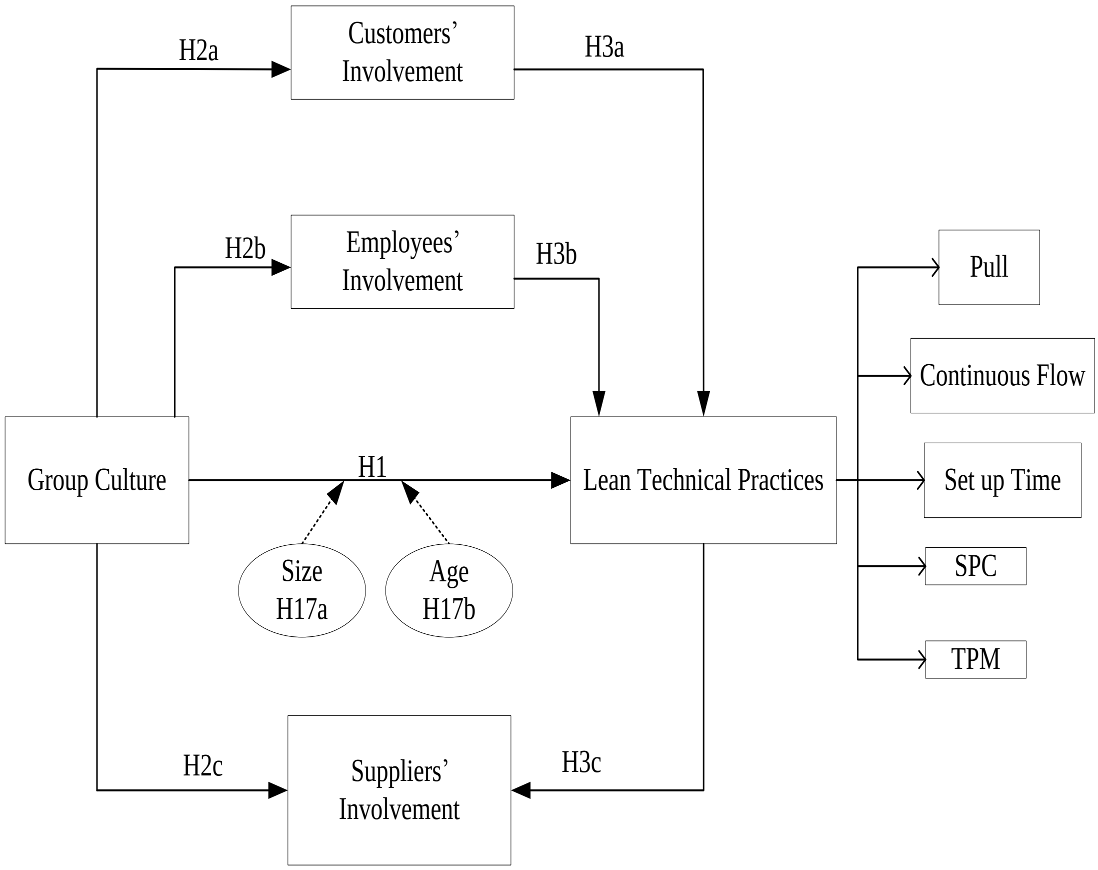
Moreover, the success in group culture is defined in terms of sensitivity to customers and concern for people (Cameron and Quinn, 2011). Naor et al. (2010) confirm that human goodness encompasses many positive features that confidently lead to higher performance. They argue that fairness in the internal relationships between employees as well as in the external treatment of both customers and suppliers are key quality attributes in lean implementation. The relationships with suppliers and customers improves information sharing which leads to improving technical processes such as lean technical practices (Yang et al., 2009).Based on the previous discussion, the following hypotheses are proposed:

H4a: Customers' involvement mediates the relationship between group culture and lean technical practices implementation.

H4b: Employees' involvement mediates the relationship between group culture and lean technical practices implementation.

H4c: Suppliers' involvement mediates the relationship between group culture and lean technical practices implementation.

Figure 3-2 Research Conceptual Model 1: Group Culture



3.3.5 The Effect of Developmental Culture on Lean Technical Practices

The second type in CVF is developmental culture. This type of culture focuses on flexibility and external positioning through continuous growth, acquisition of new resources, experimenting, taking risks, creativity and innovation (Cameron and Quinn, 2011, Karimi and Kadir, 2012, Yu and Wu, 2009, Zu et al., 2011). In addition, entrepreneurial leadership is required in developmental culture to let the firm be dynamic and change quickly (Cameron and Quinn, 2011). Leaders in developmental culture are motivated to initiate new improvement projects and ensure that they are supported with the required tools and resources. In developmental culture, there is a focus on creating new processes or introducing new products to the market. In a manufacturing context, those characteristics reinforce efforts to stay on the industry's leading edge by continuously pursuing new ideas and ways to perform tasks (Naor et al., 2014).

Organisations who adopt developmental culture seek to allocate specific resources to train employees in order improve their knowledge and technical skills (Zu et al., 2010).

For example, using SPC as one of lean technical practices needs control charts skills to detect problems. Therefore, developmental culture's values let employees feel more open to learning and applying lean technical skills. Lean is a philosophy of manufacturing that focuses on people development and continuous improvement and both of these concepts are implied in the developmental culture beliefs (Naor et al., 2008). Developmental culture encourages workers to utilise creativity to develop new processes based on new technologies that may result in cost improvements (Naor et al., 2014). In many previous studies, such as Haffar et al. (2013), Al-Khalifa and Aspinwall (2001) and Prajogo and McDermott (2011), it has been found that developmental culture facilitates process and product quality and innovation. As well as organisations being dominated by developmental culture, they enable a higher likelihood of successful quality management practices. In a study for Strode et al. (2009) it has been found that the existence of innovative and risk-taking culture positively affects the effective use of agile method techniques. Furthermore, Zammuto and O'Connor (1992) conclude that an organisation characterised by more flexible culture, such as a developmental culture, would show a higher level of effectiveness in advanced manufacturing technologies implementation than those that are more control-oriented.

The traits associated with developmental culture such as creativity and the search for innovations to improve work processes and product can improve the degree of conformance to specifications, quality conformance, as products often incorporate better resources and complicated processes (Naor et al., 2014). The capability to identify and implement new technological developments should result in less rework, defects, and scrap (Naor et al., 2014), all of which reflect waste minimisation in the lean concept. In addition, the characteristics of developmental culture help to decrease time to market and delivery, because they focus on being a leader in the market. Therefore, the traits of developmental culture result in shorter production times due to the capability of identifying and implementing leading-edge innovations (Naor et al., 2014). Shorter production time is associated directly with reduced set-up time and set-up time reduction is considered an important lean technical practice (Shah and Ward, 2007).Finally, In a recent study by Hardcopf and Shah (2014), it has found that lean’s effect on quality and flexibility is dependent upon having a developmental culture. Accordingly, the following hypothesis is proposed:

H5: Developmental Culture has a positive effect on lean technical practices implementation.

3.3.6 The Effect of Developmental Culture on Lean Human Practices

As discussed in subsection 3.3.5, developmental culture focuses on continuous improvement in both products and processes (Naor et al., 2008). Developing a culture that creates the involvement and development of everyone in the organisation is a critical element of lean philosophy (Womack et al., 1990). Everyone in the organisation needs to be trained and developed in lean concept as well as the planning, design, implementation and evaluation of the changes so that lean is driven by all of the people, usually through teams, in the organisation, not just the senior management (Sohal and Egglestone, 1994)**.** Therefore, emphasising developmental culture encourages employees' involvement as an internal lean human practice.

Furthermore, Heizer and Render (2013) argue that lean operations provide the customer with exactly what the customer wants, when the customer wants it, without waste through continuous improvement. The drive for companies to invest in quality improvement programmes is to achieve market advantage. Customers by nature prefer products of higher quality and thus market shares tend to move toward the organisations which can offer high quality products (Zu et al., 2010). Efforts in quality improvement are expected to bring in more satisfied customers with greater loyalty and increased sales (Ahire and Dreyfus, 2000, Kaynak, 2003, Zu et al., 2010). In order to meet customer and market needs, the organisations should involve customers in product design and information exchange to obtain the necessary feedback for determining their desires and to obtain reliable and fast feedback on the quality levels of products (Flynn et al., 1994, Zu et al., 2010). To do so, organisations need to emphasise a high extent of developmental culture to be flexible and to adapt to changing customer demands over time (Naor et al., 2008, Zu et al., 2010). In organisations emphasising the developmental culture, the values of external adaptation and creating flexibility and diversity would encourage the members' interests in pursuing and understanding customers' needs. Such organisations tend to build a strong relationship with customers because customer focus is accepted and understood throughout the organisation to develop dynamism and readiness to meet new challenges (Al-Khalifa and Aspinwall, 2001).

Moreover, organisations with an emphasis on the developmental culture continuously seek for new resources and external support for growth (Denison and Spreitzer, 1991). These organisations are more likely to build cooperative relationships with their key suppliers. The quality of an organisation's products is affected by the materials provided by the suppliers not just by the internal processes (Zu et al., 2010, Kaynak, 2003). To achieve high quality firms cannot rely on internal resources alone (Robinson and Malhotra, 2005). Strategic partnerships with suppliers enable the organisation to bridge boundaries to obtain access to valuable specialised capabilities from the suppliers (Holcomb and Hitt, 2007). Finally, Braunscheidel et al. (2010) conclude in their study that high adhocracy (developmental) scores positively affect the adoption of external integration practices with both key suppliers and customers. Therefore, the following hypotheses are proposed:

H6a: Developmental Culture has a positive effect on customers' involvement.

H6b: Developmental Culture has a positive effect on employees' involvement.

H6c: Developmental Culture has a positive effect on suppliers' involvement.

3.3.7 The Effect of Lean Human Practices on Lean Technical Practices in Developmental Culture

Organisations that emphasise developmental culture motivate workers to take risks and develop their skills in order to create new ideas in the product process or design (Naor et al., 2014). Baird et al. (2011) have examined the association between organisational cultures and the extent of use of quality management practices. It has been found that employees are an influential group affecting the implementation of quality management and they suggest that employees must be motivated to actively contribute their skills and wisdom collectively in the business process. In a study for Cheng and Liu (2007), it has been found that management of employees in the developmental culture had a significant positive effect on implementing quality management practices.

Several studies (Dal Pont et al., 2008, Flynn et al., 1995, Furlan et al., 2011, Sakakibara et al., 1997) highlight the importance of employees' involvement as a crucial infrastructural dimension in successful lean implementation. Employees’ involvement becomes a differentiator between lean and non-lean firms as it reinforces information sharing and empowers people to identify problems and solve them as they happen (Dal Pont et al., 2008).With respect to customers' involvement, a central objective of lean manufacturing is to eliminate waste in order to provide better quality and less costs to customers (Bakås et al., 2011). All efforts in lean are supposed to bring in more satisfied customers. Therefore, organisations who adopt developmental culture concentrate on involving customers, in order to be able to adapt to changing customer demands over time (Naor et al., 2008, Zu et al., 2010) .

Furthermore, adoption of techniques such as pull system requires the communication between manufacturers and suppliers to allow better conveyance of product requirements and specifications which in turn reinforce the confidence that products will be delivered on time and enabling the elimination of waste such as unnecessary inventory (Baird et al., 2011).

Dal Pont et al. (2008) has confirmed the central role of human lean practices as a prerequisite for lean implementation and found through a statistical analysis on the interrelationships among lean bundles and their effects on operational performance, that human lean practices represent a suitable ground on which other lean practices can be effectively built. For example, the relationship with suppliers is directly related to process flow system, since purchased materials are a dominant source of process variability. Suppliers' involvement can help organisations in producing materials and parts that can be used efficiently, which in turn will enable them to reduce waste and create leaner operations (Krajewski et al., 2001). Creating leaner operations means achieving improvement, which is the essence of developmental culture beliefs. Therefore, the following hypotheses are proposed:

H7a: Customers' involvement in developmental culture has a positive effect on lean technical practices implementation.

H7b: Employees' involvement in developmental culture has a positive effect on lean technical practices implementation.

H7c: Suppliers' involvement in developmental culture has a positive effect on lean technical practices implementation.

All the proposed hypotheses from subsection 3.3.5 to 3.3.7 are illustrated in figure 3.3.

3.3.8 The Mediating Role of Lean Human Practices in the Relationship between Developmental Culture and Lean Technical Practices

The glue that holds the organisation together in developmental culture is commitment to experimentation and innovation. The focus is on being on the leading edge. The organisation's long-term interest is on growth, continuous improvement, and acquiring new resources. Additionally, the organisation encourages employees' initiatives, suggestions and freedom (Cameron and Quinn, 2011). In the same manner, the continuous improvement of lean processes requires long-term commitments and involvement from employees (Atkinson, 2010, Emiliani, 2003). In developmental culture everyone has dual responsibilities to another paradox: the day- to- day success of the business and continuous improvement, that allows the work to continue in the future (Womack and Jones, 2010). Toyota has implemented various strategies for continuous improvement and innovation which is considered an important pillar in Toyota culture (Liker, 2004).The employees in Toyota provide ideas for improvement using lean techniques which resulted in each employee generating about 187 ideas each year, of which 98 per cent were implemented. With a workforce, worldwide of 60,000, it means almost 11 million ideas for continuous improvement are implemented each year. With a 250 day working year that means that daily Toyota is working through 44,000 ideas for being more competitive (Atkinson, 2010). Employees’ involvement plays a big role in the relationship between developmental culture and lean technical practices.

Furthermore, in using lean processes, external involvement is important; organisations work closely with their suppliers under long-term cooperative agreements, interlocking business relationships and reciprocal shareholdings (Bozdogan, 2010). Supplier development is a critical factor of success in the Japanese car manufacturers (Sako, 2004). The suppliers’ partnership and collaboration, which are key to lean processes, require a long time frame for development and perfection (Mi Dahlgaard-Park and Dahlgaard, 2006). Prajogo and McDermott (2005) have concluded in their study that developmental culture represents the flexible-type cultures that match the human characteristics of TQM such as leadership, people management and customer focus.

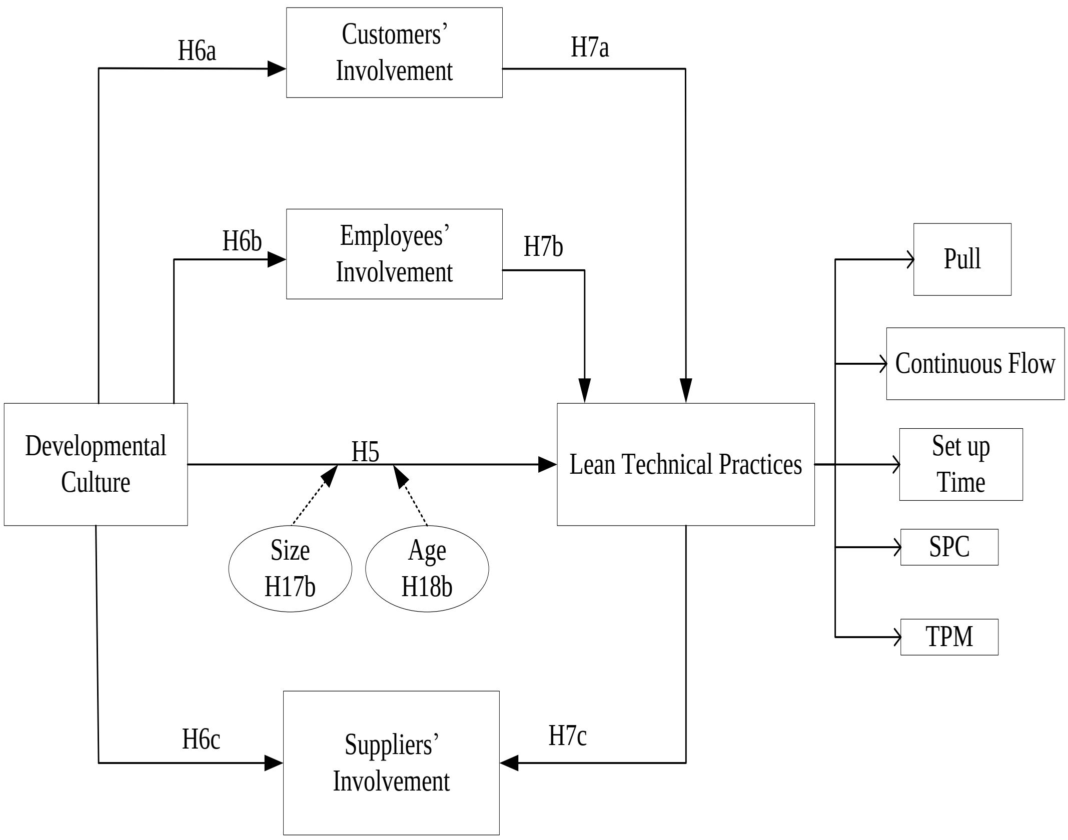
Sakakibara et al. (1997) have demonstrated that lean human practices give incentives to workers to be innovative and autonomous through the development of teams aimed at problem solving and this in turn improves the implementation of the pull system. For example, shop floor workers' suggestions arouse new ways of decreasing set-up times, thus facilitating pull production flows. Based on the previous discussion, the following hypotheses are proposed:

H8a: Customers' involvement mediates the relationship between developmental culture and lean technical practices implementation.

H8b: Employees' involvement mediates the relationship between developmental culture and lean technical practices implementation.

H8c: Suppliers' involvement mediates the relationship between developmental culture and lean technical practices implementation.

Figure 3-3 Research Conceptual Model 2: Developmental Culture



3.3.9 The Effect of Hierarchical Culture on Lean Technical Practices

The third type of culture in the CVF is hierarchical culture. This cultural type focuses on stability and the internal activities of the organisation (Cameron and Quinn, 2011). The main values of hierarchical culture are centralised authority, respect for formal hierarchy, efficiency, reliability, predictability and standardisation (Helfrich et al., 2007, Zu et al., 2011). Procedures govern what employees do and the leaders work as good coordinators and organisers. Success is defined in terms of dependable delivery, smooth scheduling and low cost (Zu et al., 2010). In a manufacturing context, the relationship between shop floor workers and management has formal structure, so that decisions need supervisor agreement (Naor et al., 2014).The impact of hierarchical culture on different manufacturing technologies has different arguments in literature. On the one hand, many previous studies argue that achieving a high quality level requires an organisational environment valuing the hierarchical culture in order to support the use of tools in process control and improvement (Cameron and Quinn, 2011). Prajogo and McDermott (2005) confirm that hierarchical culture has a significant positive relationship with some hard practices of TQM such as strategic planning and information and analysis. Also, in another study for Prajogo and McDermott (2011), it has been found that hierarchical culture is associated with process quality in Australian firms.

Japanese lean organisations adopt the hierarchical culture; they have a culture of written and unwritten rules, and workers are carefully socialised into the way things are done in the firm (Mehri, 2006). Cameron and Quinn (2011) argue that the highest degrees of quality in organisations requires the application of hierarchical culture’s activities such as improving measurements, process control and systematic problem solving. These activities facilitate the usage of technical tools such as Pareto charts, fishbone diagramming and variance plots. Stability and standardisation in work are important traits in hierarchical culture (Cameron and Quinn, 2011) which facilitates the technical implementation of lean. In lean implementation, the measurements are made constantly and in every minor part of the job (Wilson, 2010). Also, standardisation is a necessary factor in lean implementation (Mann, 2014). Mehri (2006) argues that hierarchical structure is promoted in lean systems, where an employee approaches the supervisor before anyone else. Hall and Hall (1987) confirm that Japanese firms have strong hierarchies, and leadership and decision-making is highly structured.Womack and Jones (2010) have proposed customer's value, value stream, flow, pull and perfection as basic principles of lean thinking (see figure 2.1). The application of these principles require control, which represents the essence of hierarchical culture.

On the other hand, some authors have contradictory viewpoints about the impact of hierarchical culture on lean manufacturing. For instance, Kull et al. (2014) argue that the more a culture values formal hierarchy and centralised decision making, the less effective lean manufacturing will be for two main reasons. First, because hierarchical culture imparts employees' reluctance to expose problems and share ideas. Participation in lean practices such as waste reduction will not be as active as they are supposed to be. JIT system will not be as effective because workers will be less likely to stop production when problems occur, allowing more waste to happen. Second, in a hierarchical culture, incremental changes, which are required for SPC, will likely be made by managers instead of employees. Since managers are generally far away from daily manufacturing activities, they may lack tacit knowledge about errors and solving problems. Haffar et al. (2013) have concluded that hierarchical culture negatively influences the implementation level of quality management in the Syrian manufacturing firms. Despite the negative perspective, the former argument about the positive effect of hierarchical culture on lean is adopted. Therefore, the following hypothesis is proposed:

H9: Hierarchical Culture has a positive effect on lean technical practices implementation.

3.3.10 The Effect of Hierarchical Culture on Lean Human Practices

Organisations that emphasise the hierarchical culture are characterised by a stable work environment as well as a formalised and structured environment to work where procedures control what people do (Cameron and Quinn, 2011). In such organisations, employees feel motivated to follow the formal procedures and use lean techniques. In Toyota, trust between employees at different levels, as well as management, represents a fundamental principle. One of the reasons behind the mutual trust in Toyota is the 'job security' policy, which means avoiding layoffs and terminations to the maximum extent possible, as the company sees its people as the driver of every change, and without them, the business will not last. Within Toyota's stable employment policy, the prime objective is to make people feel secure, which in turn creates trust (Toyota, 2005).

In addition, Lee et al. (2006) have found in their study that consistency and coordination cultural traits of hierarchical culture demonstrate the only unique effect on customer satisfaction.In addition, the hierarchical culture's characteristics facilitate suppliers' involvement as Hassini et al. (2008) argue that the hierarchical culture naturally supports efficient supply chain practices that are built on mechanistic and internal control mechanisms. Therefore, the following hypotheses are proposed:

H10a: Hierarchical culture has a positive effect on customers' involvement.

H10b: Hierarchical culture has a positive effect on employees' involvement.

H10c: Hierarchical culture has a positive effect on suppliers' involvement.

3.3.11 The Effect of Lean Human Practices on Lean Technical Practices in Hierarchical Culture

Dean and Bowen (1994) have investigated the effect of human resource practices such as employees' involvement and workers' education and training on high-quality standards. They found that these practices are key antecedents of quality improvements. For example, the more workers' suggestions on work activities are gathered, the more likely are that *poka-yoke*[9] solutions flow down through the organisation. Also, Furlan et al. (2011) have investigated the role of lean human resource practices such as employees' involvement in the complementarity between JIT and TQM across three different industries. It was found that human resource practices are not only enhancers but also enablers of the complementarity between JIT and TQM. In addition, they argued that an organisation that does not apply human practices is neither able to create new technical skills in house nor ever on those tools acquired from external sources to achieve a sustainable competitive advantage (Furlan et al., 2011).

9: is any mechanism in a lean manufacturing process that helps an equipment operator avoid (yokeru) mistakes (poka).

Many scholars confirm that adopting hard tools in manufacturing without implementing soft human practices is considered as the main reason for poor performance in organisations (Liker and Hoseus, 2008). Humans are perceived as the core of TPS and the cornerstone of creating value. Therefore, Toyota invests in human resources by training employees, growing leaders, and supporting suppliers in continuous improvement (Liker and Hoseus, 2008). Previous studies (Hsu et al., 2009, Romano and Formentini, 2012) confirm that the collaboration and integration with customers and suppliers is important in a lean management environment as without strong supplier support, the technical lean practices cannot be successful. Numerous empirical studies (Flynn et al., 1995, Furlan et al., 2011, Jayaram et al., 2008, Liker and Hoseus, 2008, Shah and Ward, 2007) support that employees' involvement and the collaborative relationships with customers and suppliers are fundamental factors for implementing lean practices effectively. Therefore, the following hypotheses are proposed:

H11a: Customers' involvement in hierarchical culture has a positive effect on lean technical practices implementation.

H11b: Employees' involvement in hierarchical culture has a positive effect on lean technical practices implementation.

H11c: Suppliers involvement in hierarchical culture has a positive effect on lean technical practices implementation.

All the proposed hypotheses from subsection 3.3.9 to 3.3.11 are illustrated in figure 3.4.

3.3.12 The Mediating Role of Lean Human Practices in the Relationship between Hierarchical Culture and Lean Technical Practices

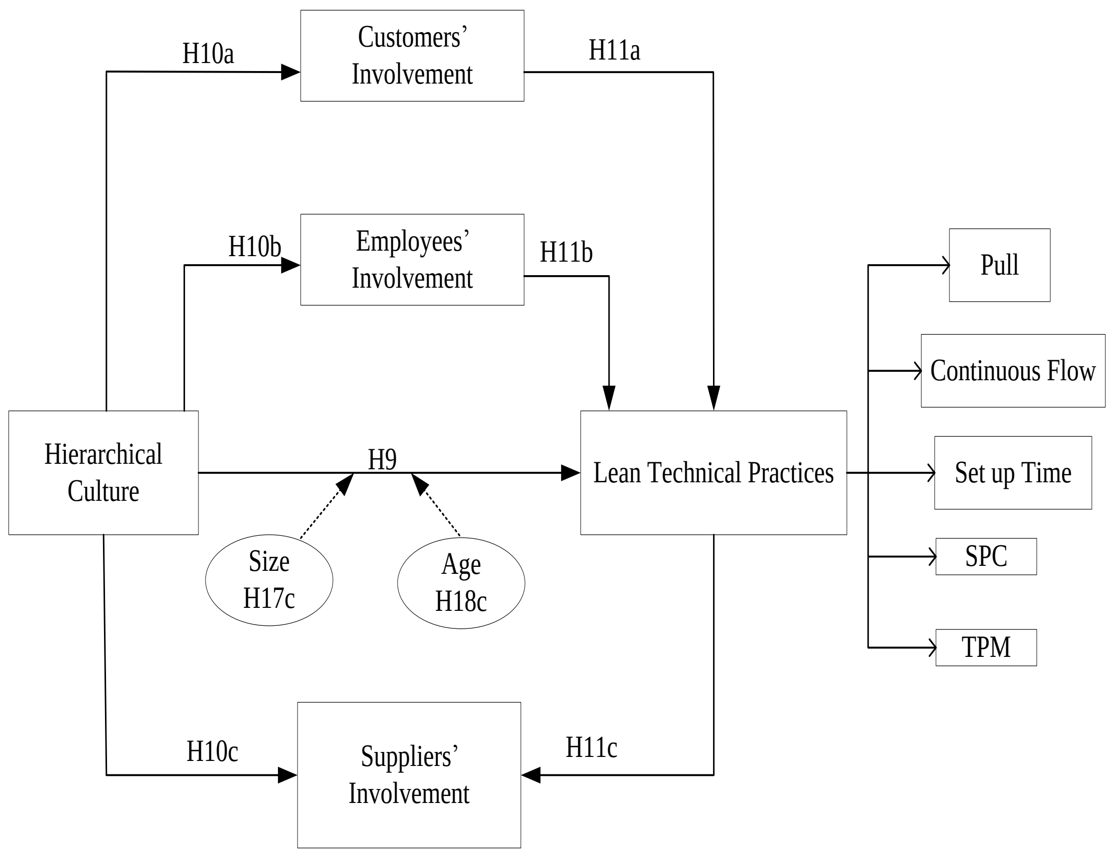
As discussed earlier in subsection 3.3.9 and 3.3.10, the highest degrees of quality programmes such as lean system requires the application of hierarchical culture's activities, such as improving measurements, process control and systematic problem solving (Cameron and Quinn (2011). The application of these activities depends on the involvement of human lean practices such as employees' involvement because the hierarchical structure is promoted in lean systems, where an employee approaches the supervisor before anyone else (Mehri, 2006). In addition, the consistency and coordination cultural traits of hierarchical culture demonstrate the unique effect on customer satisfaction (Lee et al., 2006). Hassini et al. (2008) argue that the hierarchical culture naturally supports efficient supply chain practices that are built on mechanistic and internal control mechanisms. Thus, the concern for predictability, uniformity and formality of rules and procedures inherent in the hierarchical culture is expected to facilitate organisations to put the lean technical procedures in effect through the effective involvement of lean human practices such as employees' involvement, customers' involvement and suppliers' involvement. Accordingly, the following hypotheses are proposed:

H12a: Customers' Involvement mediates the relationship between hierarchical culture and lean technical practices implementation.

H12b: Employees' Involvement mediates the relationship between hierarchical culture and lean technical practices implementation.

H12c: Suppliers' involvement mediates the relationship between hierarchical culture and lean technical practices implementation.

Figure 3-4 Research Conceptual Model 3: Hierarchical Culture



3.3.13 The Effect of Rational Culture on Lean Technical Practices

The last type in the CVF is the rational culture which focuses on the external environment and it is a results-oriented type (Zu et al., 2011). Rational culture is characterised by clarity of tasks and goals; therefore it puts a great emphasis on efficiency and measurable results (Helfrich et al., 2007). Organisations that adopt the rational culture prefer competition and the achievement of well-defined goals, and all activities focus on efficient planning and control of production to achieve competitive advantage and high productivity (Denison and Spreitzer, 1991). In manufacturing, this means the firm formally has and frequently revises strategic plans and written mission statements to ensure implementation (Naor et al., 2014). Success in rational culture is defined in terms of market share and penetration because the organisation's style is hard-driving competitiveness (Cameron and Quinn, 2011). Kull et al. (2014) argue that a high task oriented dimension which reflects the rational culture's values helps in increasing the effectiveness of lean manufacturing practices for many reasons. First, employees' training and their need for achievements that are valued in rational culture help workers to get skills and knowledge to implement lean practices. For example, the successful use of SPC depends on process mapping skills to streamline activities and control chart skills to detect errors. Second, because a high task culture values ambitious goals, employees will find the challenging goal of zero inventories in JIT motivating. Third, a high task culture values timely feedback, which motivates an effective implementation of lean practices. In the case of set-up time reduction, as feedback is given on time performance, workers in a rational culture will be encouraged to seek more progress in reducing set-up time.

All lean techniques target eliminating waste and improving the quality of a firm's products and processes in order to be competitive in the market (Mi Dahlgaard-Park et al., 2006). One of the elements that define rational culture is outcome excellence, which is congruent with the general goals of lean manufacturing and quality management (Naor et al., 2014). Stock et al. (2007) argue that rational culture, with its strong concentration on results and competent decision making mechanisms, is well- aligned to responsive supply chain practices that have high value emphasis on achievement, market leadership and competitiveness. Prajogo and McDermott (2011) have found that rational culture has a positive relationship with process quality. This is because quality is defined in terms of conformance and the conformance requires a standardised and stable process to ensure consistency.

Pakdil and Leonard (2015) argue that lean technical tools such as VSM, TPM, JIT, and SPC reflect the nature of rational culture. The extensive usage of lean tools and techniques has been shown to result in improved quality performance and higher efficiency and productivity and in turn better financial and market performance, higher customer satisfaction and competitive advantage (Hendricks and Singhal, 2001). As the rational culture values the aforementioned results (Cameron and Quinn, 2011), the application of lean practices are supported in the organisation emphasising rational culture because its managers and employees believe that these are critical parts of the desired organisational goals (Zu et al., 2010). Accordingly, the following hypothesis is proposed:

H13: Rational Culture has a positive effect on lean technical practices implementation.

3.3.14 The Effect of Rational Culture on Lean Human Practices

Lean thinking focuses on identifying value according to customers' needs (Womack and Jones, 2010), therefore manufacturing activities may include dealing with variations and flexibility in product mix to satisfy customers' needs. Usually employees may be frustrated and unmotivated when they must deal with flexibility in production, especially in the absence of specific goals such as not knowing what to do at the next stage. Thus, developing clear targets gives direction and a sense of purpose to employees (Zu et al., 2010). The capability to plan and set goals that reflect a rational culture's beliefs should also support greater employees' involvement.

Moreover, measuring customers' preferences is critical for organisations to achieve a competitive position as the organisation is emphasising rational culture and pursuing productivity and profitability (Denison and Spreitzer, 1991). The emphasis on rational culture helps the organisation to work closely with the customers and involve them in production to understand their needs and expectations, so as to better position their products in the market (Flynn et al., 1994, Zu et al., 2010). Similarly, emphasising rational culture allows organisations to collaborate with key suppliers through strategic partnerships to leverage strategic position and improve operating efficiency and productivity (Flynn et al., 1994, Zu et al., 2010). Achieving the improvements necessary to gain competitive advantage requires effectively integrating customers and suppliers into the supply chain (Kaynak and Hartley, 2008, Naor et al., 2008). Generally, rational culture's focus on the external market and constituencies is expected to support firms to build close relationship with customers and suppliers (Zu et al., 2010). In a study for Karimi and Kadir (2012), it has been found that rational culture has a significant positive effect not just on the technical hard quality management practices such as continuous improvement and benchmarking but also on the soft human practices which include supplier's support and increased interaction with employees and customers. Similarly, Baird et al. (2011) have found that organisations that promote a culture that emphasises action, achievements and results use quality practices to a high extent. Accordingly, the following hypotheses are proposed:

H14a: Rational culture has a positive effect on customers' involvement.

H14b: Rational culture has a positive effect on employees' involvement.

H14c: Rational culture has a positive effect on suppliers' involvement.

3.3.15 The Effect of Lean Human Practices on Lean Technical Practices in Rational Culture

Shah and Ward (2007) have explained how lean human and technical practices are interrelated with each other as follows, 'to facilitate continuous flow, products are grouped in families and equipment is laid out accordingly. To prevent frequent stop and go operations, machines undergo frequent preventive maintenance. Closely grouped machines and the similarity of items allow employees to detect errors through self-directed teams and solve problems in a faster and more effective way. In addition, actively involved customers enable companies to predict customer demand accurately. Reduced set-up times and quality assurance programmes allow companies to predict process output more accurately. To produce items, at the time and quantity required, organisations use pull production which means that suppliers deliver the right quantity and quality at the right time'.

Lean human practices help build the right environment for implementing hard lean tools (Bortolotti et al., 2015). In a recent study for Bortolotti et al. (2015), it was found that hard lean practices do not differentiate successful lean companies and they are different when they adopted soft practices. This means that successful lean firms give more attention to employee training, group problem solving, and maintain more collaborative relationships with suppliers and customers. Accordingly, the following hypotheses are proposed:

H15a: Customers' involvement in a rational culture has a positive effect on lean technical practices implementation.

H15b: Employees' involvement in a rational culture has a positive effect on lean technical practices implementation.

H15c: Suppliers' involvement in a rational culture has a positive effect on lean technical practices implementation.

All the proposed hypotheses from subsection 3.3.13 to 3.3.15 are illustrated in figure 3.5.

3.3.16 The Mediating Role of Lean Human Practices in the Relationship between Rational Culture and Lean Technical Practices

As discussed in subsection 3.3.13 and 3.3.14, rational culture puts a great emphasis on developing clear goals and measurable results (Helfrich et al., 2007). Developing clear goals gives direction and a sense of purposefulness to employees to be involved more in the manufacturing process (Zu et al., 2010). The involvement of employees will help workers in turn to get technical skills and knowledge to implement lean practices (Kull et al., 2014). Rational culture is also focused on a hostile external environment rather than internal environment, including suppliers and customers, and its primary aim is to improve its competitive position in the market (Cameron and Quinn, 2011). To achieve this, rational cultures concentrate on their customers and on improving their competitive advantage (Pakdil and Leonard, 2015). The external environment drives activities within the organisation toward winning and creating leaders centred on achievement. Quality strategies in rational culture measure customer preferences, creating partnership and involving customers and suppliers (Cameron and Quinn, 2011).

In organisations that adopt rational culture, measuring customers' needs is necessary for organisations to achieve competitive position as the firms focusing on the rational culture strive to increase productivity and profit (Denison and Spreitzer, 1991). This type is also called market culture because it focuses on transactions with the external suppliers and customers rather than focusing on internal issues (Demir et al., 2011). Customer satisfaction and loyalty are main concerns in lean implementation, reflecting the rational culture (Pakdil and Leonard, 2015).

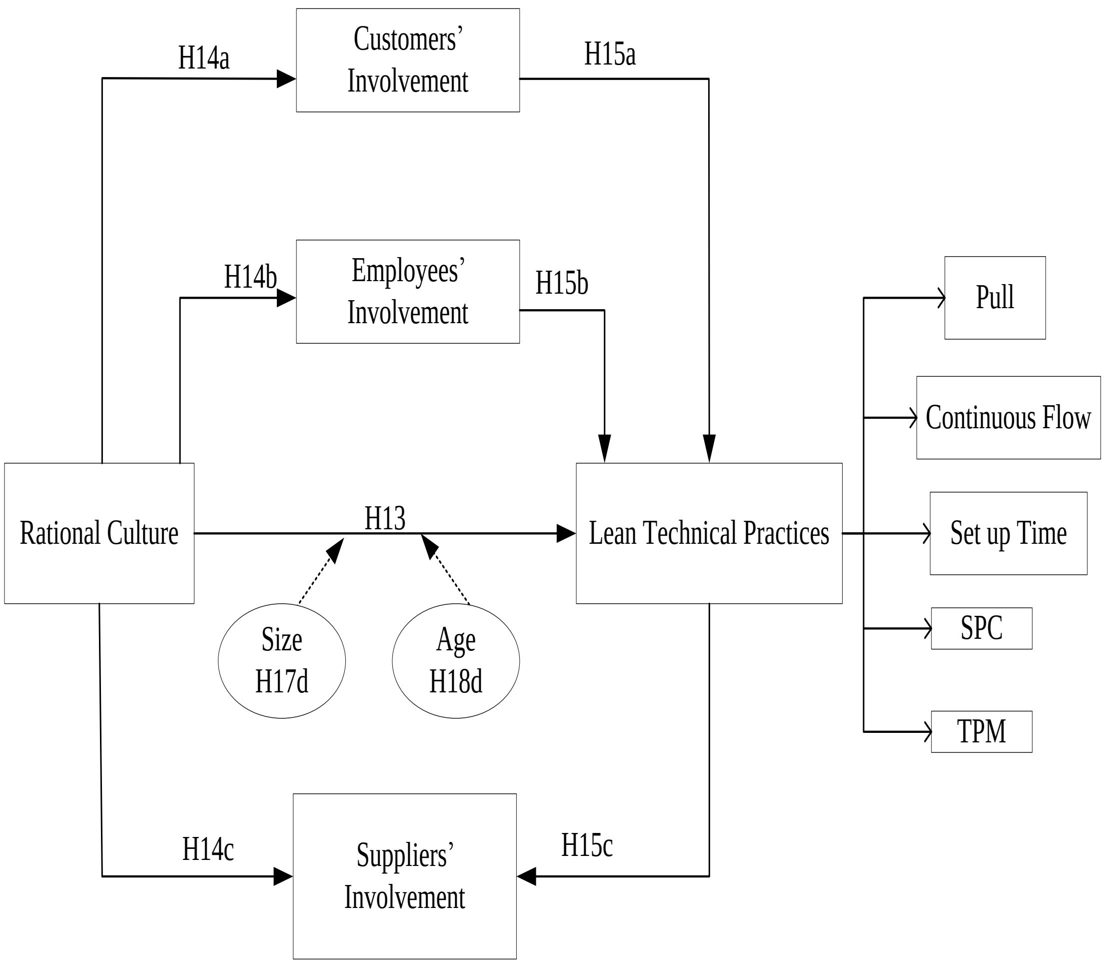
Cameron and Quinn (2011) argue in their book that ‘World- class quality requires the application of market culture activities such as measuring customer preferences before and after product and service delivery, improving productivity, creating partnerships with suppliers and customers, and honing competitiveness by involving customers in planning and design’. Therefore, the following hypotheses are proposed:

H16a: Customers' Involvement mediates the relationship between rational culture and lean technical practices implementation.

H16b: Employees' Involvement mediates the relationship between rational culture and lean technical practices implementation.

H16c: Suppliers' involvement mediates the relationship between rational culture and lean technical practices implementation.

Figure 3-5 Research Conceptual Model 4: Rational Culture



3.3.17 The Moderating Effect of Firm Size and Firm Age on the Relationship between Organisational Culture and Lean Technical Practices

3.3.17.1 The Moderating Effect of Firm Size on the Relationship between Organisational Culture and Lean Technical Practices

Firm size can also have an impact on the adoption of lean technical practices. Some arguments insist on the implementation of lean practices in SEMs (Saad et al., 2006, Karlsson and Åhlström, 1997, Powell et al., 2013, Zhou, 2012). The smaller size of these organisations means that they can better manage their resources. For example,Rahman et al. (2010) found in Thailand manufacturing firms that the regression weight for the relationship between lean practices and operational performance is significantly higher in small and medium-sized firms compared to large firms. However, large firms have more complex operations, administrative tasks and therefore can be more reluctant or slower in adopting innovative methods and techniques that are capable of improving their performance (Hannan and Freeman, 1984, Shah and Ward, 2003)。

Other arguments confirm that the higher level of resources available for large firms can be advantageous by allowing for more experimentation with new technologies and innovations (e.g. lean practices) that may improve their productivity and efficiency (Coad et al., 2013; Wagner et al., 2012; Shah and Ward, 2003). In the empirical study of Shah and Ward (2003), they found evidence of a positive relationship between firm size and 20 out of 22 lean practices. They found that large firms are likely to implement lean practices more extensively compared to small firms. Furthermore, whether a firm being small or bigger is detrimental of the level of implementation of customer focus, core process quality practices and the use of accurate quality measurements in the Kuwaiti manufacturing firms (Mady, 2009). The result of Mady's (2009) study concludes that the extent of implementation has been greater with large companies while the adoption by small firms has been minimal.

Furthermore, Jayaram et al. (2010) found in the manufacturing plants in the USA that the relationships among culture, quality system design and customer satisfaction were statistically different across small and large firms. Some relationships were stronger for large size firms and other relationships that were stronger for small size firms. This study suggests a deeper role into specific linkages that could be effective in small firms that may not be as effective in large firms. Similarly, there are linkages effective in large firms that may not be as effective in small firms. Whereas Sila (2007) reported that large companies and SMEs in the manufacturing and services industries in the USA were similar in terms of the fit of their TQM practices and the structural model relationships. The mixed evidence associated with the previous studies is referred to the contingency theory that discussed earlier in subsection 3.2.2, it is necessary to consider the effect of firms' size when studying the organisational culture/ lean technical practices relationship in the Jordanian context. Therefore, the following hypotheses are proposed:

H17 a: The effect of group culture on lean technical practices is moderated by firm's size.

H17b: The effect of developmental culture on lean technical practices is moderated by firm's size.

H17c: The effect of hierarchical culture and lean technical practices is moderated by firm's size.

H17d: The effect of rational culture and lean technical practices is moderated by firm's size.

3.3.17.2 The Moderating Effect of Firm Age on the Relationship between Organisational Culture and Lean Technical Practices

Firm age can affect the implementation of lean practices in different ways (Shah and Ward, 2003). On the one hand, old firms are more likely to be more experienced in running a businesses in comparison with young firms (Coad et al., 2013).The accumulated knowledge and experience may help old firms to be more efficient than less experienced firms that prevent the need for adopting lean practices to improve efficiency(Coad et al., 2013, Glancey, 1998, Lundvall and Battese, 2000). Furthermore, old firms may suffer from rigidity and inflexibility in responding to market changes and adopting innovations such as lean practices.

On the other hand, the newer manufacturing firms have a natural advantage in implementing new lean practices because of a younger, arguably less cynical workforce and because of fewer physical barriers to lean practices such as set-up time reduction (Coad et al., 2013, Shah and Ward, 2003, Wagner et al., 2012). Shah and Ward (2003) have found empirical evidence that newer manufacturing firms in USA facilitates the adoption of some lean practices, such as cross-functional work force, cycle time reduction, JIT/continuous flow production, maintenance optimisation, reengineered production process and self-directed work teams. Therefore, the following hypotheses are proposed:

H18 a: The effect of group culture on lean technical practices is moderated by firm age.

H18b: The effect of developmental culture on lean technical practices is moderated by firm age.

H18c: The effect of hierarchical culture on lean technical practices is moderated by firm age.

H18d: The effect of rational culture on lean technical practices is moderated by firm age.

3.4 Chapter summary

This chapter outlines the theories that can help explain the link between the four organisational cultural types in the CVF and the implementation of lean technical practices. In addition, the mediating role of lean human practices in the relationship between each type of organisational culture and lean technical practices was discussed individually based on theory. Four conceptual models are developed in this study. Each conceptual model represents one type of organisational culture with ten hypotheses. The four conceptual models address the following: First, a positive direct relationship exists between each type of organisational culture and lean technical practices. Second, a positive direct relationship exists between each type of organisational culture and lean human practices represented by customers' involvement, employees' involvement and suppliers' involvement. Third, a positive direct relationship exists between each lean human practice (customers' involvement, employees' involvement and suppliers' involvement) and lean technical practices. Fourth, the relationship between each type of organisational culture and lean technical practices might be mediated by customers' involvement, employees' involvement and suppliers' involvement. However, there has been little research that has attempted to test the effect of organisational culture on lean technical practices. In addition, there is no research examined empirically the effect of lean human practices on the relationship between organisational culture and lean technical practices. Therefore, this study aims to extend the existing literature on the relationship between organisational culture and lean technical practices. In addition, it aims to examine the mediating role of lean human practices in the organisational culture/ lean technical practices relationship.

In addition, the chapter presents eight hypotheses regarding the moderating effect of firm age and size on the relationship between each type of organisational culture and lean technical practices. Therefore, forty-eight hypotheses will be tested. The next chapter provides an overview about Jordan and the manufacturing sector in Jordan. Then the methodology used to test the hypotheses proposed in the current study will be provided in chapter 5.

CHAPTER FOUR: An Overview of the Jordanian Context

4.1 Introduction

This chapter aims to familiarise the reader with an overview of the context in which the empirical work of the current study has been conducted. Further to this introductory section, the chapter is organised into four other sections. Section 2 provides a brief description of Jordan in terms of its history, geography and climate, its people and the economic situation. Section 3 focuses on the research context, which is the manufacturing firms in Jordan. The fourth section sheds light on the population of this study represented by the Jordanian Industrial Estates. The fifth section describes the Industrial Estates within which the empirical work that has been carried out. Finally, a chapter summary is provided in section six at the end of this chapter.

4.2 Jordan: General Overview

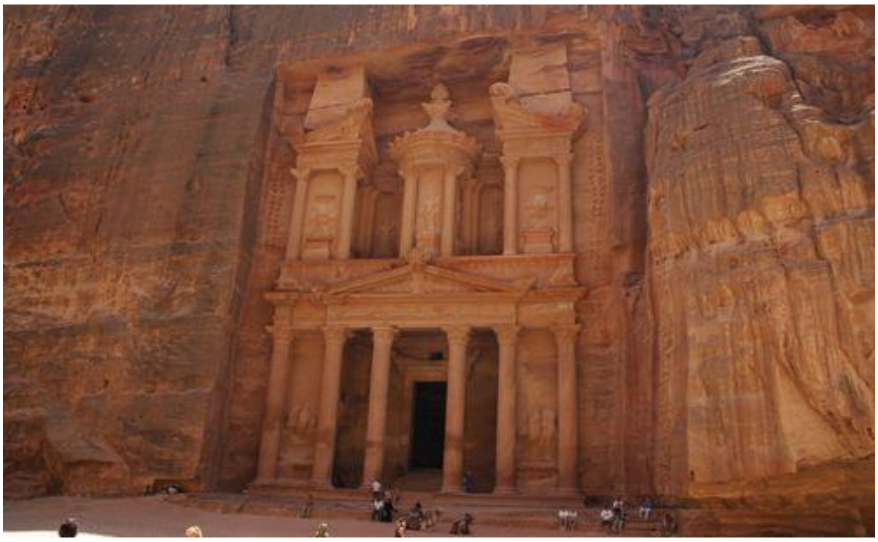
This section presents an overview of Jordan where the fieldwork has been carried out. It includes a brief historical background on Jordan, its geography and climate, its people, and its economic situation.

4.2.1 History, Geography, People and Culture

Jordan (or what is now officially known as the Hashemite Kingdom of Jordan) has an ancient history. Jordan is a country of vast diversity, great natural beauty and a unique regional role. It is a young nation founded on ancient land; home to a dozen civilisations, heartland of religions, a sea of languages, cultures and traditions (King Abdullah II Official Website, 2016).

Jordan's history did not truly start until the Bronze Age (3200-1950 BC) when permanent villages and forts were constructed. Civilisation disseminated during the increased migrations to the Middle East in the beginning of the Middle Bronze Age (1950-1550 BC). Then, during the first and second century, the ancient Kingdoms of the Nabatean Petra (see figure 4.1), Edom, Ammon, and Moab thrived across Jordan. It was the Nabateans who built the Arabic Script, a cross between Aramaean and ancient Classical Arabic, which finally transformed into Modern Arabic. At the turn of the 7th century AD, Jordan evolved into the major core of the Arabic Islamic Empire. It was governed by the Abbasid Empire, followed by the Mongols, the Crusaders, the Ayyubids, and the Mamluks until the Ottoman Empire took control in 1516 (World Atlas, 2016).

Figure 4-1 Petra



Source: The Mystery of the Treasury Monument Website (2016)

Following World War I and the dissolution of the Ottoman Empire, the League of Nations awarded Britain the mandate to govern much of the Middle East. Britain demarcated a semi-autonomous region of Transjordan from Palestine in the early 1920s. The region got its independence in 1946 and after that became The Hashemite Kingdom of Jordan. Jordan’s long-time ruler, King Hussein (1953-1999), successfully navigated competing pressures from the greatest powers in the US and the UK, different Arab states, Israel, and a large internal Palestinian population. Abdullah II, King Hussein’s eldest son, assumed the throne following his father’s death. He implemented modest political and economic reforms, but in the wake of the 'Arab Revolution' across the Middle East, Jordanians continue to press for further political liberalisation, government reforms, and economic improvements (Central Intelligence Agency, 2016).

Furthermore, Jordan has a rich religious history. For Jews and Christians, it is part of the Holy Land, sacred for its connection to the Jewish patriarchs Abraham and Moses, as well as Christian biblical symbols such as John the Baptist. Jordan is equally important in the history of Islam, as many tombs of Prophet Mohammed's companions are in Jordan. Jordan is where the non-Arab world first contacted Islam more than fifteen hundred years ago (Countries and Their Cultures Website, 2016).

Jordan is a relatively small country situated at the junction of the Levantine and Arabian areas of the Middle East. As shown in Jordan map in figure 4.2 below, the country is bordered on the north by Syria, to the east by Iraq, and by Saudi Arabia on the east and south. To the west is Israel and the occupied West Bank, while Jordan's only outlet to the sea, the Gulf of Aqaba, is to the south. Jordan occupies an area of approximately 96,188 square kilometres including the Dead Sea, making it similar in size to Austria or Portugal. However, Jordan's diverse terrain and landscape belie its actual size, demonstrating a variety usually found only in large countries. Jordan has a port on the Red Sea through the city of Aqaba, located in the far north of the Gulf of Aqaba. The lowest point is the surface of the Dead Sea and at 408 m below sea level. The highest point stands at 1,854 m on the summit of Mount Umm Al-Dami (The Official Site of the Jordanian e-Government, 2016).

Western Jordan has essentially a Mediterranean climate with a hot, dry summer, a cool, wet winter and two short transitional seasons. However, about 75 per cent of the country can be described as having a desert climate with less than 200 mm. of rain annually. Jordan can be divided into three main geographic and climatic areas: the Jordan Valley, the Mountain Heights Plateau, and the eastern desert, or Badia region (King Hussein I Official Website, 2001a).

Figure 4-2 Jordan Map

Source: World Atlas (2016)

The official language in Jordan is Arabic, while the use of English is the second and most common foreign language. Islam is the official religion of the country (The Official Site of the Jordanian e-Government, 2016). More than 92 per cent of Jordanian people are Sunni Muslims, and about 6 per cent are Christians who live mainly in Amman, Madabas, Karak and Salt. Several small Shi'a and Druz populations can also be found in Jordan. Jordan values its diverse population, and has consequently provided for the cultural rights of all its citizens. All of Jordan's ethnic and religious groups have full freedom to form and be involved in their own clubs, associations, schools and places of worship. The tradition of tolerance and appreciation for diversity has long been a hallmark of Jordan, which provided a stable social base on which the country was developed (King Hussein I Official Website, 2001b). Table 4.1 below gives recent statistics about the population in Jordan.

Table 4-1 Jordan Population Indicators at the End of October 2016

Total population	**7,786,422**
% Male	**51.18 %**
% Female	**48.81%**
Density (per sq. km)	**87**
Growth rate	**1.65%**
Births per day	**538**
Deaths per day	**83**
Life expectancy	**74.5 years**

Source: World Population Review Website (2016)

Furthermore, there are many other ethnic groups in Jordan. There are about 500,000 Iraqis, and over 500,000 Syrian refugees have moved to Jordan to escape violence in the last two years (World Population Review Website, 2016). More than 60 per cent of the population lives in the capital of Jordan, Amman, concentrating the culture of Jordan in that city. The Jordanian people's culture is heavily influenced by the Western culture. European and American music, movies, fashion and other form of entertainment are familiar among Jordan's people. Amman is consistently stated to be one of the most westernised and modern cities in the region. Malls, Western-brand stores, and hotels are important aspects in Amman's urban life. Westernisation is happening because of the heavy Western influence on the nation's political life and foreign affairs (Countries and Their Cultures Website, 2016). Handshaking is the customary form of greeting. Jordanians are proud of their Arab culture and they consider hospitality a great issue. Visitors are made to feel very welcome and Jordanians are happy to behave as hosts and guides, keen to tell others about their traditions and culture (World Travel Guide Website, 2016).

When people visit a family or a friend, tea, Turkish coffee or Arabic coffee, or fruit juice is served. Often this meal includes sweets, especially on holidays. The national main dish is called 'Mansaf', which consists of lamb cooked in dried yogurt and is served with rice on flat bread. Mansaf is always served on holidays and special family occasions, such as visits to relatives or friends, engagements and weddings (Countries and Their Cultures Website, 2016). Islam plays a big role in the Jordanian culture.

Therefore, Muslin women's clothing often covers their arms, legs and hair. At the same time, local women in Jordan enjoy considerable freedom when compared to many other countries in the region. Women are entitled to a full education, they can vote, they can drive cars, and they often play significant roles in business and politics (Jordan Tourism Board, 2013)

According to the Human Development Report for Jordan (2015), Jordan's Human Development Index (HDI) value for 2014 is 0.748, which put Jordan in the high human development category and positioned it at 80 out of 188 countries and territories (UNDP, 2015).

As discussed earlier in chapter two (section 2.3) that the organisational culture is developed through the daily activities and rituals of people and it is built on strong values which are reserved by the organisational members. Therefore, the organisational culture in any firm could be a reflection of its national culture.

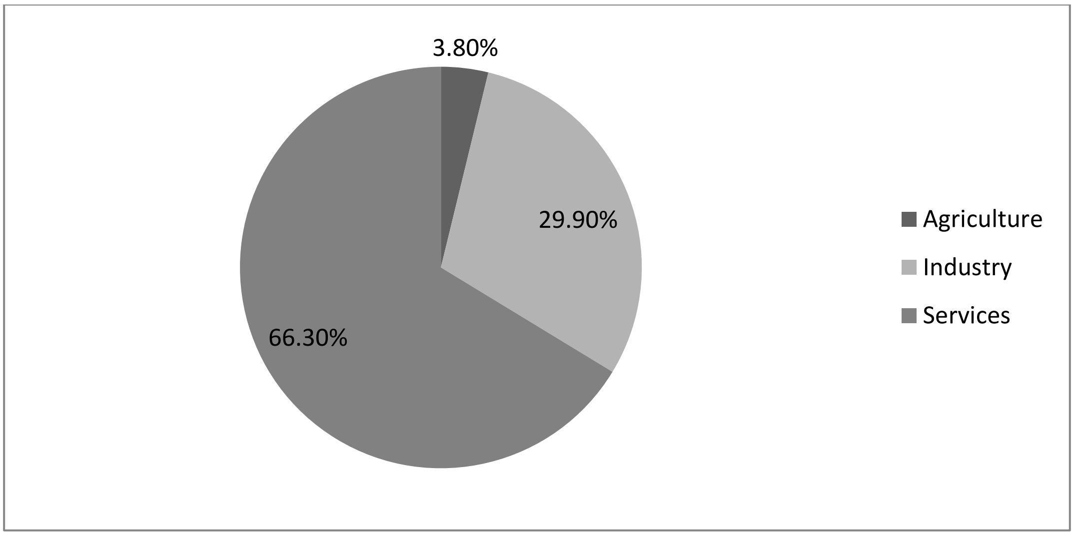
According to Hofestede's (1984) national culture dimensions, Jordan is considered a collectivist society. People in Jordan tends to focus on relationships where people take responsibility and take care of their families and others, the relationship between the employees and the employer are normal like a family link. Also, Jordan scores high on power distance dimension which means that people in Jordan accept the hierarchical order and prefer little consultation between superiors and subordinates. Additionally, Jordan scores high on uncertainty avoidance, thus the workers need rules and they value time, precision, punctuation and the security. The Jordanian culture is deeply rooted in its people. Their rituals are part of their daily lives. Due to this, it is not out of ordinary that Jordanian people will deliver some of their cultural values into the workplace, which will contribute to the uniqueness of their organisational cultures, which are typically Arab Muslim in nature.

As culture tends to affect strongly the managerial practices and organisational behaviours, the effective implementation of lean practices may vary across different cultures. Based on the contingency theory discussed in section 3.2, the effective lean practices must be matched with the cultural and organisational context. Therefore, there is a need to examine the different cultural types on lean practices in less developing countries such as Jordan, because of the limited resources, the rapid of business globalisation and the increased of international trade with these countries.

4.2.2 Economy in Jordan

Jordan is an emerging knowledge economy. Jordan's economic resource base centres on phosphates, potash, and their fertiliser derivatives. In addition, it depends on tourism, overseas remittances, and foreign aid. These are its basic sources of hard currency earnings. The Gross Domestic Product (GDP) in Jordan was worth 37.52 billion US dollars in 2015. The GDP value of Jordan represents 0.06 percent of the world economy. GDP in Jordan averaged 9.11 USD billion from 1965 until 2015, reaching an all-time high of 37.52 USD billion in 2015 and a record low of 0.56 USD billion in1968 (Trading Economics Website, 2016). Figure 4.3 presents the GDP composition by sector in Jordan.

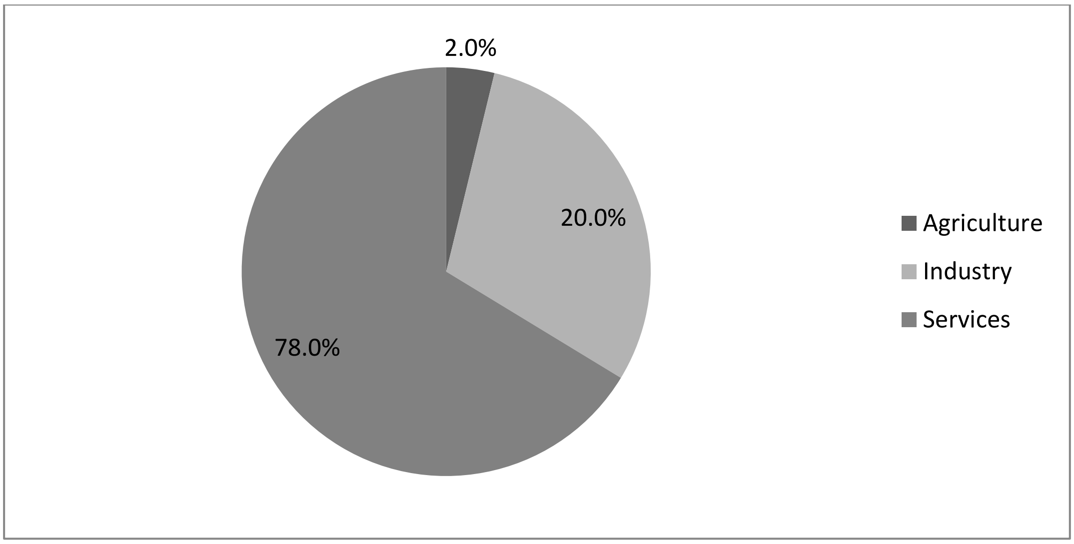
Figure 4-3 GDP Composition by Sector in Jordan



Source: Central Intelligence Agency Website (2016)

The employment rate in Jordan averaged 33.40 per cent from 2007 until 2016, reaching an all-time high of 35.80 per cent in the second quarter of 2009 and a record low of 30.50 per cent in the first quarter of 2016 (Trending Economics Website, 2016). Figure 4.4 presents the composition of the labour force by occupation in Jordan.

Figure 4-4 Composition of Labour Force by Occupation in Jordan

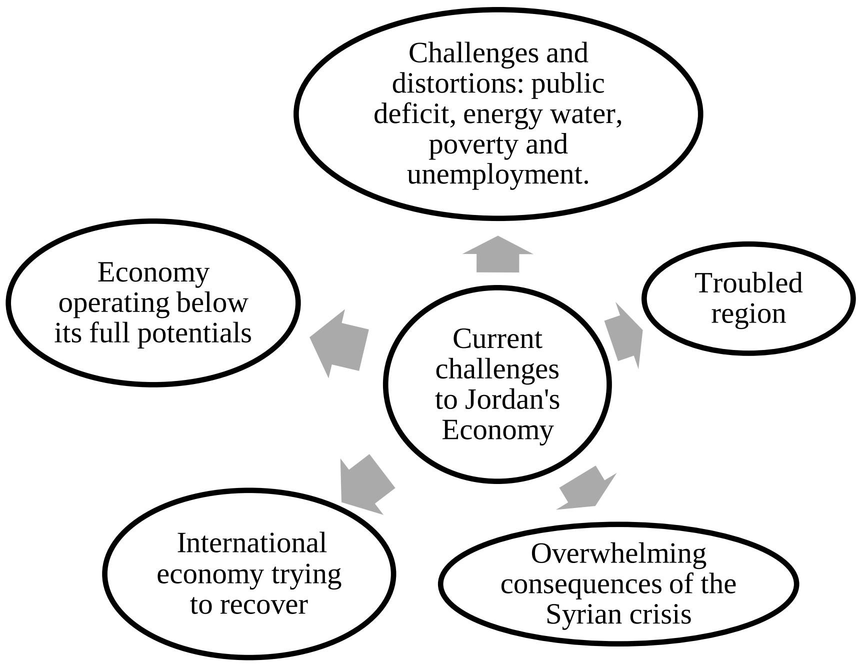


Source: Central Intelligence Agency Website (2016)

4.2.2.1 Economic Challenges

The official currency in Jordan is the Jordanian dinar, which equals 1.41 (as at October 2016) of a United States Dollar. Economically, Jordan has been exposed to a series of many pressures in the last few years. Figure 4.5 below shows Jordan's economic sphere and the challenges it started since late 2010. The main challenge besetting Jordan's economy today is the volatile environment of the region and the unrest in the neighbouring countries. The consequential burdens of the Syrian Crisis and the deterioration of the Iraqi crisis on Jordan's economy are so huge and showed clearly on the foreign trade and ability to attract investments. Jordan can no longer look for the expansion of its market, particularly given the uncertainties brought about by the two crises. The burdens on Jordan's economy increased with the Syrian refugee crisis, whose cost on the under-resourced country is estimated at over five billion Jordanian dinars for the period 2011-2014 (Jordan's Economic Outlook Report, 2015). Internationally, the crisis reverberates in Europe adding up to the consequences of the regional crisis, especially because the euro zone is a key player in Jordan's foreign trade accounting for almost a third of its exports. Upon the execution of the Jordan-US free trade in the early 2000s, the United States of America became busy wiping away the damages sustained by its economy due to the latest financial crisis (Jordan's Economic Outlook Report, 2015).

Figure 4-5 Jordan's Economic Challenges



Source: Jordan's Economic Outlook Report (2015, p.2)

4.2.2.2 Economic Policy and Reforms

Despite these challenges, there are signs of economic recovery. The GDP growth exceeded 4.0 per cent in 2014. Foreign direct investment (FDI) and tourism are slowly rebounding, and businesses in the medical services, clean technology, and information and communications technology (ICT) sectors have showed a continued capacity to grow (USAID, 2016).

Jordan has emerged as the 'business capital of the Levant'. The free market economy of Jordan has grown 7 per cent annually since the accession of King Abdullah in 1999. It relies on foreign trade for its energy and natural resource requirements. Due to the implementation of liberal economic policies, the nation has become one of the most competitive Middle Eastern economies. Jordan boasts a modern and developed banking system and is attracting significant foreign investment. This has also enabled the country to smoothly tackle the global financial downturn of the late 2000s (Jordan Investment Commission, 2015b).

The total exports of goods and services in Jordan in 2014 were around US$15,506 billion, while its total imports of goods and services in the same year were about US$24,796 billon. Exports of goods and services formed 43.28 per cent of GDP whereas the total imports of goods and services formed 69.21 per cent of GDP(Global EDGE Website, 2016). The key exported commodities have emerged from the industrial sector in Jordan include potash, phosphates, clothing, vegetables, fertilisers and pharmaceuticals and these are mainly exported to the USA, Iraq, Saudi Arabia, India, Indonesia, Kuwait, Turkey and Qatar. Whereas the imports are primarily crude oil, machinery, transport equipment, iron and cereals which are imported mostly from Saudi Arabia, China, USA, India, United Arab Emirates, Germany, Italy and Turkey (Global EDGE Website, 2016, Central Intelligence Agency, 2016).

Jordan has shown a keen commitment towards developing an outward-oriented and global economy. It has been a member of the World Trade Organisation since 2000 and it is the first Arab country to have a dual free trade agreement with the United States of America. Other free trade agreements are with the European Union, Malaysia, Canada, Singapore, Tunisia, Syria, Turkey and many other Arab countries. In the last decade, successive governments have largely adopted a number of key economic reform initiatives, including enacting laws to handle economic corruption, privatisation, encouraging foreign investment, the gradual dropping of fuel subsidies and commencing tax reforms (The Official Site of the Jordanian e-Government, 2016).

During the first decade of the 2000s, King Abdullah II implemented important economic reforms, such as expanding foreign trade and privatising state-owned firms that attracted foreign investment and contributed to average annual economic growth of 8 per cent for 2004 through 2008. The global economic decline and regional turmoil contributed to slower growth from 2010 to 2014, with an average growth of 2.8 per cent per year. Through 2014, Jordan's finances were strained by a series of natural gas pipeline attacks in Egypt, disrupting natural gas exports to Jordan, which led Jordan to depend on costlier diesel imports, primarily from Saudi Arabia, to provide electricity. Jordan is currently trying to discover nuclear power generation to diversify its energy mix. In 2015, Jordan completed a $ 2.1 billion, three-year International Monetary Fund (IMF) standby arrangement, which the government had participated in to help correct budgetary and balance of payments imbalances. Jordan plans to increase on its fiscal reform measures enacted over the last few years with a follow-on IMF agreement in 2016 to boost government revenues, decrease the budget deficit, and manage its burgeoning debt, brought on in part by an influx of over 630,000 Syrian refugees since 2011, which put additional pressure on resources (Central Intelligence Agency, 2016). Table 4.2 below shows the macro-economic indicators in Jordan from 2012 until September 2015.

Table 4-2 Macro-Economic Indicators in Jordan (2012- 2015)

	2012	**2013**	**2014**	**Jan-Sep 2015**
GDP at current prices ($ million)	30981.73	33641.82	35877.36	27574.10
Real GDP Growth rate %	2.7	2.8	3.1	2.3
Per Capita GDP at current prices ($)	4850.50	5152.34	5375.19	-
Inflation rate %	4.5	4.8	2.9	-0.9

Source: Jordan Chamber of Industry (2016)

Generally, based on the World Bank’s classification (2016), the kingdom is one of the developing upper middle-income countries. As well as this, the Jordanian economy is one of the freest economies in the Middle East and North Africa (Economic Freedom Website, 2016). Table 4.3 below presents a snapshot about the economic freedom in Jordan.

Table 4-3 Economic Freedom Snapshot

- Economic Freedom Status: **Moderately free**
- 2016 Economic Freedom Score**: 68.3 (World's average: 60.7)**
- Global Ranking: **46th**
- Regional Ranking: **5th in the Middle East/ North Africa Region**
- Notable Successes: **Trade Freedom and Monetary Freedom**
- Concerns: **Management of Public Spending and Business Freedom**

Source: Economic Freedom Website (2016)

4.3 The Manufacturing Sector in Jordan

The industrial sector in Jordan is one of the most promising sectors in Jordan due to the number of industrial cities and areas of development concerned with the support of medium and small industries, many of which benefited from the free trade agreements Jordan has(Jordan Investment Commission, 2015a). The industrial sector consists of a heterogeneous mixture of manufacturing and conversion activities, ranging from converting raw materials into refined products such as phosphate, cement, plastics and glass, to those with highly finished end-products, such as food processing and chemicals sectors. The industrial sector can be classified in terms of the nature of activity and the size of the industry. Micro enterprises generally dominate the sector by 87 per cent, with the engineering, electrical, and IT having the largest proportion, followed by furniture and wood, and construction (The World Bank, 2009). The GDP from manufacturing in Jordan averaged 394.92 JOD[10]million from 2003 until 2016, reaching an all-time high of 514 JOD million in the third quarter of 2015 and a record low of 210.60 JOD million in the first quarter of 2003 (Trending Economics Website, 2016). Table 4.4 below shows some industrial economic indicators in Jordan from 2012 until September 2015.

Table 4-4 Industrial Economic Indicators (2012-2015)

	2012	**2013**	**2014**	**Jan-Sep 2015**
Industrial production ($ million)	6826.53	7290.99	7790.99	5845.00
Its shares from GDP (%)	25.0	24.6	24.6	24
Manufacturing sector (%)	18.8	19.4	19	18.3

Source: Jordan Chamber of Industry (2016)

The Ministry of Industry and Trade is the primary government entity responsible for the regulation of the manufacturing sector in Jordan. In addition to the Ministry of Industry and Trade, the Central Bank of Jordan reports data on industry within Jordan. Different regulatory bodies also regulate some subsectors of manufacturing. For example, the National Resources Authority regulates the manufacturing of mineral by products. As well as to governmental regulatory bodies, different professional associations have been developed within the manufacturing sector. These associations are usually separated by specific subsectors of manufacturing.

10: 1 JOD = 1.41 US dollar

Some of these associations such as the Jordan Garments, Accessories And Textiles Exporters association, the Jordan Association Of Pharmaceutical Manufacturers, and the Jordan Furniture Exporters And Manufacturers Association (The World Bank, 2009).

In Jordan, the national classification of industrial subsectors has been determined by a decree issued by the Jordan Cabinet in 2005 to cover all industrial enterprises operating in one or more industrial activity. This classification is partly different from the United Nations international standard industrial classification- the International Standards for Industrial Categories (ISIC) - that offers a standard set of economic activities classifying firms based on the activity they undertake. The ISIC categorised industries into mining, transformational industries and the power generating industry. The Jordanian industrial classification system combined some of the International Industrial categories based on specific similarities. The result was the following national industrial categorisation system (The World Bank, 2009):

1. Leather and Garments
2. Therapeutics and Medical
3. Chemical and Cosmetics
4. Plastic and Rubber
5. Engineering, Electrical Industries and Information technology
6. Furniture and wooden
7. Construction
8. Food, supplies, agriculture and livestock
9. Packing, packaging, paper, cardboard and stationeries
10. Mining

The Jordan Chamber of Industry's law for the year 2005 adopted a formal description of the size of industrial firms working in industry solely based on the registered capital size and labour size. The law defined and classified firms into two types (The World Bank, 2009), (1) industrial enterprises, which employ 10 or more workers and subscribed to the Social Security Corporation, and has a registered capital of JOD 30,000 or more, (2) micro enterprises, which employ less than ten employees and subscribed to the Social Security Corporation, and has a registered capital of less than JOD 30,000.

A representative committee from the public and private sectors was formed to expand studying this issue based on the Trade and Industry Law for the year 1998, and the Chamber of industry Law for the year 2005. This committee added two additional categorisation criteria that are based on the registered capital size and the labour size Table 4.4 below shows a summary of this categorisation.

Table 4-5 Classification of Industrial Firms in Jordan in terms of Size and Capital

Type of industrial establishments	Labour size	Registered capital
Handicrafts	1-9	Less than JOD* 30,000
Small	10-49	More than JOD 30,000
Medium	50-249	More than JOD 30,000
Big	More than 250	More than JOD 30,000

1 JOD= 1.41 US dollar
Source: The World Bank (2009)

4.4 Jordan Industrial Estates

Central to the manufacturing sector in Jordan is the country's bilateral relations with the United States and the economic agreements that have resulted from this relationship. Two important aspects of these agreements are the creation of industrial estates that are considered qualified industrial zones (QIZs) in Jordan and the signing of the US-Jordan free trade agreement in 2000. The QIZs are geographical zones offering lower taxes and fewer labour regulations meant to motivate the growth of manufacturing. They also allow for goods manufactured in the QIZs to be exported duty-free to the US provided no less than 35 per cent of the appraised value of the product come from a combination of Jordan (11.7 per cent) and Israel (7-8 per cent) with the rest coming from the US, Israel, Jordan or the Palestinian Territories. The US-Jordan free trade agreement was the first Arab free trade agreement. The agreement increased the domestic-value added requirement from 11.7 per cent to 35 per cent(CSR Watch Jordan, 2014)

According to USAID (2007), the QIZs are developed for two main purposes:

1. Local economic development by providing appropriate soft infrastructure (policies and procedures) and hard infrastructure to attract investment and increase local income and employment.

2. A model for national economic reform to demonstrate best practice and test the impact of economic reforms before introducing them nationally.

The industrial estates are models of the various special economic zones. Most industrial projects in Jordan are located within industrial estates. These projects are granted incentives and exemptions such as developed plots and buildings, infrastructure such as road networks and ancillary services, utilities such as electricity and water at reasonable cost, access to international markets through trade agreements, freedom to own or rent property at competitive prices, full repatriation of profits and capital, free transfer of shares, duty-free and quota-free access to US markets and full exemption from taxes and fees on fixed assets and spare parts (Jordan Economic and Commerce Bureau, 2010). Jordan has continued through its industrial estates to attract local and foreign investment. These make a great contribution to national exports and to the Jordanian economy in general (Oxford Business Group, 2016).

The Jordan Industrial Estate Corporation (JIEC) governs all industrial estates. JIEC is a quasi-governmental corporation established in 1984 with public and private ownership. Its role is to contribute to the development of small and medium industries by offering comprehensive and integrated industrial estates, to increase support and encourage the manufacturing sector, and to increase investment opportunities in the manufacturing sector. One of its main goals is to promote Jordan's industrial development by providing an appropriate home for both local and foreign industries (Jordan Industrial Estates Corporation Website, 2009a).

JIEC is considered as a municipality and it exercises the authorities of the local and the regional planning committees within industrial estates. Hence, it is entitled to issue vocational licences and construction and building permits to industrial estate tenants (USAID, 2007). JIEC owns and manages five industrial estates in the largest cities in Jordan. Three of these are considered QIZs. These estates are fully equipped with advanced facilities, equipment and machines including roads, full maintenance, utilities and sewage and disposal treatment plants. Additional services include vocational training centres, banking services, customs clearing centres, Ministry of Industry and Trade branch offices, as well as branches of the Amman Chamber of Industry (Amman Chamber of Industry Website, 2016).

4.4.1 The Rationale behind Choosing Jordan Industrial Estates as the Target Population in the Current Study

JIEC has accomplished an effective developmental and strategic performance, as it works in close cooperation with private sector institutions in promoting Jordan as a suitable and distinguished environment for investment. The industrial estates in Jordan work as a holistic approach, which provides modern infrastructure services, modern facilities, developed lands as well as prepared industrial buildings for serving the investors. Armed with a long history of experiences that have been dedicated to give the best shot of it, JIEC has transformed itself into the Jordanian specialist in developing the industrial estates in Jordan. It has acquired the ISO quality certification and has been awarded the first-place gold award of King Abdullah II for Excellence in Government Performance and Transparency, in addition to many certificates and awards on both national and international levels. This reason has motivated the researcher to conduct the empirical fieldwork in the industrial estates in Jordan believing that these estates are qualified in implementing lean manufacturing practices. Therefore, the obtained data serve the purpose of the current study.

Moreover, Jordan's industrial estates make a sizeable contribution to the Jordanian economy. According to JIEC, total invested capital in 2011 stood at around 1.57billion Jordanian dinars (JD) ($2.2billion) which is equivalent to roughly 5.5 per cent of GDP. The exports from the estates were valued at JD860 million ($1.2billion), or about 18 per cent of total national exports. The best-represented industries in the estates are cotton and weaving (making up 25.7 per cent of total capital in 2010), food (16.8 per cent), metallic and electric engineering (13.3 per cent), and pharmaceuticals (12.8 per cent) (Oxford Business Group, 2016).

4.4.2 The Industrial Estates within Which the Empirical Work has been Carried Out

The first industrial estate is also the oldest – The Abdullah II Ibn Al Hussein Industrial Estate at Sahab (figure 4.6) located 12 km south of Amman. This estate was established in 1984 and is the biggest estate in Jordan, home to 358 medium and small-scale industries, with over JD1billion ($1.4 billion) of investment and jobs for 13,042 workers. The total land area of this estate is 2,530,000 m2. It has a proximity to the main routes that connect Jordan with the neighbouring countries (Jordan Industrial Estates Corporation Website, 2009b). Firms are evenly distributed across food, engineering (metal and electronic), plastic and rubber, pharmaceuticals, chemical industries, cotton and weaving, wooden and metallic furniture, printing and packaging (USAID, 2007).

Figure 4-6 Abdullah II Bin Al-Hussein Industrial Estate

Source: Jordan Industrial Estates Corporation Website (2009b)

The second estate is the Al Hassan Industrial Estate (figure 4.7). It is the first qualified industrial zone (QIZ) in Jordan. It is built in 1991 and located in the Irbid governorate. It has a total area of 117.8 m2 and over 101 firms are located there, with more than JD 222.5million ($313million) in capital invested (Oxford Business Group, 2016). It has a proximity to the northern border crossing and is the largest industrial complex in the north region (Jordan Industrial Estates Corporation Website, 2009b). Most firms in this estate are garment firms. Other major industries represented include engineering, plastic, rubber, and pharmaceuticals (USAID, 2007).

Figure 4-7 Al Hassan Industrial Estate

Source: Asharq Al-Awsat Newspaper (2015)

The third estate is the Al Hussein Bin Abdullah II Industrial Estate (figure 4.8). It was established in 2000 in Al Karak city, 118 km south of Amman. This estate is the second qualified industrial zone in Jordan. This estate has 14 companies located there, with around JD33.6million ($47.2 million) in capital invested (Oxford Business Group, 2016).

Figure 4-8 Al Hussein bin Abdullah II Industrial Estate

Source: Jordan Industrial Estates Company Website (2009)

The fourth estate is Al Muwaqar Industrial Estate. The total land area of this estate is 2,500,000 m2. It is the second industrial estate in the capital of Jordan (Amman) and is considered an extension to the Abdullah II Ibn Al Hussein Industrial Estate. This estate is located adjacent to the highway, which connects Jordan, Saudi Arabia and Iraq. It is located 120 km from the Jordanian-Saudi borders and 310km from the Jordanian-Iraqi borders. This estate provides excellent incentives and exceptions for local and foreign investors. Also, this estate was equipped completely in terms of infrastructure and basic services provided, as the best international practices in the field of establishing and developing Industrial Estates have been adopted in this estate (Jordan Industrial Estates Corporation Website, 2009b).

Table 4.5 below shows the number of companies, investment volume, exports and number of workers in all Industrial Estates in Jordan in 2014.

Table 4-6 The Number of Companies, Investment Volume, Exports and Number of Workers in the Industrial Estates in Jordan in 2014.

Industrial Estate	**Number of companies**	**Investment ($ million)**	**Exports ($ million)**	**Number of workers**
Abdullah II Industrial Estate	435	231495.52	71758.96	17473
Al-Hassan Industrial Estate	80	57224.37	56313.23	21292
Al-Hussein Bin Abdullah Industrial Estate	14	5638.94	14809.62	3843
Al-Muwaqar Industrial Estate	9	40430.26	9543.04	4880
Total	538	334789.1	152426.26	47488

Source: Jordan Industrial Estates Company Website (2014)

4.5 Chapter Summary

The aim of this chapter is to introduce the research context of the current study. The chapter provides an overview of Jordan including the country's history, geography, its people and culture and its economic conditions. It also discusses the manufacturing sector in Jordan and its importance in the Jordanian economy. In addition, this chapter presents an overview about the Industrial Estates in Jordan within which the fieldwork has been conducted.

This chapter provides a brief background about Jordan and its culture because it is believed that the national culture affects the daily lives of its people, which in turn affect their behaviours in their work environment. Furthermore, the chapter provides background about the target population to which the findings of the current study will be directly generalised. The next chapter will present more details about the sampling process, which depends on the target population presented in this chapter. In addition, chapter six will provide descriptive statistics about the dominant different types of organisational culture based on the CVF across different manufacturing sectors in Jordan.

CHAPTER FIVE: Research Methodology

5.1 Introduction

In general, the term research refers to a process of planning, implementing and investigating in order to reach to answers to specific questions (Ghauri and Grønhaug, 2005). In addition, research is "a process that people undertake in a systematic way to find out things, thereby increasing their knowledge"(Saunders et al, 2016, p.5). There is a general agreement that research is a systematic and methodical process of investigation and is seeking with a view to increasing knowledge (Collis and Hussey, 2013). Therefore, research in its true meaning has three characteristics: the research must be guided by a clear purpose to detect things, must use a systematic way in data collection and use of systematic method in interpreting the collected data (Saunders et al., 2016).

In order to meet the characteristics of the scientific research, a researcher should adopt what is known as a research methodology which refers to the rationale for the application of specific research methods (Hammond and Wellington, 2012). Many of the characteristics of good study can be established by adopting a methodical approach. Methodological rigor refers to "the appropriateness and intellectual soundness of the research design and the systematic application of the research methods"(Collis and Hussey, 2013, p.18).

Accordingly, this chapter is intended to present the research methodology adopted in answering the research questions and meeting the research's aim and objectives. This chapter presents the whole research process including the research design, research philosophy, research perspective, and logic of the research, research methods, research strategy, time horizon, sampling, process, methods of data collection and the techniques used in data analysis. The chapter introduces the main methodological choices that should be taken by any researcher in each phase in the research process, followed by the rationale behind each methodological decision made along this research process.

5.2 Research Design

Many research designs could be used to study business problems. Hair et al (2007) classify them into three groups based on the purpose of the study.

The first group of research design is *Exploratory Research*, which is used when the researcher has little information about the problem or opportunity. It is developed to discover new relationship, patterns, themes and ideas. Therefore, it is not intended to test specific hypotheses (Hair et al., 2007, Collis and Hussey, 2013). An exploratory study is a valuable way to ask open questions to discover what is happening and to obtain insights about a topic of interest (Saunders et al, 2016).

Exploratory research depends more deeply on **qualitative techniques**, even though the quantitative methods can be used (Hair et al., 2007). The researcher can search the literature or conduct in depth or unstructured interviews with experts in the topic or making focus groups interviews (Saunders et al., 2016). Therefore, Ghauri and Grønhaug (2005) argue that exploratory research requires key skills, such as the ability to observe, obtain information and provide explanation that is theorising. Additionally, the exploratory research is considered flexible and can be changed. Newer data and newer insights will result in newer direction in the study (Saunders et al., 2016).

The second group of research design is *Descriptive research*, which is designed to analyse data that describe the traits of the topic of interest in the study. It is usually structured and accurately developed to assess the characteristics described in research questions (Hair et al., 2007). Descriptive research is used to specify and obtain information on the properties of a specific issue (Collis and Hussey, 2013). The research questions that are descriptive are probably begin with or include terms such as 'who', 'what', 'where', 'when', or 'how' (Saunders et al., 2016). Hypotheses, derived from theory, serve as a guide to the process and offer a list of what requirements are to be measured (Hair et al., 2007). With descriptive studies, the data collection process is conducted in a structured process through observation or structured interviews (Hair et al., 2007). Descriptive research may be an extension of an exploratory research or a forerunner to an explanatory research. Such studies are known as *descripto-explanatory* studies. These studies mean that the research utilises description because it is likely to be a precursor to explanation (Saunders et al., 2016).

The third group of research design is *Causal research*, which tests whether one event causes another (Hair et al., 2007). Saunders et al. (2016) term this design explanatory research while Collis and Hussey (2013) call it analytical research. It is used as a continuation of descriptive research and aims to understand the problems by discovering and assessing causal relations among them (Collis and Hussey, 2013). The researcher is faced with cause and effect problem and the primary task is to isolate cause(s) and inform whether and to what degree cause(s) result(s) in effect(s) (Ghauri and Grønhaug, 2005)

Causality is a powerful concept in causal research, which focuses on explaining how a change in a variable X (cause) brings a change in a related variable Y (effect). As well as that, it needs very accurate execution and often takes a long time from planning to execution (Hair et al., 2007). Research questions that seek explanatory answers are likely to begin with or include 'why' or 'how'. The purpose is to study a situation or a problem to examine the relationships between variables (Saunders et al., 2016). Hair et al. (2007) put four conditions for researchers look for in testing X -Y relationship:

1- Time order: the cause must happen before the effect.
2- Covariance: a change in the cause is related with a change in the effect.
3- Right association: the relationship between X and Y is true not because of something else that just occurs to influence both X and Y. This needs to control or eliminate any other expected causes.
4- Theoretical support in which a rational explanation should be existent for why X and Y relationship exists.

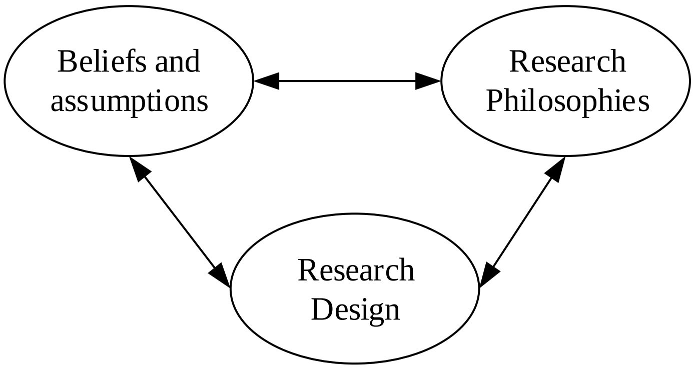
This study adopts the causal research because it aims to examine the effect of organisational culture (represents X variable) on lean technical practices (represents Y variable) and investigating the role of lean human practices (Z variable) as an intervening variable in the organisational culture/ lean technical practices relationship.

5.3 Research Philosophy (Paradigm)

Research philosophy is defined as "a system of beliefs and assumptions about the development of knowledge" (Saunders et al., 2016). Collis and Hussey (2013) term research philosophy as research design or paradigm. Paradigm is defined as a framework that guides the process of research based on people's philosophies and assumptions about the world and the nature of knowledge (Collis and Hussey, 2013). The research philosophy or paradigm is precisely the exact thing every researcher is doing when a research is conducted and that is the will to develop knowledge in a specific field (Saunders et al., 2016).

Saunders et al. (2016) argue that few students think about their own beliefs about the nature of the world around them, about what constitutes acceptable and desirable knowledge, or about the extent to which they believe it important to remain detached from their research data. The process of exploring and understanding the research philosophy needs to start as a 'reflexive process'. Developing the skill of reflexivity is required by the researcher to become aware of and actively form the relationship between the philosophical position and how the research is undertaken (Alvesson and Skoldberg, 2000).The reflexive process is illustrated in figure 5.1

Figure 5-1 Developing Research Philosophy: A Reflexive Process



Source: Saunders et al. (2016, p.126)

The figure above shows that two things are necessary to begin a good philosophical approach: first, to ask questions about our research beliefs and assumptions, second, to be familiar with the major research philosophies within business and management (Saunders et al., 2016).

Through reviewing the research methodology's literature (Collis and Hussey, 2013; Saunders et al., 2016), it is found that different research philosophies have been determined. These include positivism and interpretivism (Collis and Hussey, 2013), positivism, realism, interpretivism and pragmatism (Saunders et al, 2016), positivism, interpretivism, objectivism and constructionism (Bryman, 2015). Nevertheless, positivism and interpretivism represent two extremes of the research paradigm continuum with a set of different approaches in between. According to most business research the research philosophy lies in either positivism or interpretivism one (Collis and Hussey, 2013).

Figure 5-2 Continuum of Research Philosophies

Source: Collis and Hussey (2013)

On the one hand, the positivism approach is an epistemological situation that emphasises the application of the methods of the natural sciences to the study of social reality and beyond (Bryman and Bell, 2015). Positivism holds a deterministic philosophy in which causes determine outcomes. Therefore, the problems studied by this approach reflect the need to identify and assess the causes that influence outcomes (Creswell, 2013). Positivist social science is an organised method for combining deductive logic with precise empirical observations of individual behaviour in order to discover and confirm a set of probabilistic causal laws that can be used to predict general patterns of human activity (Kreuger and Neuman, 2006).

Saunders et al. (2016) indicate that the name positivism refers to the importance of what is 'posited' or 'given'. This ensures the positivist focus on strictly scientific empiricist method developed to get facts unaffected by human explanation or bias (Saunders et al., 2016).

Bryman and Bell (2015) explain four important principles to understand the positivism approach. These principles are:

First, only phenomena and hence knowledge confirmed by the senses can genuinely be warranted as knowledge.

Second, the purpose of theory is generating hypotheses to be tested and allowing explanations of laws to be evaluated.

Third, knowledge is gained via the collecting of facts, which provide the basis for laws.

Fourth, science must be conducted in an objective way.

On the other hand, interpretivism is an alternative to the positivist approach and depends on the view that a strategy is needed that appreciates the differences between humans and the objects of the natural sciences and therefore needs the social scientist to discover the subjective meaning of social behaviour (Bryman and Bell, 2015). Interpretivism focuses on the meanings people bring to situations and behaviours and which they use to make sense of their world. These meanings are essential to understand behaviour (Punch, 2013).

Interpretivism emphasises that humans and their social world cannot be studied in an objective manner as a physical phenomenon (Sunders et al., 2016). As different persons of multiple cultural backgrounds, under many situations and at different times make different meanings, they therefore experience different social realities. The purpose of this approach is developing new, richer explanations of social worlds (Saunders et al., 2016). The interpretive approach is the systematic analysis of socially meaningful action through the direct detailed observation of people in natural settings in order to arrive at understandings and interpretations of how people create and maintain their social worlds (Kreuger and Neuman, 2006).Table 5.1 illustrates the differences between the two philosophies.

Table 5-1 A Comparison of the Two Main Research Philosophies in Business and Management Research

Philosophical assumption	Positivism	Interpretivism
Ontology: The researcher's view of the nature of reality	External, one true reality (universalism), independent and ordered.	Socially constructed through culture and language, complex, rich, has different meanings and explanations, includes a flux of processes, experiences and behaviours.
Epistemology: the researcher's view regarding what constitutes acceptable knowledge	Scientific method, observable phenomena can provide credible data and measurable facts. Focus is on causality and on law-like generalisations, Focus on using numbers, the contribution happens through prediction.	Focus on stories, viewpoints and interpretations, has too simplistic theory or concepts, the contribution happens through new understandings.
Axiology: The researcher's view of the role of values in research.	Research is undertaken in a value-free way; the researcher is independent of what is researched and maintains an objective stance.	Research is value bound, the researcher is part of what is being researched and his interpretations necessary to contribution, the researcher is subjective and reflexive.
Data collection techniques	Highly structured, large samples, measurement, quantitative, but can also use qualitative	Small samples, in-depth investigation, qualitative methods are used.

Source: Saunders et al. (2016, p.136)

In the current study, the positivism approach best describes the research's philosophy adopted in this thesis. As discussed in this section, positivism is used with problems that need to assess the causes that affect outcomes and in the current study, there are two main causes: organisational culture and lean human practices. Both are assessed to examine their impact on lean technical practices implementation. Therefore, the study is focused on causality and causality is linked to the positivism approach.

Furthermore, the focus of the current study is on conducting an objective test for the main constructs either the independent variables (organisational culture) or the dependent variables (lean practices). This is more likely achieved by adopting the positivism approach which assumes that the research is conducted in a value freeway (see table 5.1 above) and the researcher is independent and maintained in an objective position. In the current study, the main constructs included in the proposed model have been chosen based on sufficient theoretical background apart from the researcher's thoughts or opinions. Furthermore, the questions are answered utilising a self-administered questionnaire without any interference by the researcher, and accordingly, such data is more objective and would not be affected by the researcher's own beliefs (Sekaran, 2009).

Moreover, an empirical study is required to examine the research hypotheses and to validate the proposed conceptual model in the current study. The tendency of this study is to attain a higher generalisability and reliability in the results. For this reason, there is a necessity to obtain accurate and sufficient quantitative data from a substantial sample of Jordanian manufacturing firms and to employ the right multivariate statistical methods .Accordingly, such instances of positivist approaches (e.g. field survey) which usually obtains the required data using convenient instruments such as the self-administered questionnaire have been found to be more applicable and feasible for the current study (Collis and Hussey, 2013, Easterby-Smith et al., 2012, Saunders et al., 2016).

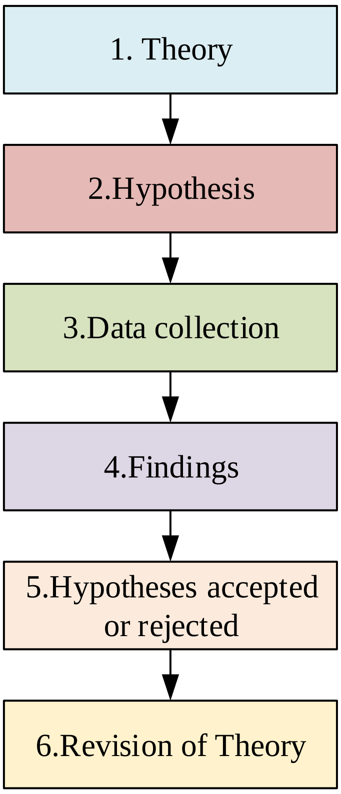
5.4 Logic of the Research (Deductive or Inductive Research)

After deciding on the research philosophy to be adopted**,** the researcher needs to identify whether the research logic moves from the general to the specific or vice versa (Collis and Hussey, 2013, Saunders et al., 2016).There are two main research approaches of developing what is true or false and to draw findings: induction and deduction (Ghauri and Grønhaug, 2005).

Deductive theory represents the popular view of the relationship between theory and research (Bryman and Bell, 2015). By deduction, the researcher draws conclusions through logical reasoning (Ghauri and Grønhaug, 2005). On the basis of what is known in a specific field, the researcher deduces a hypothesis that should be subjected to empirical test (Bryman and Bell, 2015). In other words, the researcher builds hypotheses from the existing literature which can be subject to empirical testing and thus could be accepted or rejected (Ghauri and Grønhaug, 2005). Collis and Hussey (2013, p.7) define the deductive approach as "a study in which a conceptual or theoretical structure is developed and then tested by empirical observations".

Kreuger and Neuman (2006) argue that theorising in a deductive direction starts with abstract concepts or theoretical propositions that outline the logical relations among concepts and then moving to the empirical evidence. Generally, this approach begins with ideas or a mental picture of the real world, and then the researcher tests his/her thinking against an observable empirical level. The order of deduction is outlined in figure5.3.

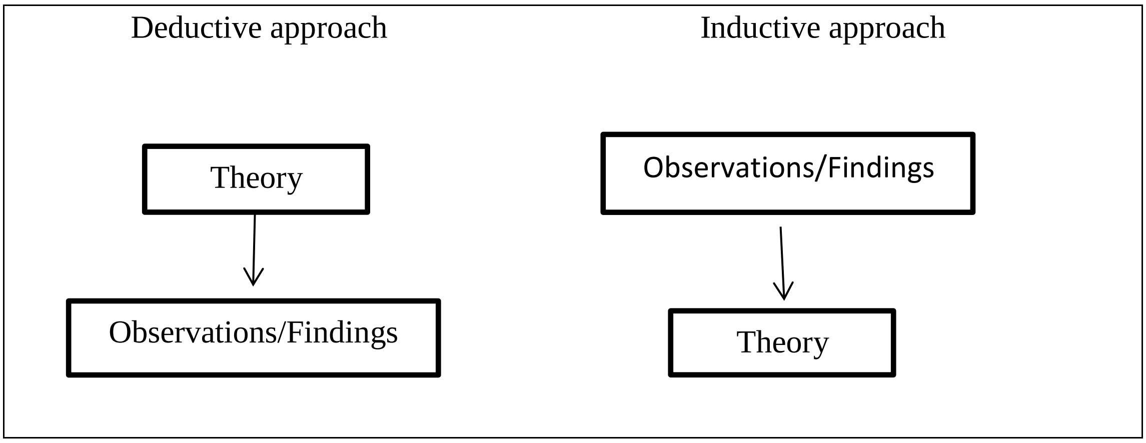
Figure 5-3 The process of Deduction



Source: Bryman and Bell (2015, p.23)

As shown in figure 5.3, the deductive process follows a clear and logical sequence and this is not always the case (Bryman and Bell, 2015). The opposite approach of deduction is induction. Inductive research is defined as "a study in which theory is developed from the observation of empirical reality" (Collis and Hussey, 2013, p 7). In this approach, the researcher moves from observations, then to conclusions, then to theory building, as results are incorporated back into existing literature to improve theories (Ghauri and Grønhaug, 2005). Kreuger and Neuman (2006) argue that theorising in an inductive direction starts with observing the empirical world, then reflecting it on what is taking place, thinking in increasingly more abstract methods to move towards theoretical concepts and propositions. Bryman and Bell (2015) argue that a researcher's perspective of theory may change because of analysis of collected data for three main reasons: (1) new theoretical ideas or results may be published before the researcher has finalised his/her outcomes; (2) the relevance of a dataset for theory may become apparent only after data have been collected; and (3) data may not match with the developed hypotheses. Figure 5.3 illustrates the main difference between deductivism and inductivism.

Figure 5-4 Deductive and Inductive Approach



Source: Bryman (2012, p.26)

The current study proposed four conceptual models (refer to chapter 3). Each conceptual model includes five main variables: the organisational culture, customers' involvement, employees' involvement, suppliers' involvement and lean technical practices. The logical relationships between variables have been developed and the hypotheses are proposed based on literature review and previous studies conducted in the domain of the current study.

The researcher moved to the empirical work to test the proposed conceptual models and examined the hypotheses. Therefore, the deduction research approach is adopted in this study.

5.5 Methodological Choice and Research Approaches (Quantitative and Qualitative Approaches)

Saunders et al. (2016) identify two main methodological choices: the mono method and the multiple methods. In the mono method, the researcher adopts a single data collection technique and analysis procedure (completely qualitative or completely quantitative).

In the multiple methods, methodological approach, the researcher decides to use either the multi-method approach, where the research incorporates different unified methods (multi-quantitative or multi-qualitative), or the mixed methods choice where the researcher integrates both quantitative and qualitative methods in the same study.

In this study, the raw data is collected using a highly structured quantitative instrument (a self- administered questionnaire). Then the raw data is numerically coded and entered the Statistical Package of Social Sciences (SPSS) software. The analysis is conducted using SEM employing AMOS graphics software. Therefore, this study can be described as a mono methodological study.

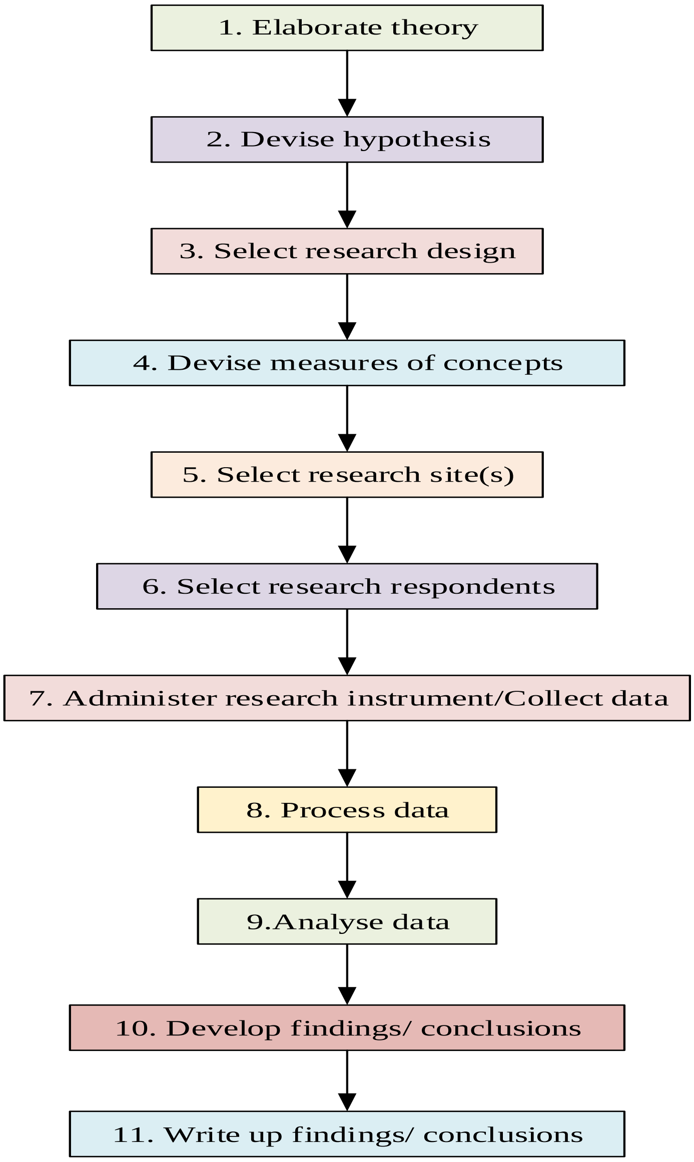
Research Methods provide the means through which data are collected and analysed within a research study (Hammond and Wellington, 2012). Methods are often discussed as quantitative or qualitative. Quantitative and qualitative have often been differentiated as methodologies. A qualitative approach implies a concern for more inductive analysis, for exploring, explaining, uncovering phenomena and for generating new theory. A quantitative approach is a more deductive approach, which is useful for testing hypotheses based on descriptive and inferential statistical analysis (Hammond and Wellington, 2012). The main differences between the two approaches could be regarded as the way the methods are utilised to collect and analyse the r data. Additionally, the extent of using numerical and quantifiable data to explain the problems under study (Bryman and Bell, 2015).

On the one hand, the quantitative research tests relationships between variables, which are measured in numbers and analysed through statistical techniques (Saunders et al., 2016). This methodology depends on using probability-sampling methods to ensure the generalisability of results. The researcher is considered independent from respondents (Saunders et al., 2016). Bryman and Bell (2015) argue that the quantitative research focuses on quantification in data's collection and analysis and it has three characteristics as follows:

1. It follows the deductive approach in which the focus is on testing theories.
2. It has integrated with the principles and norms of the natural scientific model especially the positivism approach.
3. It believes that the social reality should be viewed as an external and objective. Quantitative method is widely used by most of the empirical studies conducted within the managerial and behavioural sciences.

Bryman and Bell (2015) develop 11 steps that should be followed in conducting the quantitative research. These steps are illustrated in figure 5.5 below.

Figure 5-5 The Process of Quantitative Research



Source: Bryman and Bell (2015, p.161)

On the other hand, qualitative research is linked with an interpretive philosophy because it studies participants' meanings and the relationships between them. The researcher needs to act within a research context to be able to build trust, involvement, access to meanings and good understanding (Saunders et al., 2016). Bryman and Bell (2015) argued that qualitative research focuses on words rather than quantification of data's collection and analysis. They described qualitative research by three characteristics as the following:

3. It believes that the social reality is as a constantly shifting emergent property of humans' creation. Table 5.3 compares between quantitative and qualitative methods.

Table 5-2 Comparison of Qualitative and Quantitative Research Methods

Description	Quantitative method	Qualitative method
Purpose	Collecting quantitative data	Collecting qualitative data
Properties	-More useful for testing. -Provides summary information on many characteristics. -Useful in tracking trends. -More structured data collection techniques and objective ratings. -Higher interest for representativeness. -Emphasis on achieving reliability and validity of measures used. -Relatively short interviews. -Large samples (over 50). -Results relatively objective.	-More useful in discovering. -Provides in-depth understanding on a few characteristics. -Discovers 'hidden' motivations and values. -More unstructured data collection techniques requiring subjective interpretation. -Less concern for representativeness. -Emphasis on the trustworthiness of respondents. -Relatively long interviews. -Small samples (1-50) -Results relatively subjective.

Source: Hair et al. (2007, p.152)

Given that the positivist paradigm has been chosen as the suitable philosophical perspective for the current study, this study employs the quantitative approach for achieving the study's aim and objectives. Indeed, the field survey study is conducted to obtain the current study's data using a self-administered questionnaire. As well as the underlying theoretical constructs in the conceptual model (organizational culture and lean practices) are characterized by using values and implementation levels. Therefore, the data obtained in the current study is more to be listed under the quantitative type rather than the qualitative one. The researcher has adopted the same steps, which are provided by Bryman and Bell (2015) and illustrated in figure 5.5.

5.6 Research Strategy

The research strategy is 'a plan of action to achieve a goal'. It is a plan about how the researcher will answer the questions of the study (Saunders et al., 2016). Saunders et al. (2016) classify the various research strategies in terms of their fit to the two main research methods as presented in table 5.4.

Table 5-3 Research Strategies under the Two Main Research Methods

Quantitative research	Qualitative research
Experimental studies	Action Research
Surveys	Case studies
	Ethnography
	Archival and Documentary Research
	Grounded theory
	Narrative enquiry

Source: Saunders et al. (2016)

For the current study, which adopts the quantitative method, the researcher has used the survey strategy. Survey strategy consists "a cross sectional design in relation to which data are collected predominantly by questionnaire or by structured interview on more than one case and at a single point in time in order to collect a body of quantitative or qualitative data in connection with two or more variables, which are then examined to detect patterns of association" (Bryman and Bell, 2015, p.63). The survey is an effective tool to get opinions, attitudes, descriptions as well as getting cause and effect relationships (Ghauri and Grønhaug, 2005). Using a survey strategy allows the researcher to collect a large amount of quantifiable data from a sizeable population in a cost-effective manner. Furthermore, it can be used to address causal relationships and validate a research-hypothesised model. The data collected may range from beliefs, attitudes and behaviours to general background information (Hair et al., 2007).

Saunders et al. (2016) summarise the benefits of using survey strategy as the following:

1- It is very common strategy in business and management research.

2- It is associated with a deductive research approach, which has been adopted in the current study.
3- It allows getting data from a large sample with less cost.
4- It is perceived as 'authoritative' by respondents and comparatively easy to interpret and understand.
5- It allows collecting quantitative data, which can be used in statistical analyses techniques.
6- It gives the researcher more control over the research process.
7- It gives a great opportunity to generalise the results if the probability sampling is used.

The conceptual models and research hypotheses, which are discussed earlier in chapter three, are based on a strong theoretical foundation and rely on adopting the explanatory (causal) research, in which each variable will be examined to investigate its effect on another variable. The aim of this study is examining the effect of organisational culture on lean manufacturing practices through a chain of cause and effect relationships among the research's variables (organisational culture, customer's involvement, employee's involvement, suppliers' involvement and lean technical practices). For that reason, there was a necessity to obtain an accurate and enough quantitative data from a substantial sample of Jordanian manufacturing firms along with utilising a multivariate statistical analysis such as SEM to validate the conceptual models and examine the underlying hypotheses (Saunders et al., 2016). Therefore, the survey strategy is considered the best-suited method to validate the conceptual models and to verify the research hypotheses within the context of production management where the research objects are individuals (production managers) in the current study. Furthermore, the survey strategy is more cost-effective method enabling the researcher to reach many respondents in a wide geographical area in Jordan within a reasonable time in comparison with other strategies such as the case study or experimental methods (Saunders et al., 2016, Sekaran, 2009). Finally, the survey strategy is considered a more acceptable, feasible and more comfortable way to obtain the perspectives of the respondents in the Jordanian context apart from the researcher's interference in comparison with other methods such as observation or action research that require the researcher to be part of the setting under study (Bryman and Bell, 2015).

5.7 Time Horizon

Scholars differentiate between two types of studies with respect to time horizon, namely cross-sectional (known as snapshot) and longitudinal (known as diary) (Saunders et al., 2016).

Cross sectional studies involve the study of a phenomenon at a specific time to describe the characteristics of a problem or to explain how variables are related in different contexts. Additionally, cross-sectional studies often use the survey strategy (Saunders et al., 2016). Bryman and Bell (2015) provide several characteristics about cross sectional studies, these are:

1- More than one case: researchers using this design are interested in variation. This variation can be developed only when more than one case is being tested.
2- At a single point in time: the data in cross-sectional study are collected simultaneously. The answers of the questions are provided at the same time.
3- Quantifiable data: to develop variation between observations, it is important to have a systematic and standardised way to measure variation. One of the benefits of quantitative data that it offers a solid benchmark to the researcher for measurement.
4- Patterns of relationships: with cross sectional studies, it is possible to test only relationships between variables. There is no time ordering to the variables, because the data are collected simultaneously and the researcher does not interfere with them.

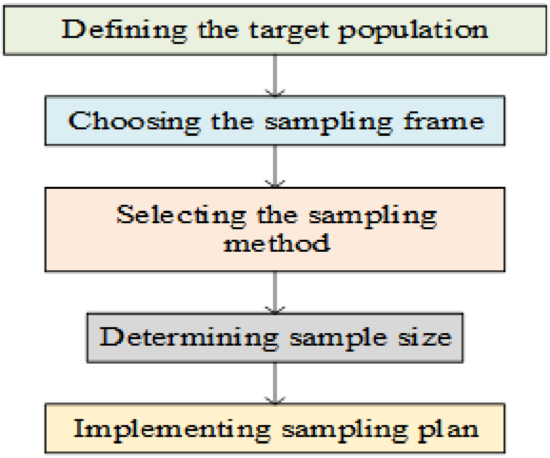
By contrast, longitudinal studies describe events over time and they are appropriate when research questions and hypotheses are affected by how things vary over time. Longitudinal studies need data to be collected from the same sample units at multiple points in time, therefore this strategy enable tracking of business elements so that trends can be observed (Hair et al., 2007). The main advantages of longitudinal studies are their ability to study change and improvement and provide a measure of control on some of the factors being studied (Saunders et al., 2016).

A researcher's decision to conduct a cross-sectional or a longitudinal study depends on the purpose of the study, the questions and the time available for the research and the sample size (Saunders et al., 2016). In this study, the empirical work was conducted in a cross-sectional manner. Primary data was collected at a single point of time over five months of fieldwork (December/ 2014 to April/ 2015). A standardised method, which is the questionnaire survey, was used as a consistent benchmark to collect data from more than one case (Jordanian manufacturing firms). The cross-sectional study was the appropriate choice in the current study.

5.8 The Sampling Process

Sampling design is part of the basic business research process (Hair et al., 2007). A set of well-defined steps suggested by Hair et al. (2007) and illustrated in figure 5.6 explain the process of sampling. These steps are adopted in the current study and they are explained in the following subsections.

Figure 5-6 The Process of Sampling



Source: Hair et al. (2007)

5.8.1 Defining the Target Population

The target population is a complete group of objects or elements related to the study. They are relevant because they own the required information for answering the research questions. Elements or objects available for choosing during the sampling process are called the sampling unit. Sampling units can be people, households, firms, or any logical unit relevant to the study's aim. When the sampling plan is executed, sampling units are drawn from the target population to use in making estimates of population demographics (Hair et al., 2007). According to Sekaran (2009) a research population is the entire group, events and things that the researcher wishes to investigate.

The aim of the current study is to examine the effect of organisational culture on lean technical practices implementation whilst considering the mediating roles of customers' involvement, employees' involvement and suppliers' involvement. To achieve the research's aim, manufacturing firms in Jordan are utilised as the research context of the study. Consequently, the targeted research population comprise all manufacturing firms listed in the Jordanian Industrial Estates Corporation (JIEC). This corporation was established to provide the growing manufacturing industry in Jordan with an efficient and well-organised management approach. It is the authorised party to establish and control Industrial Estates(Jordan Economic and Commerce Bureau, 2010). The rationale behind selecting the Industrial Estates in Jordan as the target population in the current study is the following:

1. The firms included in the Industrial Estates are developed based on the international standards of infrastructure, services, equipment and operational procedures. Therefore, the researcher believed that lean practices could be available in the manufacturing firms enlisted in the Industrial Estates not in the traditional manufacturing firms.
2. Availability of obtaining a sampling frame enlisted formally in the official website of the Industrial Estates Corporation. Obtaining a sampling frame is an important issue because it represents a condition to apply probability sampling (Saunders et al., 2016).
3. The manufacturing firms included in the Industrial Estates represent the industrial sector in Jordan. They are in the largest cities in Jordan such as Amman and Irbid and include different manufacturing sectors (refer to chapter 4)
4. Simplicity for the researcher to reach the highest possible number of manufacturing firms with less time and effort due to the existence of large number of firms in the same area.

5.8.2 Choosing the Sampling Frame

The sampling frame provides a practical definition of the target population (Hair et al., 2007). A sampling frame is as complete a list as possible of all the elements in the population from which the sample is drawn (Hair et al., 2007). In this thesis, to develop a sampling frame from which a research sample can be drawn, a lot of time and effort was exerted by the researcher through searching the official website of Jordan Industrial Estates Corporation (JIEC). The researcher obtained a list of about 400 manufacturing firms located in the different Industrial Estates in Jordan. The list included the name of the firm, the name of the owner or the senior manager, the firm's telephone or mobile number and the electronic mail of the firm. This list was very helpful for the researcher in selecting the sampling method and in identifying the sample size.

5.8.3 Selecting the Sampling Method

Choosing the sampling method depends on different theoretical and empirical issues such as the nature of the study, the objectives, the time and budget (Hair et al., 2007).

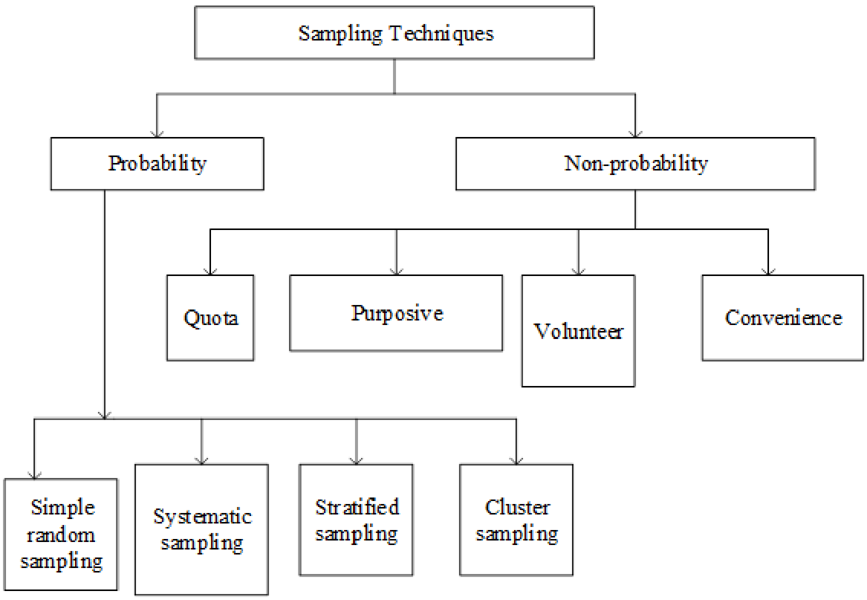
Traditional sampling methods can be divided into two main categories: probability and non-probability. In probability sampling, the researcher ensures that the sample is representative. Probability samples depend on each case in the population having an equal opportunity of being chosen. While the non-probability samples are used when it is difficult to determine all potential cases in the population (David and Sutton, 2004).

With non-probability sampling, the inclusion or exclusion of objects in a sample is left to the decision of the researcher. Despite this, a careful selection process should result in a reasonable representative sample (Hair et al., 2007).

As a rule, developed by Saunders et al. (2016) for choosing the appropriate sampling technique, is considering the feasibility and sensibility of collecting data to answer the research's questions and to achieve the objectives of the study. If the research questions and objectives require statistical estimation and the sample size is large, or requires generalisation of findings, the probability sampling is the best choice. If the research questions and objectives do not require statistical analysis and the sample size is small, the non-probability sampling is better. In the current study, the research questions and objectives need statistical analysis. As well as this, the sample size is large and the generalisation of results is an important issue. Thus, probability sampling is adopted.

As shown in figure 5.7 below, the non-probability sampling methods include quota sampling, purposive, volunteer and haphazard (convenience). Probability sampling techniques include: simple, systematic, stratified and cluster. For many research studies, a combination of sampling techniques can be used (Saunders et al., 2016).

Figure 5-7 Types of Sampling Methods



Source: Saunders et al. (2016, p.276)

Simple random sampling involves randomly choosing units from a sampling frame using mathematical techniques. The mathematical methods are also used at the analysis stage and form the basis of inferential statistic and parametric tests (David and Sutton, 2004). In the current study, a simple random sampling technique is used because of the following recommendations given by Saunders et al. (2016) and it is found appropriate to the current study.

1- A simple random sample needs an accurate and accessible sampling frame. This condition has been achieved through getting a sampling frame consisting of 400 manufacturing firms in different regions in Jordan with different sectors.

2- Better, with over a few hundred and the sample size in the current study exceeds 100 cases.
3- It needs a concentrated geographical area if face-to-face contact is needed. The geographical area in the current study is one country, which is Jordan, and the face to face contact is used to collect data.
4- Using a simple random method leads to higher possibility to generalize the results of the current study at least in the Jordanian context.

5.8.4 Determining Sample Size

Efficient sample sizes can be drawn from either large (infinite) populations or small (finite) population (Hair et al., 2007). Determination of the sample size is complex because of the many dimensions that should be taken into consideration simultaneously. These include the variability of elements in the target population, type of sample required, time available, budget, required estimation precision and whether the results are to be generalised, and if so, with what degree of confidence (Hair et al., 2007).

Many statistical formulates can be used to calculate the sample size. When the formulas are used to identify the sample size, three issues are important: (1) the degree of confidence (often 95per cent); (2) the specified level of precision (amount of acceptable error), which is the maximum acceptable difference between the estimated sample value and the true population; (3) the amount of variability (population homogeneity), which is measured by its standard deviation (more homogeneous population, smaller standard deviation) (Hair et al., 2007). In this study, the sample size is determined through using the available sample size calculator on the Survey Monkey Website (2014). The calculation is also done by the normal calculator using the following formula, which is used on the previous mentioned website.

$$Sample\ Size = \frac{\frac{z^2 \times p(1-p)}{e^2}}{1+\left(\frac{z^2 \times p(1-p)}{e^2 N}\right)}$$

Source: Survey Monkey Website (2014)

Where, N: population size (in the current study 500 cases), e: margin of error (5%), z: Z score (1.96 under the confidence level of 95%), p: the expected proportion of the population to have the attribute that you are estimating from your survey (the sample size calculator uses a normal distribution (50%) to calculate the optimum sample size).

$$\textit{Sample size} = \frac{(1.96)^2 \times 0.50(1-0.50)/\ (0.05)^2}{1+\left(\frac{1.96^2 \times 0.50\ (1-0.50)}{0.05^2 \times 500}\right)} = \mathbf{218} \text{ cases}$$

The minimum number of sample size based on the sample size formula should be 218 cases. Regarding the current study, a SEM has been selected as a suitable statistical technique for testing the research hypotheses. Therefore, the researcher was also concerned with the required sample size to have a good SEM and whether the number of 218 is acceptable or not. After reviewing the literature about the sample size in SEM, no absolute guidelines have been found about the recommended sample size but some recommendations were offered. Most scholars agree that "bigger sample size is always better" (Iacobucci, 2010) but as a rule of thumb a sample size of at least 200 to conduct SEM is recommended to be used when the proposed model is complex and consists many constructs and causal paths (Kline, 2005). Iacobucci (2010) recommends that if there are no problems with the data, such as missing data or non-normal distributions, a minimum sample size of 200 for any SEM is acceptable.

5.8.5 Implementing Sampling Plan

The sampling plan should be implemented after all the details of the sampling design have been agreed upon. Many details must be decided on before final sample plan is accepted and implemented because once the data is collected; it is late to change the sampling design (Hair et al., 2007).

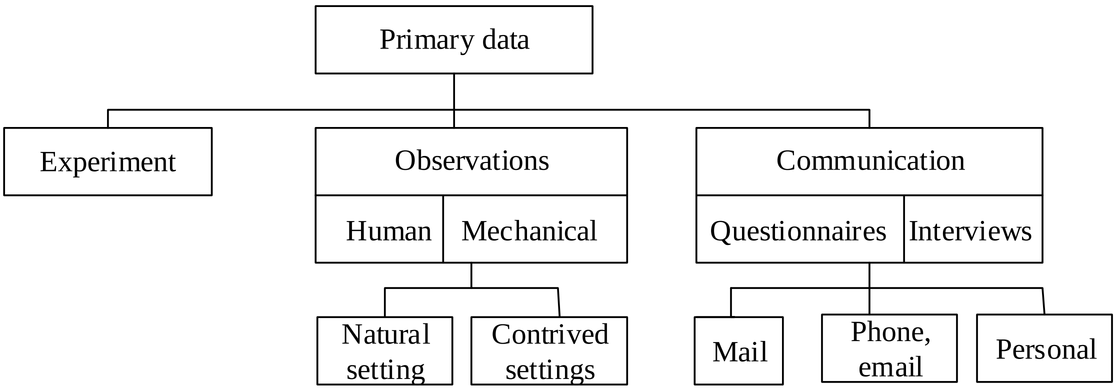
5.9 Data Collection Methods

Data can be obtained from different sources and types of data are either primary or secondary data (Saunders et al., 2016, Bryman, 2015). This step in the research process is critical because once the data is collected the researcher cannot move back to an earlier step to correct wrong decisions leading to limitations in the study (Hair et al., 2007). Secondary data includes both raw data and published summaries. Once collected, these data can be analysed in a new way to add new or different knowledge, explanations or findings (Saunders et al., 2016).

The process of data collection starts by reviewing secondary data. The secondary data collection process involves assessing internal data sources and external data. If the research objectives can be accomplished using secondary data, there is no need to obtain primary data (Hair et al., 2007). Secondary data could be books, journals, big data sets, industry statistics and reports, publications, newspapers and recordings (Saunders et al., 2016).

Primary data is obtained for the first time by the researcher himself/herself for a certain research purpose (Sekaran, 2009). Primary data have many sources including observations, experiments and surveys (questionnaires) and interviews (Ghauri and Grønhaug, 2005) as illustrated in figure 5.8.

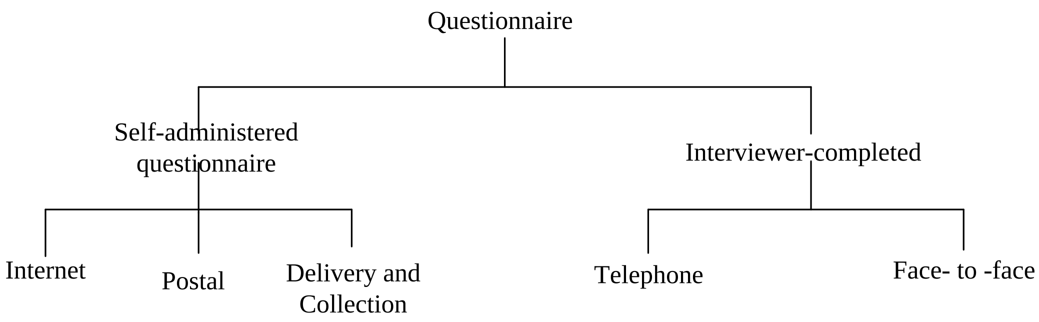
Figure 5-8 Sources of Primary Data



Source: Ghauri and Grønhaug (2005, p.102)

Amongst the main data collection methods identified earlier, a questionnaire is the most convenient and the most familiar tool applicable in a survey strategy (Saunders et al., 2016, Bryman, 2015). A questionnaire (also known as instrument) is " a general term to include all methods of data collection in which each person is asked to respond to the same set of questions in a predetermined order"(Saunders et al., 2016, p.437). Similarly, Hair et al. (2007) define the questionnaire as "a predetermined set of questions designed to capture data from respondents". When respondents answer questions by completing the questionnaire themselves, the questionnaire is termed 'by self-completion or self-administered' questionnaire (Bryman, 2015). In this manner, Saunders et al. (2016) classify types of questionnaires based on the method of delivery and the amount of contact between the researcher and the respondents. The classification includes two main types: self-completed questionnaires and interviewer-completed questionnaires. Figure 5.9 illustrates the two types of questionnaire.

Figure 5-9 Types of Questionnaires



Source: Saunders et al. (2016)

Self-completion questionnaires are often referred to as surveys and can be distributed to respondents through three methods:

- Internet: the respondents access the questionnaire through web browser or directly through mobile devices.
- Postal mail: the respondent can return the questionnaire by post after completing it.
- Delivery and collection: the researcher distributes the questionnaire by hand to each respondent and collects later (Saunders et al., 2016). This strategy is called a 'drop and pick-up' questionnaire. This involves leaving self-administered questionnaires with respondents and picking the surveys up later. The person dropping off the surveys can give simple instructions and a brief description of the survey effort (McLafferty, 2003).

Interviewer-completed questionnaires are recorded by the researcher (who plays the role of interviewer) based on the answers of each respondent. This type can be conducted through using telephone or personal communication. When the interviewer meets the respondent face to face to question them, it is also called a structured interview (Saunders et al., 2016).

Each type has its advantages and disadvantages. Therefore, the researcher should choose the right type based on first, the research questions and objectives; second, the characteristics of the respondents; third; importance of personal contact with the respondents; fourth, size of sample especially the required response rate; finally, types and number of questions that will be asked (Saunders et al., 2016).

Self-completion surveys use structured questionnaires, which area scientifically developed instrument for measurement of key characteristics of individuals, companies, events and other phenomena (Hair et al., 2007). In conducting a self-completion questionnaire, several factors should be considered. These include: the general design of the questionnaire, validation of the questionnaire by pre-testing and the method by which the questionnaire is conducted (Hair et al., 2007).

In the current study, a self-administered questionnaire, using a delivery and collection type, is used as the data collection method. The rationale behind choosing this type are as follows:

1- A self-completion questionnaire is more convenient and common for respondents than any other method, especially in the Jordanian context, because as Bryman (2015) argues, that they can fill it when they want and at the speed that they want to.
2- Giving the questionnaire by hand to the intended respondent and asking him/her to fill it in is socially accepted way in the Jordanian culture because it exhibits a form of appreciation and respect for the respondent's knowledge and experience. Therefore, respondents will be motivated to fill it in without ignoring it.
3- The studies about lean manufacturing concept are too few in Jordan. Therefore, the availability of the researcher by herself and handing over the questionnaire by hand is preferred, to clarify any vague terms related to the topic and letting the person answer questions with more confidence and without any misunderstandings.
4- This method increases the response rate. The sampling frame is 400 and the study needs at least half of them (200). Delivery and collection by the researcher ensures a higher response rate compared to other types such as web surveys (Bryman, 2015)

5- Self-administered questionnaires ensure minimum interviewer effect or bias compared to interviewer-completed questionnaires (Bryman, 2015).
6- This method provides to some extent a guarantee that the intended person will fill the questionnaire in and it will not be given to someone else.

5.10 Questionnaire Development

The development of questions is a time-consuming process that needs sufficient allocation of time and effort (David and Suttan, 2004). The questions must be carefully thought through in a systematic manner, piloted, then reviewed and modified before the full survey commences ((David and Suttan, 2004). Many factors should be taken into consideration in developing the questionnaire. These factors are as follows.

5.10.1 Questions Types and Format

There are several different types and formats of questions. A combination of these is possibly to be used in the same survey (David and Sutton, 2004). The questions can be grouped into three categories:(1) factual and demographic questions which focus on collecting background information about the respondent such as age, gender, income, or educational level; (2) questions concerned with opinions, beliefs or attitudes which concern how participants feel or think about something; (3) behaviour or event-related questions which include data about the behaviour of people in the past, present or the future (Saunders et al., 2016, David and Sutton, 2004).

The format of a question can be open-ended or close-ended. Open-ended questions also known as unstandardized questions, give the respondent the freedom to offer an answer in his/her own words (David and Sutton, 2004). Close- ended questions, also known as standardised questions need the respondent to choose from a range of alternative answers (Saunders et al., 2016; David and Sutton, 2004). In the current study, a close-ended format has been used for the following reasons:

- Enables the respondent to give a quick response. Generally, respondents have a desire to answer a set of questions with less time and less effort (Saunders et al., 2016).

- Simpler for the researcher to deal with especially in the case of using statistical analysis (David and Sutton, 2004).

There are different types of closed questions which are classified by Saunders et al. (2016) and can be used. These types are: (1) list questions, which offer a list of statements from which the respondent can select; (2) category questions, where only one answer can fit the respondent;(3) ranking questions, which needs the respondent to set the answer in order; (4) rating questions, which used to collect opinion data, the Likert style rating is the most common form of rating questions; (5) quantity questions, which need the respondent to provide a number related to some characteristics; (6) matrix questions, where answers to two or more questions can be recorded using the same grid.

According to Easterby-Smith et al. (2012), researchers commonly use two types of measurement scales that differ in terms of number of distinctions between alternative points on the scale. These are:

1- Category scales: these provide few distinctions and may come in the form of ordered scales having a natural order and called ordinal scales, or unordered scales that do not have a natural order. The latter are called nominal scales.
2- Continuous scales: these consist of several distinctions and allow others to respond based on the value on the scale; therefore, they are order scales in nature. This kind of scales involves: (1) Interval scales, which have an equal distance between points on the scale, but do not have a true zero value; (2) Ratio scales, which have equal distances between points on the scale and with a true zero value.

In the current study, both category scales (nominal and ordinal) and continuous scales (interval) are used in developing the questionnaire. On the one hand, a category-nominal scale is used to obtain information relating to respondents and their organisations, such as gender and educational level. Category-ordinal scales are used to obtain other data including size of the organisation, age of the respondent and age of the organisation. On the other hand, continuous-interval scales are applied in the second and third parts of the questionnaire. In the second part, a five point Likert scale ranging from 'no implementation'(1) to 'complete implementation'(5) is used to indicate the level of implementing lean practices in the firm. In the third part, also a five-point Likert scale ranging from 'strongly disagree'(1) to 'strongly agree'(5) is used to indicate the respondent's level of agreement and disagreement with the statements relating to the organisational culture.

5.10.2 Questionnaire Layout and Flow of Questions

Questionnaire layout can be critical for two reasons: (1) reducing non-response rate and (2) avoiding response errors (Stern et al., 2007). The questionnaire layout is recommended to be neat and tidy as this can impact the respondent's willingness to answer. In addition the questions should be asked in the right order (Ghauri and Grønhaug, 2005). Different guidelines on the convenient layout of a questionnaire are determined when developing the questionnaire of the current study; these are summarised in the following:

1- Questions move from the general to more specific to make the questionnaire easier to be answered as recommended by Ghauri and Grønhaug (2005). Also, Saunders et al. (2016) argue that attributes questions are usually more straightforward to be answered by the participant than answering questions about opinions.

2- The more complex questions are placed in the middle of the questionnaire as suggested by Saunders et al. (2016), because by this stage most participants feel more confident to answer questions and are not yet bored or tired.

3- Grouping the questions into several parts (sections) that make sense to the respondent (Saunders et al, 2016).

4- To facilitate the control of the questionnaires in the fieldwork questionnaires need to be given serial number to guarantee no copy to be lost.

5- To get a high response rate, a questionnaire must not be either too long or too short; the self-completed questionnaire range between 4 to 8 A4 pages is acceptable (Saunders et al., 2016).

6- Allocating codes for the items in the questionnaire prior to collecting data to facilitate their analysis by computer (Saunders et al., 2016).

5.10.3 Covering Letter

Most self- administered questionnaires are provided with a covering letter, which is the first part that a respondent looks at in the questionnaire (Saunders et al., 2016). A considerable amount of attention has been given to the content of covering letter in this study. The content includes clear and complete information about the purpose and importance of the study, the reasons for which the specific respondent has been contacted and the great positive influence of his/her participation, the confidentiality of information provided by the participant, contact details of the researcher and the supervisor in the case of any enquires needed. A copy of the covering letter is presented in Appendix A.

5.10.4 Translating the Research Questionnaire

The process of translating the questionnaire into different language needs attention (Saunders et al., 2016). This study has been empirically conducted in Jordan where Arabic is the main language. Therefore, the questionnaire, which is derived from previous studies in Western contexts, needed to be translated into Arabic to be understandable and clear for respondents. When translating the source questionnaire, some factors are given attention as suggested by Saunders et al. (2016), these suggestions are:

1. Lexical meaning, which concerns with the accurate meaning of individual words.
2. Idiomatic meaning, which is the meanings of a collection of words that are natural to a native speaker and not deducible from those of the individual words.
3. Experiential meaning, which concerns with familiarity of meanings of words for people in their daily experiences.
4. Grammar and syntax, which focuses on using the language in the right order and form.

To translate the questionnaire in the current study, based on the suggestions mentioned above, a parallel translation technique is used. The researcher adopts parallel translation because it is a time saving technique since the translation is a parallel task rather than sequential one. As well as this, the technique leads to good wording of the target questionnaire (translated questionnaire).

Accordingly, the source questionnaire (English version that is to be translated) was translated into Arabic to develop the target questionnaire. Two independent professional translators who have some background in business studies translated the questionnaire. The translated questionnaires have then been compared and considered to create the final Arabic version (Appendix C). Then the final version of the target questionnaire was also evaluated by two academics from the Jordanian universities (a professor in operations management and the other in industrial engineering) to ensure that the academic concepts related to the study are used correctly in the right place.

5.10.5 Questionnaire Pre-Testing Process

Piloting a questionnaire instrument is an essential step especially when the data are collected only once from participants (Bryman and Bell, 2015). The expected benefits of this step according to Bryman and Bell (2015) are the following:

1. Addressing problems in the readability of the questionnaire.
2. Discovering any incomplete or unclear instructions to answer the questions.
3. Pointing to limitations that question the comprehension of the questionnaire to adequately cover the topic it is intended to cover.
4. Helping in identifying problematic items or questions, which make the respondent feel uncomfortable.
5. Providing a great chance to have suggestions related to removing, adding, or modifying items to improve the flow, content and understanding of the questions.

The number of participants in the pilot study depends on the research questions, objectives, the size of the study project, the resources such as money and time and how well the initial questionnaire has been designed (Saunders et al., 2016). Julious (2005) recommends that the minimum number for a pilot is 12. Accordingly, 15 operations managers who are professional in the Jordanian manufacturing sector and were selected for a pilot study tested the questionnaire of the current study. The 15 participants were appropriate because of their higher-level education, expertise and knowledge in the lean manufacturing system. All participants were asked to fill in the questionnaire and provide constructive feedback related to clarity of questions and instructions, time to complete the questionnaire, simplicity of answering the questions, layout and flow of questions and the need to add, delete or modify some items in the questionnaire (Bell, 2014).

Important feedback has been received from participants in the pilot study. One useful suggestion from most participants was to add the main concepts of the study such as lean manufacturing, set-up time, JIT and other concepts in both languages (English and Arabic) which make the concept more understandable towards filling in the questionnaire. This suggestion was important because the textbooks in universities in the Jordanian context are in English, thus, most managers have more knowledge about lean manufacturing in English language than Arabic.

Generally, most comments were positive and supportive. For example, one participant in the pilot study confirmed the comprehensiveness of the statements undertaken in the questionnaire regarding lean manufacturing practices and organisational culture. Another one confirmed the accuracy and clarity of the statements. The questionnaire was modified accordingly to have its final version in Arabic as presented in Appendix C.

5.10.6 Questionnaire Administration

Many previous studies in operations management (Flynn et al., 2010, Wong et al., 2011, Zhao et al., 2008) used a single informant in their studies. Zhao et al. (2011) suggest that the best way forward is that a single key informant who is knowledgeable in supply chain and operations management, to collect reliable data. Consistent with the above discussion, the questionnaire was given personally to a key informant in the manufacturing firm. Typical titles such as operations/production managers, CEO (Chief Executive Officer), supply chain manager, senior manager, quality manager or industrial engineer are identified as the key respondents because of their knowledge on the operations management practices in their firms and the cultural dominant type. It is believed that people in those job titles can offer valid, honest and complete answers asked in the questionnaire.

Each respondent received a copy from the researcher herself providing instructions for answering. Furthermore, to encourage participation and increase the response rate, the respondents were promised a summary of the study’s results sent to their emails according to their wishes. In addition, the researcher saved the mobile/telephone number for each respondent before moving to another firm. A follow-up call and message were made to remind participants filling the questionnaire and to ask them about a convenient time to come again to collect the copy, as well as to clarify any statements or concerns that potentially had arisen. The researcher, offering thankful words and appreciation to the participant, also collected all completed questionnaires.

A total of 250 questionnaires were distributed and 209 questionnaires were obtained. Of the 209 remaining questionnaires, four are not usable because of excessive amounts of missing data, leaving a final usable total of 205, yielding a response of 82 per cent, which exceeds by a high range the recommended 20 percent for empirical studies in operations management (Malhotra and Grover, 1998).

5.10.6.1 Ethical Considerations in Questionnaire Administration

In social research, a researcher might have to deal with a position having several ethical considerations. Such ethical considerations can be generally classified into three domains:

Firstly: ethical standards for social research, which refer to a set of guidelines that are developed by different professional institutions to guide social researcher.

Secondly: procedural issues, which concern with carrying out the data collection process such as informed consent and the selection of participants.

Thirdly: confidentiality and the right to privacy which concerns participants' privacy and protecting them from deception (Kimmel, 1988).

In this thesis, the ethical issues associated with the fieldwork are taken into consideration. Before conducting the fieldwork, an official approval by the Research Ethics Panel was obtained based on the ethical standards of Aberystwyth University. In the light of the University's regulations, a completed ethical application form was submitted. This form includes details about the research instrument, the type of the participants, and the participant invitation letter. As for the procedural ethical issues, a short interview was conducted with each respondent for permission to fill the questionnaire. This procedure can serve as an ethical standard, which protects the privacy of the context of the study. As well as that, each questionnaire distributed in the manufacturing firms was accompanied by a covering letter clarifying the purpose of the research, indicating that participation is voluntary and that data is anonymous and will be handled with complete confidentiality. This ensures that anonymity and personal privacy will be protected. Furthermore, no confidential information about participants has been gathered or disclosed. This is in line with the ethical standard of the need to decrease any possible harm to respondents.

In filling in the research questionnaire, participants were asked to answer all the questionnaire's questions based on their own opinions. This was clearly indicated in the questionnaire, where the respondents were also notified that there would not be any right or wrong answers. In addition, as discussed earlier in subsection 5.10.2, the research questionnaire is organised in a way that eliminated any confusion and misunderstanding. Instructions on how to respond to the measurement scales are indicated at the commencement of each section of the questionnaire. These procedures ensured meeting the ethical principle of eliminating the possibility of participant deception.

5.10.6.2 Difficulties in Conducting the Fieldwork

Generally, the fieldwork process was successful and the respondents were supportive and co-operative. Few difficulties faced the researcher. The first one was the different and far distance of cities that the researcher had to travel to every day during the fieldwork period to deliver the questionnaire by hand to each manufacturing firm. Some cities are located far from the researcher's place of residence. The researcher lives in a city called Ajloun in the north of Jordan, which is far from the Industrial Estate in Amman by about 97 kilometres. The researcher had to go daily to Amman because it includes most of the study population and return in the same day because of her family. This difficulty led to taking a long time, a big exertion and high travel costs. The second difficulty was that the researcher had to visit some firms more than one time to see the intended respondent face to face and give him/her the questionnaire. The third difficulty was the forgetfulness of filling the questionnaire by some respondents after giving the researcher an appointment to come and collect it, hence, few of those apologised and asked the researcher to wait for them to fill in the questionnaire, so the researcher had sometimes to wait a long time in the same firm to collect the questionnaire. The fourth difficulty was related with the feeling of discomfort of the researcher as a female in collecting data from the Industrial Estates in Jordan, which is considered traditionally a masculine environment. Therefore, the researcher preferred to accompany her father to each firm during the whole process of fieldwork who made the researcher more comfortable and helped her in facilitating the communication process with the respondents of the survey.

5.11 Variables Measurement in the Questionnaire:

As indicated earlier, this study utilises a questionnaire survey as the research strategy. In developing the research questionnaire, multi-item scales used in previous empirical studies are identified and adopted to fit the context of the current study.

The questionnaire consists of three parts, which included 69 items intended to measure eight main constructs. The first four constructs are related to lean manufacturing practices (technical and human), the other four constructs are linked to four types of organisational culture. Before explaining the three parts, the questionnaire provided a brief description letter clarifying the purpose of the study, indicating the participation is voluntary and assuring the anonymity of the participant and the confidentiality of the responses.

The first part of the questionnaire is devoted to gaining the demographical background of the firm and the respondent. This part includes information about gender, age, educational level, job title and years of experience, ISO certification, and type of sector, type of ownership, age and size of the firm, and finally awareness and training in the lean system.

The second part is intended to assess the level of implementation of lean technical and human practices. In total 45 measurement items, have been used to assess the implementation of four main constructs, namely lean technical practices, customers' involvement, employees' involvement and suppliers' involvement. The construct of lean technical practices is measured through five sub constructs using 19 statements. The 19 items have been measured using a five-point Likert scale ranging from 'no implementation' (1) to 'complete implementation' (5). The five sub constructs are the following:

Pull system sub construct: is measured using four statements. The four items are adopted from Shah and Ward (2007), and include: "the usage of a production system in which units are produced only in necessary quantities, no more and no less"; "Production at a workstation is performed based on the current demand of the next workstation"; "Products are not produced unless orders for them are received from customers"; and "the usage of Kanban, squares, or containers of signals for production control".

Continuous flow sub construct it is measured using three items, which are adopted from Shah and Ward (2007) and include: "Products are categorised into groups with similar processing requirements"; "Machines are arranged in relation to each other to produce a continuous flow of families of products"; "Families of products determine our factory layout".

Set-up time reduction sub construct: it is measured using three items adopted from Shah and Ward (2007) and include "practicing set-ups by employees to save time"; "working aggressively to reduce set-up times in the plant"; and "having low set-up times of equipment".

SPC sub construct: it is measured using five items adopted from Shah and Ward (2007) and include: "Large number of equipment/ processes on shop-floors is currently under SPC"; "Statistical techniques are used to identify and reduce process variance"; "Charts showing defect rates are used as tools on the shop floor"; "the usage of Fishbone type diagrams to identify causes of quality problems"; and "process capability studies are conducted before product launch".

TPM sub construct: it is measured using four items adopted from Shah and Ward (2007) and include: "dedicating a specific time to planned equipment maintenance related activities every day"; "maintaining excellent records of all equipment maintenance related activities"; "posting equipment maintenance records on shop floor for active sharing with employees"; and "maintaining all our equipment regularly".

The construct "customers' involvement" is operationalised using six items adopted from Shah and Ward (2007), Alsmadi et al. (2012), and Hofer et al. (2012) and include: "keeping close relationship with the customers"; "customers visit the organisation in order to give some ideas about quality control that the company can follow"; "customers are actively or directly involved in current and future product offerings"; "customers frequently share current and future demand information with marketing department";

"administering customer satisfaction surveys frequently"; and "customers give the organisation feedback on quality and delivery performance". The six items are measured using a five-point Likert scale ranging from "no implementation" (1) to "complete implementation" (5)

The construct "employees' involvement" is measured using seven items. The items are adopted from Shah and Ward (2007); Sim and Rogers (2009) and include: "shop-floor employees are key to problem solving teams"; "shop-floor employees lead product/ process improvement efforts"; "shop-floor employees drive suggestion programmes"; "shop-floor employees undergo cross-functional training"; "Employee involvement through quality circles and continuous improvement teams is encouraged and supported"; "Employees are empowered to stop the production line if abnormalities occur"; and "implementing actions to increase the level of knowledge of the employees about lean system". The seven items are measured using a five-point Likert scale ranging from "no implementation" (1) to "complete implementation" (5)

The construct "suppliers' involvement" is measured using 13 items related to supplier feedback, supplier development and JIT delivery. All items are adopted from Shah and Ward (2007), Nawanir et al. (2012), Alsmadi et al. (2012) and include: "the frequency of close contact with the suppliers"; "visiting the supplier's plants by the organisation"; "the organisation is usually visited by its suppliers"; "suppliers are provided with feedback on quality and delivery performance"; "striving for building long-term relationship with the suppliers"; "suppliers are directly involved in the new product development"; "having a formal supplier certification programme"; "suppliers are contractually committed to annual cost reductions"; "the main suppliers are located in close distance to the organisation"; "having corporate level communication on important issues with key suppliers"; "taking active steps to decrease the number of suppliers in each category"; "the inventory is managed by the key suppliers"; "evaluating the suppliers on the basis of the total cost not on the price per unit". The 13 items are measured using a five-point Likert scale ranging from "no implementation" (1) to "complete implementation" (5).

The third part consists of 24 statements describing types of organisational culture through the measurement of four constructs (group culture, developmental culture, hierarchical culture and rational culture). Each construct is measured using six items.

All items in this part are adopted from Cameron and Quinn (2011). The 24 items are measured using a five-point Likert scale ranging from 'strongly disagree' (1) to 'strongly agree'(5). (See Appendix B for all items statements).

5.12 Data Analysis Techniques

The main aim of the current study is to empirically examine the effect of organisational culture on lean technical practices and to investigate the mediating role of lean human practices represented by customers' involvement, employees' involvement and suppliers' involvement in the organisational culture/ lean technical practices relationship (see chapter 1, section 1.5). This aim is accomplished by conducting an analysis of the data obtained from the manufacturing firms in Jordan. Accordingly, there is a necessity to subject the dataset to a few preliminary tests. Furthermore, to validate the conceptual models and verify proposed research hypotheses presented earlier in chapter 3, the SEM has been conducted using AMOS version 22. The quantitative data has been analysed through successive stages of analysis: preliminary analysis, descriptive analysis and SEM. Further discussion is represented in the following subsections.

5.12.1 Preliminary analysis

The purpose of preliminary analysis is to test the necessary conditions prior to multivariate analysis (e.g. SEM). In preliminary analysis, the researcher investigates important issues such as addressing missing data, dealing with outliers, and testing the normal distribution of variables (Tabachnick and Fidell, 2013, Kline, 2005, Hair et al., 2010).

5.12.1.1 Treatment of Missing Data

Missing data can result from different reasons such as data entry errors, respondents' refusal to answer certain questions, or when respondents do not have enough knowledge to answer a question. This problem cannot be prevented totally, but it can be considerably reduced (de Leeuw and Huisman, 2003). To reduce missing data, De Leeuw et al. (2003) recommend researchers to use well-designed and extensively pretested self-administered questionnaires. The researcher has followed these suggestions as discussed earlier in chapter five (see section 5.10) and this has resulted in small amount of missing data in the current study. The missing data are solved using the imputation method (Hair et al., 2010). The imputation method means estimating the missing observations based on the valid values of other observations in the data set. Despite that imputation by calculating replacement, values have some disadvantages such as reducing variance of the distribution or distorting the distribution of the data, this method is easily implemented and provides all cases with complete information (Hair et al., 2010). Furthermore, the mean substitution method is preferred to be used when the number of missing data is relatively low. In the current study, the number of missing data are low; therefore, it has been decided to use the mean imputation substitution as recommended by Hair et al. (2010). For the detailed results see chapter seven (subsection 7.2.1).

5.12.1.2 Outliers

Outliers represent cases whose scores are significantly different from all other values in a specific set of data (Byrne, 2010). A univariate outlier has an extreme value on a single variable, and this type of outliers can be found by inspecting frequency distributions of z scores (Kline, 2005). Whereas, a multivariate outlier has extreme values on two or more variables, or its pattern of scores is atypical. For instance, a case may have scores between two and three standard deviations above the mean on all variables (Kline, 2005). Although none of the individual scores may be considered extreme, the case can be a multivariate outlier if this pattern is unusual in the sample (Kline, 2005). The detection of multivariate outlier is more difficult than the univariate one, so some computer programs for SEM identify cases that contribute the most to multivariate non-normality (Kline, 2005). A very popular approach for detecting multivariate outliers is the computation of the squared Mahalanobis distance (D^2) for each case, this statistic measures the distance in standard deviation units between a set of values for one case and the sample means for all variables (centroids) (Byrne, 2010). Within large samples, D^2 is distributed as Pearson chi-square (X^2) statistics with degrees of freedom equal to the number of variables. A value of D^2 with a relatively low p value in the appropriate chi-square distribution may guide to the rejection of the null hypothesis that the case comes from the same population as the rest (Kline, 2005). In the current study, the computation of the squared Mahalanobis distance (D^2) has been conducted using AMOS 22 (see detailed results, in subsection 7.2.2).

5.12.1.3 Data Normality

The most important assumption underlying multivariate analysis is the normality of data. Normality refers to the extent, which the distribution of the sample data corresponds to the normal distribution (Hair et al., 2010). Screening the data for univariate normality is a common approach that can help inform whether multivariate normality may be a problem (Hair et al., 2010, Weston et al., 2008). If variables can be shown to be univariate normal, then multivariate analysis can be assumed (Weston et al., 2008).

Normality can be assessed by looking at two main measures: skewness and kurtosis. Skewness refers to the degree of symmetry of a distribution around the mean. In a positively skewed distribution, the long tail of the distribution is to the right (towards the higher values in the horizontal axis). When the distribution has a positive skew, the mean is larger than the median, which is larger than the mode. Conversely, a negatively skewed distribution has a long tail on the left side (towards the low values on the horizontal axis). The mean here is less than the median, which is less than the mode (Hair et al., 2010). Whereas, Kurtosis refers to the flatness or peakedness of a distribution compared to the normal distribution (Hair et al., 2010). A positive kurtosis indicates that the distribution is more peaked than the normal distribution, whereas a negative kurtosis indicates that the distribution is less peaked than the normal distribution (Weston et al., 2008). According to Kline (2005), skewness values of less than 3 and kurtosis values of less than 8 suggest no serious violations of the normality assumption. In the current study, data normality related to the distribution of all individual measurement items of the study's variables have been checked by evaluating skewness and kurtosis values using SPSS version 22 (see detailed results in subsection 7.2.3).

5.12.2 Descriptive Analysis

According to Pallant (2013) the descriptive analysis has multiple benefits:

First: to explain the characteristics of the sample;

Second: to test the variables for any violation of the assumptions underlying the statistical techniques that are used to address the research questions.

The descriptive analyses include frequency, percentage, central tendency measure (such as mean); variability (dispersion) measures such as standard deviation and maximum and minimum scores and some information concerning the distribution of scores (skewness and kurtosis) (Tabachnick and Fidell, 2013). The SPSS version 22 has been used to conduct the descriptive analysis in the current study. This package is the most widely used computer software for the analysis of quantitative data for social scientists (Saunders et al., 2016).

With respect to the frequency and percentage tables, provide the number of individuals belonging to each of the categories for the variable in question and it can be used in relation to all the multiple types of variable (Sanders et al., 2016).

Furthermore, one of the most common central tendency measures that has been established in the current study is the mean. The mean is simply the average, which is the sum of all the scores in a distribution and dividing by the number of scores (Hinton, 2014). The mean has been calculated for all interval/ ratio variables in this study because it is a common measure used for this type of variable (Saunders et al., 2016).

In addition, the most popular and clear techniques of measuring dispersion are the range and standard deviation (Saunders et al, 2016). Range means the difference between the highest (maximum) and lowest (minimum) data values (Hinton, 2014). Whereas, the standard deviation, which is the most frequent way to measure variability of a set of data as it gives a good picture of how the data is spread around, but it is still influenced by the extreme scores (outliers) (Bryman and Bell, 2015). The values of the descriptive analysis in the current study are presented in the next chapter.

5.12.3 Structural Equation Modelling (SEM)

The empirical analysis of the current study aims to examine the effect of each type of organisational culture (independent variable) on lean technical practices (dependent variable) as well as investigating the mediating effect of customers' involvement, employees' involvement and suppliers' involvement on each type of organisational culture/ lean technical practices relationship. For this type of analysis, SEM has been recommended as the most appropriate analytical strategy (Byrne, 2010). SEM is one form of multivariate analysis, which entails the simultaneous analysis of three or more variables (Saunders et al., 2016). Multivariate analysis refers to "all statistical techniques that simultaneously analyse multiple measurements on individuals or objects under investigation" (Hair et al, 2010, p.4). Thus, SEM is a collection of statistical techniques allowing a set of relationships between one or more independent variables, either continuous or discrete, and one or more independent variables either continuous or discrete, to be examined (Ullman, 2006). Both independent and dependent variables can be either measured variables (directly observed) or latent variables (unobserved) (Hair et al., 2010). Shah and Goldstein (2006) define SEM as a technique to specify, estimate and evaluate models of linear relationships among a set of observed variables with a fewer number of unobserved variables. SEM is also referred to as causal modelling, causal analysis, covariance structure analysis, latent variable analysis, path analysis or confirmatory factor analysis (CFA) (Hair et al., 2010, Ullman, 2006). Sometimes SEM is called by the software package used such as AMOS or LISREL (Hair et al., 2010).

SEM has two goals: understanding the patterns of correlations/ covariances among a number of variables and explaining as much of their variance as possible with the model specified (Suhr, 2006).

On the one hand, SEM is like traditional methods such as correlation, regression and analysis of variance in two points. First, both traditional techniques and SEM rely on linear statistical models. Second, statistical tests associated with both techniques are valid if certain assumptions are met (Suhr, 2006).
On the other hand, SEM differs than other multivariate techniques such as multiple regression analysis, factor analysis, and multiple analyses of variance (MANOVA) in a number of characteristics summarised by many authors (Bagozzi and Yi, 2012, Byrne, 2010, Hair et al., 2010, Suhr, 2006, Ullman, 2006). These characteristics are considered the rationale behind using SEM in the current study and they are as follows:

1- Estimation of multiple and interrelated dependence relationships can happen in SEM.
2- SEM has an ability to show unobserved factors (concepts or constructs) in these relationships. Using SEM procedures can incorporate both latent (unobserved) and observed variables, whereas other methods rely on observed measurements only.

3- SEM provides explicit estimates for measurement errors in the estimation process. Indeed, alternative methods such as those rooted in regression or the general linear model assume that errors in the explanatory variables are disappearing. Thus, applying the traditional methods when there is an error in the explanatory variables is equivalent to ignoring errors, which may result in significant inaccuracies. In SEM, random or measurement error in indicators of latent variables can be modelled and estimated explicitly, as well as a systematic or method error can also be represented. The result is that focal parameters corresponding to hypotheses are purged of specific types of bias, and certain errors in inference avoided.
4- SEM defines a model to explain the whole set of relationships.
5- SEM takes a confirmatory rather than exploratory approach to the data analysis. By contrast, most other multivariate procedures are essentially descriptive in nature so that hypothesis testing is difficult, if not impossible.
6- Meditational processes can be tested and information related to the adequacy of the modifications can be included in the SEM analysis.

SEM is considered a unique combination of an interdependence and dependence techniques because it lies in two major multivariate methods: factor analysis and multiple regression analysis (Hair et al., 2010). In other words, SEM is composed of the measurement model and the structural model (regression or path analysis) in a simultaneous statistical test (Hair et al., 2010). The purpose of developing a measurement model is to conduct a confirmatory factor analysis (CFA). CFA is done for assessing the 'fit' of the indicators representing the latent variable.

Bagozzi and Yi (2012) provide a list of benefits that SEM use may offer. These benefits are:

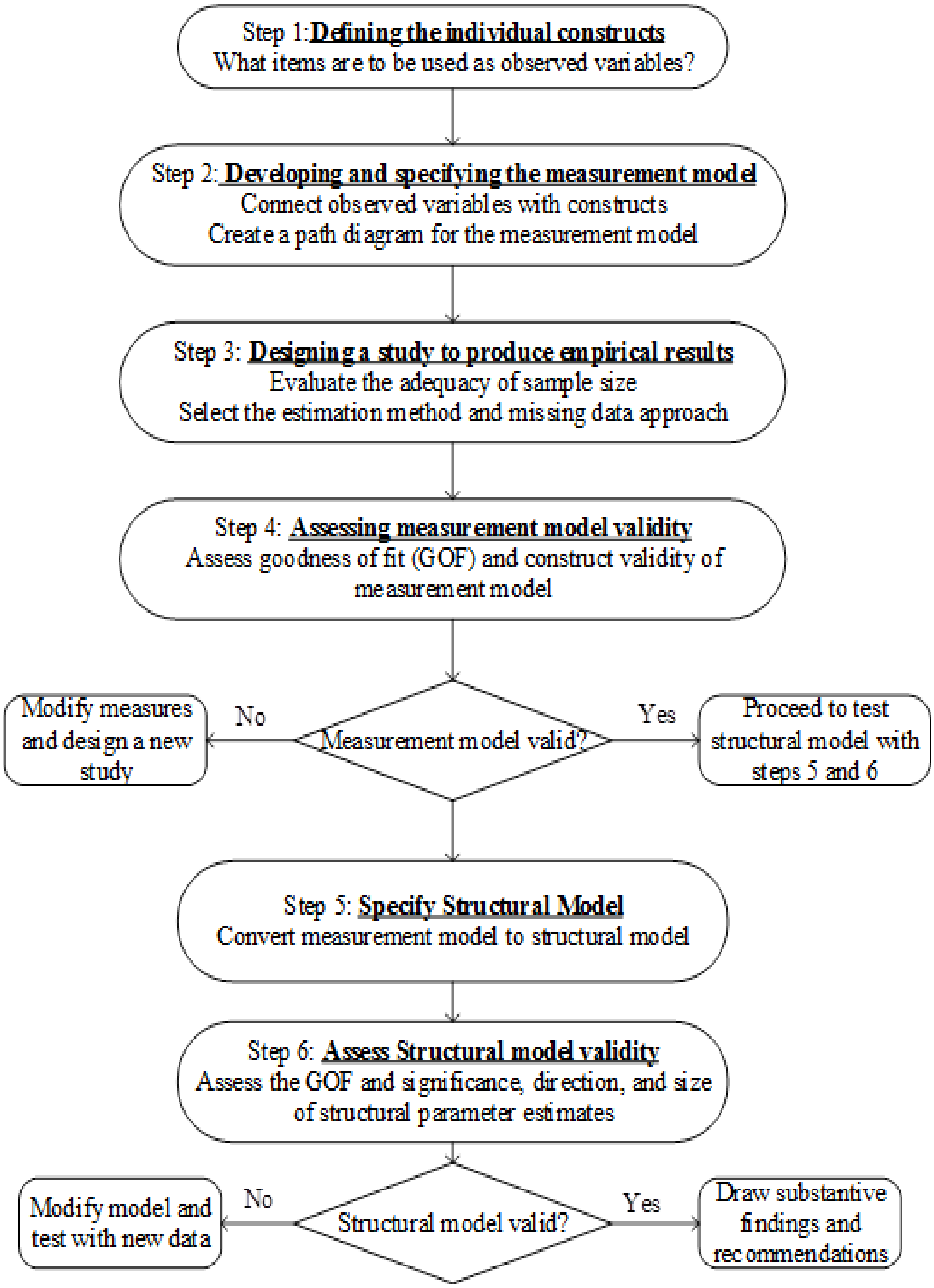
1. Providing integrative function (a single umbrella of methods under leading programmes).
2. Helping researchers to be more accurate in their hypotheses' development and operationalisation of constructs.
3. Considering reliability of measures in tests of hypotheses in methods, go beyond the averaging of multi-measures of factors.

4. SEM works well under the philosophy of discovery (exploratory research) or the philosophy of confirmation.
5. Useful in experimental or survey research, cross-sectional or longitudinal studies, measurement or hypotheses testing endeavours, within or across groups and organisational or cultural contexts.
6. SEM is easy to use and interesting in the same time.

5.13 SEM Analysis Procedures

In the current study, the six steps, which are developed by Hair et al. (2010), have been adopted and are illustrated in figure 5.10. These steps will be explained in the following subsections subsequently.

Figure 5-10 Steps of Structural Equation Modelling



Source: Hair et al. (2010, p.654)

5.13.1 Defining the Individual Constructs

The process starts with listing the constructs that will establish the measurement model. A good measurement theory is important requirement to get useful results from SEM. The measurement model explains how the constructs are developed. The researcher must give a sufficient time and effort in the research process to ensure the good quality of the chosen scales in which will enable valid outcomes in the end (Hair et al., 2010). Three rules of thumb are recommended by Hair et al. (2010) in this step:

1- If the scales are new or taken from previous studies, all constructs must be checked and display an acceptable construct validity.
2- Even the established scales should be judged both qualitatively (expert opinion) and empirically (convergent validity)
3- To purify measures before confirmatory testing through pretesting.

In the current study, the researcher has selected the specific constructs and the item statements based on previous empirical studies as discussed earlier in section 5.11. In addition, the measurement scales have been tested qualitatively as discussed earlier in subsection 5.10.5 and will be tested empirically in chapter 7.

5.13.2 Developing and Specifying the Measurement Model

The SEM can be divided into two parts: measurement model and structural model (Byrne, 2010). The part of the model that relates the measured variables (also called observed variables, indicators, or manifest variables) to the factors (also called latent variables, constructs or unobserved variables) is called measurement model (Ullman, 2006).

In this step, each latent construct in the conceptual model is identified and the measured variables (items) are assigned to latent construct. In addition, the researcher must carefully consider how all the individual constructs will come together to develop an overall measurement model (Hair et al., 2010). This step is a confirmatory rather than an exploratory technique (Ullman, 2006). Confirmatory technique means that it can be used when the researcher relies on knowledge of the theory about the relations between the observed variables and the unobserved ones as "a priori" and then examines this hypothesized model statistically (Byrne, 2010). Indeed, one cannot implement SEM analysis without prior knowledge of, or hypotheses about, potential relationships among variables (Ullman, 2006).

Hair et al. (2010) recommend many of issues should be considered in this step.

First: Unidimensionality

It means that a set of items can be explained by only one construct. Each measured variable is hypothesised to connect to only one latent variable. All cross loadings are assumed zero when unidimensional constructs exist (Hair et al., 2010). Nunnally (1978) confirms the necessity of checking the unidimensionality of each construct included in the conceptual model as a prerequisite step for validity and reliability tests. In the current study, unidimensionality has been established using confirmatory factor analysis by which the measurement items for each construct have been specified. The measurement model was refined based on standardised regression weights, that is, observed variables that did not have satisfactory standardised regression weights (< 0.50) were dropped from the measurement model. Furthermore, Cronbach's alpha values were also inspected to check the internal consistency among the observed items of each construct in the measurement model. The Cronbach's alpha values for all constructs are above the recommended threshold level of (0.70). Accordingly, the unidimensionality of each construct in the current study was verified. The results of unidimensionality will be illustrated chapter seven (subsection 7.3.2)

Second: Number of items per construct

More items are not necessarily better. Although more items produce higher reliability estimates and generalisability, more items also need larger sample sizes and can make it hard to establish truly unidimensional factors (Hair et al., 2010). As a rule of thumb recommended by Hair et al. (2010) this dictates a minimum of three items per construct. Therefore, it is preferred in the current study to keep at least three items for each construct. The results of confirmatory factor analysis for each construct in subsection 7.3.2 provides an evidence that each construct used in the current study has at least three items.

Third: Identification of the model

The issue of identification focuses on whether there is a unique set of parameters consistent with the data. If the values of the structural parameters of the model achieved a unique solution, the model is identified (Byrne, 2001). Measurement models can be characterised by their degree of identification, which is defined by the degrees of freedom (DF) of a model after all the parameters to be estimated are specified (Hair et al., 2010). The models may be just identified, over-identified, or under-identified (Byrne, 2010). Researchers can use the following formula to calculate the DF and determine if the model is over, under or just identified (Weston and Gore, 2006)

(Number of observed variables [number of observed variables +1])/ 2

When the effective number of free parameters is exactly equal to the number of equations (DF= zero), the model is called "just identified" or "saturated". Just identified model offers an exact solution for parameters (Shah and Goldstein, 2006). It is the one in which there is "a one-to-one correspondence between the data and the structural parameters", in other words the number of data variances and covariances equals the number of parameters to be estimated (Byrne, 2010). When the effective number of free parameters is greater than the number of equations (DF < zero), the model is "under-identified" and sufficient information is not existent to estimate the parameters uniquely (Shah and Goldstein, 2006). An under-identified model is explained by Byrne (2010) where" the number of parameters to be estimated exceeds the number of variances and covariances (data points)". Therefore, the model contains incomplete information for attaining a determinate solution of parameter estimation (Byrne, 2010). For models in which there are fewer unknowns than equations (DF > zero), the model is over identified. Byrne (2010) defines the over-identified model as one in which "the number of estimable parameters is less than the number of data points (variances and covariances of the observed variables)". An over identified model is highly desirable because more than one equation is used to estimate at least some of the parameters (Shah and Goldstein, 2006).

In this study, the number of degrees of freedom for each individual construct and for the whole measurement models will be presented in subsections 7.3.2 and 7.3.3 as evidence of identifiable modelling. The calculation of degrees of freedom has been done automatically on AMOS software and the output shows that all models are over-identified, and only one construct (employees' involvement construct) is found saturated (just identified) after making some modifications.

5.13.3 Designing a Study to Produce Empirical Results

In this step, the researcher must give attention to two main issues: research design and estimation (Hair et al., 2010). Research design includes three major dimensions: (1) the type of data to be analysed; (2) missing data impact and remedies; and (3) effect of sample size (Hair et al., 2010). Also in this step, it is important to decide the estimation method and the current computer software being used (Hair et al., 2010).

Based on the research design, the researcher should give attention to the type of data being used for each observed variable, so that the convenient measure of association can be calculated (Hair et al., 2010). There are usually two types of data: metric data (interval or ordinal) and this type of data are directly adjustable to the covariances' calculations among items; nonmetric data (such as binary or nominal) and this type is unallowable to be used in many software programmes (Hair et al., 2010). Furthermore, the researcher should make necessary decisions regarding missing data (Hair et al., 2010) as discussed earlier in subsection 5.12.2.1.

With respect to the sample size, many arguments occurred around the required minimum sample size in SEM and many guidelines have been developed based on analysis procedures and model complexity (Hair et al., 2010). Even though SEM is a large sample technique, new test statistics have been established allowing for estimation of models with as few as 60 observations (Tabachnick and Fidell, 2013). Kline (2005) provides two recommendations: (1) assigning 10 to 20 participants per estimated parameter (20:1 or 10:1) would result in a realistic sample, (2) a sample size of 200 or even much bigger may be necessary for a complex path model. According to Hair et al.'s (2010) recommendation, the sample size should be representative to the population of interest. As discussed earlier in subsection 5.8.4, this study took into consideration the minimum sample size recommended by many scholars, which is 200 (Kline, 2005, Wolf et al., 2013).

Based on the estimation method, fitting a model to data means solving a set of equations. On the one hand, there is the model with its parameters, whose values should be estimated. On the other hand, there are the sample statistics that are known to be good estimates of the corresponding population values. In SEM, it is usually assumed that the sample data follow a multivariate normal distribution, so that the means and covariance matrix contain all the information. The basic model in statistical modelling is DATA=MODEL+ERROR. SEM software uses complex algorithms that maximise the fit of the model, taking all model restrictions such as fixed parameters and equality constraints into account (Hox and Bechger, 1998). The estimation technique involves determining the value of the unknown parameters and the error associated with the estimated value (Weston and Gore, 2006). A variety of estimation methods such as Maximum Likelihood Estimation (MLE), Generalised Least Square (GLS), Weighted and Unweighted Least Square (WLS and ULS), Asymptotically Distribution Free (ADF) and Ordinary Least Square (OLS) are available (Shah and Goldstein, 2006). The choice of the appropriate estimation technique depends on sample size, plausibility of the normality and independence assumptions (Ullamn, 2006). The MLE has been used in this study for the following reasons:

1- MLE is the most frequently used SEM estimation method in most programmes (Hair et al., 2010; Ullman, 2006). It is the default in most SEM programmes.
2- MLE may be good selection with medium to large samples and evidence of the plausibility of the normality and independence assumptions (Ullman, 2006). MLE provides valid results with sample sizes as small as 50 (Hair et al., 2010).
3- Researchers who compared MLE with other estimation techniques and the results were reliable under many different situations (Hair et al., 2010).
4- A majority (68.9per cent) of research in operations management used MLE (Shah and Goldstein, 2006)
5- MLE yields the most accurate (smallest variance) estimates when the data are normal (Ullman, 2006).
6- MLE is quite robust against violations of the multivariate normality assumption (Hair et al., 2010; Hox and Bechger, 1998).

In this study, the collected data are normal, the sample size is 205 cases, and the field of study is related to operations management research. Thus, MLE is considered the best choice for the researcher.

It is worthwhile of mention that many available statistical programs are convenient for applying SEM. The most familiar one is LISREL (LInear Structural RELations) which is the first SEM software programme(Schumacker and Lomax, 2010) that can be applied in different situations (Hair et al., 2010). EQS (an abbreviation of equations) is another widely programme that can be used to run regression analysis, factor analysis and test structural equation models (Hair et al, 2010). AMOS (Analysis of Moment Structures) or in other words, the analysis of mean and covariance structures is the first SEM programme to use graphical interface for all functions (Byrne, 2010). Mplus is a flexible modelling program with multiple techniques that is especially useful in complex applications (Hair et al., 2010). Finally, CALIS (Computer-Assisted Learning for Information Searching) is an SEM program traditionally available within SAS (Statistical Analysis System). Schumacker and Lomax (2010) were not able to give a recommendation regarding the best software programme. The decision depends upon the researcher's needs and preferences, as well as many issues such as site license arrangement, the pricing information for SEM software, corporate or educational settings and even whether one is student or faculty member (Schumacker and Lomax, 2010).

In the current study, AMOS 22 version software programme has been chosen to conduct SEM analysis and test the proposed model. The reasons behind choosing AMOS are:

(1) The availability of AMOS license software in the researcher's university (Schumacker and Lomax, 2010).

(2) Detailed goodness of fit information is provided in output (Ullamn, 2013).

(3) AMOS has extensive bootstrapping capabilities that can be used for assessing mediation (Ullamn, 2013).

(4) Missing data and outliers can be estimated in AMOS (Ullman, 2013).

(5) AMOS has a clever output property. For example, if the cursor is put on certain number in output within AMOS programme, a help screens pops up and explains that part of the output (Ullman, 2013).

(6) Feeling comfortable and interesting to work within a graphical interface with drag-and-drop drawing tools that allow the path diagrams to be easy to understood for the researcher and the reader.

Interestingly, AMOS allows models to be developed through diagrams and equations (Ullamn, 2013). Using AMOS-basic, the work is based on equation statements, whereas, in AMOS-graphics, models are represented in graphical forms or symbols. Four major symbols including oval or circular shapes (for latent variable), rectangles (for indicators), single-headed arrows and double-headed arrows are used to depict structural equation models.

5.13.4 Assessing Measurement Model Validity

Assessing the validity of the measurement model is the most critical step in SEM testing. According to Hair et al. (2010), the validity on the measurement model depends on:

(a) Developing acceptable goodness of fit levels for the measurement model. In this subsection, this issue will be discussed.

(b) Evidence on the construct validity. This issue will be presented in depth in section 5.14 because of its importance.

One dimension of a 'good' model is the existence of a fit between the sample covariance matrix and the estimated population covariance matrix (Tabachnick and Fidell, 2013). Assessing a model's fit is one of the most complicated issues of SEM, because unlike the traditional statistical tools, it depends on non-significance (Hair et al, 2010).This means that a good fit model is sometimes assessed by a non-significant Chi-square (X^2) (Tabachnick and Fidell, 2013).

Goodness of fit (GOF) measures are classified into three categories: absolute fit measures, incremental fit measures and parsimony fit measures (Hair et al., 2010; Byrne, 2001).

Absolute fit indices measure the extent to which the proposed model reproduces the observed data. (Hair et al, 2010); they directly assess how well a model fits the observed data (Weston and Gore, 2006). They only assess the overall fit of the model (both the structural and measurement models together) without comparing it with any other model. Absolute fit measures include the Chi-square (X^2) statistic, the goodness-of-fit index (GFI), the root mean square error of approximation (RMSEA) and the standardised root mean residual (SRMR) (Byrne, 2010, Hair et al., 2010, Schumacker and Lomax, 2010, Shah and Goldstein, 2006). Historically, the most familiar index used to assess the overall goodness of fit is the chi-square (X^2), although its conclusions regarding model significance are generally ignored (Shah and Goldstein, 2006).

A significant X^2 suggests the model does not fit the sample data while a non-significant X^2 is an evidence of a model fits the data well. The Chi square X^2 value assess the magnitude of discrepancy between the observed and estimated matrices (Hu and Bentler, 1999). Two limitations exist with the chi-square statistic: (1) this index tests if the model is an exact fit to the data and reaching to a perfect fit is rare; (2) with most statistics, large samples increase power, resulting in significance with small effect size (Henson, 2006). Therefore, researchers typically consider additional fit indices to determine if the model fit is acceptable (Weston and Gore, 2006).

One of the first fit statistics to address the limitations of Chi square value is using the Normed Fit Chi-square (Minimum discrepancy (CMIN)/DF) ratio. This index is referred to as "subjective" or "practical" or "ad-hoc" index of fit which can be used instead of X^2 (Byrne,2010). Given the sensitivity of the chi-square statistic for sample size, researchers have proposed a variety of alternative fit indices to assess model fit. All goodness-of -fit measure are some function of the chi-square and the degrees of freedom (Hox and Bechger, 1998).

Incremental fit indices (also called comparative fit indices) compare the proposed model to some alternative baseline model, which is usually referred to as null model (Hair et al, 2010). Fit indices that use comparative statistics place the hypothesized model somewhere in between along this continuum (Byrne, 2010, Tabachnick and Fidell, 2013). At one extreme of the continuum is the independence model which corresponds to completely unrelated variables and have degrees of freedom equal the number of data points minus the variances that are estimated (Byrne, 2010, Tabachnick and Fidell, 2013). The independence model is the null model or model without parameters estimated (Schumacker and Lomax, 2010). At the other extreme lies the saturated (full or perfect) model with zero degrees of freedom, as in the case of the just-identified model (Byrne, 2010, Tabachnick and Fidell, 2013). The saturated model is with all parameters indicated (Schumacker and Lomax, 2010). Comparative statistics include indices such as the Normed Fit Index (NFI), the Tucker-Lewis Index (TLI), the Comparative Fit Index (CFI), and the Incremental Fit Index (IFI) (Byrne, 2010, Tabachnick and Fidell, 2013).

Parsimony fit indices provide information about which model amongst a set of competing models is best, considering its fit relative to its complexity. They are helpful in comparing the fit of two models, one more simple than the other compares. The most widely used parsimony fit measures include the Adjusted Goodness-Of-Fit Index (AGFI) and the Parsimony Normed Fit Index (PNFI) (Byrne, 2010, Hair et al., 2010, Schumacker and Lomax, 2010, Shah and Goldstein, 2006).

There is much dispute on what constitutes an adequate or good fit. According to Hair et al (2010), it is recommended that the use of three to four indices helps provide adequate model fit evidence and that at least, besides the value, one absolute fit index and one incremental index should be reported (Hair et al., 2010). (Tabachnick and Fidell, 2013) argue that if all indices lead to similar conclusions, the matter of choosing indices refers to the personal preference, as well as they suggest the use of CFI and RMSEA because they are the most frequently reported fit indices.

Interestingly, a review of SEM-based operations management studies reveals that the model fit in these studies was mostly concluded based on absolute and incremental fit indices. Among the most common indices used, as reported in this review, were Normed fit Chi-square and RMSEA (absolute fit indices) as well as CFI and IFI (incremental fit indices) (Shah and Goldstein, 2006). Therefore, in the current study that four fit indices representing two different kinds of goodness of fit (absolute and incremental) along with Chi-square and the associated degrees of freedom and significance value have been reported to conclude the model's fit. Table 5.4 summarises the main fit statistics used in this study.

Table 5-4 Main Fit Indices Used in the Study

Fit index	Kind	Description	Recommended values
CMIN or X^2 (Chi-square)	Absolute fit index	Test of null hypothesis that the estimated variance-covariance matrix deviates from the sample. Significantly affected by sample size (less meaningful as sample sizes or the number of measured variables become larger)	Non-significance with a p-value larger than 0.05 ($p > 0.05$)
(CMIN/DF) (Normed fit Chi-square)	Absolute fit index	Used as a substitute of X^2 statistics because it is more subjective and practical index.	Values less than 2 and as high as 5 indicate a reasonable fit.
CFI (Comparative Fit Index)	Incremental fit index	It is among the most widely used indices because of its relative and insensitivity to model complexity. Values range from zero to 1.00 and derived from the comparison of a hypothesised model with the independence model. CFA does a good job of estimating model fit even in small samples.	Values close to 0.90 or 0.95 indicate a good model fit.
IFI (Incremental Fit of Index)	Incremental fit index	Comparative index between proposed and null models adjusted for degrees of freedom.	Values close to 0.90 or 0.95 indicate a good model fit.
RMSEA (Root Mean Square Error of Approximation)	Absolute fit index or parsimonious fit index	It better represents how well a model fits a population, not just a sample used for estimation. It estimates the lack of fit in a model compared to a perfect model. Thus, lower values indicate better fit.	Values of 0.05 to 0.08 indicate a good fitting model. Values larger than 0.10 indicate poor fitting models.

Source: Kline (2005), Hair et al. (2010), Byrne (2010), Schumacher and Lomax (2010).

5.13.5 Specifying Structural Model

This step involves the specification of the structural model through assigning relationships from one construct to another based on the proposed theoretical model (Hair et al., 2010). Structural models are referred to as theoretical model or causal model. In this step, the researcher must differentiate between exogenous and endogenous constructs. The traditional independent variables should be named exogenous constructs and the traditional dependent variables are named endogenous constructs (outcomes). Theory is examined by testing the impact of exogenous variables on endogenous variables.

Structural models differ from measurement models in that the focus moves from the relationships between latent constructs and measured items to the nature and magnitude of the relationships between constructs. Measurement models are examined using confirmatory factor analysis (CFA). The CFA is then converted based on the nature of relationships among constructs through using the single-headed arrows for the hypothesised causal relationships instead of the correlational relationships among variables used in CFA. The main purpose of this step is developing a structural model to test the hypothesised theoretical model (Hair et al., 2010).

In this study, eight structural models are specified. The first four structural models illustrate the direct relationships between organisational culture and lean technical practices. These four models will be called the direct structural models. Each type of organisational culture will be tested separately from the other three types to simplify the model and to compare each type with other types to reach to the ideal one. The type of organisational culture will be the exogenous construct and the lean technical practices construct will be the endogenous one. The results of the four direct structural models will be presented in section 8.2.

The other four structural models will examine the indirect relationships between organisational culture and lean technical practices through using three mediators (customers' involvement, employees' involvement and suppliers’ involvement) as hypothesised in the four conceptual models in chapter 3. Each type of organisational culture will be taken separately as an exogenous construct to examine its direct impact on the three mediators (endogenous constructs) and its indirect impact on lean technical practices (endogenous constructs) to examine the mediating role of each mediator in the relationship between organisational culture and lean technical practices. The other four structural models will be called mediated structural models. The results of these models will be provided in section 8.3.

5.13.6 Assessing Structural Model Validity

The final step of SEM is to test the validity of the complete structural model beside its corresponding hypothesised relationships. It should be noted that only when the measurement model has achieved an acceptable fit, attention could be turned to testing the structural relationships. If an acceptable fit is not achieved for the measurement model, model fit will not improve when the structural relationships are specified (Hair et al., 2010).

The same guidelines that are used to assess the model fit of the measurement model remain the same for evaluating the fit of the structural model (subsection 5.13.4). Likewise, acceptable model fit is not enough in this step to support our theoretical model. The parameter estimates against the corresponding hypotheses must be assessed through examining the statistical significance of the standardised estimates (path coefficients) and the predicted direction of the relationship (estimates higher than zero indicate positive relationship and less than zero for a negative relationship) (Hair et al., 2010). As a rule of thumb, the path coefficient statistically significant if its critical value (z- value) is greater than 1.96 with p-value less than 0.05 (Hair et al. 2010). Based on this rule, the decision has been made to accept or reject the hypothesis.

5.14 Validity and Reliability of Measures

Validity and reliability are two main criteria for social research evaluation (Bryman, 2012). It is important that the scores analysed in SEM are both reliable and valid (Kline, 2005). Many procedures are used to assess the validity and reliability of the measurement models in this study according to Hair et al.'s (2010) recommendations.

5.14.1 Validity

Validity is the extent to which a scale or set of items accurately reflects the theoretical concept of interest (Hair et al., 2010). The most common forms of validity are convergent and discriminant validity.

On the one hand, the *convergent validity* is the degree to which a construct's items are correlated with each other (Hair et al, 2010). In the current study, convergent validity is established by examining the statistically significant factor loadings on each construct. Standardised loading estimates of 0.5 or higher indicate convergent validity (Hair et al., 2010). Convergent validity results will be presented in chapter 7 (subsection 7.3.2).

On the other hand, *discriminant validity* ensures that a construct measure is empirically unique and represents phenomena of interest that other measures in a SEM do not capture (Hair et al., 2010). If discriminant validity is not established , the constructs have an influence on the variation of more than just the observed variables to which they are theoretically related and as a consequence the researcher cannot ensure that the outcomes supporting the hypothesised relationships in the structural model are real or as result of statistical analysis (Farrell, 2010). Fornell and Larcker (1981) suggest that discriminant validity is achieved if a latent construct accounts for more variance in its associated measured variables than it shares with other variables in the same model. To achieve this condition, each construct's Average Variance Extracted (AVE) should be compared to its squared correlations with other constructs in the model (Henseler et al., 2015). The AVE represents the average amount of variance that a construct explains in its observed variables (items) relative to the overall variance of its indicators (Henseler et al, 2015). Evidence of discriminant validity is provided when the square root of the AVE for a construct is found to be higher than the correlation estimate between that construct and all other constructs (Hair et al., 2010). Fornell and Larcker (1981) explain that for any two constructs, A and B, the AVE for A and the AVE for B must be higher than the shared variance (square of the correlation) between A and B.

In the present study, discriminant validity will be assessed by comparing the square root of the AVE values with the correlation estimate between constructs using a reliable excel statistical tools package (Gaskin, 2016b) based on the outputs of AMOS analysis. The results of discriminant validity will be presented in chapter 7 (subsection 7.3.3).

5.14.2 Reliability

Reliability refers to the extent to which the measures (scores) are free from random measurement error (Kline, 2005). It is estimated as one minus the percentage of the observed variance happens because of random error (Kline, 2005). Coefficient alpha (also known as Cronbach’s alpha) is the mostly used measure for reliability, which assesses the consistency of the entire scale (Hair et al., 2010). This statistic measures the degree to which answers are consistent across all items within a single measure (Kline, 2005). If internal consistency reliability is low, the content of the items may be heterogeneous that the total score is not the best possible unit of analysis for the measure (Kline, 2005). In this study, the values of Cronbach's alpha for each construct are evaluated using SPSS 22 software and are presented in chapter seven (subsection 7.3.2)

A major problem with coefficient alpha is its positive relationship with the number of scale items. Increasing the number of the scale items will increase the value of coefficient alpha. Thus, Cronbach’s alpha may be inappropriately inflated by including several redundant items (Hair et al., 2010). To overcome this problem, reliability measures derived from CFA results have been suggested (Hair et al., 2010). In operations management research, Shah and Goldstein (2006) recommend that reporting at least one measure of construct reliability based on estimated model parameters such as composite reliability (CR) or AVE is important. In this thesis, the CR is used to measure the reliability of each construct.

CR is often used in SEM models. It means that the measures all consistently reflect the same latent variable. (Hair et al, 2010). Reliability values between 0.60 and 0.70 are generally considered acceptable. The values of 0.70 or higher indicate a good reliability (Hair et al., 2010). According to Kline (2005, p.59), reliability coefficients around 0.90 are considered "*excellent*", values around 0.80 are "*very good*", and values around 0.70 are "*adequate*". CR has been calculated using the online composite reliability calculator (Composite Reliability Calculator Website, 2016). The CR is computed from the squared sum of factor loadings or regression weights (λ) for each construct and the sum of the error variance terms of a construct (ε).

$$\mathrm{CR} = \frac{\left(\sum \lambda_i\right)^2}{\left(\sum \lambda_i\right)^2 + \sum Var\left(\varepsilon_i\right)}$$

Source: Composite Reliability Calculator Website (2016)

The results of CR are presented in chapter seven (subsection 7.3.2).

5.15 Other Issues in SEM

5.15.1 Common Method Bias

Common method bias refers to the "variance that is attributable to the measurement method rather than to the constructs the measures represent" (Podsakof et al., 2003, p. 879). It represents a methodological concern when applying survey research in general or when collecting data from the same respondents (Siemsen et al., 2010). Common method bias may evolve mainly because of one or more of the following: the use a common source (e.g. the same respondent assesses the predicting and criterion variables); the use of a common measurement context (e.g. measuring the predicting and criterion variables at the same time and place); item context (e.g. item context-induced mood due to the approach by which the items are worded) and item characteristics (e.g. measuring different constructs using a similar scale format). In such cases, researchers need to assess whether or not common method bias is a concern in their studies (Podsakoff et al., 2003). The results of common method bias will be provided in chapter 7 (subsection 7.3.3).

5.15.2 Model Modification Techniques

If the fit of a model is not adequate, it has become a popular step to modify the model, by deleting parameters that are not significant or have a standardised regression weights less than 0.50 to improve the fit (Hair et al., 2010). Furthermore, AMOS software can compute modification indices for each fixed parameter. The value of a given modification index is the minimum amount that the chi-square statistic is expected to decrease if the corresponding parameter is freed. Researchers often use this information to manage a sequence of model modifications. At each step a parameter is freed that produces the largest improvement in fit, and this process is continued until an adequate fit is achieved. For instance, if in a confirmatory factor model a loading that is fixed to zero shows a big modification index, the researcher may free this parameter and estimate its value. This process will improve the fit of the model, at the cost of one degree of freedom (Hox and Bechger, 1998).

Finally, the essence of SEM is to determine the fit between the restricted covariance matrix, implied by the hypothesised model and the sample covariance matrix; any discrepancy between the two is noticed by the residual covariance matrix. This matrix includes the standardised residuals which are fitted residuals divided by their asymptotically standard errors (Byrne, 2010). They represent estimates of the number of standard deviations the observed residuals are from the zero residuals that would exist if model fit was perfect (the restricted covariance matrix - the sample covariance matrix= zero) (Byrne, 2010). Therefore, examining the magnitude of standardised residual values, which are provided in the optional AMOS output, is of interest in alerting the researcher to possible areas of model fit. The residuals should be small and centred around zero because the frequency distribution of the residual covariances should be symmetrical (Tabachnick and Fidell, 2013). Standardised Residual values, modification indices and the parameters are used to modify the models in the current study.

5.16 Chapter Summary

This chapter has provided a detailed explanation of the methodological approach used in the current study. This study is positioned within the positivist research paradigm and accordingly, research strategies related to quantitative research have been discussed. The present study is an explanatory cross-sectional study based on a deductive approach. The questionnaire survey is used as the main data collection method, and its development and translation followed solid procedures recommended by different scholars in research methods. SEM will be used to test the proposed research model and hypotheses, and its steps are discussed. A discussion about issues of validity, reliability, model improvement and common method bias are presented in the final part of this chapter.

CHAPTER SIX: Descriptive Analysis

6.1 Introduction

This chapter focuses on the descriptive analysis of the final data collected from the survey and summarises the basic statistics related to the respondents' demographic profile and the measurement items for all constructs of the study. The SPSS version 22 has been used for the descriptive analysis of the data. The chapter is structured into four sections. The second section deals with response and non-response rate. The third section presents the demographic profile of the survey respondents. The fourth section presents the descriptive analysis of responses to the questionnaire items. The fifth section presents the correlation matrix of the study's constructs. A chapter summary is provided in section six.

6.2 Response Rate and Non-Response Rate

250 questionnaires have been distributed to professionals in the manufacturing firms in Jordan. 209 questionnaires were returned to the researcher. Of these 205 were useable for analysis, giving an effective response rate of 82 per cent. This response rate is considered to be reasonably sufficient for robust statistical analysis, where according to Baruch and Holtom (2008), the average response rate for surveys that utilised data collected from individuals in organisational research is 52.7per cent.

Non-response bias, also known as non-response error, occurs when respondents of a survey differ significantly from non-respondents on the variables of interest in a study (Coderre et al., 2004, Dooley and Lindner, 2003). According to Dooley and Lindner (2003), when non-response bias occurs, the conclusions drawn and recommendations made in a study are not valid. To check for non-response bias, responses of early respondents to the survey were compared to the responses of late respondents, where late respondents were used as a proxy for non-respondents (Armstrong and Overton, 1977). The first 10 per cent of returned questionnaires were considered as early respondents and the last 10 per cent were considered as late respondents. Independent sample t-tests were conducted to determine whether significant differences exist between the two groups of respondents. The results show that there are no significant differences in most of the response patterns of early and late respondents, suggesting that non-response bias is not a problem in the present study (see Appendix H for detailed results).

6.3 Demographic Characteristics

As discussed earlier in chapter five (subsection 5.10.6), 205 usable responses have been analysed. As shown in table 6.1, most respondents (83.9 per cent) were male, whereas 16.1 per cent were females. This is because of the nature of work in the manufacturing sector, which is considered physically suitable for men more than for women. Furthermore, generally the Jordanian culture discourage the female population from working in the industrial sector.

Regarding respondents age, the descriptive statistics reveal that the largest part of respondents is in the age group of 30- 39 (32.7 per cent) followed by the age group of 40-49 (26.3per cent). The age group of 50 and above comprised of 22.4 per cent and about 18.5 per cent of respondents are recognised within the age group of fewer than 30. According to the researcher’s viewpoint, the age group 30-39 represents the highest rate because young people in Jordan complete their studies between 22 and 25; moreover, they need 5 to 10 years of extra practical experience in the same manufacturing field to prove their merit and promote to a managerial position. In addition, most general managers prefer to hire young and expert people who have new knowledge in the manufacturing techniques and can develop the strategies of their firms. It is noted that the age group of most of the respondents is less than 50 years old, which indicates the attractiveness of the manufacturing sector to the young people.

In terms of the educational level, the descriptive statistics show that the most prominent educational level of respondents (62.0per cent) had gained a Bachelor's degree followed by a Diploma degree (17.1per cent). The lowest two shares of respondents (11.2 per cent and 9.8 per cent) held Masters/ PhD degrees and high school respectively. The high percentage of Bachelor's degree holders can be attributed that manufacturing firms require university graduates to occupy production posts since the positions they are occupying, require professional and technical knowledge and skills to be able to make the appropriate decision. Generally, in any sector in Jordan the bachelor’s degree is considered the minimum academic qualification for people to be hired in any job. It is worthwhile to mention that the educational index of Joran is considered one of the high educated nations with a value reached to 0.70 (UNDP, 2016). This result indicates that well- educated people who have good knowledge about organisational culture and lean manufacturing will answer the questionnaire.

Relating to the job title, the descriptive statistics indicate that the job title of production or operations managers got the highest percentage (46.8per cent). The second largest percentage is for the job title of general manager, CEO or plant manager (27.8per cent), followed by quality or quality control manager (13.7per cent). This indicates that key personnel in the firm, who are expected to be aware of the key terms and practices addressed in this study, have completed the questionnaire. This study has selected people in these job titles because they are the most capable people who have knowledge related to lean practices as well as knowledge of the values and traditions in their firms. Most authors in operations management research choose the same job titles adopted in the current study (Fullerton and Wempe, 2009, Ghosh, 2012, Hofer et al., 2012, Khanchanapong et al., 2014, Rahman et al., 2010).

Based on the results in table 6.1, more than half of the respondents (51.7per cent) have had experience in their firms of over ten years, followed by 22.9 per cent of respondents in the experience group of 6-10 years. This means that our results came from people who have substantial experience in their work, which will contribute on the validity of the results. In addition, this result shows stability in the manufacturing environment in Jordan.

The last two variables are about awareness of lean by respondents and if they received any type of training. It can be seen from table 6.1 that 62.4 per cent of respondents are aware of lean system but only 32.7 per cent of respondents received training about lean. The high awareness of lean by more than half of the respondents indicates that the Jordanian manufacturing firms are interested to minimise waste in their manufacturing processes and they know that lean manufacturing is from the important means to reduce costs and improve quality.

Table 6-1 Demographic Characteristics: Respondents Background

Demographic profile	Number of respondents N=205	Percentage
Gender		
Male	172	83.9
Female	33	16.1
Total	205	100
Age		
Under 30	38	18.5
30-39	67	32.7
40-49	54	26.3
50 and above	46	22.4
Total	205	100
Educational level		
Master's/PhD	23	11.2
Bachelor's degree	127	62.0
Diploma	35	17.1
High school	20	9.8
Total	205	100.0
job title		
Plant manager/ CEO/ General Manager	57	27.8
Production/Operations Manager	96	46.8
Quality/Quality Control Manager	28	13.7
Inventory Manager	3	1.5
Industrial Engineer	10	4.9
Other	11	5.3
Total	205	100
Experience		
Fewer than 3 years	32	15.6
3-5	20	9.8
6-10	47	22.9
More than 10	106	51.7
Total	205	100.0
Awareness of lean		
Yes	128	62.4
No	77	37.6
Total	205	100.0
Training in lean		
Yes	67	32.7
No	138	67.3
Total	205	100.0

Source: based on SPSS outputs

In terms of the types of sector, this study involves all manufacturing sub-sectors in Jordan as shown in table 6.2, plastics and rubber sector (20 per cent) has the highest share, followed by food sector (16.1per cent). Both chemicals sector and garments sector have the same percentage (14.1per cent). The pharmaceutical and medical sector represents 9.8 per cent which followed by engineering sector (9.3 per cent). This represents a good mix of sub-sectors within the manufacturing sector in Jordan, which ensure a good deal of variation in types of organisational cultures and practices of lean manufacturing. Therefore, this will serve the objective of our study.

Table 6.2 indicates that 66.3 per cent of the firms are ISO 9001 certified, while 33.7 per cent are not. This indicates that applying ISO Jordanian manufacturing firms is a significant sign that allows them to implement quality strategies such as lean system. Chapman and Al-Khawaldeh (2002) have emphasised the importance of ISO certification as being an excellent foundation for achieving better quality systems. This result ensures that the manufacturing firms in Jordan strive to enhance their competitiveness in the local and international markets through working within the international standardisation or the Jordanian standardisation.

Furthermore, as shown in table 6.2 that most of the firms are Jordanian owned firms (64.4 per cent). Some firms are owned by Arab owners from other Arab countries such as Syria, Iraq, and Egypt and represent 14.1 per cent. Joint venture owned firms present 15.1 per cent of the firms. This indicates that the results of this study can be generalised not just to the Jordanian context but also to other Arab or foreign contexts.

Another variable is the age of the firm (in years). As shown in table 6.1, more than half of the firms (55.6 per cent) are more than 15 years old, while 20 per cent were in the 5-10 years' age group, followed by 13.7 per cent in the less than 5 years' age group. The lowest percentage was 10.7 per cent in the 11-15 years' age group. Therefore, information received from companies that have been in manufacturing in Jordan for many years, which suggested that their answers would be useful for the study. As shown in table 6.2, most of the firms (74.6 per cent) are considered SEMs[11] with 25.4 per cent are large companies. This result can be attributed to the fact that most manufacturing firms are using automatic producing machines and this reduces the number of workers needed.

11: This study classifies the manufacturing firms in two main categories: large companies that have more than 100 employees; small companies that have less than 100 employees (Khalifa and Aspinwall, 2000).

Table 6-2 Demographic Characteristics: Firms Background

Demographic Profile	N=205	Percentage
Type of sector		
Food/beverages	33	16.1
Plastics and rubber	41	20.0
Printing/packing/packaging paper	15	7.3
Pharmaceutical and medical	20	9.8
Chemical and cosmetics	29	14.1
Furniture/kitchens and woods	6	2.9
Engineering (metal and electric)	19	9.3
Construction	5	2.4
Leather/cotton and garments	29	14.1
Other	8	3.9
Total	205	100
ISO9001certified		
Yes	136	66.3
No	69	33.7
Total	205	100.0
Owner of the org		
Local	132	64.4
Arab (except Jordan)	31	15.1
Foreign	12	5.9
Joint venture	29	14.1
Other	1	0.5
Total	205	100
Age of the org		
Less than 5 years	28	13.7
5-10	41	20.0
11-15	22	10.7
More than 15	114	55.6
Total	205	100.0
Number of employees		
Fewer than 50	111	54.1
50-99	42	20.5
100-250	28	13.7
250 or more	24	11.7
Total	205	100.0

Source: Based on SPSS outputs

6.4 Descriptive Statistics for Measurement Items in Each Construct

To gain more understanding of the data at hand, all the measurement items are subjected to descriptive analysis using SPSS version 22. As discussed earlier in chapter five (subsection 5.12.2), the descriptive measures in this study involve mean, standard deviations, minimum value and maximum value for each construct. The measures for every measurement item in the questionnaire are examined here.

6.4.1 Lean Technical Practices Statistics

Lean technical practices construct is operationalized using 19 items measured on a five-point Likert scale ranging from 1= no implementation to 5= complete implementation. Lean technical practices construct is considered as second order construct and has been categorized into five first order constructs, which are explained earlier in chapter 2 (subsection 2.2.5.1).

Table 6-3 Descriptive Statistics for Lean Technical Practices

Main construct	Sub construct	Item code	Mean	Standard deviation	Min	Max
Lean Technical Practices	Pull System	PULL1	3.3171	1.42180	1	5
		PULL2	3.5171	1.31580	1	5
		PULL3	3.5268	1.40221	1	5
		PULL4	2.4049	1.54253	1	5
		Total	3.1915	1.11402	1	5
	Continuous Flow	CF1	3.8195	1.08085	1	5
		CF2	4.1707	0.85470	1	5
		CF3	3.8683	0.99372	1	5
		Total	3.9528	0.76087	1	5
	Set up Time	ST1	3.7268	1.03541	1	5
		ST2	4.0634	0.88610	1	5
		ST3	3.6780	1.08183	1	5
		Total	3.8228	0.83726	1	5
	SPC	SPC1	3.1707	1.29672	1	5
		SPC2	3.2244	1.33519	1	5
		SPC3	2.5707	1.37951	1	5
		SPC4	2.8927	1.30166	1	5
		SPC5	3.0244	1.36640	1	5
		Total	2.9766	1.04911	1	5
	TPM	TPM1	3.2244	1.15402	1	5
		TPM2	3.4390	1.28049	1	5
		TPM3	2.7951	1.36374	1	5
		TPM4	3.7220	1.14864	1	5
		Total	3.2951	0.99698	1	5
	Total		**3.4477**	**0.9516**		

Source: based on SPSS outputs.

The five first order factors are pull system (4 items), continuous flow (3 items), set up time reduction (3 items), SPC (5 items) and TPM (4 items). Table 6.3 shows the descriptive statistics for each item as well as for each sub construct. As shown in table 6.3 that the five lean technical practices are moderately implemented in the Jordanian manufacturing firms in the sample employed in this study as reflected by the average score of 3.447 (**printed in bold**) for the lean technical practices construct.

At individual sub constructs level, table 6.3 highlights that two sub constructs (continuous flow and set up time) have an average score higher than the average score of the scale (3.95 and 3.82 respectively out of 5) and have standard deviations values of 0.76 and 0.84 respectively which are less than the average standard deviation for whole construct (0.95). Such results can be attributed that the Jordanian manufacturing firms seek to reduce the set-up time by training their operators how to save time in setting the machines up to avoid waste labour time and reduce the production costs. As well as, the Jordanian manufacturing firms aware of reducing the distance between work stations and they group similar operations to save time and achieve high efficiencies of scale. Whereas, the average score of the other three sub constructs (pull system, SPC and TPM) are slightly below the average score of the scale (3.19, 2.97, and 3.29 respectively out of 5). The highest standard deviation with an average of 1.11 related to the pull system and this represents a high variation in answers. However, the average scores for the last three sub constructs still ensure that the Jordanian manufacturing firms are good implementers of lean technical practices.

6.4.2 Customers' Involvement Statistics

Customers' involvement's construct is operationalized using 6 items measured on a five point Likert scale ranging from 1= no implementation to 5= complete implementation. Table 6.4 shows the descriptive statistics for each item as well as for the whole construct.

Table 6-4 Descriptive Statistics for Customers' Involvement

Construct	Items code	Mean	Standard deviation	Min	Max
Customers' involvement	CUI1	4.4293	0.74828	2	5
	CUI2	3.5756	1.22089	1	5
	CUI3	3.4244	1.12476	1	5
	CUI4	3.6878	1.17160	1	5
	CUI5	3.8049	1.15511	1	5
	CUI6	4.0244	0.95198	1	5
	Total	**3.8244**	**0.79318**		

Source: based on SPSS outputs.

It seems from table 6.4 that the Jordanian manufacturing firms in the sample employed in this study generally involve their customers in the production process as reflected by the average score of 3.82 (out of 5) for the customers' involvement construct. The standard deviation values also show some variations in the answers to all the items measuring customers' involvement. The most emphasized item in the customers' involvement construct is CUI1 "keeping close relationships with the customers" with an average score of 4.42 (out of 5) and a standard deviation of 0.748. Whereas, the least emphasized item is CUI3 "customers are actively and directly involved in the current and future product offerings" with an average score of 3.42 (out of 5) and a standard deviation of 1.124. Despite the last rating is considered the lowest but it is still high. These results confirm that the different manufacturing sub sectors in Jordan aware of the importance of getting the customers involved and keeping in touch with them because the manufacturing sector is heavily affected by new technology, trends, styles, and the people in Jordan are well educated and aware of the new technology, which reflect on their needs and expectations.

6.4.3 Employees' Involvement Statistics

Employees' involvement's construct is operationalized using 7 items measured on a five point Likert scale ranging from 1= no implementation to 5= complete implementation. Table 6.5 shows the descriptive statistics for each item as well as for the whole construct.

Table 6-5 Descriptive Statistics for Employees' Involvement

Construct	Items code	Mean	Standard deviation	Min	Max
Employees' involvement	EMP1	3.7171	0.97917	1	5
	EMP2	3.4976	0.95806	1	5
	EMP3	3.1512	1.02017	1	5
	EMP4	3.3024	1.18663	1	5
	EMP5	3.8780	1.17563	1	5
	EMP6	2.9854	1.25822	1	5
	EMP7	3.3220	1.18973	1	5
	Total	**3.422**	**0.77524**		

Source: based on SPSS outputs.

As shown in table 6.5 that the Jordanian manufacturing firms in the sample employed in this study involve generally their employees in the production process as reflected by the average score of 3.42 (out of 5) for the employees' involvement construct. The standard deviation values show variations in the answers to all the items measuring employees' involvement, which all are above the average standard deviation (0.775) for the whole construct. The most emphasized item in the employees' involvement construct is EMP5 "encouraging employees' involvement through quality circles and continuous improvement teams" with an average score of 3.878 (out of 5) and a standard deviation of 1.175. Whereas, the least emphasized item is EMP6 "empowering employees to stop the production line if abnormalities occur" with an average score of 2.985 (out of 5) and a standard deviation of 1.258.

6.4.4 Suppliers' Involvement Statistics

Suppliers' involvement construct is operationalized using 13 items measured on a five point Likert scale ranging from 1= no implementation to 5= complete implementation. Table 6.6 shows the descriptive statistics for each item as well as for the whole construct.

Table 6-6 Descriptive Statistics for Suppliers' Involvement

Construct	Items code	Mean	Standard deviation	Min	Max
Suppliers' Involvement	SUPP1	4.1805	0.97599	1	5
	SUPP2	3.0000	1.14189	1	5
	SUPP3	3.1463	1.13243	1	5
	SUPP4	3.8098	1.03748	1	5
	SUPP5	4.3561	0.77017	2	5
	SUPP6	2.9415	1.21932	1	5
	SUPP7	3.2244	3.2244	1	5
	SUPP8	2.4537	1.16065	1	5
	SUPP9	2.4976	1.28957	1	5
	SUPP10	3.6000	1.04130	1	5
	SUPP11	3.0000	1.17574	1	5
	SUPP12	1.7122	1.04323	1	5
	SUPP13	3.1024	1.38417	1	5
	Total	**3.1557**	**0.58945**		

Source: based on SPSS outputs.

As shown in table 6.6 that the Jordanian manufacturing firms in the sample employed in this study generally use the suppliers' involvement as reflected by the average score of 3.15 (out of 5) for the suppliers' involvement construct. The standard deviation values show variations in the answers to all the items measuring suppliers' involvement. The most emphasized item in the suppliers' involvement construct is SUPP5 "striving for building long term relationships with the suppliers" with an average score of 4.356

(out of 5) and a standard deviation of 0.77. Whereas, the least emphasized item is SUPP12 “managing the inventory by the key suppliers” with an average score of 1.71 (out of 5) and a standard deviation of 1.04. These results show the attention that the manufacturing firms in Jordan pay to the supplier feedback. In addition, the manufacturing firms in Jordan involve in activities or programs that lead to suppliers’ development, and finally they ask suppliers to deliver based on the JIT system.

6.4.5 Organizational Culture's Four Types Statistics

The organizational culture is operationalized through four constructs. Each construct represents a type of organizational culture. Each type of organizational culture is measured using six items measured on a five point Likert scale ranging from 1= strongly disagree to 5= strongly agree. Table 6.7 shows the descriptive statistics for each item as well as for each construct.

As shown in table 6.6, the rational culture is the most dominant type in the Jordanian manufacturing firms with a mean score of 4.10 (out of 5) and a standard deviation of 0.532, the group culture is the second most dominant type with a mean score of 4.00 (out of 5), while the hierarchical culture is third dominant type (3.96 out of 5) and finally, the developmental culture is the least dominant one with a mean score of 3.77 (out of 5) and a standard deviation of 0.723.

Table 6-7 Descriptive Statistics for the Four Types of Organizational Culture

Constructs	Items code	Mean	Standard deviation	Min	Max
Group Culture	GC1	3.9902	0.74089	2	5
	GC2	3.9756	0.84852	1	5
	GC3	3.8780	0.85162	1	5
	GC4	4.0927	0.80817	1	5
	GC5	4.0146	0.83712	1	5
	GC6	4.0927	0.82616	1	5
	Total	**4.0073**	**0.64324**		
Developmental Culture	DC1	3.3122	1.03852	1	5
	DC2	3.6244	0.92376	1	5
	DC3	3.4732	1.07808	1	5
	DC4	3.9707	0.94926	1	5
	DC5	4.0146	0.89376	1	5
	DC6	4.2146	0.78764	2	5
	Total	**3.7683**	**0.72393**		
Rational Culture	RC1	4.0683	0.63030	2	5
	RC2	4.0976	0.71417	2	5
	RC3	4.0049	0.74424	1	5
	RC4	4.1171	0.77709	1	5
	RC5	4.0878	0.83554	1	5
	RC6	4.2683	0.67969	2	5
	Total	**4.1073**	**0.53206**		
Hierarchical Culture	HC1	3.7659	0.96192	1	5
	HC2	3.809	0.81524	1	5
	HC3	3.809	0.87330	1	5
	HC4	3.931	0.75746	2	5
	HC5	4.097	0.67173	2	5
	HC6	4.3415	0.68634	2	5
	Total	**3.959**	**0.6211**		

Source: based on SPSS outputs.

6.5 Correlations and Multicollinearity

Table 6.8 presents the correlation matrix of all dependent variables and independent variables of this study to detect the correlations and multicollinearity between variables. Multicollinearity takes place when independent variables in a model are strongly associated with each other. The ideal situation for a researcher is to have a high correlation between the independent variables and the dependent variable, but no or little correlation between the independent variables (Hair et al., 2010). High levels of multicollinearity negatively affect the validity of results produced by the examined model because they effect imprecise estimation of the regression coefficients and sometimes their sign too (Hair et al., 2010). One method for assessing multicollinearity is to examine the correlation matrix of the variables. The presence of high correlations between independent variables (0.90 or more) can be an indication of a multicollinearity problem (Hair et al., 2010). The correlation matrix as shown in table 6.8, do not indicate the presence of multicollinearity problem given that the highest correlation is approximately 0.716 which is less than the 0.90 value suggested by Hair et al. (2010).

Furthermore, table 6.8 offers some insight into the relationships between all variables in the study. The table shows that all correlations between all types of organisational culture, all lean human practices (customers' involvement, employees' involvement and suppliers' involvement) and lean technical practices are positive and most of them are significant at 5 per cent level of significance. The positive correlations vary in magnitude between the four types of organisational culture (independent variables) and lean technical and human practices (dependent variables). The correlation matrix results confirm the positive effect of organisational culture on lean technical practices, the positive effect of organisational culture on lean human practices, and the positive effect of lean human practices on lean technical practices. These results confirm the hypothesized positive relationships between research constructs as explained earlier in chapter 3. The correlations matrix presents the channels through which the relationships between all variables work and these relationships will be validated using SEM in the following analysis chapters.

Table 6-8 The Correlation Matrix of all Variables of this Study

Variables	Group Culture	Developmental Culture	Rational Culture	Hierarchical Culture	Lean Technical Practices	Suppliers' Involvement	Employees' Involvement	Customers' Involvement
Group Culture	1							
Developmental Culture	0.541**	1						
Rational Culture	0.585**	0.499**	1					
Hierarchical Culture	0.716**	0.629**	0.623**	1				
Lean Technical Practices	0.452**	0.591**	0.447**	0.606**	1			
Suppliers' Involvement	0.388**	0.371**	0.336**	0.395**	0.472**	1		
Employees' Involvement	0.245**	0.213**	0.120	0.304**	0.337**	0.319**	1	
Customers' Involvement	0.296**	0.341**	0.283**	0.368**	0.529**	0.396**	0.274**	1

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

Source: based on SPSS outputs.

6.6 Chapter Summary

This chapter has reported the descriptive analysis of the questionnaire survey, which was conducted by the researcher in the manufacturing firms in Jordan. The response rate was 82 per cent and the non-response rate bias examined in the current study was proved no problem. In addition, this chapter summarised the basic statistics related to the background of survey respondents and their firms. Based on the results, it can be concluded that the questionnaire was directed to experienced and highly qualified people who could judge and evaluate the research constructs. In addition, the statistics of respondents' firms have shown a reasonable spread of variation concerning firm's sector, ownership type, firm age and number of employees.

Furthermore, eight research constructs, lean technical practices, customers' involvement, employees' involvement, suppliers' involvement, group culture, developmental culture, hierarchical culture and rational culture were analysed in this study. The respondents demonstrated that the Jordanian manufacturing firms are moderately implementing lean technical practices. Furthermore, the lean human practices were revealed important factors in lean implementation in the Jordanian manufacturing firms. The descriptive analysis show that the manufacturing firms in Jordan focus on customers' involvement, employees' involvement and suppliers' involvement respectively in a moderate to high extent. Furthermore, the descriptive statistics show that the rational culture is the most dominant type in the Jordanian manufacturing firms, whereas the developmental type is the least dominant one.

Finally, the last section presented the correlation matrix table for all variables in the study. The correlation table shows positive and significant relationship between the independent variable (organisational cultures types) and dependent variables (lean technical and human practices). This chapter provides descriptive background about the study's sample and descriptive statistics about the research constructs. The results of this chapter confirm that the manufacturing firms in Jordan are aware and implement all lean practices and have a deal of variation in the cultural characteristics. The next chapter will present the results of the evaluation of the measurement models using Confirmatory Factor Analysis.

CHAPTER SEVEN: Measurement Models Evaluation Using CFA

7.1 Introduction

As indicated in the methodology chapter, the research population of this study is the manufacturing firms in Jordan. A questionnaire survey has been administered using the self-completed technique to collect the raw data. Then SEM using AMOS-graphics 22 has been employed to analyse that data.

The aim of this chapter is to assess the validity and reliability of the data to be used in SEM. This chapter is divided into four sections. Section 2 presents the preliminary analysis of data. Section three presents the CFA results for each construct individually as well as the CFA results for the overall measurement models. Once the measurement models are validated, the data will be ready for conducting the SEM as will be seen in chapter eight to ultimately test the research hypotheses. Section 4 summarises this chapter.

7.2 Preliminary Analysis

As discussed earlier in subsection 5.12.1, the statistical issues related with screening the data are conducted with the purpose of detecting any missing values or outliers. Then, a normality test is done to check if the data satisfied the normal distribution standards, and hence, they could be targeted for further multivariate analysis such as SEM (Kline, 2005).

7.2.1 Treatment of Missing Data

According to Hair et al. (2010), there are two basic methods for solving the missing data problem, these methods are:

1. The complete case approach which is known as list wise deletion. This method depends on deleting the cases with any missing data from the analysis.
2. The all- available approach, which is an imputation method, depends on using valid data to replace the missing values. The imputation method takes different forms such as using replacement values (mean substitution or regression imputation).

The percentage of missing values of the current study was just 0.2 per cent and according to Hair et al. (2010), any of the imputation methods can be applied when missing data are under 10 percent. As discussed earlier in chapter 5 (subsection 5.12.1.1), the missing values in the current study has been substituted with the variable mean as highly recommended by Hair et al. (2010) and Tabachnick, and Fidell (2013).

7.2.2 Outliers

As discussed earlier in chapter 5 (subsection 5.12.1.2), an examination of the values of Mahalanobis-D squared distance (D^2) which is provided in the AMOS output file and illustrated in table 7.1 have indicated that there are just six outlier cases with a p value less than the cut-off point (<0.001) as recommended by (Kline, 2005).

Table 7-1 Detecting Outliers

Observation number	Mahalanobis d-squared	p1	p2
140	85.354	.000	.000
89	74.576	.000	.000
91	70.954	.000	.000
124	70.567	.000	.000
122	69.239	.000	.000
78	66.475	.000	.000

Source: based on AMOS outputs

Even though removing these outliers' cases could enhance the multivariate analysis, the results generalizability could be negatively affected by doing this (Hair, 2010, Tabachnick and Fidell, 2007). In addition, a small number of outliers could not be problematic (Kline, 2005). Accordingly, the decision has been taken to retain these outliers.

7.2.3 Data Normality

As discussed earlier in chapter 5 (subsection 5.12.1.3), there was a necessity to look at the actual data distribution and see how they are normally and symmetrically distributed (Byrne, 2010, Hair, 2010, Kline, 2005). Therefore, a skewness- kurtosis approach is employed to test univariate normality for each variable. Using SPSS, the statistical values of skewness and kurtosis have been tested for the dataset and it is found that all values are within their respective levels. As reported in table 7.2, all the values give support for the normality of univariate distribution because all values of skewness are below their cut off point of 3 as well as all values of kurtosis are found to be not more than 8 (Kline, 2005).

Table 7-2 Assessment of Normality

Constructs	Variable	Skewness	Kurtosis	Constructs	Variables	Skewness	Kurtosis
Lean Technical Practices	PULL1	-0.358	-1.204	Employees' Involvement	EMP1	-0.577	0.014
	PULL2	-0.500	-0.877		EMP2	-0.229	-0.502
	PULL3	-0.524	-1.063		EMP3	0.028	-0.620
	PULL4	0.561	-1.237		EMP4	-0.250	-0.945
	CF1	-0.881	0.329		EMP5	-1.004	0.135
	CF2	-0.859	0.349		EMP6	-0.151	-1.000
	CF3	-0.731	0.308		EMP7	-0.240	-00.854
	ST1	-0.716	0.151	Group Culture	GC1	-0.496	0.211
	ST2	-1.064	1.501		GC2	-1.023	1.768
	ST3	-0.573	-0.286		GC3	-0.773	0.935
	SPC1	-0.322	-1.028		GC4	-0.846	0.855
	SPC2	-0.256	-1.097		GC5	-1.040	1.458
	SPC3	0.332	-1.132		GC6	-0.965	1.317
	SPC4	-0.068	-1.147	Developmenta l Culture	DC1	-0.443	-0.256
	SPC5	-0.103	-1.184		DC2	-0.615	0.286
	TPM1	-0.197	-.715		DC3	-0.416	-0.498
	TPM2	-0.386	-.875		DC4	-0.740	0.015
	TPM3	0.119	-1.144		DC5	-0.986	0.872
	TPM4	-0.575	-.576		DC6	-0.826	.2950
Suppliers' Involvement	SUPP1	-1.041	0.351	Rational Culture	RC1	-0.527	1.274
	SUPP2	0.180	-0.794		RC2	-0.527	.925
	SUPP3	0.056	-0.851		RC3	-0.800	1.798
	SUPP4	-0.675	-0.155		RC4	-0.966	1.478
	SUPP5	-1.230	1.394		RC5	-0.829	0.598
	SUPP6	-0.018	-0.943		RC6	-0.675	0.484
	SUPP7	-0.283	-1.325	Hierarchical Culture	HC1	-0.783	0.384
	SUPP8	0.417	-0.592		HC2	-0.623	0.400
	SUPP9	0.449	-0.871		HC3	-0.690	0.378
	SUPP10	-0.506	-0.281		HC4	-0.364	-0.131
	SUPP11	-0.110	-0.651		HC5	-0.312	-0.064
	SUPP12	1.411	1.182		HC6	-0.928	1.068
	SUPP13	-0.241	-1.128				
Customers' Involvement	CUI1	-1.386	1.853				
	CUI2	-.512	-.704				
	CUI3	-.269	-.633				
	CUI4	-.626	-.472				
	CUI5	-.903	.114				
	CUI6	-.772	.013				

Source: based on SPSS outputs.

7.3 Confirmatory Factor Analysis (CFA) Results

7.3.1 Introduction

In the current study, the data analysis followed the six steps of Hair et al.'s (2010) which have been explained earlier in chapter 5 (section 5.13). The six procedures are summarized by two main phases according to Anderson and Gerbing (1988): First, estimating the measurement model using CFA; second, testing hypotheses through the proposed structural model. Byrne (2010, p6) argues that" Confirmatory Factor Analysis is appropriately used when the researcher has some knowledge of the underlying latent variable structure. Based on knowledge of the theory, empirical research, or both, he or she postulates relations between the observed measures and the underlying factors *a priori* and then tests this hypothesized structure statistically…. Because CFA model focuses solely on the link between factors and their measured variables, within the framework of SEM, it represents what has been termed a measurement model". Thus, CFA is used when the researcher has a well-developed theoretical background underlying the measurement model.

The main purpose of the measurement model testing is to identify the goodness- of- fit between the hypothesized model and the sample data (Byrne, 2010). Hair et al. (2010) recommends using at least one absolute fit index and one incremental index. Additionally, it is recommended to use the chi-square value, which is called in AMOS software CMIN and degrees of freedom (DF) (Hair et al., 2010). In this thesis, CMIN, normed CMIN (CMIN/DF), RMSEA as absolute fit indices as well as CFI, and IFI as incremental fit indices are adopted to test the models fit.

In the current study, the evaluation of the measurement model will be conducted in two stages. First, CFA will be conducted for each construct (latent variable) individually. Second CFA will be conducted for the overall measurement models in which all the latent constructs under study are correlated with each other.

7.3.2 CFA Results for Individual Constructs

In this section, the CFA is used to check the model fit, reliability and validity for each construct of the eight constructs used in this study. The eight constructs are: lean technical practices, customers' involvement, employees' involvement, suppliers' involvement, group culture, developmental culture, hierarchical culture, and rational culture. As recommended by Hair et al. (2010) and Byrne (2010), the MLE method has been used (see subsection 5.13.4) to run the model.

7.3.2.1 CFA Results for Lean Technical Practices Construct

The lean technical practices construct is tested as a second order measurement model indicated by five first order constructs: pull system, continuous flow, set up time, SPC, and TPM. Four indicators are used to measure pull system, three indicators for continuous flow, three indicators for set up time, five indicators for SPC and four indicators for TPM (see Appendix B). The five constructs are considered first order latent variables because they represent the higher order variable (lean technical practices). The CFA is employed to initially evaluate the measurement model's fitness.

As shown in table 7.3, the preliminary fit indices of the second order measurement model were found as follows: Chi square (CMIN) =354.659, degree of freedom (DF) = 147, p-value= 0.000 which is significant; CMIN/DF= 2.413, CFI= 0.877, IFI=0.878, RMSEA=0.083. Owing to the fact that some of these values (CFI and IFI) are less than the threshold value of 0.900 (Hair, 2010, Kline, 2005, Schumacker and Lomax, 2010), further modifications were conducted so as to enhance the model’s fitness. The modification process has followed several criteria as discussed earlier (subsection 5.15.2). These criteria include inspection of standardised regression weights (factor loadings), modification indices (MIs), and standardized covariance matrix (Byrne, 2010, Hair, 2010).

By inspecting the standardized regression weights (factor loadings) and p- values for all items in lean technical practices construct, it has been found that the standardised regression weight of "PULL 4" from pull system sub construct is (0.410) less than the cut-off point (0.50). In addition, the standardised regression weight for SPC5 from SPC sub construct (0.320) is less than the cut-off point. Accordingly, PULL4 and SPC5 have been dropped from the model. It is important to mention that Pull system sub construct had a low factor loading (0.400) before deleting item PULL4 and item SPC5. This means that this construct reflects the second order factor (lean technical practices) lower than the other constructs. Despite the low factor loading for pull system sub construct, it was decided to keep it in the model for its theoretical importance, which is one of the most important lean technical practices (Shah and Ward, 2007). In addition, all the factor loadings of the first-order factors, including pull sub construct, converge to the second order factor (lean technical practices) and all of them are significant at the 0.05 level. It is expected to find a first order factor reflects the second order in a lower factor loading compared to the other first-order factors and despite that it could not be dropped if it is considered critical factor in the study (Zhang et al. 2012, Li et al. 2006).

The CFA for lean technical practices' model has been run again after deleting just two items (PULL4) and (SPC5). The new fit indices indicate a good model fit as reported in table 7.3. This time all the fit indices are within the recommended levels. Despite the significance of the chi-square in the refined model (CMIN= 238.967, DF= 114, p-value=.000), it has decreased compared to the prior value in the first run of the model.

Table 7-3 Fit Indices of Lean Technical Practices

Fit indices	Cut-off point	Initial model	Modified model
CMIN/DF	≤ 5.000	2.413	2.096
CFI	≥ .90	0.877	0.920
IFI	≥ .90	0.878	0.921
RMSEA	≤ .10	0.083	0.073

Source: based on AMOS outputs

After the model's fitness of lean technical practices construct has been achieved, an examination of the construct reliability and convergent validity have been conducted via testing the internal consistency (Cronbach's alpha α), CR , and the standardized regression weights for all items (Anderson and Gerbing, 1988). As shown in table 7.4, the Cronbach's alpha (α) for lean technical practices construct (0.805) and the CR is very good (0.811) as reported by Kline (2005). Moreover, all the factor loadings of the first order sub constructs reflect significantly the second order construct ($p< 0.001$). This indicates the convergent validity of the postulated second order construct (Lean Technical Practices) (Byrne, 2010).

Table 7-4 CFA Results for the Second Order Construct "Lean Technical Practices"

Higher order construct	First order factors	Std. regression weights	t-value	α
Leantech α= 0.805 CR=0.811	Pull	0.370	3.930***	0.853
	ContFlow	0.772	-----***[12]	0.853
	SetupT	0.746	5.930***	0.769
	SPC	0.769	5.792***	0.780
	TPM	0.710	5.775***	0.823

***p< 0.001, 12: fixed parameter

Leantech: Lean Technical Practices, Pull: Pull system, ContFlow: Continuous Flow, SetupT: Set up time, SPC: statistical process control, TPM: total productive maintenance.

Source: based on AMOS outputs

Furthermore, as shown in table 7.5, all the standardised regression weights of all the remaining 17 items are above the cut-off point (0 .50) and all t- values are statistically significant at p values < 0.001 (Hair et al, 2010). These results ensure unidimensionality, convergent validity, and reliability of lean technical practices construct. Figure 7.1 illustrates the final CFA second order model for lean technical practices construct.

12: it is a customary solution in SEM used by default on AMOS by fixing one loading to one to give the latent construct an interpretable scale. (Hox and Bechger, 2011). For identification of the model, (see subsection 5.13.2).

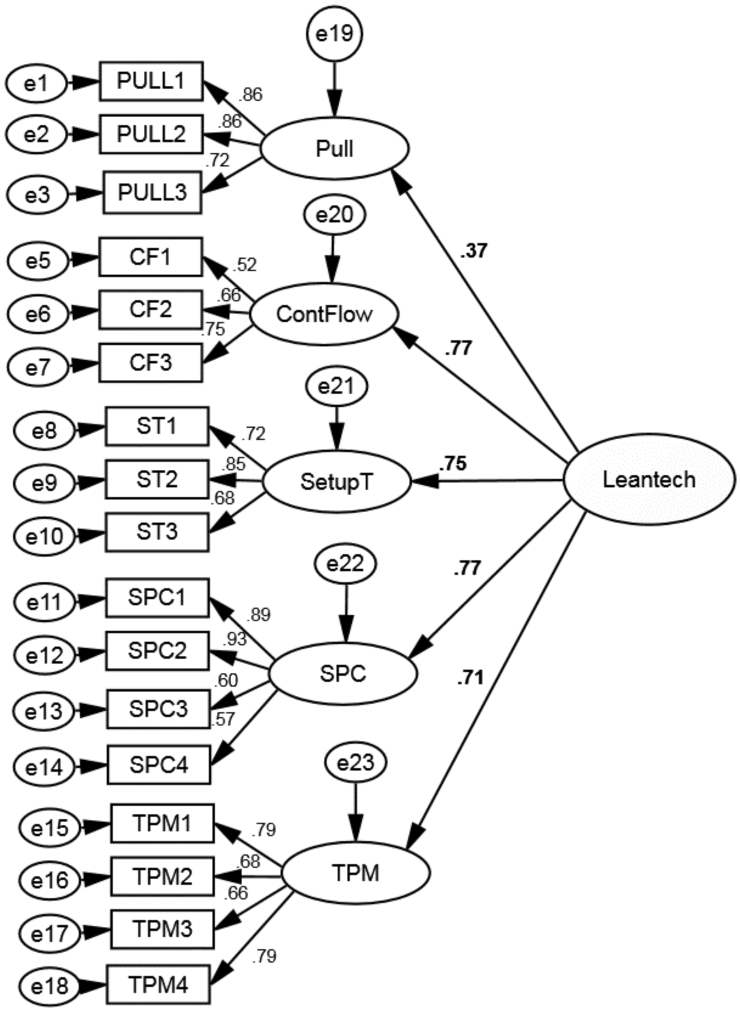
Table 7-5 CFA Results for the First Order Factors

First Order Construct	Items code	Items	Std. regression weights	t-value
Pull System	PULL1	We use a production system in which units are produced only in required quantities (no more and no less).	0.865	11.012***
	PULL2	Production at a workstation is performed based on the current demand of the next workstation.	0.856	10.991***
	PULL3	Products are not produced unless orders for them are received from customers.	0.723	----***
Continuous Flow	CF1	Products are categorized into groups with similar processing requirements.	0.514	6.072***
	CF2	Machines are arranged in relation to each other to produce a continuous flow of families of products.	0.654	7.272***
	CF3	Families of products determine our factory layout.	0.760	----*
Set up Time	ST1	Our employees practice set ups to save time.	0.724	8.650***
	ST2	We are aggressively working to reduce set up times in our plant.	0.847	9.260***
	ST3	We have low set up times of equipment in our plant	0.679	----*
SPC	SPC1	Large number of equipment/ processes on shop-floors are currently under SPC	0.885	9.406***
	SPC2	Statistical techniques are used to identify and reduce process variance.	0.930	9.553***
	SPC3	Charts showing defect rates are used as tools on the shop floor.	0.598	----*
	SPC4	We use Fishbone type diagrams to identify causes of quality problems.	0.574	6.982***
TPM	TPM1	We dedicate a specific time to planned equipment maintenance related activities every day.	0.788	8.998***
	TPM2	We maintain excellent records of all equipment maintenance related activities.	0.679	8.073***
	TPM3	We post equipment maintenance records on shop floor for active sharing with employees.	0.656	-----*
	TPM4	We maintain all our equipment regularly.	0.794	9.034***

***p< 0.001, * fixed parameter (see footnote 12)

Source: based on AMOS outputs

Figure 7-1 CFA Diagram for Lean Technical Practices



 : Path coefficient for regression of a measured variable onto a latent variable

 : Measurement error

Source: based on AMOS outputs

7.3.2.2 CFA Results for Customers' Involvement Construct

Table 7.6 presents the CFA results of customers' involvement construct. Customers' involvement is measured using six items (Appendix B). The first run of the CFA model shows a good model fit indices as reported in table 7.6, despite the significance of p-value (CMIN=21.439, DF=9, p value= 0.011). Accordingly, there is no a need for re-specifying or improving the model (Hair et al, 2010, Byrne, 2010).

Table 7-6 Fit Indices of Customers' Involvement

Fit indices	Cut-off point	Initial model
CMIN/DF	≤ 5.000	2.382
CFI	≥ .90	0.969
IFI	≥ .90	0.969
RMSEA	≤ .10	0.08

Source: based on AMOS outputs

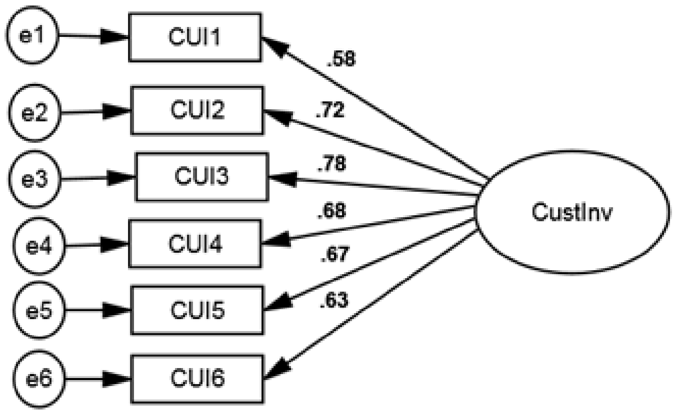
As shown in table 7.7, all items represent customers' involvement construct were tested to ensure an adequate level of reliability and convergent validity. Statistical findings in this regards indicate that this construct has high internal consistency where Cronbach's alpha (α) for the scale (0.833) and the CR (0.837) are very good (Kline, 2005). Relating to the convergent validity, AMOS outputs reveal that the standardized regression weights of all the items range from 0.578 to 0.777 and t- values are significant at p <0.001. This confirms that the scale has an acceptable convergent validity. These results confirm the unidimensionality of the construct and provide evidence that the indicators converge to their latent variable and they are reliable in capturing customers' involvement construct. The results of the six-indicator model of customers' involvement are illustrated in figure 7.2.

Table 7-7 CFA Results for Customers' Involvement

Construct	Items code	Items	Std. regression weights	t-value
CusInv α=0.833 CR=0.837	CUI1	We are in close relationship with our customers.	0.578	6.896***
	CUI2	Our customers visit our organization to give them some ideas about quality control that the company can follow.	0.716	8.138***
	CUI3	Our customers are actively or directly involved in current and future product offerings.	0.777	8.587***
	CUI4	Our customers frequently share current and future demand information with marketing department.	0.683	7.861***
	CUI5	We frequently administer customer satisfaction surveys.	0.675	7.791***
	CUI6	Our customers give us feedback on quality and delivery performance.	0.634	-----*

***p< 0.001, * fixed parameter (see footnote 12)
CusInv: Customers' Involvement
Source: based on AMOS outputs

Figure 7-2 CFA Diagram for Customers' Involvement



 : Path coefficient for regression of a measured variable onto a latent variable

 : Measurement error

Source: based on AMOS outputs

7.3.2.3 CFA Results for Employee's Involvement Construct

Employees' Involvement is measured using six items. The initial fit indices regarding employees’ involvement construct were found as follows: CMIN= 140.735, DF=14, p-value=0.000, CMIN/DF= 10.053, CFI=0.749, IFI=0.752, RMSEA=0.211. It is noted that the values of CFI and IFI are less than the cut-off point of 0 .90 and RMSEA value is higher than its recommended threshold (0.10). Thus, the initial measurement model has required further modification to improve the model fitness.

First, all standardized factor loadings and p- values for this construct have been checked. Because of this inspection, one item (EMP6) has been dropped because of its low factor loading (0.484). Furthermore, the standardised residual covariance for all items have been assessed. It has been found in the standardised residual covariance table on AMOS output file that the standardised residual covariance for EMP5 is high, and accordingly it is dropped as recommended by (Byrne, 2010).

The CFA has been run for the second time. The new run of the model after dropping EMP5 and EMP6 shows acceptable fit indices (CMIN/DF= 2.39, CFI=0.974, IFI=0.975, RMSEA=0.08), but this time when the standardised regression weights are checked again, it has been found that two indicators, EMP4 (0.477) and EMP7 (0.480), have low standardised regression weights which are less than the cut-off point of 0.50 (Hair et al., 2010). Therefore, those two items (EMP4 and EMP7) have been removed from the model to achieve a high convergent validity. The CFA for employees' involvement construct has been run again and as expected the model was perfectly improved and the modified CFA for employees’ involvement construct was able to adequately fit the observed data.

Table 7-8 Fit Indices of Employees' Involvement

Fit indices	Cut-off point	Initial model	Modified model*
CMIN/DF	≤ 5.000	10.053	0.000
CFI	≥ .90	0.749	1.000
IFI	≥ .90	0.752	1.000
RMSEA	≤ .10	0.211	0.551

*the model is perfect fit, this happens because of the number of indicators, the model was just identified where the number of data variances and covariances equalled the number of parameters to be estimated (Byrne, 2010), for more details see section 5.13.2.

Source: based on AMOS outputs

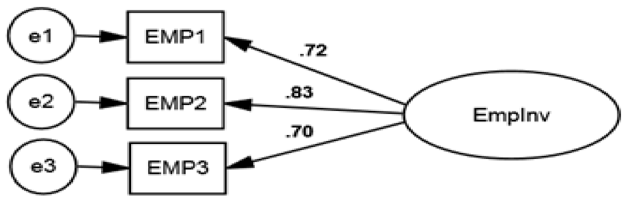
After the model’ fitness of employees' involvement construct has been achieved, an examination of the construct reliability and convergent validity have been conducted via testing the internal consistency (Cronbach's alpha), CR, and the standardized regression weights for all items (Anderson and Gerbing, 1988). As shown in table 7.9, the Cronbach's alpha (0.795) for the 3 remaining items and the CR (0.798) are good (Hair et al, 2010). Related to the convergent validity, the three remaining items reveal significant standardised regression weights range from 0.704 to 0.830 and all t-values are statistically significant at $p < 0.001$. These results provide evidence on unidimensionality, convergent validity and reliability of this construct as the three indicators converge to their latent variable and they are reliable in capturing employees' involvement construct. Figure 7.3 illustrates the final CFA results of employees' involvement construct.

Table 7-9 CFA Results for Employees' Involvement

Construct	Items code	Items	Std. regression weights	t-value
EmpInv α =0.795 CR=0.798	EMP1	Our shop-floor employees are key to problem solving teams.	0.723	8.613***
	EMP2	Our shop-floor employees lead product/ process improvement efforts.	0.830	----*
	EMP3	Our shop-floor employees drive suggestion programs.	0.704	8.526***

***p< 0.001, * fixed parameter (see footnote 12)
EmpInv: Employees' Involvement
Source: based on AMOS outputs

Figure 7-3 CFA Diagram for Employees' Involvement



 : Path coefficient for regression of a measured variable onto a latent variable

: Measurement error

Source: based on AMOS outputs

7.3.2.4 CFA Results for Suppliers' Involvement Construct

Suppliers' involvement construct is measured using thirteen items. The preliminary fit indices for the CFA model were found as follows: CMIN= 186.598, DF= 65, p value= 0.000, CMIN/DF=2.871, CFI=0.772, IFI=0.777, RMSEA=0.098. It is noted that some indices (CFI and IFI) are less than the cut-off point of 0.90. Thus, the CFA for suppliers' involvement construct has required further modification to enhance the fitness of the model.

First, all standardized regression weights and p-values of the indicators have been checked. Seven of them are found with low regression weights (SUPP7= 0.356, SUPP8=0.407, SUPP9=0.227, SUPP10=0.443, SUPP11=0.193, SUPP12=0.208, SUPP13=0.165). All the seven items have been dropped to enhance the model's fitness. The CFA model has been run again as suggested by Byrne (2010) and Kline (2005) and as expected the model fit indices have been improved after deleting the seven items as reported in table 7.10. This time all the fit indices are within the recommended levels as suggested by Byrne (2010) and Kline (2005). Despite the significance of the chi-square in the refined model (CMIN= 18.200, DF= 9, p- value=0.000), it decreased compared to the prior value in the first run of the model.

Table 7-10 Fit indices of Suppliers' Involvement

Fit indices	Cut-off point	Initial model	Modified model
CMIN/DF	≤ 5.000	2.871	2.022
CFI	$\geq .90$	0.772	0.973
IFI	$\geq .90$	0.776	0.973
RMSEA	$\leq .10$	0.098	0.071

Source: based on AMOS outputs

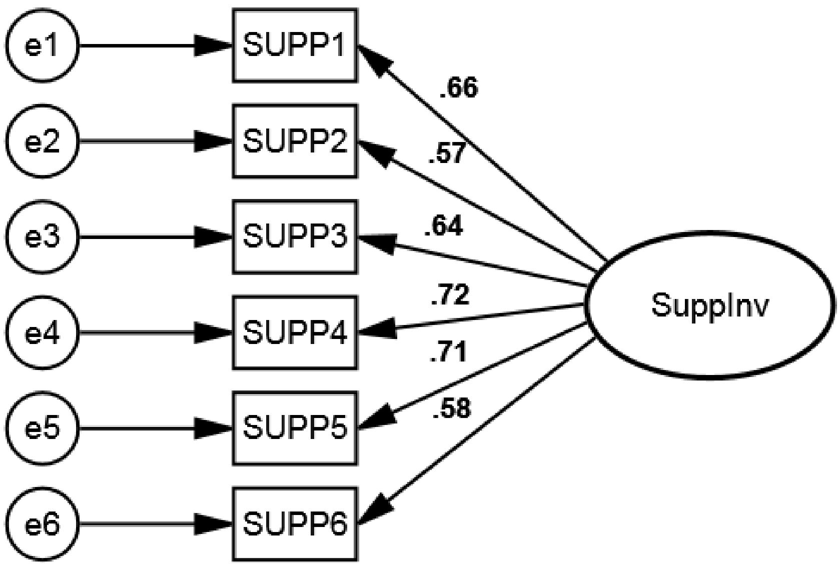
After checking the model fit, the construct reliability and convergent validity for suppliers' involvement construct have been examined. As shown in table 7.11, the statistical findings reveal that the internal consistency (α) of the scale (0.804) and the CR (0.807) are very good (Kline, 2005). In addition, the six remaining items show standardised regression weights range from 0.572 to 0.723 and significant t-values at $p< 0.001$. These results confirm the unidimensionality, convergent validity and reliability of this latent variable. Hence, all the remaining six indicators converge to their latent variable and they are reliable in capturing suppliers' involvement construct. Figure 7.4 illustrates the final CFA results of suppliers' involvement construct.

Table 7-11 CFA results for Suppliers' Involvement

Construct	Items code	Items	Std. regression weights	t-value
SuppInv α= 0.804 CR=0.807	SUPP1	We are frequently in close contact with our suppliers.	0.659	6.901***
	SUPP2	We usually visit our supplier's plants.	0.572	6.279***
	SUPP3	Our suppliers usually visit our organization.	0.640	6.777***
	SUPP4	Suppliers are provided with feedback on quality and delivery performance.	0.723	7.286***
	SUPP5	We strive to build long-term relationship with our suppliers.	0.711	7.223***
	SUPP6	Our suppliers are directly involved in the new product development.	0.578	----*

***p< 0.001, * fixed parameter (see footnote 12)
SuppInv: Suppliers' Involvement
Source: based on AMOS outputs

Figure 7-4 CFA Diagram for Suppliers' Involvement




: Path coefficient for regression of a measured variable onto a latent variable
e : Measurement error
Source: based on AMOS outputs

7.3.2.5 CFA Results for Group Culture Construct

Table 7.12 presents the CFA results of group culture construct. Group culture is measured using six items. The first run of the CFA model has shown a good model fit as reported in table 7.12 despite the significance of p value (CMIN=27.68, DF=9, p value= 0.000).

Table 7-12 Fit Indices of Group Culture

Fit indices	Cut-off point	Initial model
CMIN/DF	$\leq$ 5.000	3.07
CFI	$\geq$ .90	0.968
IFI	$\geq$ .90	0.968
RMSEA	$\leq$ .10	0.10

Source: based on AMOS outputs

Additionally, the group culture construct was tested to ensure an adequate level of reliability and convergent validity. The statistical results indicate that the group culture scale has high internal consistency where the Cronbach's alpha (α) for the scale (0.875) and the CR (0.881) are very good (Kline, 2005). Relating to the convergent validity, as shown in table 7.13, all the standardized regression weights of the indicators of group culture construct are above their cut off point (0.50) which range from 0.506 to 0.832 and all t- values are significant at $p<0.001$. This means that the scale has achieved the convergent validity. These results provide evidence on unidimensionality, reliability and convergent validity of this construct. Hence, all the remaining six indicators converge to their latent variable and they are reliable in capturing group culture construct. The diagram of the six-indicator model of group culture is illustrated in figure 7.5.

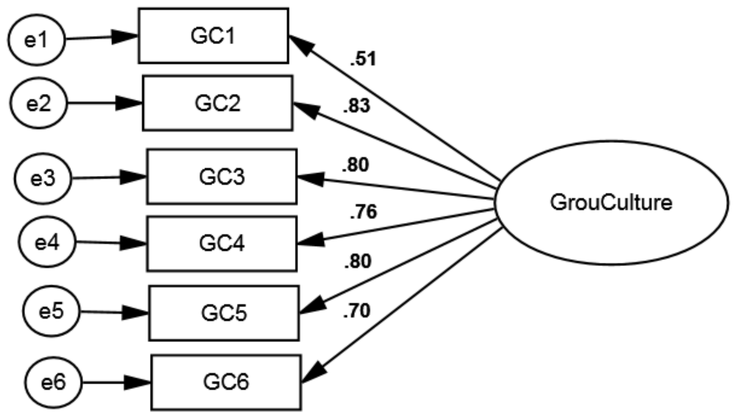
Table 7-13 CFA Results for Group Culture

Construct	Items code	Items	Std. regression weights	t-value
GrouCulture α =0.875 CR=0.881	GC1	Our organization is a very personal place. It is like an extended family. People seem to share a lot about themselves with others.	0.506	6.732***
	GC2	Managers in our organization are warm and caring. They seek to develop employees' full potential and act as their mentors or guides.	0.832	10.713***
	GC3	The management style in our organization is characterised by teamwork, consensus and participation.	0.801	10.372***
	GC4	The glue that holds our organization together is loyalty and mutual trust. Commitment to this organization runs high.	0.763	9.929***
	GC5	We emphasize human development. High trust, openness, and participation are important.	0.801	10.368***
	GC6	We define success based on the development of human resources, teamwork, employee commitment and a concern for people.	0.696	----*

***p< 0.001, * fixed parameter (see footnote 12),
GrouCulture: Group Culture

Source: based on AMOS outputs

Figure 7-5 CFA Diagram for Group Culture



: Path coefficient for regression of a measured variable onto a latent variable

: Measurement error

Source: based on AMOS outputs

7.3.2.6 CFA Results for Developmental Culture Construct

Developmental culture is measured using six items. As shown in table 7.14, the preliminary fit indices were found as follows: CMIN= 40.05, DF= 9, p- value = 0.000, CMIN/DF=4.45, CFI=0.941, IFI= 0.941 and RMSEA=0.13. It is noted that the value of RMSEA is above the cut-off point 0.10 (Byrne, 2010), therefore some modifications are required to reduce the value of RMSEA to improve the fitness of the model (Byrne, 2010). First, the standardised regression weights have been checked. It is found that all items in this construct (p< 0.001) are above the recommended value of 0.50 (Byrne, 2010, Hair et al. 2010). Second, the standardised residuals table for this construct has been checked as recommended by Byrne (2010). The standardised residual table revealed that the first item in this construct (DC1) has a high-standardised residual covariance. Therefore, it is dropped and the model has been run again. As reported in table 7.14, all the fit indices have been found within the recommended levels after deleting DC1. In addition, it is noted that the value of the chi-square in the refined model became insignificant (CMIN= 8.479, DF= 5, p- value=0.132) compared to the prior value in the first run of the model.

Table 7-14 Fit Indices of Developmental Culture

Fit indices	Cut-off point	Initial model	Modified model
CMIN/DF	≤ 5.000	4.45	1.696
CFI	≥ .90	0.941	0.991
IFI	≥ .90	0.941	0.991
RMSEA	≤ .10	0.13	0.058

Source: based on AMOS outputs

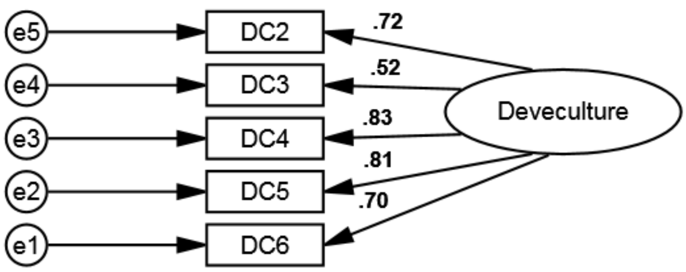
After checking the model fitness, the construct reliability and convergent validity have been examined. The statistical results reveal that the developmental culture scale has high internal consistency where the Cronbach's alpha α (0.742) and the CR (0.742) are adequate (Kline, 2005). In addition, the scale has an acceptable convergent validity because all the standardized regression weights of the five remaining indicators range from 0.519 to 0.832 and all t- values are significant at $p< .001$ as reported in table 7.15. These results provide evidence on unidimensionality, convergent validity and reliability of this construct. Hence, all the remaining five indicators converge to their latent variable and they are reliable in capturing developmental culture construct. The results of the five-indicator model of developmental culture are illustrated in figure 7.6.

Table 7-15 CFA Results for Developmental Culture

Construct	Items code	Items	Std. regression weights	t-value
DeveCulture α =0.742 CR=0.742	DC2	Leaders in our organization are generally considered to exemplify in entrepreneurship, innovation or risk taking.	0.719	9.205***
	DC3	The management style in the organization is characterized by individual risk taking, innovation, freedom and uniqueness.	0.519	6.777***
	DC4	The glue that holds our organization together is commitment to innovation and development. There is an emphasis on being first.	0.832	10.357***
	DC5	We emphasize growth, acquiring new resources and creating new challenges. Trying new things and prospecting for opportunities are valued.	0.810	10.169***
	DC6	We define success based on having unique or the newest products.	0.700	----*

***p< 0.001, * fixed parameter (see footnote 12)
DeveCulture: Developmental Culture
Source: based on AMOS outputs

Figure 7-6 CFA Diagram for Developmental Culture



 : Path coefficient for regression of a measured variable onto a latent variable
 : Measurement error
Source: based on AMOS outputs

7.3.2.7 CFA Results for Hierarchical Culture Construct

Hierarchical culture construct is measured using six items. As shown in table 7.16, the preliminary fit indices were found as follows: (CMIN=59.297, DF= 9, p value= 0.000, CMIN/DF=6.589, CFI=0.900, IFI=0.901, RMSEA=0.166). The value of CMIN/DF is found greater than the recommended value of 5 and RMSEA is found greater than the recommended value of 0.10 (Byrne, 2010). Thus, the initial measurement model has required re-specification to improve the model fitness.

First, all standardised regression weights and p-values of the items in this construct have been checked. All of them revealed acceptable values (above 0.50) and statistically significant ($p<0.001$). Turning to the modification indices (MIs) related to the covariances, it is noted a clear evidence of misspecification associated with the pairing of error terms associated with item 5 (HC5) and item 6 (HC6) and those associated with item 4 (HC4) and item 5 (HC5). These measurement error covariances represent systematic, rather than random measurement error in item responses, and they may derive from characteristics specific either to the items or to the respondents (Byrne, 2010). Accordingly, it was decided to conduct a covariation of error term of HC5 with HC6 and error terms of HC4 with HC5. The CFA has been run again. The main results of this measurement model revealed that the model fitness was improved and all the values of the fit indices are within their threshold values as reported in table 7.16. Despite the significance of the chi-square in the refined model (CMIN=23.132, DF= 7, p- value=0.002), it decreased compared to the prior value in the first run of the model.

Table 7-16 Fit Indices of Hierarchical Culture

Fit indices	Cut-off point	Initial model	Modified model
CMIN/DF	≤ 5.000	6.589	3.305
CFI	≥ .90	0.900	0.968
IFI	≥ .90	0.901	0.968
RMSEA	≤ .10	0.166	0.100

Source: based on AMOS outputs

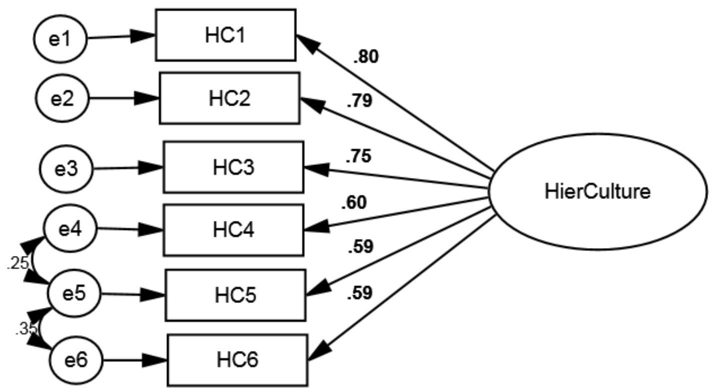
After checking the model fitness, the construct reliability and convergent validity have been examined. The statistical results reveal that the hierarchical culture scale has high internal consistency where the Cronbach's alpha (α) (0.852) and the CR (0.869) are very good (Kline, 2005). In addition, relating to the convergent validity, the six indicators have high standardised regression weights range from 0.595 to 0.788 and all t-values are significant at p<0.001 as reported in table 7.17. These results provide evidence on unidimensionality, convergent validity and reliability of this construct. Hence, all the remaining six indicators converge to their latent variable and they are reliable in capturing hierarchical culture construct. The results of the six-indicator model of hierarchical culture are illustrated in figure 7.7.

Table 7-17 CFA Results of Hierarchical Culture

Construct	Items code	Items	Std. regression weights	t-value
HierCulture α =0.852 CR=0.869	HC1	Our organization is a very controlled and structural place. People pay attention to formal procedures to get things done.	0.800	8.192***
	HC2	Leaders in our organization are generally considered to exemplify coordinating, organizing, or smooth-running efficiency.	0.788	8.132***
	HC3	The management style in our organization characterised by security of employment, conformity, predictability, and stability in relationships.	0.750	7.913***
	HC4	The glue that holds our organization together is formal rules and policies. People feel that following rules is important.	0.599	6.792***
	HC5	We emphasize permanence and stability. Efficiency, control, and smooth operations are important.	0.595	8.378***
	HC6	We define success based on efficiency. Dependable delivery. Smooth scheduling and low-cost production are important.	0.592	------***

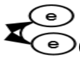
***p<0.001, * fixed parameter (see footnote 12)
HierCulture: Hierarchical Culture
Source: based on AMOS outputs

Figure 7-7 CFA Diagram for Hierarchical Culture



 : Path coefficient for regression of a measured variable onto a latent variable.

 : Measurement error

Covariance between error terms

Source: based on AMOS outputs

7.3.2.8 CFA Results for Rational Culture Construct

Table 7.18 presents the fit indices of rational culture model. Rational culture is measured using six items. The first run of the CFA model revealed that the model has good fitness since all the fit indices are within the recommended values (see table 7.18) as suggested by Hair et al (2010) and Byrne (2010) despite the significance of p value (CMIN=23.80, DF=9, p value= 0.005).

Table 7-18 Fit Indices of Rational Culture

Fit indices	Cut-off point	Initial model
CMIN/DF	≤ 5.000	2.645
CFI	≥ .90	0.962
IFI	≥ .90	0.962
RMSEA	≤ .10	0.09

Source: based on AMOS outputs

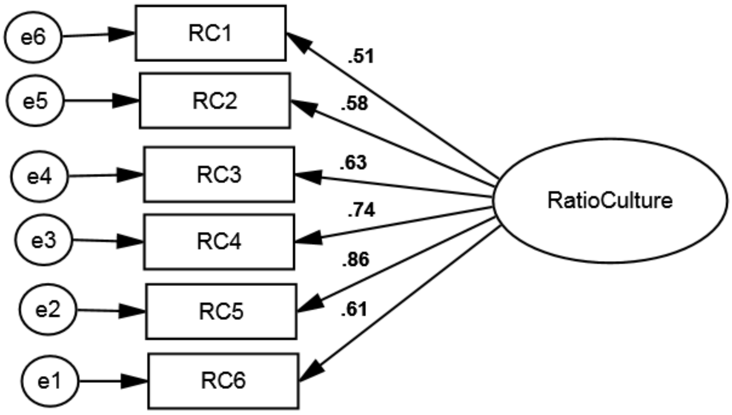
After checking the model fitness, the construct reliability and convergent validity have been examined. The statistical results reveal that the rational culture scale has high internal consistency where the Cronbach's alpha (α) (0.820) and the CR (0.822) are very good (Kline, 2005). In addition, relating to the convergent validity, the six indicators have high standardised regression weights range from 0.511 to 0.855 and all t-values are significant at p<0.001 as reported in table 7.19. These results provide evidence on unidimensionality, convergent validity and reliability of this construct. Hence, all the remaining six indicators converge to their latent variable and they are reliable in capturing the rational culture construct. The results of the six-indicator model of rational culture are illustrated in figure 7.8.

Table 7-19 CFA Results for Rational Culture

Construct	Items code	Items	Std regression weights	t-value
RatioCulture α =0.820 CR=0.822	RC1	Our organization is a very production-oriented place. A major concern is with getting the job done. People are very competitive and achievement oriented.	0.511	6.164***
	RC2	Managers in our organization are considered to exemplify a no-nonsense, aggressive, results oriented focus.	0.584	6.877***
	RC3	The management style in our organization is characterized by hard-driving competitiveness, high demands, and achievement.	0.628	7.266***
	RC4	The glue that holds our organization together is an emphasis on tasks and goal accomplishment.	0.740	8.170***
	RC5	We emphasize competitive actions and achievement. Measurable targets and winning in the marketplace are important.	0.855	8.788***
	RC6	We define success based on winning in the marketplace and outpacing the competition. Competitive market leadership is key.	0.613	----*

***p<0.001, * fixed parameter (see footnote 12)
RatioCulture: Rational Culture
Source: based on AMOS outputs

Figure 7-8 CFA Diagram for Rational Culture



 : Path coefficient for regression of a measured variable onto a latent variable.

: Measurement error

Source: based on AMOS outputs

7.3.3 CFA Results for the Overall Measurement Models

7.3.3.1 Introduction

The above results of the CFAs of individual constructs are used as the basis for constructing the four overall measurement models. Specifically, all items retained in the CFAs of the individual constructs regarding lean technical practices, customers' involvement, employees' involvement, suppliers' involvement, group culture, developmental culture, hierarchical culture and rational culture are used to develop four overall measurement models. Each measurement model consists one type of organizational culture (independent variable) with the other dependent variables (lean technical practices, customers' involvement, employees' involvement, and suppliers' involvement). The measurement models are named and numbered as the following:

1. **Overall Measurement Model 1: Group Culture.**
2. **Overall Measurement Model 2: Developmental Culture.**
3. **Overall Measurement Model 3: Hierarchical Culture.**
4. **Overall Measurement Model 4: Rational Culture.**

The model fit for each measurement model is assessed according to the same fit indices used earlier in assessing the model fitness of the individual constructs in subsection 7.3.2. This section will add the examination of discriminant validity, which is explained earlier in chapter, 5 (subsection 5.14.1). According to Kline (2005), the discriminant validity involves the evaluation of measures against each other. Several variables presumed to measure the same construct shows convergent validity if their intercorrelations are at least moderate in magnitude. In contrast, as set of variables presumed to measure different constructs shows discriminant validity if their intercorrelations are not too high (Kline, 2005). In addition, the common method bias, which is explained earlier in the chapter 5, will be tested for each overall measurement model using SPSS (see subsection 5.15.1).

7.3.3.2 CFA Results of the Overall Measurement Model 1: Group Culture

As shown in figure 7.9, five latent constructs (Lean Technical Practices (Leantech) Customers' Involvement (CusInv), Employees' Involvement (EmpInv), Suppliers' Involvement (SuppInv) and Group Culture (GrouCulture) has formed the measurement model 1 and therefore are subjected to the CFA. Furthermore, 38 indicators (items) are used to measure those latent variables. As shown in table 7.20, the preliminary fit indices have been found as follows: CMIN=1157.041, DF=650, p value= 0.000, CMIN/DF= 1.780, CFI=.861, IFI=.863, RMSEA=.062. Having a closer look at some of the fit indices (e.g. CFI and IFI), the model does not seem to have adequate fit to the data and therefore some modifications must be done to improve the model fitness. The modification process has followed a number of criteria to enhance the model's fitness including inspection of standardised regression weights (factor loadings), MIs, and standardized covariance matrix (Byrne, 2010, Hair, 2010).

By inspecting the standardised regression weights for each item in this model, it has been found that all items have acceptable and significant regression weights (factor loadings) which are greater than the minimum required value (0.50). Turning to the MIs related to the covariances, it is noted a clear evidence of misspecification associated with error terms. In reviewing the MIs, it was decided to covary the error terms of items exist in the same construct as recommended by Gaskin (2016a) when he argues the following" we should not covary error terms with observed or latent variables, or with other error terms that are not part of the same factor. Thus, the most appropriate modification available to us is to covary errors terms that are part of the same factor". It is noted a clear evidence of misspecification associated with the pairing of error terms associated with GC5 and GC6 and those associated with SUPP3 and SUPP6.

Accordingly, we conducted a covariation of error term of GC5 with GC6 and a covariation of error term of SUPP3 with SUPP6. Furthermore, the standardised residuals table in AMOS output has been checked to see any room for modifying the model. It is noted that five items (SPC4, TPM3, CUI5, CUI6 and GC1) have high values of standardised residual covariances which are greater than the minimum recommended value of 2.58 (Byrne, 2010). Therefore, those five items have been excluded and the model has been run again. As expected, this time the fit indices are adequately improved since all the fit indices have been found within the recommended level as reported in table 7.20. Despite the significance of the chi-square in the modified model (CMIN=748.760, DF=478, p value=0.000), it has decreased compared to the prior value of the original model.

Table 7-20 Fit indices of Overall Measurement Model 1: Group Culture

Fit indices	Cut-off point	Initial model	Modified model
CMIN/DF	≤ 5.000	1.780	1.566
CFI	≥ .90	0.861	0.911
IFI	≥ .90	0.863	0.912
RMSEA	≤ .10	0.062	0.053

Source: based on AMOS outputs

Furthermore, an inspection of the correlations between the five constructs has been checked to ensure the existence of discriminant validity. The correlation results, which are represented in figure 7.9, have revealed that all inter-correlation estimates are less than threshold value of 0.85 (Kline, 2005). Also important, as shown in table 7.21, the square root of AVE exhibited for each latent construct is higher than the inter-correlation estimates with other corresponding constructs (Fornell and Larcker, 1981). In the light of these results, the overall measurement model 1: Group culture has attained an adequate level of discriminant validity.

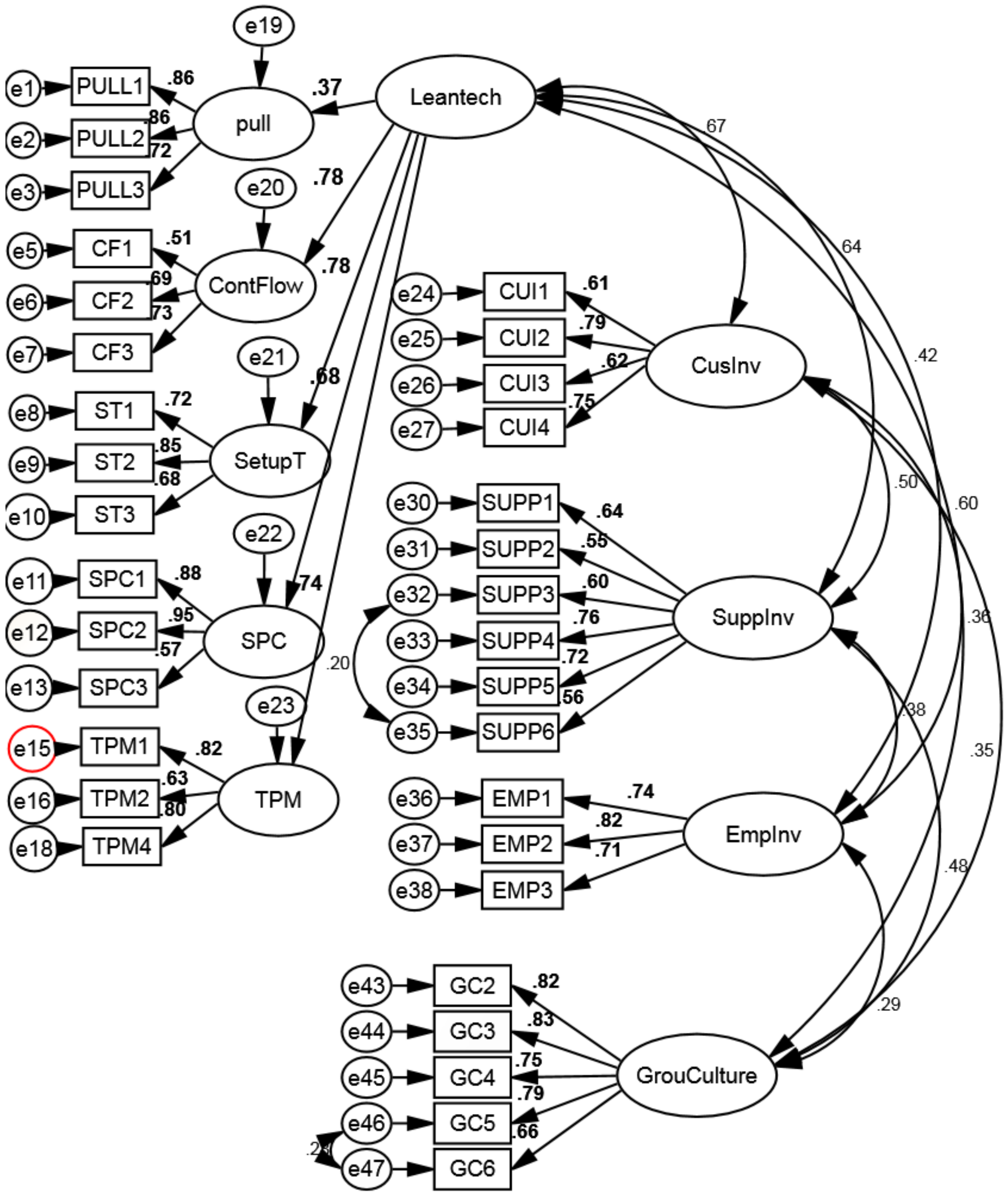
Table 7-21 Discriminant Validity: Overall Measurement Model 1: Group Culture

	CusInv	Leantech	SuppInv	EmpInv	GrouCulture
CusInv	**0.696**				
Leantech	0.666	**0.689**			
SuppInv	0.500	0.637	**0.643**		
EmpInv	0.356	0.424	0.384	**0.754**	
GrouCulture	0.354	0.599	0.476	0.288	**0.773**

*Diagonal values are squared roots of AVE; off- diagonal values are the estimates of inter-correlation between the latent constructs.
CusInv: Customers' Involvement, Leantech: Lean technical practices, SuppInv: Suppliers' Involvement, EmpInv: Employees' Involvement, GrouCulture: Group Culture.
Source: Author’s calculations

Finally**,** To ensure that the overall measurement model 1: group culture is free from common method bias, an inspection of Harman's single factor with the five constructs and 33 scale items has been conducted (Harman, 1976, Podsakoff et al., 2003). All the items have been loaded into the exploratory factor analysis on SPSS and have been examined via using an un-rotated factor solution. The statistical results indicate (Appendix D) that no single factor can emerge as well as the first factor is able to account for 27.79 per cent of variance which is less than the cut off value of 0.50 (Peng et al., 2006, Podsakoff et al., 2003).Thus, the sample data of this model does not have any concerns regarding the common method bias.

Figure 7-9 Overall Measurement Model 1: Group Culture



: Path coefficient for regression of a measured variable onto a latent variable.

: Measurement error

: Covariance between error terms

Source: Based on AMOS outputs

7.3.3.3 CFA Results of the Overall Measurement Model 2: Developmental Culture

As shown in figure 7.10, five latent constructs (Lean Technical Practices (Leantech), Customers' Involvement (CusInv), Employees' Involvement (EmpInv), Suppliers' Involvement (SuppInv) and Developmental Culture (DeveCulture) have formed the measurement model 2 and therefore are subjected to the CFA. Furthermore, 37 indicators (items) have been used to measure those latent variables. As shown in table 7.22, the preliminary fit indices have been found as follows: CMIN=1101.475, DF=649, p value= 0.000, CMIN/DF=1.697, CFI=0.873, IFI=0.875, RMSEA=0.058. Having a closer look at some of the fit indices (CFI and IFI), the model does not seem to have adequate fit to the data and therefore some model's modifications must be done (Byrne, 2010; Hair et al., 2010).

By inspecting first, the standardized regression weights for each item, it has been found that all items have standardised regression weights (factor loadings) which are greater than the minimum required value (0.50) and all t-values are significant at $p < 0.05$ (Hair et al, 2010, Byrne, 2010). By looking again to the modification indices (MIs) table and the standardised residuals table in AMOS, it is noted a clear evidence of misspecification associated with the pairing of error terms associated with SUPP3 and SUPP6. Accordingly, we conducted a covariation of error term of SUPP3 with SUPP6. Furthermore, the standardised residuals table in AMOS output has been checked to see any room for modifying the model. It is noted that six items (SPC4, CUI5, CUI6, TPM3, DC4, and DC6) have high values of standardised residual covariances. Therefore, those six items have been excluded and the model has been run again. As expected, this time the fit indices are adequately improved since all the fit indices have been found within the recommended level as reported in table 7.22. Despite the significance of the chi-square in the modified model (CMIN=666.086, DF=417, p-value=.000), it has decreased compared to the prior value of the original model.

Table 7-22 Fit indices of Overall Measurement Model 2: Developmental Culture

Fit indices	Cut-off point	Initial model	Modified model
CMIN/DF	≤ 5.000	1.697	1.527
CFI	≥ .90	0.873	0.915
IFI	≥ .90	0.875	0.916
RMSEA	≤ .10	0.058	0.051

Source: Based on AMOS outputs

After checking the goodness of fit values, an inspection of the correlations between the five constructs has been conducted to check the discriminant validity. The correlation values among constructs have revealed that all inter-correlation estimates are less than threshold value of 0.85(Kline, 2005) as shown in figure 7.10. To confirm the discriminant validity, the square root of AVE exhibited for each latent construct has been found higher than the inter-correlation estimates with other corresponding constructs (Fornell and Larcker, 1981) as shown in table 7.23. In the light of these results, the overall measurement model 2: developmental model has attained an adequate level of discriminant validity.

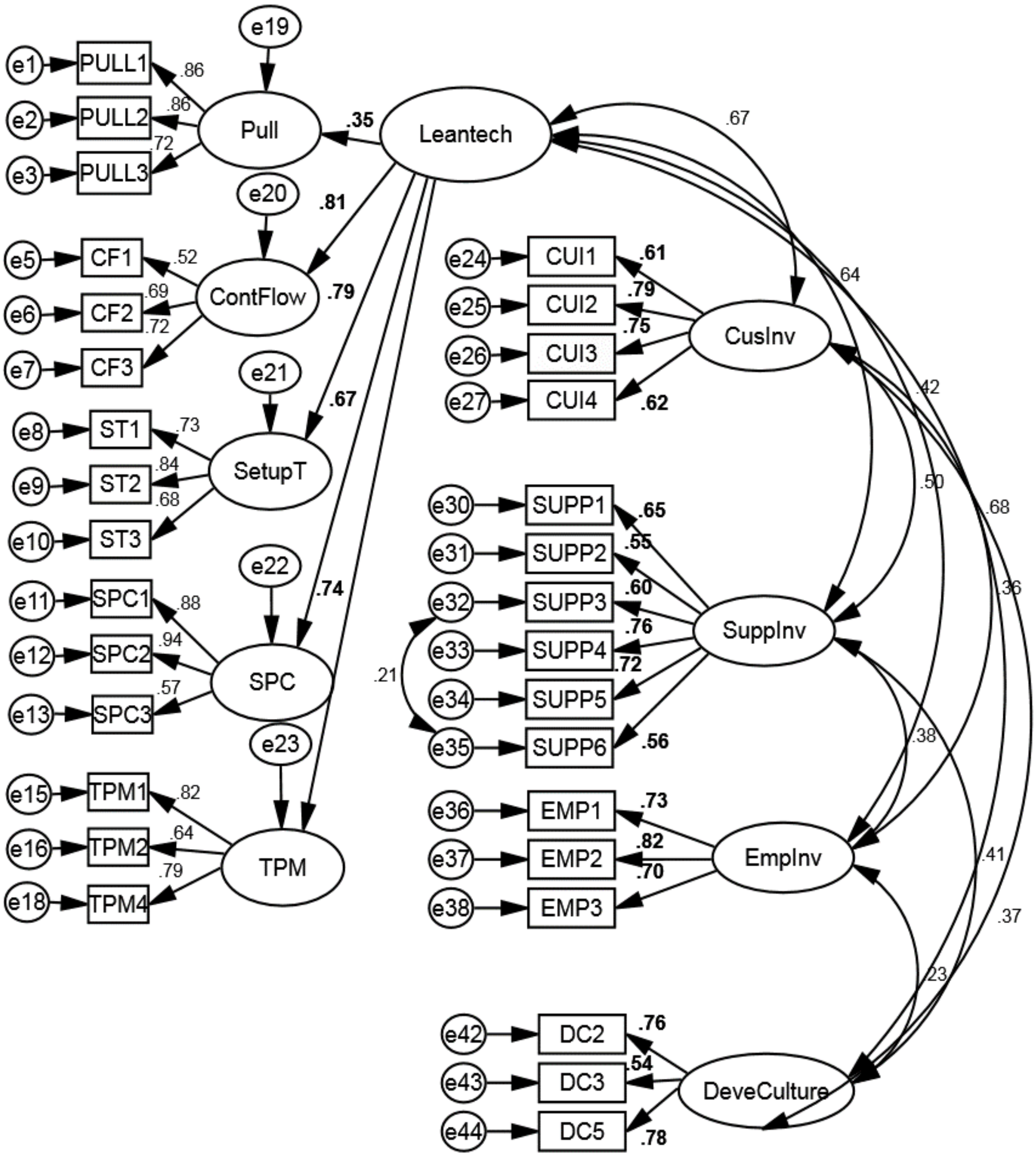
Table 7-23 Discriminant validity: Overall Measurement Model 2: Developmental Culture

	CusInv	Leantech	SuppInv	EmpInv	DeveCulture
CusInv	**0.696**				
Leantech	0.668	**0.690**			
SuppInv	0.500	0.636	**0.644**		
EmpInv	0.355	0.421	0.382	**0.754**	
DeveCulture	0.368	0.678	0.413	0.232	**0.704**

*Diagonal values are squared roots of AVE; off- diagonal values are the estimates of inter-correlation between the latent constructs.
CusInv: Customers' Involvement, Leantech: Lean Technical Practices, SuppInv: Suppliers' Involvement, EmpInv: Employees' Involvement, DeveCulture: Developmental Culture.
Source: Author’s calculations

To ensure that the overall measurement model 2: developmental model is free from common method bias, an inspection of Harman's single factor with the five constructs and 31 scale items have been conducted (Harman, 1976, Podsakoff et al., 2003). All the items have been loaded into the exploratory factor analysis on SPSS and examined via using an un-rotated factor solution. The statistical results have indicated (Appendix E) that no single factor can emerge as well as the first factor could account for 27.44 per cent of variance, which is less than the cut off value of 50 per cent as suggested by Podsakoff et al., (2003). Thus, the sample data of this model does not have any concerns regarding the common method bias.

Figure 7-10 Overall Measurement Model 2: Developmental Culture



: Path coefficient for regression of a measured variable onto a latent variable.

: Measurement error

: Covariance between error terms

Source: Based on AMOS outputs

7.3.3.4 CFA results for the Overall Measurement Model 3: Hierarchical culture

As shown in figure 7.11, five latent constructs (Lean Technical Practices (Leantech) Customers' Involvement (CusInv), Employees' Involvement (EmpInv), Suppliers' Involvement (SuppInv) and Hierarchical Culture (HierCulture)) has formed the measurement model 3 and therefore are subjected to the CFA. Furthermore, 38 indicators (items) have been used to measure those latent variables. As shown in table 7.24, the preliminary fit indices have been found as follows: CMIN=1098.121, DF=648, p value= 0.000, CMIN/DF=1.695, CFI=0.873, IFI=0.875, RMSEA=0.058. Having a closer look at some of the fit indices (e.g. CFI, and IFI), the model does not seem to have adequate fit to the data. Thus, the CFA for this measurement model has required further modification to enhance the fitness of the model. (Byrne, 2010; Hair et al., 2010).

By inspecting first, the standardized regression weights for each item, it has been found that all items have standardised regression weights (factor loadings) which are greater than the minimum required value of 0.50 and all t-values are significant at $p < 0.05$ (Hair et al., 2010, Byrne, 2010). Therefore, the tables of the modification indices (MIs) and the standardised residuals have been checked on AMOS output to explore any room for modifying the model. It is noted no room for re-specification by MIs, thus, we turned to check the standardised residuals table. It is noted that six items (SPC4, CUI5, CUI6, TPM3, HC1 and HC2) have high values of standardised residual covariances. Therefore, those six items have been excluded and the model has been run again. As expected, this time the fit indices are adequately improved since all the fit indices have been found within the recommended level as reported in table 7.24. Despite the significance of the chi-square in the modified model (CMIN=685.307 DF=447, p - value=.000), it has decreased compared to the prior value of the original model.

Table 7-24 Fit Indices of Overall Measurement Model 3: Hierarchical Culture

Fit indices	Cut-off point	Initial model	Modified model
CMIN/DF	≤ 5.000	1.695	1.533
CFI	≥ .90	0.873	0.912
IFI	≥ .90	0.875	0.913
RMSEA	≤ .10	0.058	0.051

Source: Based on AMOS outputs

Furthermore, to check the discriminant validity, an inspection of the correlations between the five constructs has been checked through looking at the inter-correlation estimates on figure 7.11. All the inter-correlation values have acceptable estimates, which are less than threshold value of .85 (Kline, 2005). In addition, to confirm this result, as shown in table 7.25, the square root of AVE exhibited for each latent construct is higher than the inter-correlation estimates with other corresponding constructs (Fornell and Larcker, 1981). In the light of these results, the overall measurement model 3: hierarchical model has attained an adequate level of discriminant validity.

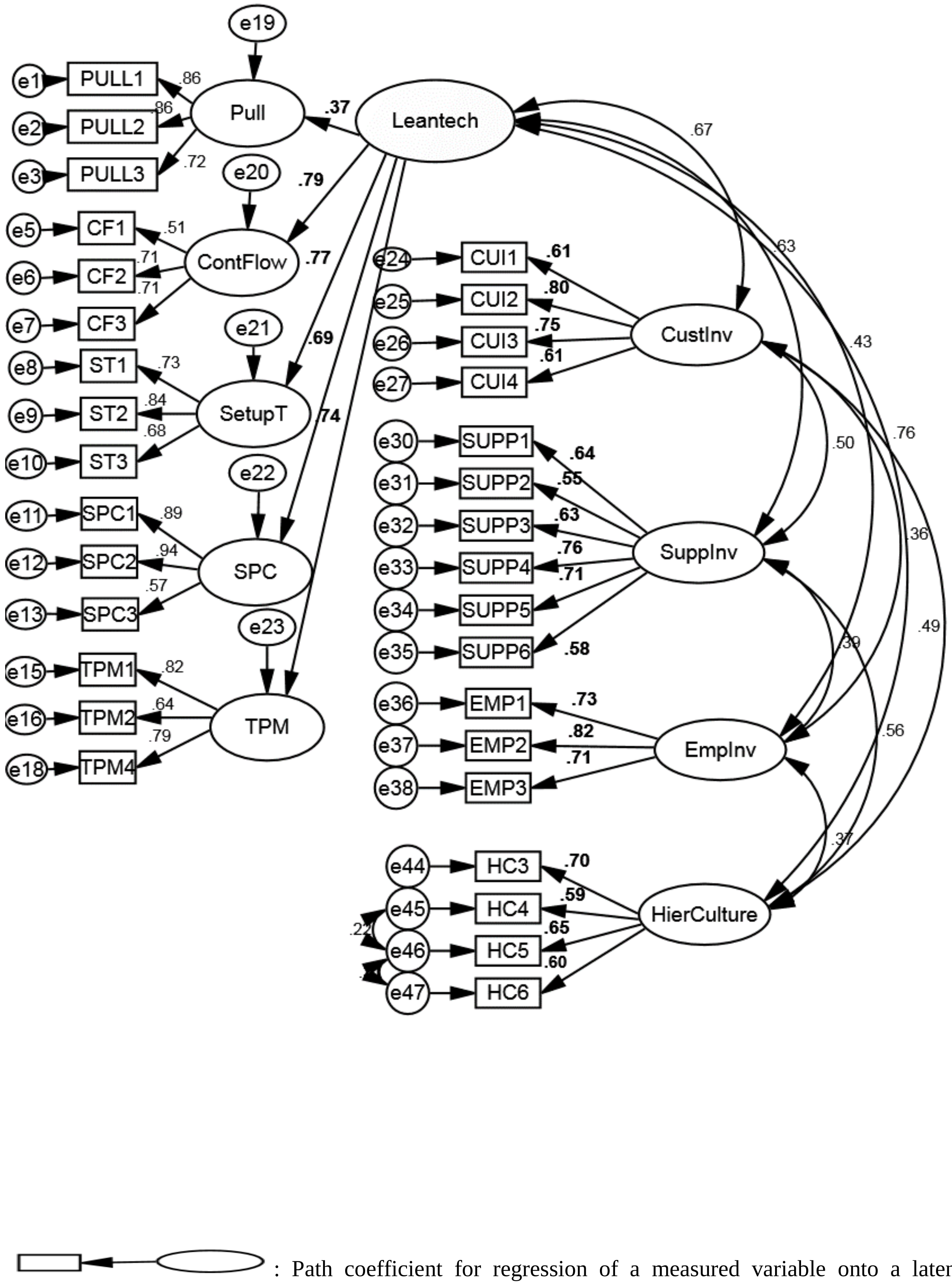
Table 7-25 Discriminant Validity: Overall Measurement Model 3: Hierarchical Culture

	CusInv	**Leantech**	**SuppInv**	**EmpInv**	**HierCulture**
CusInv	**0.696**				
Leantech	0.667	**0.690**			
SuppInv	0.499	0.635	**0.648**		
EmpInv	0.356	0.425	0.386	**0.755**	
HierCulture	0.434	0.685	0.477	0.290	**0.706**

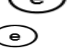
*Diagonal values are squared roots of AVE; off- diagonal values are the estimates of inter-correlation between the latent construct.
CusInv: Customers' Involvement, Leantech: Lean technical practices, SuppInv: Suppliers' Involvement, EmpInv: Employees' Involvement, HierCulture: Hierarchical Culture.
Source: Author’s calculations

To ensure that the overall measurement model 3 is free from common method bias, an inspection of Harman's single factor with the 5 constructs and 32 scale items has been conducted (Harman, 1976; Podsakoff et al., 2003). All the items have been loaded into the exploratory factor analysis on SPSS and examined via using an un-rotated factor solution. The statistical results have indicated (Appendix F) that no single factor can emerge as well as the first factor could account for 27.65 per cent of variance, which is less than the cut off value of 50 per cent as suggested by Podsakoff et al., (2003). Thus, the sample data of this model does not have any concerns regarding the common method bias.

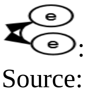
Figure 7-11 Overall Measurement Model 3: Hierarchical Culture



 : Path coefficient for regression of a measured variable onto a latent variable.



: Measurement error



: Covariance between error terms

Source: Based on AMOS outputs

7.3.3.5 CFA Results of the Overall Measurement Model 4: Rational Culture

As shown in figure 7.12, five latent constructs (Lean Technical Practices (Leantech), Customers' Involvement (CusInv), Employees' Involvement (EmpInv), Suppliers' Involvement (SuppInv) and Rational Culture (RatioCulture)) has formed the measurement model 4 and therefore are subjected to the CFA. Furthermore, 38 indicators (items) have been adopted to measure those latent variables. As shown in table 7.26, the preliminary fit indices have been found as follows: CMIN=1117.432, DF=650, p value= 0.000, CMIN/DF= 1.719, CFI=0.862, IFI=0.864, RMSEA=.059. Having a closer look at some of the fit indices (e.g. CFI and IFI), the model does not seem to have adequate fit to the data and therefore some modifications should to be done (Byrne, 2010; Hair et al., 2010).

By looking at the standardised regression weights for each item, it has been found all items have acceptable and significant regression weights (factor loadings) which are greater than the minimum required value (0.50). By looking to the modification indices, it has been found many suggestions to modify the model through correlating the error terms of items as suggested by Byrne (2010) and Hair at al. (2010). It is noted that there is a clear evidence of misspecification associated with the pairing of error terms associated with SUPP3 and SUPP6. Accordingly, we conducted a covariation of error term of SUPP3 with SUPP6. Furthermore, the standardised residuals table in AMOS output has been checked to see any room for modifying the model. It is noted that there are six items (SPC4, TPM3, CUI5, CUI6, RC1, and RC2) have high values of standardised residual covariances Therefore, those six items have been excluded and the model has been run again. As expected, this time the fit indices are adequately improved since all the fit indices have been found within the recommended level as reported in table 7.26. Despite the significance of the chi-square in the modified model (CMIN=670.725, DF=448, p value=0.000), it decreased compared to the prior value of the original model.

Table 7-26 Fit indices of Overall Measurement Model 4: Rational Culture

Fit indices	Cut-off point	Initial model	Modified model
CMIN/DF	≤ 5.000	1.719	1.497
CFI	≥ .90	0.862	0.917
IFI	≥ .90	0.864	0.919
RMSEA	≤ .10	0.059	0.049

Source: Based on AMOS outputs

Furthermore, an inspection of the correlations between the five constructs has been conducted to check the discriminant validity. The correlation table provided in the AMOS output file and shown in figure 7.12 has revealed that all inter-correlation estimates have been found to be less than threshold value of 0.85(Kline, 2005). In addition, important, as shown in table 7.27, the square root of AVE exhibited for each latent construct was higher than the inter-correlation estimates with other corresponding constructs (Fornell and Larcker, 1981). In the light of these results, the overall measurement model 4: rational culture has attained an adequate level of discriminant validity.

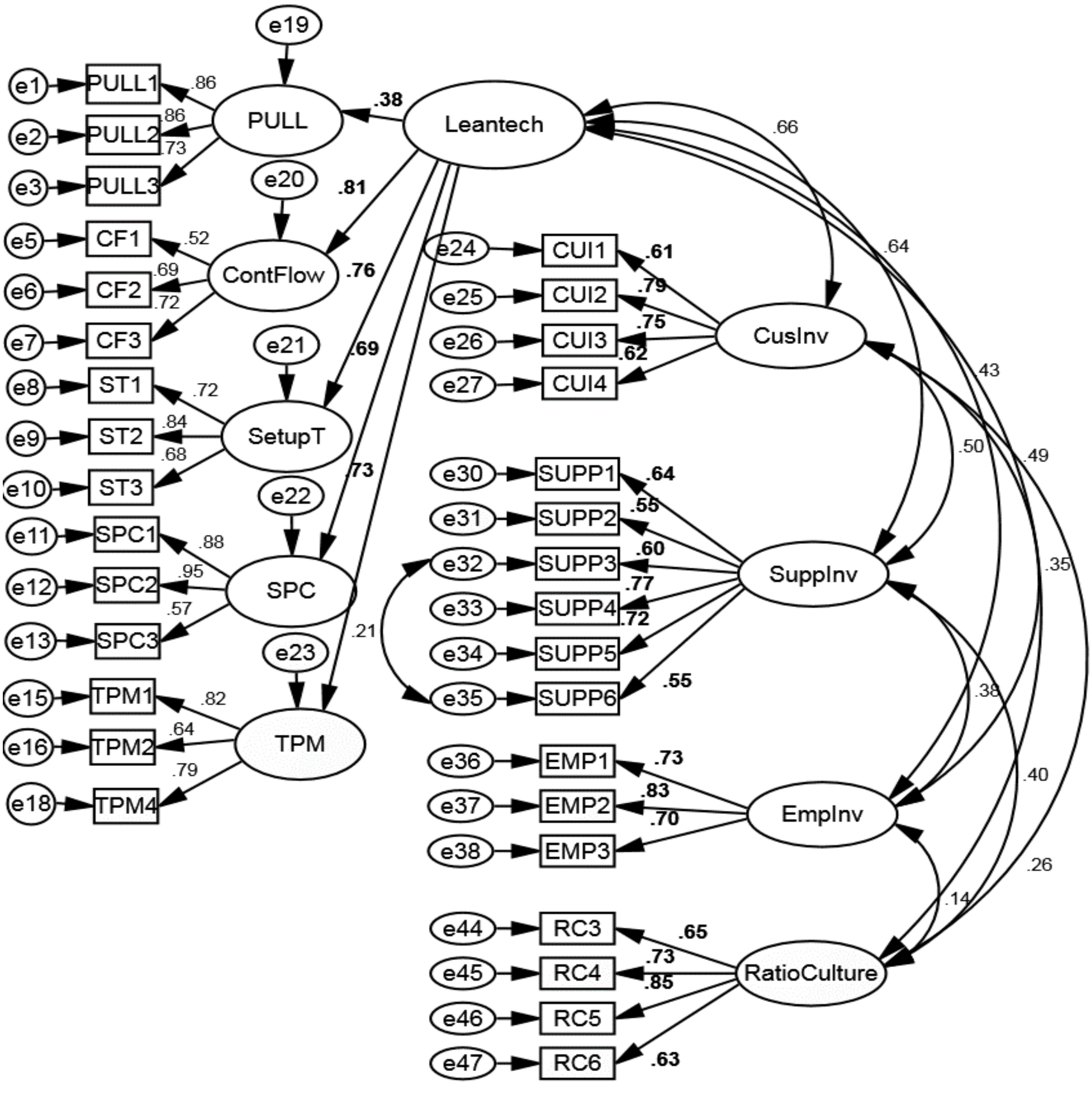
Table 7-27 Discriminant Validity: Overall Measurement Model 4: Rational Culture

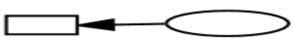
	CusInv	**Leantech**	**SuppInv**	**EmpInv**	**RatioCulture**
CusInv	**0.696**				
Leantech	0.665	**0.691**			
SuppInv	0.500	0.638	**0.643**		
EmpInv	0.355	0.428	0.382	**0.755**	
RatioCulture	0.261	0.489	0.398	0.139	**0.721**

*Diagonal values are squared roots of AVE; off- diagonal values are the estimates of inter-correlation between the latent constructs.
CusInv: Customers' Involvement, Leantech: Lean technical practices, SuppInv: Suppliers' Involvement, EmpInv: Employees' Involvement, RatioCulture: Rational Culture.
Source: Author’s calculations

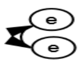
To ensure that the overall measurement model 4: rational culture is free from common method bias, an inspection of Harman's single factor with the five constructs and 32 scale items was conducted (Harman, 1976, Podsakoff et al., 2003). All the items have been loaded into the exploratory factor analysis on SPSS and examined via using an un-rotated factor solution. The statistical results have indicated (Appendix G) that no single factor can emerge as well as the first factor accounts for 26.51 per cent of variance, which is less than the cut off value of 50 per cent as suggested by Podsakoff et al., (2003). Thus, the sample data of this model does not have any concerns regarding the common method bias.

Figure 7-12 Overall Measurement Model 4: Rational Culture



: Path coefficient for regression of a measured variable onto a latent variable.

: Measurement error



: Covariance between error terms

Source: Based on AMOS outputs

7.4 Chapter Summary

This chapter begins with the data preparation and screening procedures including the treatment of missing data, detection of outliers, and normality results are presented. The amount of missing data is very small and has been treated using mean substitution method. A few outliers are detected and have been retained since there is no evidence that they are not part of the population. The results of normality test have revealed that all the skewness values are less than 3, the kurtosis values are less than 8, and thus, there is no serious violation of the normality assumption. In section 3, both the latent constructs and observed measures have been validated using CFA. Different procedures have been used to modify the model; including reviewing the modification indices on AMOS outputs or deleting any problematic items such as items with low factor loadings or high-standardized covariance values.

Although dropping items could negatively reflect on the constructs' validity as argued by MacCallum et al. (1992), there are several SEM scholars (i.e. Anderson and Gerbing, 1988; Byrne, 2010, Hair et al., 2010) who stressed the necessity of purification of the measurement model by removing the problematic items to improve the model fitness. Hence, a decision was taken to remove the most problematic items over the four CFA measurement models related to group culture, developmental culture, hierarchical culture and rational culture to enhance the measurement models fitness. Such processes of modifying the measurement model by dropping redundant items have been employed by different studies in operations management and organisational culture (Bortolotti et al., 2015, Gregory et al., 2009, Li et al., 2006, Sadikoglu and Zehir, 2010, Sila, 2007, Zu et al., 2010, Kaynak, 2003).

All the individual constructs after making modifications have shown good model fit indices as shown in the summary table 7.28.

Moreover, all the constructs have good internal consistency and convergent validity, where all the CR and the Cronbach's alpha values are above the threshold of 0.70, and all the standardised regression weights exceed 0.50. The results of the CFA for each construct individually form the base for validating the measurement models of the study with multiple latent variables. The measurement models for four types of organisational culture have been validated again using CFV. The four measurement models have good fit indices as summarised in table 7.29 below.

Table 7-28 Summary of Goodness of Fit Statistics for Individual Constructs

Goodness of fit statistics	Cut-off value	Lean technical practices	Customers' Involvement	Employees' Involvement	Suppliers' Involvemen t
CMIN/DF	≤ 5.0	2.096	2.38	0.000	2.02
CFI	≥ 0.90	0.920	0.969	1.00	0.973
IFI	≥ 0.90	0.921	0.969	1.00	0.973
RMSEA	≤ 0.10	0.073	0.08	0.55	0.071
Goodness of fit statistics	Cut-off value	Group culture	Developmental Culture	Hierarchical culture	Rational culture
CMIN/DF	≤ 5.0	3.07	1.69	3.30	2.65
CFI	≥ 0.90	0.968	0.991	0.968	0.962
IFI	≥ 0.90	0.968	0.991	0.968	0.962
RMSEA	≤ 0.10	0.10	0.058	0.10	0.09

Source: Based on AMOS outputs

Table 7-29 Summary of Goodness of Fit Statistics for CFA of the Four Measurement Models

Goodness of fit statistics	Cut off value	Model 1: Group culture	Model 2: Developmental culture	Model3: Hierarchical culture	Model4: Rational culture
CMIN/DF	≤ 5.0	1.566	1.527	1.533	1.497
CFI	≥ 0.90	0.911	0.915	0.912	0.917
IFI	≥ 0.90	0.912	0.915	0.913	0.919
RMSEA	≤ 0.10	0.053	0.051	0.051	0.049

Source: Based on AMOS outputs

Furthermore, the discriminant validity has also established where the square root of the AVE for each construct has been higher than the correlation between that construct and other constructs in the four measurement models. Thus, all measurement models satisfy the criteria for unidimensionality, reliability and construct validity.

This chapter forms the basis for proceeding in the SEM analysis procedures. The CFA has been conducted as a preceding important stage in SEM steps (see figure 5.10). The results of the CFA confirm that all measurement scales in the current study possess satisfactory validity and reliability and thus, they will consequently have employed in the hypotheses testing. The next chapter will continue the last two steps in SEM, which are: (1) specifying the structural model by converting each measurement model assessed in the current chapter into structural model, (2) assessing the structural model validity to draw findings related to the size, direction and significance of the hypothesized relationships between the study's constructs.

CHAPTER EIGHT: Testing the Direct and Indirect Effect of Organisational Culture on Lean Technical Practices Using SEM

8.1 Introduction

The previous chapter has evaluated the measurement models of the study constructs. The results reveal that all the measurement models have satisfied the requirements of unidimensionality, reliability, and validity. Accordingly, these measurement scales will be used to assess the hypothesized relationships among the study constructs. The present chapter aims to examine the relationships between the constructs of interest.

The chapter is organized into four sections. In the second section, the hypotheses regarding the direct relationships between each type of organisational culture and lean technical practices will be estimated. In the third section, the mediating effects of customers' involvement, employees' involvement and suppliers' involvement on the relationship between organisational culture and lean technical practices will be investigated. A chapter summary will be provided in the fourth section of the chapter.

8.2 Structural Direct Models Results

8.2.1 Introduction

This section addresses the hypotheses, which are outlined in chapter 3. These hypotheses are developed based on theory to examine the direct effect of each type of organizational culture (group, developmental, hierarchical or rational) on lean technical practices implementation. SEM techniques are used to examine four hypotheses (H1, H5, H9 and H13) in the current study. Therefore, four structural direct models will be tested in this section. Each overall measurement model that has been assessed in the previous chapter will be converted into a structural direct model with two latent variables. Each structural direct model tests the direct effect of one type of organizational culture, which represents the exogenous latent variable (independent variable) on lean technical practices, which represents an endogenous latent variable (dependent variable) in the model.

In this section, each structural direct model is numbered and named as the following:

1. **Structural Direct Model 1: Group Culture.**

2. **Structural Direct Model 2: Developmental Culture.**
3. **Structural Direct Model 3: Hierarchical Culture.**
4. **Structural Direct Model 4: Rational Culture.**

The purpose of testing each of the four cultural types in separate models is to ascertain the effect of each type individually and to make a comparison among the four cultural types to explore which type(s) is the ideal one. This purpose serves to achieve the first two objectives of the current study as stated in chapter 1 (section 1.6). These objectives are:

1. Examining the effect of organisational culture (group culture, developmental culture, hierarchical culture and rational culture) on lean technical practices implementation.

2. Exploring the type (s) of organisational culture that best fit(s) with implementing lean technical practices.

8.2.2 Structural Direct Model 1: Group Culture

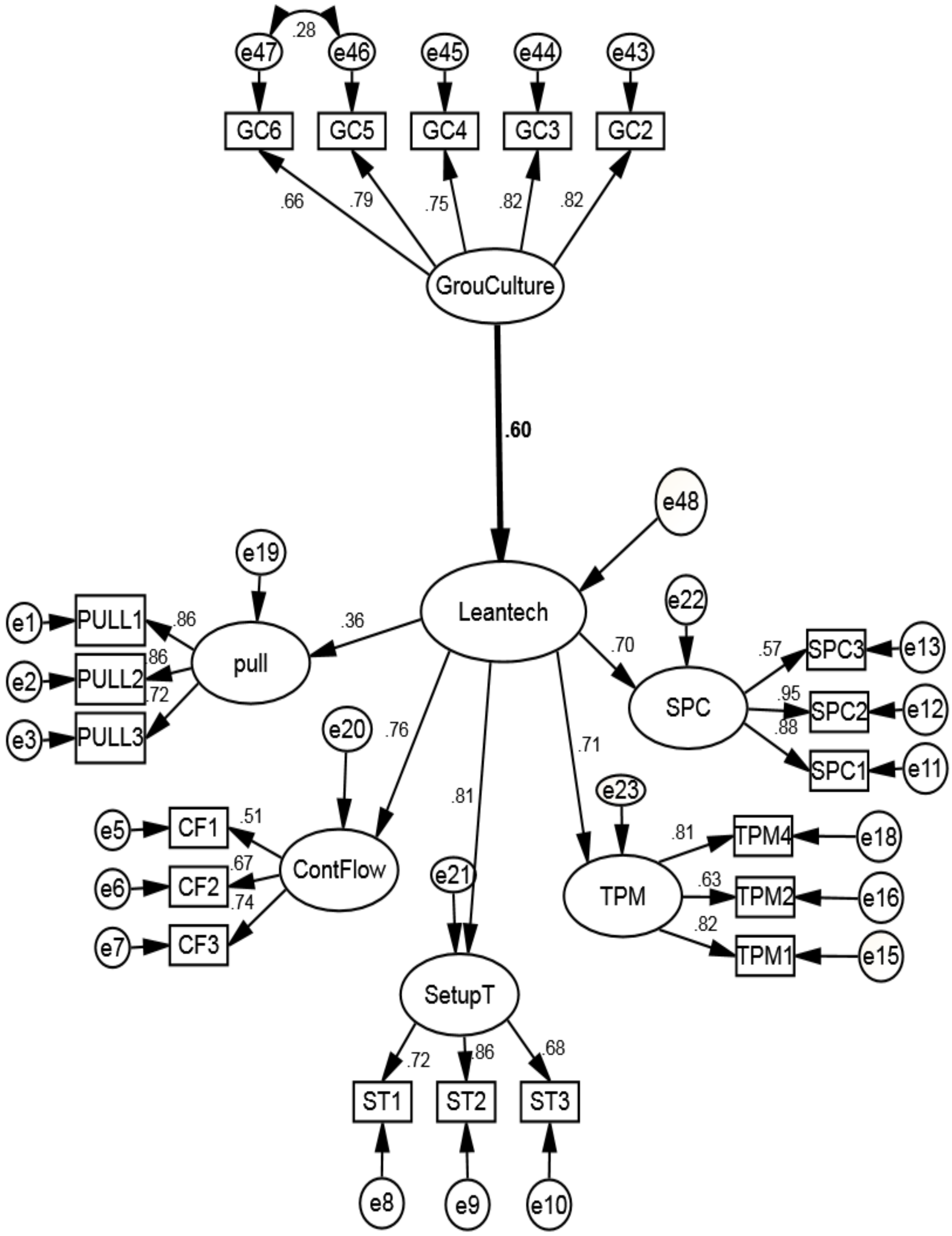
The proposed hypothesis in this model is:

H1: Group Culture has a positive effect on lean technical practices implementation.

The proposed structural direct model 1 is composed of two latent constructs. The first one is exogenous variable (group culture) and the other is endogenous variable (lean technical practices). Figure 8.1 presents the structural direct model 1 for the relationship between the two constructs.

Prior to discussing the result of the hypothesis proposed in the current study, the overall fit of the structural direct model 1 has been assessed so as to evaluate the extent to which the proposed causal relationship between the latent constructs fit the research data (Byrne, 2010). The overall fit of the structural direct model 1 is assessed with the same set of fit indices as those of the measurement models. The initial fit indices indicate that the structural direct model 1 has a good fit with the data as follows: CNIM= 252.393, DF= 163, p value= 0.000, CMIN/DF=1.548, CFI=0.954, IFI=0.955 and RMSEA=0.052.

Figure 8-1 Structural Direct Model 1: Group Culture



: Structural regression coefficient

: Path coefficient for regression of a measured variable onto a latent variable.

: Measurement error

: Covariance between error terms

Source: Based on AMOS outputs

The causal research hypothesis underlying the direct effect of group culture on lean technical practices implementation has been examined and it is found that the path representing this hypothesis has a standardised beta coefficient (β) of 59.9 per cent and the effect in this path is significant ($p < 0.001$), indicating a significant positive effect of group culture on lean technical practices implementation. Table 8.1 presents the result of H1.

Table 8-1 H1 Test Result

Hypothesized direct relationship		St. regression weight	p-value	Result
H1	Group culture → Lean technical practices	0.599	0.000	supported

Source: Based on AMOS outputs

8.2.3 Structural Direct Model 2: Developmental Culture

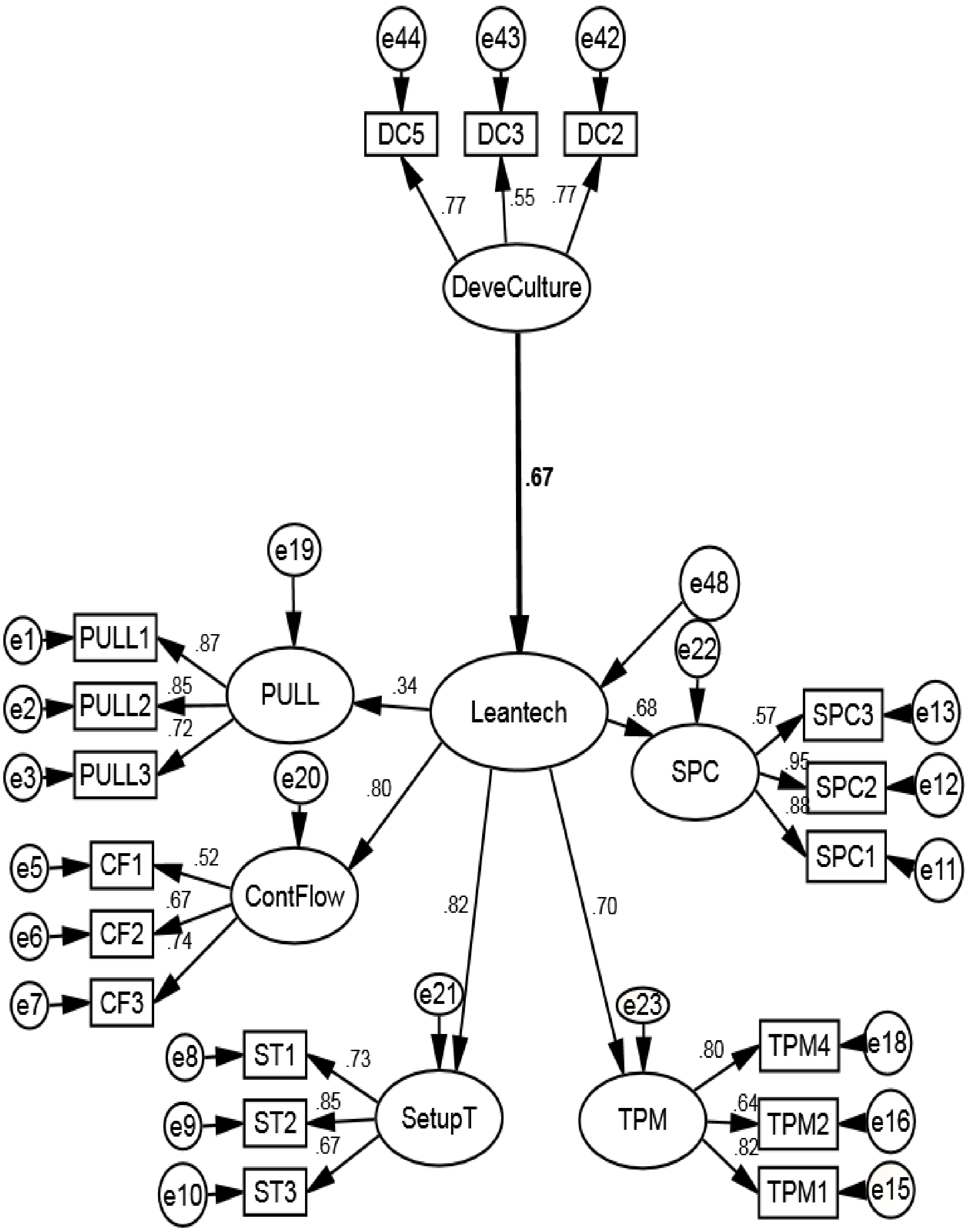
The proposed hypothesis in this model is:

H5: Developmental Culture has a positive effect on lean technical practices implementation.

In the current study, the proposed structural direct model 2 is composed of two latent constructs. Of which one is exogenous (developmental culture) and the other is endogenous (lean technical practices). Figure 8.2 presents the structural direct model 2 for the relationship between the two constructs.

Before discussing the result of the hypothesis proposed in the current study, the overall fit of the structural direct model 2 is assessed in order to evaluate the extent to which the proposed causal relationship between the latent constructs fit the research data (Byrne, 2010). The fit indices indicate that the structural direct model 2 has a good fit with the data as follows: CMIN=182.469, DF=129, p value= 0.001 CMIN/DF=1.414, CFI=0.965, IFI=0.965, RMSEA=0.045.

Figure 8-2 Structural Direct Model 2: Developmental Culture



: Structural regression coefficient

: Path coefficient for regression of a measured variable onto a latent variable.

: Measurement error

: Covariance between error terms

Source: Based on AMOS outputs

The causal research hypothesis underlying the direct effect of developmental culture on lean technical practices implementation has been examined and it is found that the path representing this hypothesis has a standardised beta coefficient (β) of 67.5 per cent and the effect in this path is significant ($p < 0.001$), indicating a significant positive effect of developmental culture on lean technical practices implementation. Table 8.2 presents the result of H5.

Table 8-2 H5 Test Result

Hypothesized direct relationship		St. regression weight	p-value	result
H5	Developmental culture → Lean technical practices	0.675	0.000	supported

Source: Based on AMOS outputs

8.2.4 Structural Direct Model 3: Hierarchical Culture

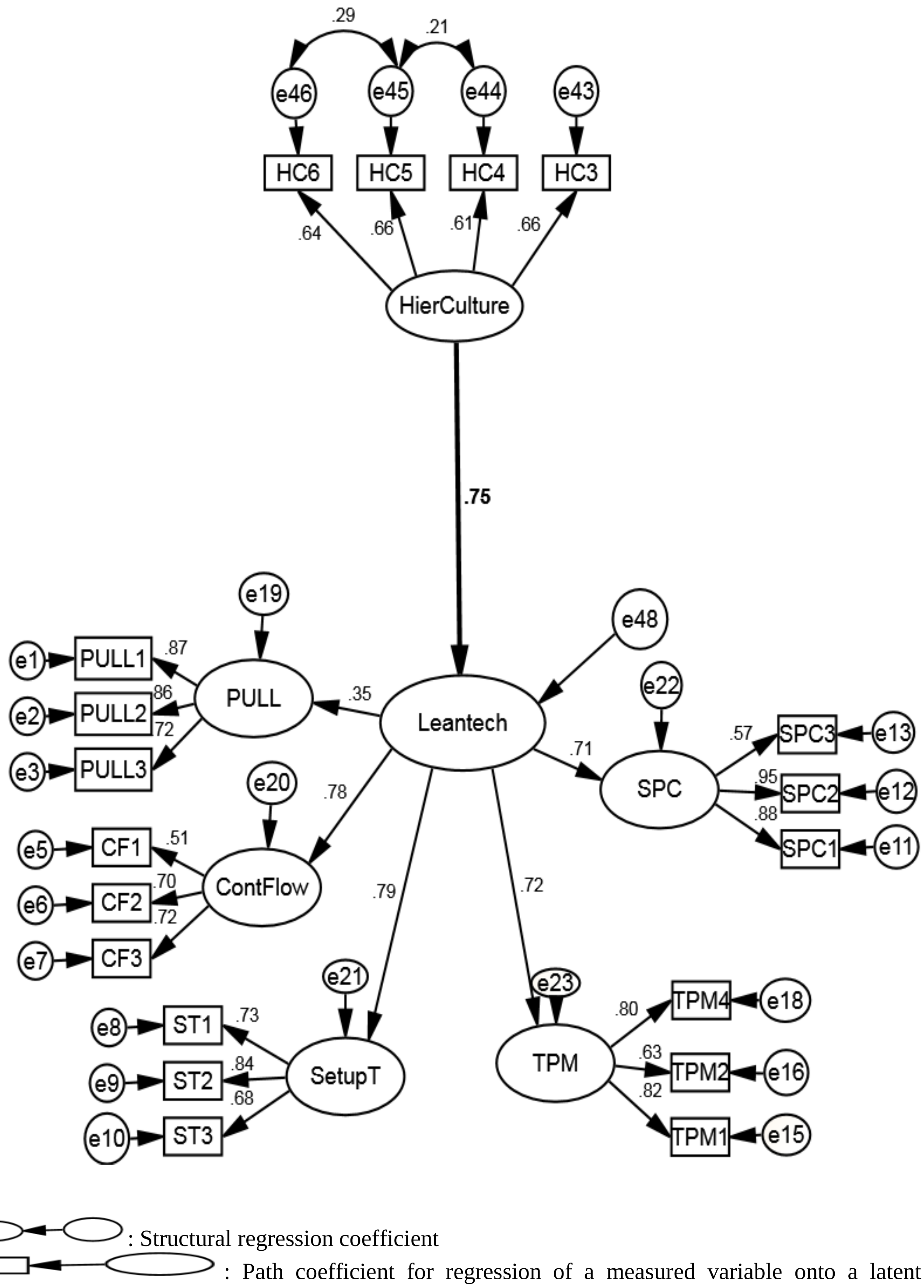
The proposed hypothesis in this model is:

H9: Hierarchical Culture has a positive effect on lean technical practices implementation.

The proposed structural direct model 3 is composed of two latent constructs. The first one is exogenous (hierarchical culture) and the other one is endogenous (lean technical practices). Figure 8.3 presents the structural direct model 3 for the relationship between the two constructs.

Prior to discussing the result of the hypothesis proposed in the current study, the overall fit of the structural direct model 3 is assessed so as to evaluate the extent to which the proposed causal relationship between the latent constructs fit the research data (Byrne, 2010). The fit indices that the structural direct model 3 has a good fit with the data as follows: CMIN=209.987, DF=144, p value= 0.000, CMIN/DF=1.458, CFI=0.959, IFI=0.960, RMSEA=0.047).

Figure 8-3 Structural Direct Model 3: Hierarchical Culture



: Structural regression coefficient

: Path coefficient for regression of a measured variable onto a latent variable.

: Measurement error

: Covariance between error terms

Source: Based on AMOS outputs

The causal research hypothesis underlying the direct effect of hierarchical culture on lean technical practices implementation has been examined and it is found that the path representing this hypothesis has a standardised beta coefficient (β) of 75.3 per cent and the effect in this path is significant ($p < 0.001$), indicating a significant positive effect of hierarchical culture on lean technical practices implementation. Table 8.3 presents the result of H9.

Table 8-3 H9 Test Result

Hypothesized direct relationship		St. regression weight	p-value	result
H9	Hierarchical culture → Lean technical practices	0.753	0.000	supported

Source: Based on AMOS outputs

8.2.5 Structural Direct Model 4: Rational Culture

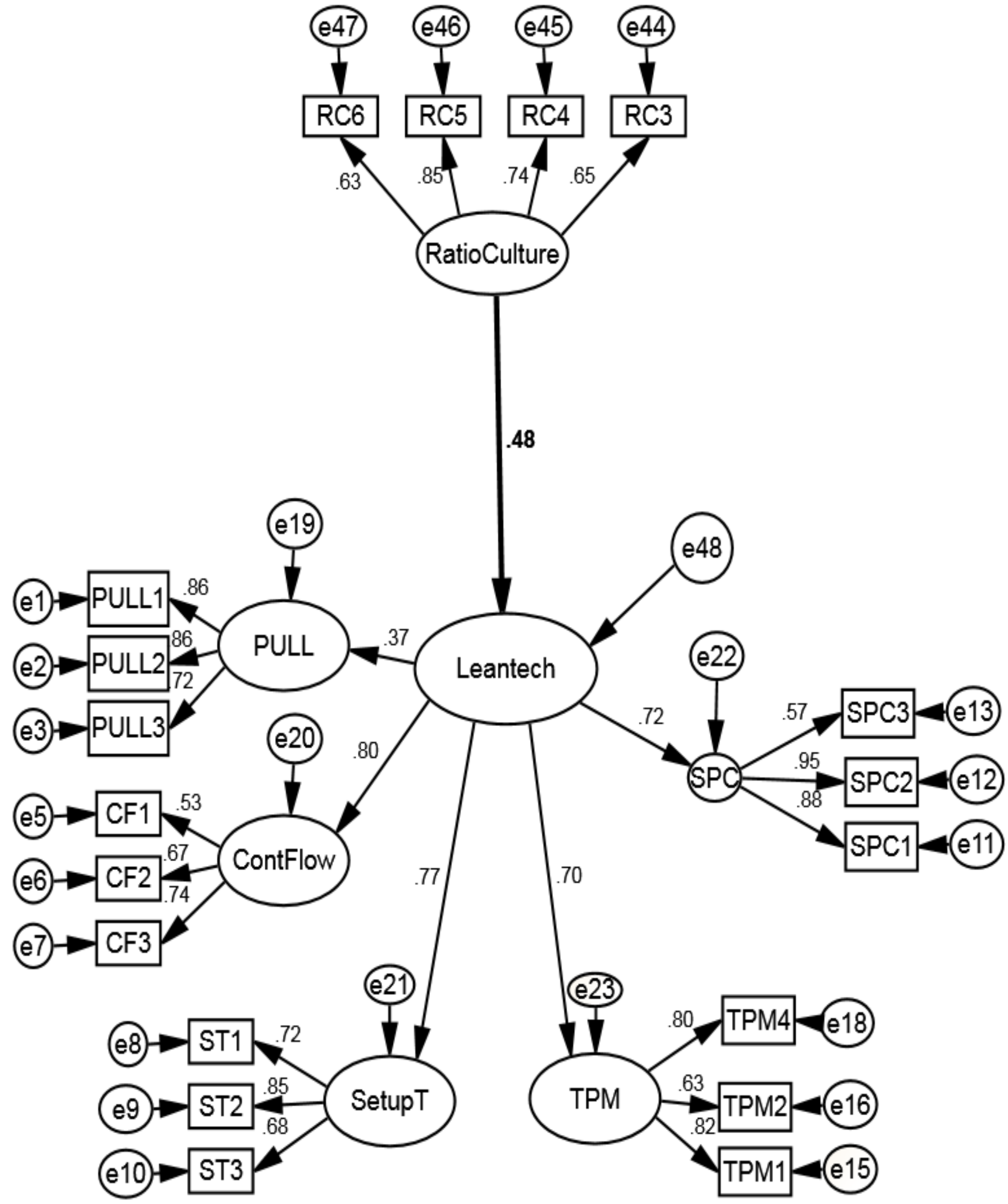
The proposed hypothesis in this model is:

H13: Rational Culture has a positive effect on lean technical practices implementation.

In the current study, the proposed structural direct model 4 is composed of two latent constructs. The first one is exogenous (rational culture) and the other is endogenous (lean technical practices). Figure 8.4 presents the structural direct model 4 for the direct relationship between the two constructs.

Before discussing the result of the hypothesis proposed by the current study, the overall fit of the structural model is assessed in order to evaluate the extent to which the proposed causal relationship between the latent constructs fit the research data (Byrne, 2010). The fit indices indicate that the structural direct model 4 has a good fit with the data as follows: CMIN=193.751, DF= 146, p value= 0.005, CMIN/DF=1.327, CFI=0.970, IFI=0.971, RMSEA=0.040).

Figure 8-4 Structural Direct Model 4: Rational Culture



: Structural regression coefficient

: Path coefficient for regression of a measured variable onto a latent variable.

: Measurement error

: Covariance between error terms

Source: Based on AMOS outputs

The causal research hypothesis underlying the direct effect of rational culture on lean technical practices implementation has been examined and it is found that the path representing this hypothesis has a standardised beta coefficient (β) of 48.5 per cent and the effect in this path is significant ($p < 0.001$), indicating a significant positive effect of rational culture on lean technical practices implementation. Table 8.4 presents the result of H13.

Table 8-4 H13 Test Result

Hypothesized direct relationship		St. regression weight	p-value	result
H13	Rational culture → Lean technical practices	0.485	0.000	supported

Source: Based on AMOS outputs

8.2.6 Comparison among the Four Structural Direct Models (1-4)

One important objective in the current study is exploring the ideal type(s) of organizational culture to implement lean technical practices effectively. Therefore, a comparison between the four types is a necessary to meet this objective especially that the previous discussed results provide evidence on the positive effect for all types of organisational culture on lean technical practices implementation.

Table 8.5 shows that the hierarchical culture has the strongest positive effect on lean technical practices implementation with a standardised path coefficient of approximately 0.75. This type of culture is followed by the developmental culture and group culture with a standardised path coefficient of approximately 0.67 and 0.60 respectively. The rational culture has the least positive effect on lean technical practices with a standardised path coefficient of 0.48 on lean technical practices implementation compared to the other three types but it is still considered to be moderately positive effect.

Table 8-5 Comparison among the Effect of the Four Cultural Types on Lean Technical Practices

Effect of organizational culture type on lean practices	Standardised path coefficient
Hierarchical culture	0.75
Developmental culture	0.67
Group culture	0.60
Rational culture	0.48

Source: Based on AMOS outputs

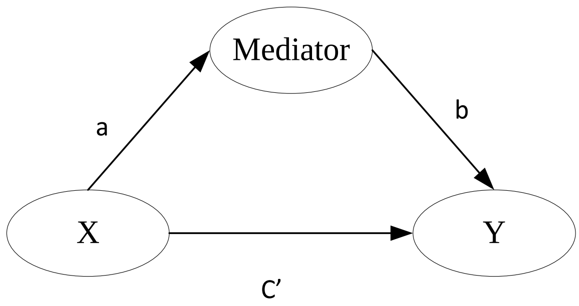
8.3 Structural Mediating Models Results

8.3.1 Introduction

In general, a mediating effect is established when a third variable (construct) intervenes between two other related variables. The direct effect links the two constructs with a single arrow, whereas the indirect effect consists a series of relationships with minimum one intervening variable included. In other words, an indirect effect is a sequence of more than two direct effects and is illustrated visually by multiple arrows. The intervening process is also called the mediating effect. (Hair et al, 2010). The most widely used application of mediation is to "explain" why a relationship between two variables exists. It can be noticed a relationship between X and Y but we do not know "why" it exists. Therefore, a mediating variable (M) can be posited in the relationship to provide some interpretation. The mediator (M) explains the association between the two constructs (X and Y) (Hair et al, 2010).

Baron and Kenny (1986, p.1176) argue that “mediators explain how external physical events take on internal psychological significance……. speak to how or why certain effects occur”. The basic causal chain involved in mediation is illustrated in figure 8.5.

Figure 8-5 Mediation Perspective



Source: Baron and Kenny (1986)

According to Baron and Kenny's (1986) the variable functions as a mediator when it achieves the three following conditions:

1-The independent variable (X) has a significant relationship with the mediator (M) as shown in path a in figure 8.5.

2- The mediator (M) has a significant relationship with the dependent variable (Y) as shown in path b in figure 8.5

3- The effect of independent variable (X) on the dependent variable (Y) must be less or zero in the existence of mediator (M) as in path c' in figure 8.5. In other words, when a significant reduction in the direct effect of independent variable (X) on dependent variable (Y) has occurred, this indicates the effect of mediator in the relationship.

Mediation necessitates significant associations among all three variables ($X \rightarrow M \rightarrow Y$). If the mediator completely explains the relationship between X and Y, we can conclude complete mediation (Hair et al, 2010). This means that if path c' is reduced to zero and the relationship between X and Y is no longer significant, a perfect mediation occurs (Baron and Kenny, 1986). If there is still significant relationship between X and Y, we can conclude partial mediation (Hair et al, 2010). Partial mediation occurs when path c' is not zero, just a significant reduction happens, this indicates that multiple mediators may operate in the relationship (Baron and Kenny, 1986). In other words, if the standardised beta coefficient value of the independent variable on the dependent variable drops considerably but is still statistically significant, then a partial mediation can be concluded in such a case.

8.3.2 Mediation Test Techniques

Two main phases are followed to test the mediation hypotheses in the current study. These two steps are recommended by Hair et al (2010) and are presented by Baron and Kenny (1986):

Phase1: Testing the estimates of an initial model with only the direct effect between X and Y. This phase has been conducted earlier in the previous section (8.2). The direct structural models are evaluated first to test the direct relationship between the independent variable (organizational culture) and the dependent variable (lean technical practices).

Phase 2: Estimating a second model adding in the mediating variable(s). In the current study, four structural mediating models are developed to detect the indirect relationships between each type of organizational culture (independent variable) and lean technical practices (dependent variables). In this phase, the three conditions which have been developed by Baron and Kenny (1986) should be checked to accept or reject the hypotheses under study.

In the current study, meditational hypotheses are posited using three mediating constructs (customers' involvement, employees' involvement, and suppliers' involvement). The purpose of mediation is to understand the mechanism by which the independent variable (organizational culture) affects the dependent variable (lean technical practices). Also, the proportion of mediation for each mediator will be calculated mathematically, to know the statistical magnitude for each mediator on the relationship between an organizational culture's type and lean technical practices.

In traditional methodology, mediation is tested by using a simple regression technique However, regression may produce an inaccurate mediator score because it does not consider the measurement error problem. The measurement error issue could cause problems in modelling causation, or possibly even result in reverse causation. Applying SEM to test the mediation effect can avoid this problem, as SEM has included the measurement error for the whole model (Hopwood, 2007). Two major advantages of SEM in testing mediation effect according to Baron and Kenny (1986) are: (1) all the relevant paths are directly tested and none are cancelled as in ANOVA; (2)

complications of measurement error and even feedback is incorporated directly into the model. Two main techniques are used in the current study to test the mediation effect: (1) Bootstrapping; and (2) Sobel test.

One way to estimate the significance of indirect effects in SEM is using bootstrapping. This approach relies on drawing samples of separate indirect pathway coefficient estimates, more specifically; this approach builds a hypothetical distribution of coefficients from which the population coefficients are then estimated. Bootstrapping is used to produce an approximation of the sampling distribution to attain confidence intervals that are more accurate than confidence intervals resulting from using standard techniques while making no assumptions of any type related to the shape of sampling distribution (Hayes and Preacher, 2010).

The major advantage of this technique is that it does not require the researcher to make the distributional assumptions necessary for parametric procedures. Also, the results of simulation studies (Mackinnon et al, 2004) comparing this method with other mediation testing approaches show that bootstrapping usually perform better than parametric techniques in small to moderate samples in terms of type 1 error rates and statistical power. Finally, unlike intervals resulting from techniques that assume normality of the sampling distribution of the statistic of interest, bootstrap confidence intervals are likely to be asymmetric, more closely resembling the real sampling distribution of products of normal random variables.

Relative to different mediation testing techniques, Sobel test with bootstrapped standard errors was also used to test the significance of mediation. Sobel test is adopted in the current study because it provides an approximate significance test for the indirect effect of the independent variable on the dependent variable via the mediator (Baron and Kenny, 1986). Sobel test is a specialised test that provides a method to determine whether the reduction in the effect of the independent variable after including the mediator in the model, is a significant reduction and whether the mediation effect is statistically significant (Preacher and Hayes, 2008). Furthermore, Sobel test can be used in more complicated models which include multiple mediators (Baron and Kenny, 1986). Therefore, it is used in the current study. The Sobel test formula is:

$$Z\text{-}value = a*b/\text{SQRT}\ (b^2*s_a{}^2 + a^2*s_b{}^2)$$

1. The path from independent variable to mediator is denoted as (a) and its standard error is (Sa).
2. The path from mediator to dependent variable is denoted as (b) and its standard error (Sb).
3. Z value is calculated using 95% confidence interval for indirect effect

Source: Preacher and Hayes (2008)

A Sobel test with bootstrapped standard errors based on 1000 resampling is conducted in the current study to test the significance of the mediation effects for three mediators (customers' involvement, employees' involvement and suppliers' involvement). The results of this test will be presented in section 8.4.

8.4 Structural Mediating Models Results

In this section, the mediating effects of customers' involvement, employees' involvement and suppliers' involvement on the relationship between organisational culture and lean technical practices will be investigated. As explained earlier that the mediation occurs when an independent variable (organisational culture) and a dependent variable (lean technical practices) is intervened by a mediating variable (e.g. customers' involvement), carrying the effect of the independent variable onto the dependent variable. The researcher seeks to know the degree to which the effect of direct or indirect through the mediating variable (Iacobucci et al., 2007). Accordingly, each structural model is developed with the existence of the three mentioned mediators as illustrated in the four conceptual models in chapter 3. The purpose of adding the mediators to the structural direct models is to explain and understand the role of each mediator in the relationship between organizational culture and lean technical practices implementation. Therefore, four structural mediated models are developed in this section and are given a number and name as the following:

1. Structural Mediating Model 1: Group Culture.

2. Structural Mediating Model 2: Developmental Culture.

3. Structural Mediating Model 3: Hierarchical Culture.

4. Structural Mediating Model 4: Rational Culture.

By analysing the four structural mediated models, the results will serve to achieve three objectives of the current study as stated in chapter 1 (section 1.6). These objectives are:

1. Examining the effect of organisational culture (group culture, developmental culture, hierarchical culture and rational culture) on lean human practices (customers' involvement, employees' involvement and suppliers' involvement).
2. Examining the effect of lean human practices (customers' involvement, employees' involvement and suppliers' involvement) on lean technical practices implementation.
3. Examining the mediating effect of customers' involvement, employees' involvement and suppliers' involvement on the relationship between organisational culture (group culture, developmental culture, hierarchical culture and rational culture) and lean technical practices implementation.

8.4.1 Structural Mediating Model 1: Group Culture

In the current study, the proposed structural mediating model 1 is composed of five latent constructs. One of them is exogenous (group culture) and four are endogenous (customers' involvement, employees' involvement and suppliers' involvement and lean technical practices). Figure 8.6 presents the structural mediating model 1: group culture.

Prior to discussing the result of the hypotheses proposed in the current study, the overall fit of the structural mediating model 1 is assessed to evaluate the extent to which the proposed causal relationship between the latent constructs fit the research data (Byrne, 2010). The fit indices indicate that the structural mediated model 1 has a good fit with the data (CMIN=783.577, DF=481, p value= 0.000, CMIN/DF=1.629, CFI=0.900, IFI=0.902, RMSEA=0.056), thus supporting the basic conceptual model 1: group culture (see figure 3.2).

Table 8-6 Hypotheses Test Results for Structural Mediating Model 1: Group Culture

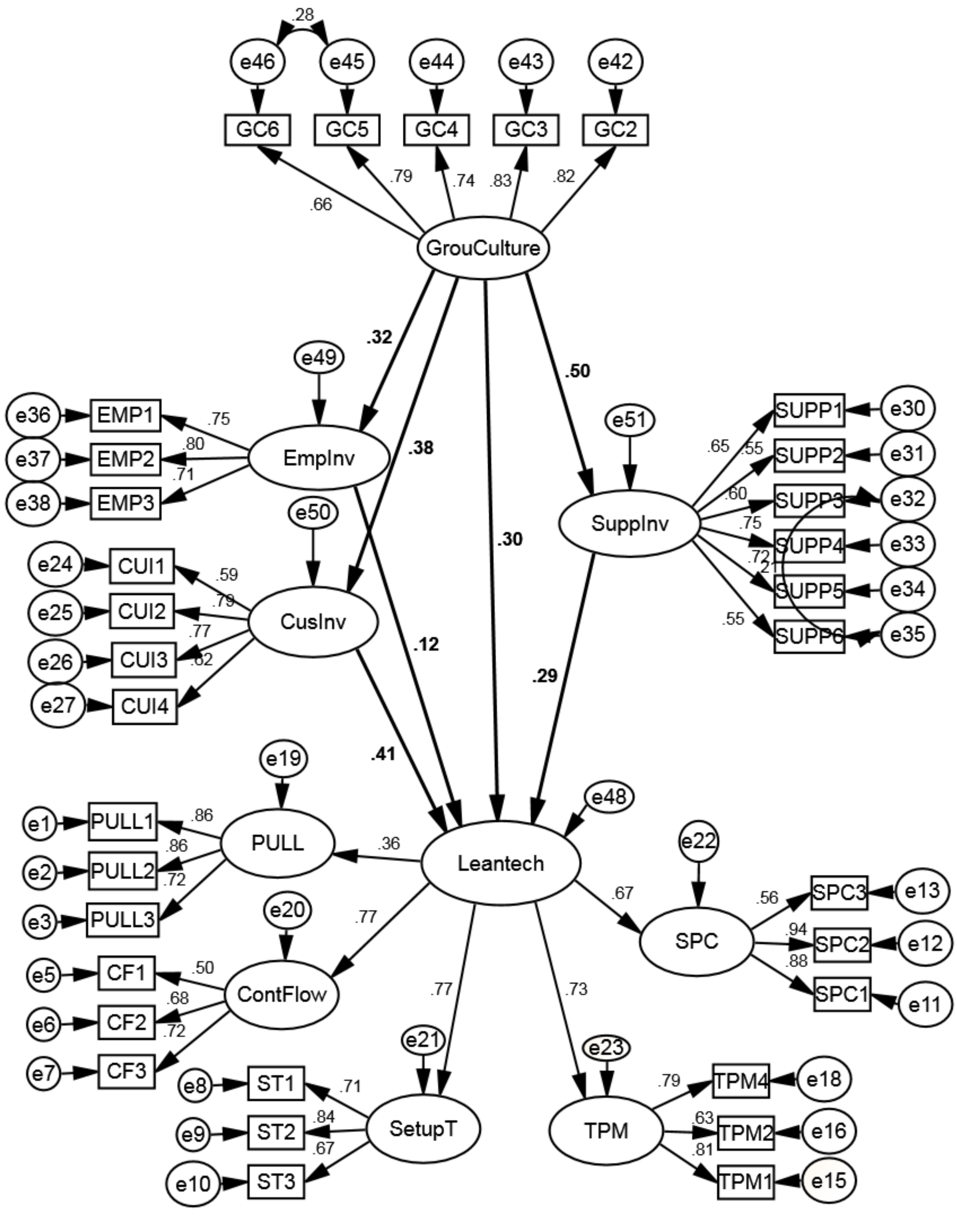
Hypothesized direct relationship		St. regression weight	p-value	Result
H2a	GrouCulture → CusInv	0.377	0.000***	Supported
H2b	GrouCulture → EmpInv	0.325	0.000***	Supported
H2c	GrouCulture → SuppInv	0.498	0.000***	Supported
H3a	CusInv → Leantech	0.406	0.002**	Supported
H3b	EmpInv → Leantech	0.124	0.096 (n.s.)	not supported
H3c	SuppInv → Leantech	0.294	0.000**	Supported

*** $p < 0.001$, ** $p < 0.01$, $p > 0.05$(n.s.)

GrouCulture: Group Culture, CusInv: Customers' Involvement, Leantech: Lean technical practices, SuppInv: Suppliers' Involvement, EmpInv: Employees' Involvement.

Source: Based on AMOS outputs

Figure 8-6 Structural Mediating Model 1: Group Culture



: Structural regression coefficient

: Path coefficient for regression of a measured variable onto a latent variable.

e : Measurement error

e e : Covariance between error terms

Source: Based on AMOS outputs

Table 8.6 presents the results of testing the hypothesized direct relationships in structural mediating model 1. Table 8.6 also includes the standardized path coefficients (regression weights) and the corresponding p- value for significance levels.

As shown in table 8.6, the hypotheses H2a, H2b and H2c investigate the direct effect of group culture on customers' involvement, employees' involvement and suppliers' involvement respectively. It is hypothesized that there would be a positive effect of group culture on customers' involvement, group culture on employees' involvement and group culture on suppliers' involvement. The results demonstrate that there are positive and significant paths from group culture to customers' involvement ($\beta= 0.377$, $p < 0.001$), from group culture to employees' involvement ($\beta= 0.325$, $p < 0.001$), and from group culture to suppliers' involvement ($\beta= 0.498$, $p < 0.001$). Thus, hypotheses H2a, H2b, and H2c are supported.

Moreover, the hypotheses H3a, H3b and H3c investigate the direct effect of customers' involvement on lean technical practices implementation, employees' involvement on lean technical practices implementation and suppliers' involvement on lean technical practices implementation. It is hypothesized that there would be a positive effect of customers' involvements on lean technical practices implementation, employees' involvement on lean technical practices implementation and suppliers' involvement on lean technical practices implementation. The results demonstrate positive and significant paths from customers' involvement to lean technical practices implementation ($\beta= 0.406$, $p < 0.01$), and from suppliers' involvement to lean technical practices implementation ($\beta= 0.294$, $p < 0.01$). Whereas, the path from employees' involvement to lean technical practices implementation is positive but not significant ($\beta= 0.124$, $p > 0.05$), Thus, hypotheses H3a and H3c are supported whereas H3b is not supported.

To investigate the mediating roles of customers' involvement, employees' involvement and suppliers' involvement in the relationship between group culture and lean technical practices implementation. A Sobel test with bootstrapped standard errors based on 1000 resampling is conducted as discussed earlier in subsection 8.3.2. The results of this test are presented in table8.7.

Table 8-7 Sobel Test Results for Structural Mediating Model 1: Group Culture

Indirect effect		Sobel test statistic	St. error	Mediation type	Result
H4a	GrouCulture → CusInv → Leantech	3.11	0.001**	Partial	supported
H4b	GrouCulture → EmpInv → Leantech	1.51	0.129(n.s)	None	Not supported
H4c	GrouCulture → SuppInv → Leantech	2.76	0.006**	Partial	supported

*** p < 0.001, ** p < 0.01, p > 0.05(n.s.)
GrouCulture: Group Culture, CusInv: Customers' Involvement, Leantech: Lean technical practices, SuppInv: Suppliers' Involvement, EmpInv: Employees' Involvement.
Source: Author's calculations

As shown in table 8.7, the results confirm that customers' involvement has a partial mediating effect on the relationship between group culture and lean technical practices implementation (Sobel test= 3.11, p< 0.01). Also, suppliers' involvement has a partial mediating effect on the relationship between group culture and lean technical practices implementation (Sobel test= 2.76, p< 0.01). Based on Baron and Kenny's (1986) mediation approach the partial mediation occurs when the path between the two constructs is not zero, just a significant reduction happens. In figure 8.5, the path from group culture to lean technical practices has a lower significant path coefficient (0.30, p< 0.01) than that of the structural direct model1: group culture in figure 8.1 (0.60, p< 0.001). This provides an evidence of the partial mediation effect for customers' involvement and suppliers' involvement on the relationship between group culture and lean technical practices implementation.

However, based on the results of Sobel test, employees' involvement has no mediation effect on the relationship between group culture and lean technical practices implementation (Sobel test= 1.51, p> 0.05). This result is confirmed through the insignificant effect of employees' involvement on lean technical practices implementation, which indicates the lack of mediation effect of employees' involvement on the relationship between group culture and technical lean practices implementation. Thus, hypotheses H4a and H4c are supported whereas H4b is not supported.

8.4.2 Structural Mediating Model 2: Developmental Culture

In the current study, the proposed structural mediating model 2 is composed of five latent constructs. One of them is exogenous (developmental culture) and the other four are endogenous (customers' involvement, employees' involvement and suppliers' involvement and lean technical practices). Figure 8.7 presents the structural mediating model 2: developmental culture.

Prior to discussing the result of the hypotheses proposed in the current study, the overall fit of the structural mediating model 2 is assessed to evaluate the extent to which the proposed causal relationship between the latent constructs fit the research data (Byrne, 2010). The fit indices indicate that the structural mediating model 2 has a good fit with the data (CMIN/DF=1.602, CFI=0.902, IFI=0.904, RMSEA=0.054), thus supporting the basic conceptual model 2: developmental culture (figure 3.3).

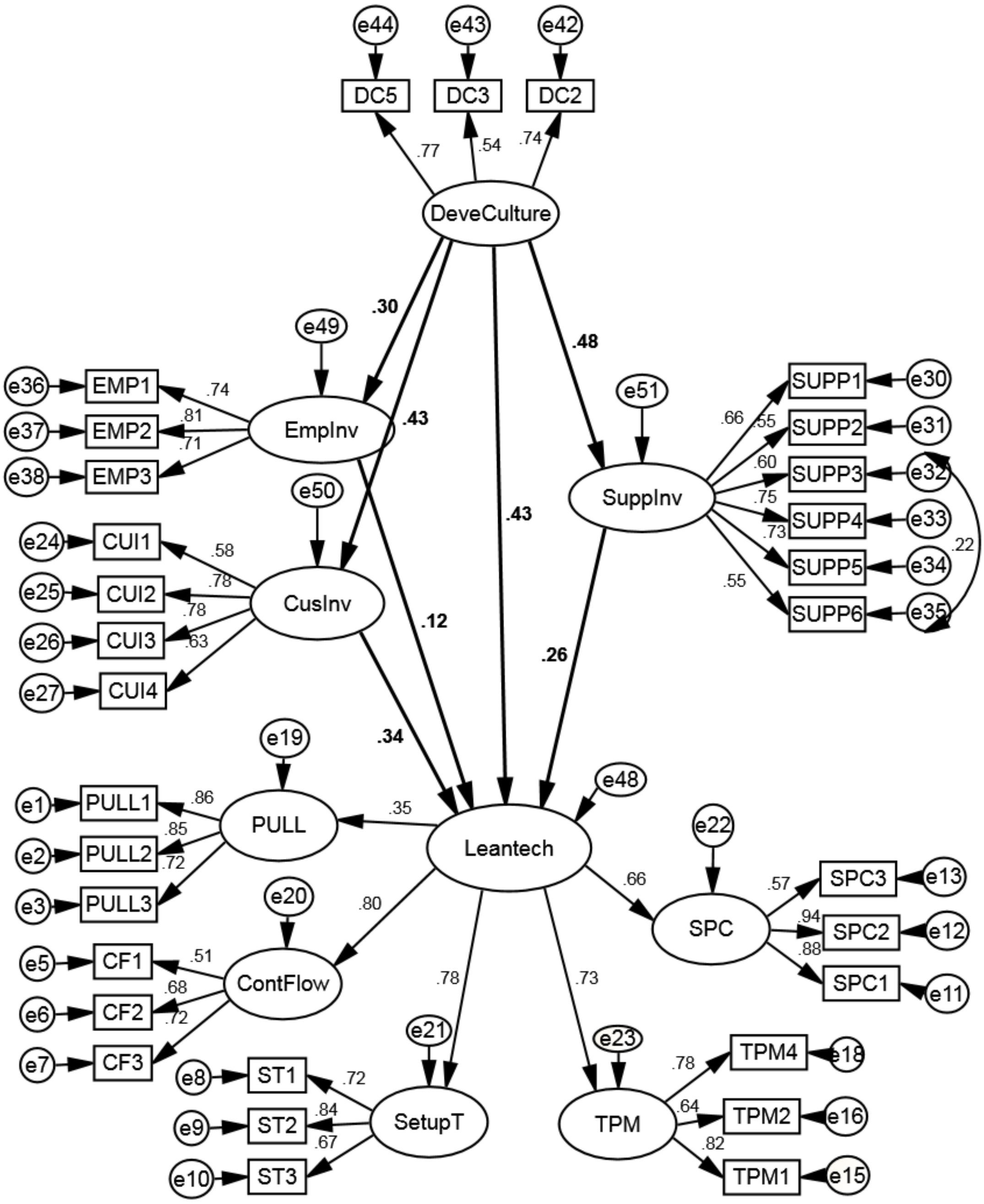
Table 8.8 presents the results of testing the hypothesized direct relationships in structural mediating model 2. The table also includes the standardized path coefficients (regression weights) and the corresponding p value for significance levels.

Table 8-8 Hypotheses Test Results for the Structural Mediating Model 2: Developmental Culture

Hypothesized direct relationship		St. regression weight	p-value	result
H6a	DeveCulture → CusInv	0.434	0.000***	supported
H6b	DeveCulture → EmpInv	0.304	0.001**	Supported
H6c	DeveCulture → SuppInv	0.482	0.000***	supported
H7a	CusInv → Leantech	0.341	0.003**	supported
H7b	EmpInv → Leantech	0.116	0.127(n.s.)	Not supported
H7c	SuppInv → Leantech	0.258	0.011*	supported

*** p < 0.001, ** p < 0.01, * p < 0.05, p> 0.05 (n.s.)
DeveCulture: Developmental Culture, CusInv: Customers' Involvement, Leantech: Lean technical practices, SuppInv: Suppliers' Involvement, EmpInv: Employees' Involvement.
Source: Based on AMOS outputs

Figure 8-7 Structural Mediating Model 2: Developmental Culture



: Structural regression coefficient

: Path coefficient for regression of a measured variable onto a latent variable.

: Measurement error

: Covariance between error terms

Source: Based on AMOS outputs

As shown in table 8.8, hypothesis H6a, H6b and H6c investigate the effect of developmental culture on customers' involvement, employees' involvement and suppliers' involvement respectively. It is hypothesized that there would be a positive effect of developmental culture on customers' involvement, developmental culture on employees' involvement and developmental culture on suppliers' involvement. The results, demonstrate positive and significant paths from developmental culture to customers' involvement ($\beta = 0.434$, $p < .001$), from developmental culture to employees' involvement ($\beta = 0.304$, $p < 0.01$), and from developmental culture to suppliers' involvement ($\beta = 0.482$, $p < .001$). Thus, hypotheses H6a, H6b, and H6c are supported.

Moreover, hypothesis H7a, H7b and H7c investigate the effect of customers' involvement on lean technical practices implementation, employees' involvement on lean technical practices implementation and suppliers' involvement on lean technical practices implementation. It is hypothesized that there would be a positive effect of customers' involvements on lean technical practices implementation, employees' involvement on lean technical practices implementation and suppliers' involvement on lean technical practices implementation. The results, demonstrate positive and significant paths from customers' involvement to lean technical practices implementation ($\beta = 0.341$, $p < 0.01$), and from suppliers' involvement to lean technical practices implementation ($\beta = 0.258$, $p < 0.01$). While the path from employees' involvement to lean technical practices, is positive but not significant ($\beta = 0.116$, $p > .05$), Thus, hypotheses H7a and H7c are supported whereas H7b is not supported.

To examine the mediating roles of customers' involvement, employees' involvement and suppliers' involvement in the relationship between developmental culture and lean technical practices implementation. A Sobel test with bootstrapped standard errors based on 1000 resampling is conducted. The results of this test are presented in table8.9.

Table 8-9 Sobel Test Results for Structural Mediating Model 2: Developmental Culture

	Indirect effect	Sobel test statistic	St. error	Mediation Type	Result
H8a	DeveCulture ⟶ CusInv ⟶ Leantech	2.46	0.013*	partial	supported
H8b	DeveCulture ⟶ EmpInv ⟶ Leantech	1.37	0.16 (n.s)	None	Not supported
H8c	DeveCulture ⟶ SuppInv ⟶ Leantech	2.24	0.025*	partial	supported

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, $p > 0.05$(n.s.)
DeveCulture: Developmental Culture, CusInv: Customers' Involvement, Leantech: Lean technical practices, SuppInv: Suppliers' Involvement, EmpInv: Employees' Involvement
Source: Author's calculations

As shown in table 8.9, the results confirm that customers' involvement has a partial mediating effect on the relationship between developmental culture and lean technical practices implementation (Sobel test= 2.46, $p< 0.05$). Also, suppliers' involvement construct has a partial mediating effect on the relationship between developmental culture and lean technical practices implementation (Sobel test= 2.24, $p< 0.05$). The partial mediation for customers' involvement and suppliers' involvement are found because based on Baron and Kenny's (1986) mediation approach, the partial mediation occurs when the path between the two variables is not zero, just a significant reduction happens. In figure 8.6, the path from developmental culture to lean technical practices has a lower significant path coefficient ($\beta = 0.43$, $p< 0.01$) than that of the structural direct model 2: developmental culture in figure 8.2 ($\beta = 0.67$, $p< 0.001$). This provides an evidence of the partial mediation effect for customers' involvement and suppliers' involvement on the relationship between developmental culture and lean technical practices implementation.

However, employees' involvement has no mediation effect on the relationship between developmental culture and lean technical practices implementation (Sobel test= 1.37, $p> 0.05$). The insignificant direct relationship between employees' involvement and technical lean practices indicates the lack of mediation effect of employees' involvement on the relationship between developmental culture and lean technical practices implementation. Thus, hypotheses H8a and H8c are supported whereas H8b is not supported.

8.4.3 Structural Mediating Model 3: Hierarchical Culture

In the current study, the proposed structural mediating model 3 is composed of five latent constructs. The first one is exogenous (hierarchical culture) and the other four are endogenous (customers' involvement, employees' involvement and suppliers' involvement and lean technical practices). Figure 8.8 presents the structural mediating model 3: hierarchical culture for the direct and indirect relationships among the five constructs.

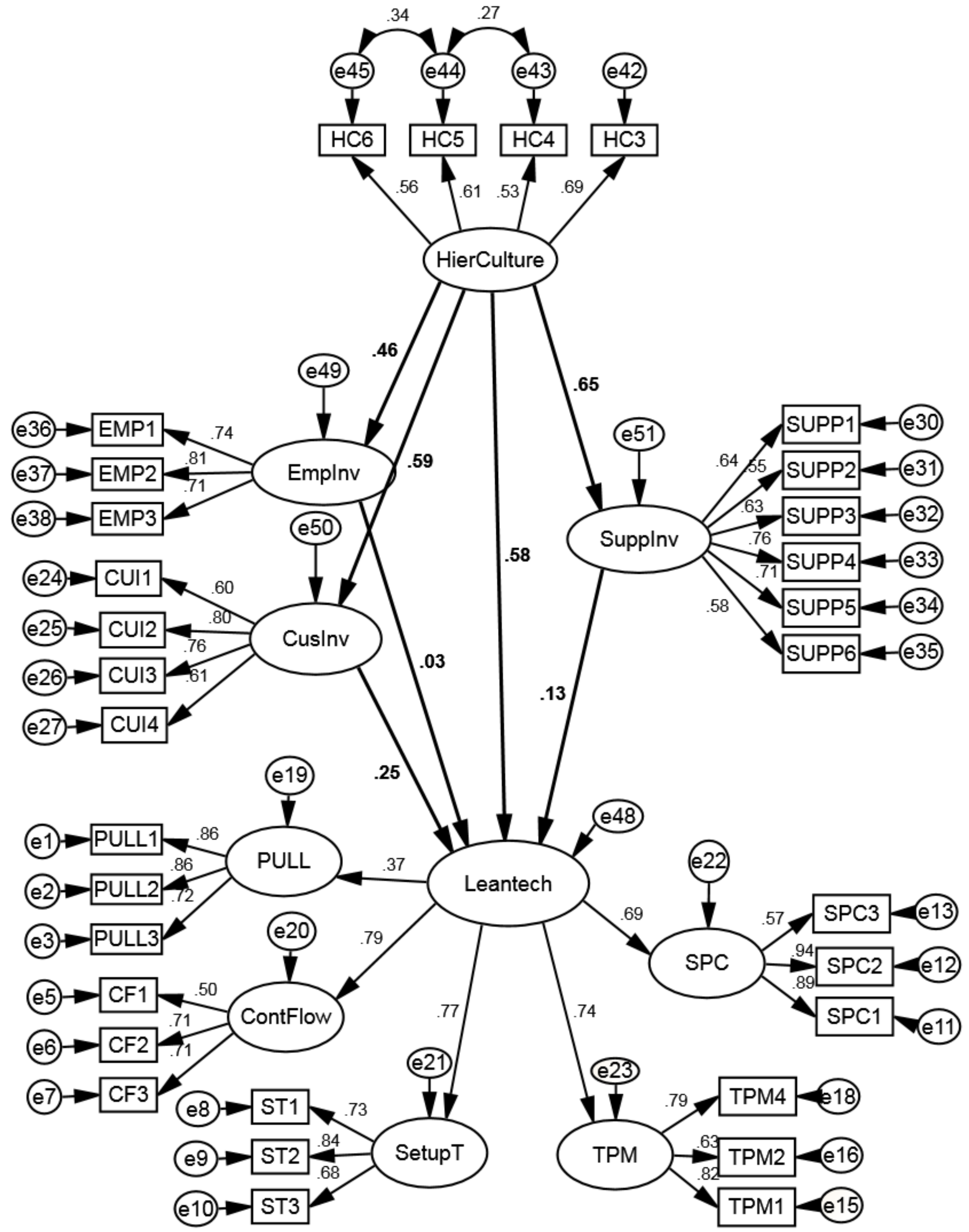
Prior to discussing the result of the hypotheses proposed by the current study, the overall fit of the structural mediating model 3 is assessed to evaluate the extent to which the proposed causal relationship between the latent constructs fit the research data (Byrne, 2010). The fit indices indicate that the structural mediating model 3 has a good fit with the data (CMIN=698.835, DF=450, p value= 0.000, CMIN/DF=1.553, CFI=0.908, IFI=0.909, RMSEA=0.052), thus supporting the basic conceptual model 3: hierarchical culture (see figure 3.4). Table 8.10 presents the results of testing the hypothesized direct relationships in structural mediating model 3. Table 8.10 also includes the standardized path coefficients (regression weights) and the corresponding p value for significance levels.

Table 8-10 Hypotheses Test Results for the Structural Mediating Model 3: Hierarchical Culture

Hypothesized direct relationship		St. regression weight	p-value	result
H10a	HierCulture ⟶ CusInv	0.588	0.000***	supported
H10b	HierCulture ⟶ EmpInv	0.458	0.000***	supported
H10c	HierCulture ⟶ SuppInv	0.654	0.000***	supported
H11a	CusInv ⟶ Leantech	0.254	0.023*	supported
H11b	EmpInv ⟶ Leantech	0.031	0.686 (n.s)	Not supported
H11c	SuppInv ⟶ Leantech	0.126	0.048*	supported

*** $p < 0.001$, ** $p < 0.01$, *$p< 0.05$, $p > 0.05$(n.s.)
HierCulture: Hierarchical Culture, CusInv: Customers' Involvement, Leantech: Lean technical practices, SuppInv: Suppliers' Involvement, EmpInv: Employees' Involvement.
Source: Based on AMOS outputs

Figure 8-8 Structural Mediating Model 3: Hierarchical Culture



: Structural regression coefficient

: Path coefficient for regression of a measured variable onto a latent variable.

: Measurement error

: Covariance between error terms

Source: Based on AMOS outputs

As shown in table 8.10, hypotheses H10a, H10b and H10c investigate the effect of hierarchical culture on customers' involvement, employees' involvement and suppliers' involvement respectively. It is hypothesized that there would be a positive effect of hierarchical culture on customers' involvement, hierarchical culture on employees' involvement and hierarchical culture on suppliers' involvement. The results, demonstrate positive significant paths from hierarchical culture to customers' involvement (β= 0.588, $p <0 .001$), from hierarchical culture to employees' involvement (β= 0.458, $p < 0.001$), and from hierarchical culture to suppliers' involvement (β= 0.654, $p < 0.001$). Thus, hypotheses H10a, H10b, and H10c are supported.

Furthermore, hypotheses H11a, H11b and H11c investigate the effect of customers' involvement on lean technical practices implementation, employees' involvement on lean technical practices implementation and suppliers' involvement on lean technical practices implementation. It is hypothesized that there would be a positive effect of customers' involvement on lean technical practices implementation, employees' involvement on lean technical practices implementation and suppliers' involvement on lean technical practices implementation. The results, demonstrate positive significant paths from customers' involvement to lean technical practices implementation (β= 0.254, $p < 0.05$), and from suppliers' involvement to lean technical practices implementation (β= 0.126, $p < 0.05$). Whereas the path from employees' involvement to lean technical practices implementation is weakly positive and not significant (β= 0.031, $p >0.05$), Thus, hypotheses H11a and H11c are supported whereas H11b is not supported.

To examine the mediating roles of customers' involvement, employees' involvement and suppliers' involvement in the relationship between hierarchical culture and lean technical practices implementation. A Sobel test with bootstrapped standard errors based on 1000 resampling is conducted. The results of this test are presented in table 8.11.

Table 8-11 Sobel Test Results for Structural Mediating Model 3: Hierarchical Culture

	Indirect effect	Sobel test statistic	St. error	Mediation type	Result
H12a	HierCulture → CusInv → Leantech	2.10	0.03*	partial	supported
H12b	HierCulture → EmpInv → Leantech	0.40	0.68(n.s)	none	Not supported
H12c	HierCulture → SuppInv→ Leantech	2.18	0.029*	partial	supported

*** p < 0.001, ** p < 0.01, *p < 0.05, p > 0.05 (n.s.)
HierCulture: Hierarchical Culture, CusInv: Customers' Involvement, Leantech: Lean technical practices, SuppInv: Suppliers' Involvement, EmpInv: Employees' Involvement
Source: Author's calculations

As shown in table 8.11, the results confirm that customers' involvement has a partial mediating effect on the relationship between hierarchical culture and lean technical practices (Sobel test= 2.10, p< 0.05). Also, suppliers' involvement has a partial mediating effect on the relationship between hierarchical culture and lean technical practices (Sobel test= 2.18, p< 0.05). The mediation effect for customers' involvement and suppliers' involvement is partial because based on Baron and Kenny's (1986) principles, a partial mediation occurs when the path between the two variables is not zero, just a significant reduction happens. As shown in figure 8.7, the path from hierarchical culture to lean technical practices has a lower significant beta coefficient (β= 0.58, p< 0.01) than that of the structural direct model 3: hierarchical culture in figure 8.3 (β= 0.75, p< 0.001). This provides an evidence of the partial mediation effect for customers' involvement and suppliers' involvement on the relationship between hierarchical culture and lean technical practices implementation.

Whereas, it is found that employees' involvement has no mediating effect on the relationship between hierarchical culture and lean technical practices (Sobel test= 0.40, p> 0.05). The insignificant direct relationship between employees' involvement and lean technical practices indicates the lack of mediation effect of employees' involvement on the relationship between hierarchical culture and lean technical practices implementation. Thus, hypotheses H12a and H12c are supported whereas H12b is not supported.

8.4.4 Structural Mediating Model 4: Rational Culture

In the current study, the proposed structural mediating model 4 is composed of five latent constructs. One of them is exogenous (rational culture) and four are endogenous (customers' involvement, employees' involvement and suppliers' involvement and lean technical practices). Figure 8.9 presents the structural mediating model 4: rational culture.

The overall fit of the structural mediating model 4 is assessed to evaluate the extent to which the proposed causal relationship between the latent constructs fit the research data. The fit indices indicate that the structural mediated model 4 has a good fit with the data (CMIN/DF=1.594, CFI=0.900, IFI=0.902, RMSEA=0.054), thus supporting the basic conceptual model 4 of the study (figure 3.5).

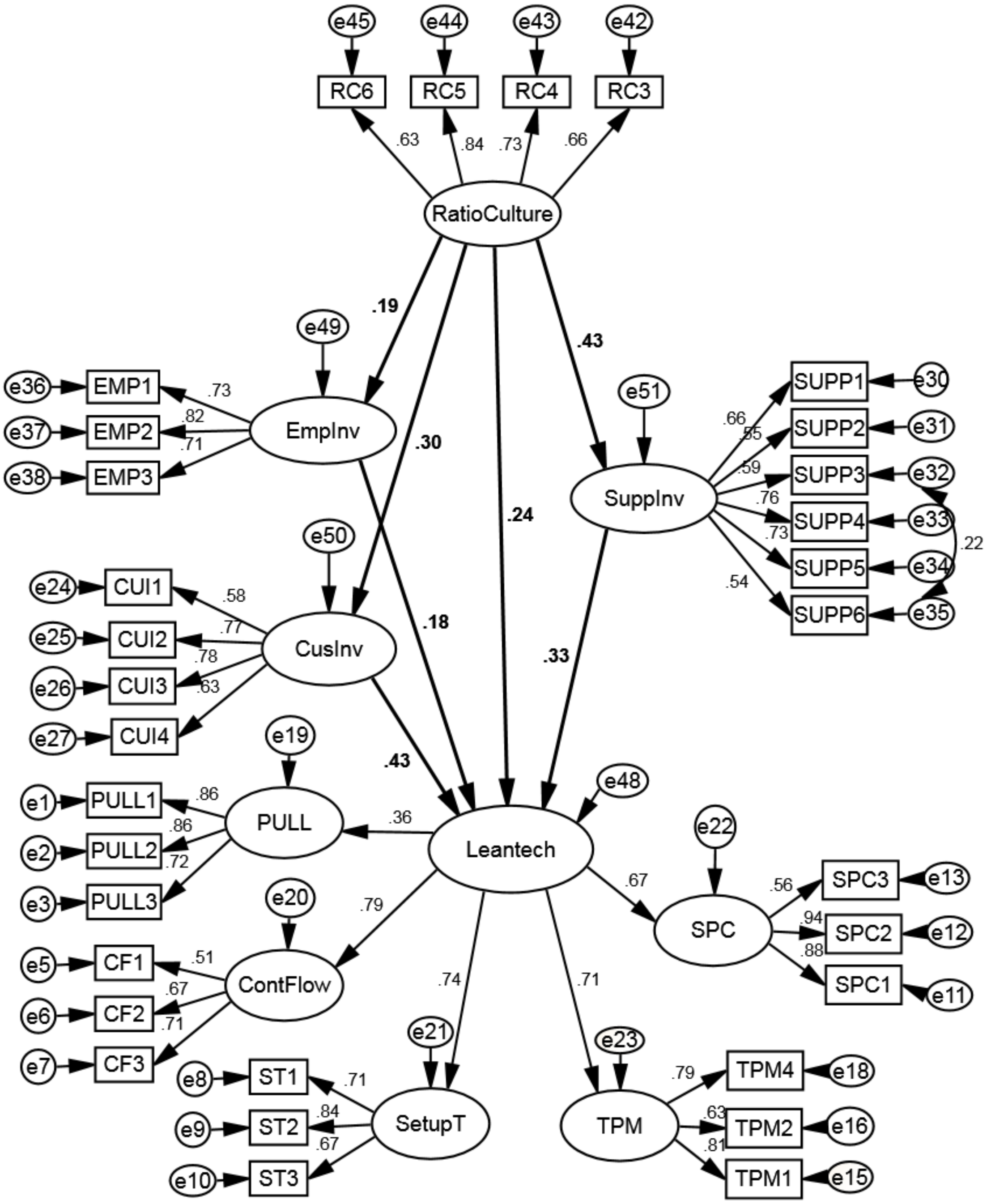
Table 8.12 presents the results of testing the hypothesized direct relationships in the structural mediating model 4. The table also includes the standardized path coefficients (regression weights) and the corresponding p value for significance levels.

Table 8-12 Hypotheses Test Results for the Structural Mediating Model 4: Rational Culture

Hypothesized direct relationship		St. regression weight	p-value	result
H14a	RatioCulture ⟶ CusInv	0.296	0.001**	supported
H14b	RatioCulture ⟶ EmpInv	0.187	0.031*	Supported
H14c	RatioCulture ⟶ SuppInv	0.428	0.000***	Supported
H15a	CusInv ⟶ Leantech	0.430	0.000***	Supported
H15b	EmpInv ⟶ Leantech	0.181	0.061(n.s.)	Not supported
H15c	SuppInv ⟶ Leantech	0.334	0.003**	supported

*** $p < 0.001$, ** $p < 0.01$, *$p < 0.05$, $p > 0.05$(n.s.)
RatioCulture: Rational Culture, CusInv: Customers' Involvement, Leantech: Lean technical practices, SuppInv: Suppliers' Involvement, EmpInv: Employees' Involvement
Source: Based on AMOS outputs

Figure 8-9 Structural Mediating Model 4: Rational Culture



: Structural regression coefficient

: Path coefficient for regression of a measured variable onto a latent variable.

: Measurement error

: Covariance between error terms

Source: Based on AMOS outputs

As shown in table 8.12, hypotheses H14a, H14b and H14c investigate the effect of rational culture on customers' involvement, employees' involvement and suppliers' involvement respectively. It is hypothesized that there would be a positive effect of rational culture on customers' involvement, rational culture on employees' involvement and rational culture on suppliers' involvement. The results demonstrate positive and significant paths from rational culture to customers' involvement ($\beta = 0.296$, $p < 0.01$), from rational culture to employees' involvement ($\beta = 0.187$, $p < 0.05$), and from rational culture to suppliers' involvement ($\beta = 0.428$, $p < .001$). Thus, hypotheses H14a, H14b, and H14c are supported.

Furthermore, hypotheses H15a, H15b and H15c investigate the effect of customers' involvement on lean technical practices implementation, employees' involvement on lean technical practices implementation and suppliers' involvement on lean technical practices implementation. It is hypothesized that there would be a positive effect of customers' involvement on lean technical practices implementation, employees' involvement on lean technical practices implementation and suppliers' involvement on lean technical practices implementation. The results demonstrate positive and significant paths from customers' involvement to lean technical practices implementation ($\beta = 0.430$, $p < .001$), from suppliers' involvement to lean technical practices implementation ($\beta = 0.334$, $p < .01$). Whereas the path from employees' involvement to lean technical practices implementation is weakly positive and not significant ($\beta = 0.181$, $p > .05$), Thus, hypotheses H15a, H15c are supported, whereas H15b is not supported.

To investigate the mediating roles of customers' involvement, employees' involvement and suppliers' involvement in the relationship between rational culture and lean technical practices implementation, a Sobel test with bootstrapped standard errors based on 1000 resampling is conducted. The results of this test are presented in table 8.13.

Table 8-13 Sobel Test Results for Structural Mediating Model 4: Rational Culture

Indirect effect		Sobel test statistic	St. error	Mediation type	Result
H16a	RatioCulture → CusInv → Leantech	2.33	0.02*	Partial	supported
H16b	RatioCulture → EmpInv → Leantech	1.53	0.12 (n.s)	None	Not supported
H16c	RatioCulture → SuppInv → Leantech	2.48	0.013*	Partial	supported

*** p < 0.001, ** p < 0.01, *p < 0.05, p > 0.05 (n.s.)
RatioCulture: Rational Culture, CusInv: Customers' Involvement, Leantech: Lean technical practices, SuppInv: Suppliers' Involvement, EmpInv: Employees' Involvement.
Source: Author's calculations

As shown in table 8.13, the results confirm that customers' involvement has a partial mediating effect on the relationship between rational culture and lean technical practices implementation (Sobel test= 2.33, $p< 0.05$). Also, suppliers' involvement have a partial mediating effect on the relationship between rational culture and lean technical practices implementation (Sobel test= 2.48, $p< 0.05$).

Based on Baron and Kenny's (1986) mediation approach, if the path between variable X (rational culture) and variable Y (lean technical practices) is reduced to zero and the relationship between them is no longer significant, a complete mediation occurs. Whereas, partial mediation occurs when the path between the two variables is not zero, just a significant reduction happens. In figure 8.8, the path from rational culture to lean technical practices has a lower significant path coefficient ($\beta = 0.24$, $p< 0.01$) than that of the structural direct model 4: rational culture in figure 8.4 ($\beta = 0.48$, $p< 0.001$). This provides an evidence of the partial mediation effect of customers' involvement and suppliers' involvement on the relationship between rational culture and lean technical practices implementation.

Furthermore, it is found that employees' involvement has no mediation effect on the relationship between rational culture and lean technical practices (Sobel test= 1.53, $p> 0.05$). The insignificant direct relationship between employees' involvement and lean technical practices indicates the lack of mediation effect of employees' involvement on the relationship between rational culture and lean technical practices implementation. Thus, hypotheses H16a and H16c are supported whereas H16b is not supported.

8.5 Proportion of Mediation in the Four Structural Mediating Models

As shown in figure 8.5, X is the independent variable, M is the mediator and Y is the dependent variable. In the same figure, *a* represents the standardized path coefficient from the independent variable to the mediator, *b* represents the standardized path coefficient from the mediator to the dependent variable and c´ represents the standardized path coefficient from the independent to the dependent variable. If both *a* and *b* are significant there is *prima facie* evidence of mediation.

According to Iacobucci et al. (2007) the proportion of mediation (i.e. the relative size of the indirect versus direct pathways) could be determined by comparing the magnitude of the indirect to total (direct plus indirect) path coefficients. This could be attained using the following equation:

$$\text{Proportion of Mediation} = \frac{a \times b}{(a \times b) + c'}$$

Source: Preacher and Hayes (2004)

Table 8.14 shows the values of the standardised path coefficient from the independent variable (organizational culture type) to mediators (customers' involvement and suppliers' involvement), the standardised path coefficients from mediators to the dependent variable (lean technical practices) and the standardized path coefficients from the independent variable (organizational culture type) to the dependent variable (lean technical practices). Table 8.14 also shows the ratios of indirect-to-total effects.

Table 8-14 Results of Testing Proportion of Mediation of Customers' Involvement and Suppliers' Involvement on Organisational Culture/ Lean Technical Practices Relationship

Indirect effect	Type of culture → Mediator (a)	Mediator → Lean technical practices (b)	Type of culture → Lean technical practices (c')	Ratio of indirect to total effect
GrouCulture → CusInv → Leantech	0.377***	0.406***	0.299**	0.338
GrouCulture → SuppInv → Leantech	0.498***	0.294**	0.299**	0.328
DeveCulture → CusInv → Leantech	0.434***	0.341**	0.434**	0.254
DeveCulture → SuppInv → Leantech	0.482***	0.258**	0.434**	0.222
HierCulture → CusInv → Leantech	0.587***	0.256**	0.577**	0.206
HierCulture → SuppInv → Leantech	0.657***	0.130**	0.577**	0.128
RatioCulture → CusInv → Leantech	0.296**	0.430***	0.242**	0.344
RatioCulture → SuppInv → Leantech	0.428***	0.334**	0.242**	0.399

*** $p < 0.001$, ** $p < 0.01$, *$p < 0.05$

GrouCulture: Group Culture, DeveCulture: Developmental Culture, HierCulture: Hierarchical Culture, RatioCulture: Rational Culture, CusInv: Customers' Involvement, Leantech: Lean technical practices, SuppInv: Suppliers' Involvement.

Source: Author’s calculations

As shown in table 8.14, the standardised path coefficient from group culture to customers’ involvement and the standardised path coefficient from customers’ involvement to lean technical practices in this type of culture are significant. The coefficient associated with the indirect path of group culture via customer’s involvement to lean technical practices equals 0.153 [0.377×0.406]. Table 8.14 also shows the ratio of indirect to total effect equals **0.338** [0.153/ (0.153 + 0.299)]. This indicates that 33.8 per cent of lean technical practices implementation variance explained by both group culture and customers' involvement is accounted for the indirect path via customers' involvement, whereas the rest of lean technical practices implementation variance explained by group culture and customers' involvement is accounted for by the direct path. Thus, there is partial mediation and the direct path is predominated.

As shown in table 8.14, the standardised path coefficient from group culture to suppliers’ involvement and the standardised path coefficient from suppliers’ involvement to lean technical practices in this type of culture are significant. The standardized coefficient associated with the indirect path of group culture via suppliers' involvement to lean technical practices equals 0.146[0.498×0.294]. Table 8.14 also shows the ratio of indirect to total effect equals **0.328** [0.146/ (0.146 + 0.299)]. This indicates that 32.8 per cent of lean technical practices implementation variance explained by both group culture and suppliers' involvement is accounted for the indirect path via suppliers' involvement, whereas the rest of the lean technical practices implementation variance explained by group culture and suppliers' involvement is accounted for by the direct path. Thus, there is partial mediation and the direct path is predominated. The results of group culture confirm that both customers' involvement and suppliers' involvement play as two mechanisms to understand how group culture affects lean technical practices implementation. In addition, the two mediators play approximately equal mediating role in the relationship between group culture and lean technical practices. In addition, the predominance of the direct path means that there are other important mediators, which affects the relationship between group culture and lean technical practices implementation that are still awaiting discovery.

Table 8.14 shows that the standardised path coefficient from developmental culture to customers' involvement and the standardised path coefficient from customers' involvement to lean technical practices in this type of culture are significant. Table 8.14 shows that the standardised beta coefficient associated with the indirect path of developmental culture via customers' involvement to lean technical practices equals 0.148 [0.434×0.341]. Table 8.14 also shows the ratio of indirect to total effect equals **0.254** [0.148/ (0.148 + 0.434)]. This indicates that 25.4 per cent of the lean technical practices implementation variance explained by both developmental culture and customers' involvement is accounted for the indirect path via customers' involvement, whereas the rest of the lean technical practices implementation variance explained by developmental culture and customers' involvement is accounted for by the direct path. Thus, there is partial mediation and the direct path is predominated.

Also, table 8.14 shows the standardised path coefficient from developmental culture to suppliers' involvement and the standardised path coefficient from suppliers' involvement to lean technical practices in this type of culture are significant. The standardized coefficient associated with the indirect path of developmental culture via suppliers' involvement to lean technical practices equals 0.124 [0.482×0.258]. Table

8.14 also shows the ratio of indirect to total effect equals **0.222**[0.124/ (0.124 + 0.434)]. This indicates that 22.2 per cent of the lean technical practices implementation variance explained by both developmental culture and suppliers' involvement is accounted for the indirect path via suppliers' involvement, whereas the rest of the lean technical practices implementation variance explained by developmental culture and suppliers' involvement was accounted for by the direct path. Thus, there is partial mediation and the direct path is predominated. The results of developmental culture confirm that both customers' involvement and suppliers' involvement play as two mechanisms to understand how developmental culture affects lean technical practices implementation. In addition, the two mediators play have moderate proportion of mediation effect on the relationship between developmental culture and lean technical practices, since customers' involvement shows slightly higher mediation effect on this relationship (0.254) compared with suppliers' involvement (0.222).Also, the predominance of the direct path means that there are other important mediators affects the relationship between developmental culture and lean technical practices implementation that are still awaiting discovery.

Table 8.14 shows that the standardised path coefficient from hierarchical culture to customers' involvement and the standardised path coefficient from customers' involvement to lean technical practices in this type of culture are significant. Table 8.14 shows that the coefficient associated with the indirect path of hierarchical culture via customers' involvement to lean technical practices equals 0.150 [0.588×0.254]. Table 8.14 also shows the ratio of indirect to total effect equals **0.205** [0.150/ (0.150 + 0.582)]. This indicates that 20.5 per cent of the lean technical practices implementation variance explained by both hierarchical culture and customers' involvement is accounted for the indirect path via customers' involvement, whereas the rest of the lean technical practices implementation variance explained by hierarchical culture and customers' involvement is accounted for by the direct path. Thus, there is partial mediation and the direct path is predominated.

In addition, table 8.14 shows the standardised path coefficient from hierarchical culture to suppliers' involvement and the standardised path coefficient from suppliers' involvement to lean technical practices in this type of culture are significant. Also, table 8.14 shows that the standardized coefficient associated with the indirect path of hierarchical culture via suppliers' involvement to lean technical practices equals 0.082 [0.654×0.126]. Table 8.14 also shows the ratio of indirect to total effect equals **0.123** [0.082/ (0.082+ 0.582)]. This indicates that 12.3 per cent of the lean technical practices implementation variance explained by both hierarchical culture and suppliers' involvement is accounted for the indirect path via suppliers' involvement, whereas the rest of the lean technical practices implementation variance explained by hierarchical culture and suppliers' involvement is accounted for by the direct path. Thus, there is partial mediation and the direct path is predominated. The results of hierarchical culture confirm that both customers' involvement and suppliers' involvement play as two mechanisms to understand how hierarchical culture affects lean technical practices implementation. In addition, the two mediators play have less proportion of mediation effect on the relationship between hierarchical culture and lean technical practices compared with group and developmental cultures. It is noted also that customers' involvement has higher mediation effect on this relationship (0.205) compared with suppliers' involvement (0.123). Also, the predominance of the direct path means that there are other important mediators affect the relationship between hierarchical culture and lean technical practices implementation that are still awaiting discovery.

Table 8.14 shows that the standardised path coefficient from rational culture to customers' involvement and the standardised path coefficient from customers' involvement to lean technical practices in this type of culture are significant. Table 8.14 shows that the coefficient associated with the indirect path of rational culture via customers' involvement to lean technical practices equals 0.127 [0.296×0.430]. Table 8.14 also shows the ratio of indirect to total effect equals **0.344** [0.127/ (0.127 + 0.242)]. This indicates that 34.4 per cent of the lean technical practices implementation variance explained by both rational culture and customers' involvement is accounted for the indirect path via customers' involvement, whereas the rest of the lean technical practices implementation variance explained by rational culture and customers' involvement is accounted for by the direct path. Thus, there is partial mediation and the direct path is predominated.

In addition, table 8.14 shows the standardised path coefficient from rational culture to suppliers' involvement and the standardised path coefficient from suppliers' involvement to lean technical practices in this type of culture are significant. Moreover, table 8.14 shows that the standardized coefficient associated with the indirect path of rational culture via suppliers' involvement to lean technical practices equals 0.143 [0.428×0.334]. Table8.14 also shows the ratio of indirect to total effect equals **0.399** [0.143/ (0.143+ 0.242)]. This indicates that 39.9 per cent of the lean technical practices implementation variance explained by both rational culture and suppliers' involvement is accounted for the indirect path via suppliers' involvement, whereas the rest of the lean technical practices implementation variance explained by rational culture and suppliers' involvement is accounted for by the direct path. Thus, there is partial mediation and the direct path is predominated. The results of rational culture confirm that both customers’ involvement and suppliers’ involvement play as two mechanisms to understand how rational culture affects lean technical practices implementation. In addition, the two mediators play have moderately high proportion of mediation effect on the relationship between rational culture and lean technical practices. It is noted also that suppliers’ involvement mediator has higher mediation effect on this relationship (0.399) compared with customers’ involvement (0.344). Also, the predominance of the direct path means that there are other important mediators affect the relationship between rational culture and lean technical practices implementation that are still awaiting discovery

8.6 Comparison among the Four Structural Mediated Models in terms of the Proportion of Mediation

Table 8.15 below shows the comparison among the four types of organizational culture regarding the mediation effect proportion of human lean practices. The table shows that customers' involvement and suppliers' involvement have the greatest mediation partial effect in rational culture (total indirect effect= **0.743** (0.344+0.399)). This indicates that customers' involvement and suppliers' involvement plays significantly the strongest mediation effect in the relationship between rational culture and lean technical practices implementation in a high extent.

The second greatest mediation partial effect is in group culture (total indirect effect= **0.666** (0.338+0.328)). This also indicates that customers' involvement and suppliers' involvement plays significantly the second strongest mediation effect in the relationship between group culture and lean technical practices implementation in a high extent

Furthermore, as shown in table 8.15 that the proportion of mediation effect caused by customers' involvement and suppliers' involvement in the developmental culture is lower than the proportion of mediation effect caused by customers' involvement and suppliers' involvement in rational and group cultures (total indirect effect= **0.476** (0.254+0.222). This indicates that customers' involvement and suppliers' involvement plays significantly highly moderate extent of mediation effect in the relationship between developmental culture and lean technical practices implementation.

The least mediation effect size for customers' involvement and suppliers' involvement is in the hierarchical culture (total indirect effect= **0.328** (0.205+0.123)). This indicates that customers' involvement and suppliers' involvement plays significantly lower mediation effect in the relationship between hierarchical culture and lean technical practices implementation compared with the other types of culture.

Table 8-15 Comparison among the Four Types of Organisational Culture in terms of the Proportion of Mediation Effect

Organisational culture/ Lean technical practices	Proportion of mediator 1 (customers' involvement)	Proportion of mediator 2 (suppliers' involvement)	Total percentage of partial mediation (Mediator1+ Mediator 2)
RatioCulture → Leantech	0.344	0.399	0.743
GrouCulture → Leantech	0.338	0.328	0.666
DeveCulture → Leantech	0.254	0.222	0.476
HierCulture → Leantech	0.205	0.123	0.328

GrouCulture: Group Culture, DeveCulture: Developmental Culture, HierCulture: Hierarchical Culture, RatioCulture: Rational Culture, Leantech: Lean technical practices

Source: Author's calculations

8.7 Chapter Summary

In this chapter the hypothesized relationship between the study's constructs has been tested using SEM. The results reveal that the four types of organisational culture have significant positive relationships with lean technical practices implementation but with different regression weights. Hierarchical culture has the highest positive effects on lean technical practices implementation followed by developmental culture, group culture and rational culture respectively.

Regarding mediation effects, the results reveal that customers' involvement partially mediates the relationship between each type of organisational culture (group culture, developmental culture, hierarchical culture and rational culture) and lean technical practices implementation. Additionally, it is found that suppliers' lean practice partially mediates the relationship between each type of organisational culture (group culture, developmental culture, hierarchical culture and rational culture) and lean technical practices implementation. Furthermore, the results reveal that employees' involvement has no mediation effect in the relationship between each type of organisational culture (group culture, developmental culture, hierarchical culture and rational culture) and lean technical practices implementation.

The proportion of mediation effect for customers' involvement and suppliers' involvement has been examined. The results found that the proportion of mediation for customers' involvement and suppliers' involvement is the highest effect on the relationship between rational culture and lean technical practices. Whereas, the least proportion of mediation effect for both customers' involvement and suppliers' involvement occurs in the relationship between hierarchical culture and lean technical practices.

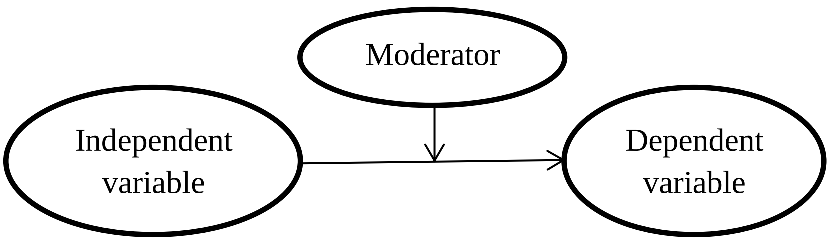
This chapter has presented the answers of the first five research’s questions as stated in section 1.7. The next chapter will present the analysis of moderating effects of firm size and age on the relationship between organisational culture and lean technical practices to answer the last question of the current study as stated in section 1.7.

CHAPTER NINE: Testing the Role of Moderators in the Organisational Culture/ Lean Technical Practices Relationship Using Multi-Group Analysis

9.1 Introduction

The moderation perspective implies that a relationship between one independent variable and one dependent variable is dependent on the level of a third variable called "moderator" (Frazier et al., 2004). Figure 9.1 depicts this type of relationship. However, a moderator is a variable that affects the relationship between an independent and a dependent variable by strengthening the relationship or changing its direction (Baron and Kenny, 1986).

Figure 9-1 Moderation Perspective



Source: Baron and Kenny (1986)

This chapter addresses the hypotheses which are developed based on theory to examine the moderating effect of firm size and age on the relationship between each type of organizational culture (group, developmental, hierarchical or rational) and lean technical practices implementation (for more details about these hypotheses, see sub section 3.3.17). The same four structural mediated models which are tested in chapter 8 will be tested again with the existence of a moderator (e.g. size). This chapter serves to achieve the last objective of the current study as stated in chapter 1 (section 1.6). This objective is:

Examining the moderating effect of contextual variables (size and age of the organisation) on the relationship between organisational culture (group culture, developmental culture, hierarchical culture and rational culture) and lean technical practices implementation.

9.2 Moderation Tests Techniques

The mechanics of testing moderation in the current study is called "Multi-group analysis" in which the group data should be pooled and all subsequent investigative analysis should be relied on single-group analysis. This test is considered reasonable and is straightforward (Byrne, 2001). The procedures of testing are as follows: **First**, the sample is divided into two groups depending on the moderator variable (e.g. firms' size). The multi group analysis in AMOS categorise the data based on the grouping value (e.g. size of the organisation) (Byrne, 2010). For each subsample, a covariance matrix is calculated, and the parameters are estimated for each subgroup by AMOS software. Of interest are the critical ratios (C.R) and regression weights (β) between paths. The pairwise comparison of the critical ratios (C.R) and regression weights (β) of two groups (e.g. small and big groups) in accordance for the two moderator variables are conducted. More specifically, the pairwise comparison may result in trimming any insignificant path in both groups and keeping just the significant ones before progressing in the analysis.

Second, a pairwise comparison is conducted between the two groups based on the chi-square difference X^2 between the two models. Chi-square is a statistical measure of difference used to compare and estimate the covariance matrices (Hair et el., 2010). The difference in chi square ΔX^2 can be computed by calculating the chi-square X^2 for the targeted model twice; the first time without regression weights constraints and called *unconstrained model*. The unconstrained model means that the moderating effect of one variable (e.g. firm's size) in which the effect of organizational culture on lean technical practices and all other paths in the model can be different. The second time the same model is tested with regression weights constraints (Byrne, 2010) and it is called *constrained model*. The constrained model means that the moderating effect of one variable in which the effect of organizational culture on lean technical practices and all other paths in the model are constrained to be equal across groups. The procedure of constrained model is explained by Byrne (2010) as the following "In structural equation modelling, testing for the invariance is accomplished by placing constraints on particular parameters. That is to say, the parameters are specified as being invariant (equivalent) across group". In AMOS software, constraints are specified through a labelling mechanism whereby each parameter to be held equal across groups is given a label. Then a comparison should be made between the chi-square X^2 of the constrained model with that for the initial model in which no equality constraints were imposed (Byrne, 2010).

The purpose of detecting the chi-square difference (ΔX^2) between the two models is checking if there is a significant difference occurs between both groups. This is the most important assumption in testing moderation. The difference in chi square (ΔX^2) should be statistically significant at the 0.05 level of significance to conclude that the model is not equivalent over the two groups. If the groups are statistically different at the model level a subsequent test for invariance is designed to pinpoint the location of this non-invariance (Byrne, 2010).

Third, detecting the location of non-invariance depends on the proposed hypotheses. In the current study, we aim to examine whether the firm size or age moderate the path between each type of organizational culture and lean technical practices implementation. This path is detected in each structural mediated model to accept or reject our hypotheses. This procedure requires to constraint just the required individual path under study (e.g. group culture/ lean technical practices). To accept or reject the hypothesis, a pairwise comparison has been conducted again as explained in the previous step based on the chi-square difference (ΔX^2) with one degree of freedom at the p- value< 0.05. In other words, if the path from the independent variable (e.g. group culture) to the dependent variable (e.g. lean technical practices) differs significantly (p-value < 0.05) by the moderator (e.g. firm's size), it is concluded that the effect of group culture on lean technical practices is moderated by firm's size.

For calculating the chi square difference ΔX^2 for the individual path, a specialized statistical excel package tool designed by Gaskin (2016) has been adopted. This tool is commonly used and valid. Additionally, the path differences are calculated and checked for any significance using the following formula:

$$t = \frac{Path_{sample\_1} - Path_{sample\_2}}{\left[\sqrt{\frac{(m-1)^2}{(m+n-2)} * S.E._{sample1}^2 + \frac{(n-1)^2}{(m+n-2)} * S.E._{sample2}^2}\right] * \left[\sqrt{\frac{1}{m} + \frac{1}{n}}\right]}$$

*m and n are the sample size of groups 1and 2 respectively. S.E is the Standard error.
Source: Hinton (2014)

9.3 The Moderating Effect of Firm's Size

9.3.1 The Moderating Effect of Firm Size on Group Culture/ Lean Technical Practices Path

The Chi square (X^2) for the structural mediated model 1: Group culture is calculated before and after applying the weight constraints to the whole model. The result shows that there is a significant difference between small and large firms at the model level (p-value <0.05) (see table 9.1).

Table 9-1 The Chi Square Difference for the Moderating Effect of Firm Size on Structural Mediating Model 1: Group Culture

	X^2	DF	p-value
Unconstrained Model	1087.356	742	0.000***
Constrained Model	1215.184	774	
Chi square difference ΔX^2	127.828	32	

*** p < 0.001

Source: Author's calculations

After proving that the firm size is a moderator at the model level; the next step is to identify the location of this non-variance by repeating the weight constraint method on the targeted individual path (group culture/ lean technical practices) and to calculate the chi square difference (ΔX^2) again. As shown in table 9.2, the analysis shows there is a significant difference (p-value < 0.05) between small and big firms in terms of the effect of group culture on lean technical practices. This means that the effect of group culture on lean technical practices is moderated by firm's size.

Table 9-2 The Chi Square Difference for the Moderating Effect of Firm Size on Group Culture/ Lean Technical Practices Path

	X^2	DF	p-value
Unconstrained Path	1091.20	742	0.001**
Constrained Path	1092.190	743	
Chi square difference ΔX^2	0.99	1	

** p < 0.01

Source: Author's calculations

Furthermore, table 9.3 shows that the regression estimate of small firms group is positive and significant (β= 0.397, p < 0.05) while the regression estimate of big firms group is negative and not significant (β= -0.323, p >0.05). This result means that the path from group culture to lean technical practices is positively stronger when the firm size is small than when it is big. Thus, H17a is accepted.

Table 9-3 Effect of Firm Size on Group Culture/ Lean Technical Practices Path

Structural Path	Small		Big	
GrouCulture → Leantech	St. regression weight	t-value	St. regression weight	t-value
	0.397	3.462***	-0.323	-1.535 (n.s.)

*** $p < 0.001$, $p > 0.05$(n.s.)
GrouCulture: Group Culture, Leantech: Lean technical practices
Source: Based on AMOS outputs

9.3.2 The Moderating Effect of Firm Size on Developmental Culture/ Lean Technical Practices Path

The Chi square (X2) for the structural mediated model 2: Developmental culture is calculated before and after applying the weight constraints to the whole model. The result shows that there is a significant difference between small and large firms at the model level (p-value <0.05) (see table 9.4).

Table 9-4 The Chi Square Difference for the Moderating Effect of Firm Size on Structural Mediating Model 2: Developmental Culture

	X^2	DF	p-value
Unconstrained Model	668.120	448	0.001**
Constrained Model	724.246	475	
Chi square difference ΔX^2	56.126	27	

** $p < 0.01$
Source: Author's calculations

After proving that the firm size is a moderator at the model level; the next step is to identify the location of this non-variance by repeating the weight constraint method on the targeted individual path (developmental culture/ lean technical practices) and calculating the chi square difference (ΔX^2) again. As shown in table 9.5 the analysis shows there is no significant difference (p-value > 0.05) between small and big firms in terms of the effect of developmental culture on lean technical practices. This means that the effect of developmental culture on lean technical practices is not moderated by the firm size because there is no significant difference between the two groups (small and big firms). Thus, **H17b** is rejected.

Table 9-5 The Chi Square Difference for the Moderating Effect of Firm Size on Developmental Culture/ Lean Technical Practices Path

	X^2	DF	p-value
Unconstrained Path	671.96	448	0.463(n.s.)
Constrained Path	668.561	449	
Chi square difference ΔX^2	3.399	1	

p > 0.05(n.s.)

Source: Author's calculations

9.3.3 The Moderating Effect of Firm Size on Hierarchical Culture/ Lean Technical Practices Path

The Chi square (X^2) for the structural mediated model 3: Hierarchical culture is calculated before and after applying the weight constraints to the whole model. The result shows that there is a significant difference between small and large firms at the model level (p-value <0.05) (see table 9.6).

Table 9-6 The Chi Square Difference for the Moderating Effect of Firm Size on Structural Mediating Model 3: Hierarchical Culture

	X^2	DF	p-value
Unconstrained Model	842.105	590	0.000***
Constrained Model	914.507	619	
Chi square difference ΔX^2	72.402	29	

*** p < 0.001

Source: Author's calculations

After proving that the firm size is a moderator at the model level; the next step is to identify the location of this non-variance by repeating the weight constraint method on the targeted individual path (hierarchical culture/ lean technical practices) and calculating the chi square difference (ΔX^2) again. As shown in table 9.7, the analysis shows there is significant difference (p-value < 0.05) between small and big firms in terms of the effect of hierarchical culture on lean technical practices. This means that the effect of hierarchical culture on lean technical practices is moderated by the firm's size.

Table 9-7 The Chi Square Difference for the Moderating Effect of Firm Size on Hierarchical Culture/ Lean Technical Practices Path

	X^2	DF	p-value
Unconstrained Path	845.95	590	0.001**
Constrained Path	851.686	591	
Chi square difference ΔX^2	5.736	1	

**p < 0.001

Source: Author's calculations

Furthermore, table 9.8 shows that the regression estimate of hierarchical culture/ lean technical practices path across the two groups is greater in big firms (β= 0.784, p < 0.05) than for the small firms group (β= 0.391, p< 0.05). This result means that the effect of hierarchical culture on lean technical practices works better when the firm size is big than when it is small. Thus, **H17c** is accepted.

Table 9-8 Effect of Firm size on Hierarchical Culture/ Lean Technical Practices Path

Structural Path	Small		Big	
HierCulture → Leantech	St. regression weight	t-value	St. regression weight	t-value
	0.391	2.357**	0.784	2.523**

** p < 0.01

HierCulture: Hierarchical Culture, Leantech: Lean technical practices

Source: Based on AMOS outputs

9.3.4 The Moderating Effect of Firm Size on Rational Culture/ Lean Technical Practices Path

The Chi square (X^2) for the structural moderated mediated model 4: Rational culture is calculated before and after applying the weight constraints to the whole model. The result shows that there is a significant difference between small and large firms at the model level (p-value <0.05) (see table 9.9).

Table 9-9 The Chi Square Difference for the Moderating Effect of Firm Size on Structural Mediating Model 4: Rational Culture

	X^2	DF	p-value
Unconstrained Model	1179.224	752	0.005**
Constrained Model	1235.788	784	
Chi square difference ΔX^2	56.564	32	

** $p < 0.01$

Source: Author's calculations

After proving that the firm size is a moderator at the model level; the next step is to identify the location of this non-variance by repeating the weight constraint method on the targeted individual path (rational culture/ lean technical practices) and calculating the chi square difference (ΔX^2) again. As shown in table 9.10, the analysis shows there is no significant difference (p-value < 0.05) between small and big firms in terms of the effect of rational culture on lean technical practices. This means that the effect of rational culture on lean technical practices is not moderated by the firm's size. Thus, **H17d** is rejected.

Table 9-10 The Chi Square Difference for the Moderating Effect of Firm Size on Rational Culture/ Lean Technical Practices Path

	X^2	DF	p-value
Unconstrained Path	1183.07	752	0.253(n.s.)
Constrained Path	1180.847	753	
Chi square difference ΔX^2	2.223	1	

$p > 0.05$(n.s.)

Source: Author's calculations

9.4 The Moderating Effect of Firm Age

9.4.1The Moderating Effect of Firm Age on Group Culture/ Lean Technical Practices Path

The Chi square (X^2) for the structural mediated model 1: group culture is calculated before and after applying the weight constraints to the whole model. The result shows there is a significant difference between old and new firms at the model level (p-value <.05) (see table 9.11).

Table 9-11 The Chi Square Difference for the Moderating Effect of Firm Age on Structural Mediating Model 1: Group Culture

	X^2	DF	p-value
Unconstrained Model	914.228	630	0.000***
Constrained Model	990.782	660	
Chi square difference ΔX^2	76.554	30	

*** $p < 0.001$

Source: Author's calculations

After proving that the firm age is a moderator at the model level; the next step is to repeat the weight constraint method on the targeted individual path (group culture/ lean technical practices) and calculating the chi square difference (ΔX^2) again. As shown in table 9.12. The analysis shows there is a significant difference (p-value < 0.05) between old and new firms in terms of the effect of group culture on lean technical practices. This means that the effect of group culture on lean technical practices is moderated by the firm age.

Table 9-12 The Chi Square Difference for the Moderating Effect of Firm Age on Group Culture/ Lean Technical Practices Path

	X^2	DF	p-value
Unconstrained Path	918.07	630	0.022*
Constrained Path	918.989	631	
Chi square difference ΔX^2	0.919	1	

$p < 0.05$

Source: Author's calculations

Moreover, table 9.13 shows that the regression estimate of group culture/ lean technical practices path across the two groups is greater in new firms ($\beta = 0.531$, $p < 0.05$) than for the old firms group ($\beta = 0.259$, $p < 0.05$). This result means that the effect of group culture to lean technical practices is positively stronger when the firm age is new than when it is old. Thus, **H18a** is accepted.

Table 9-13 Effect of Firm Age on Group Culture/ Lean Technical Practices Path

Structural Path	Old		New	
GrouCulture → Leantech	St. regression weight	t-value	St. regression weight	t-value
	0.259	2.323**	0.531	3.458***

*** $p < 0.001$, ** $p < 0.01$

GrouCulture: Group Culture, Leantech: Lean technical practices

Source: Based on AMOS outputs

9.4.2 The Moderating Effect of Firm Age on Developmental Culture/ Lean Technical Practices Relationship

The Chi square (X^2) for the structural moderated mediated model 2: developmental culture is calculated before and after applying the weight constraints to the whole model. The result shows that there is a significant difference between old and new firms at the model level (p-value <.05) (see table 9.14).

Table 9-14 The Chi Square Difference for the Moderating Effect of Firm Age on Structural Mediating Model 2: Developmental Culture

	X^2	DF	p-value
Unconstrained Model	1003.344	740	0.002**
Constrained Model	1065.621	773	
Chi square difference ΔX^2	62.277	33	

** $p < 0.01$

Source: Author's calculations

After proving that the firm age is a moderator at the model level; the next step is to repeat the weight constraint method on the targeted individual path (developmental culture/ lean technical practices) and calculating the chi square differenceΔX^2 again. As shown in table 9.15 the analysis shows that there is a significant difference (p-value < 0.05) between old and new firms in terms of the effect of developmental culture on lean technical practices. This means that the effect of developmental culture and lean technical practices is moderated by the firm age.

Table 9-15 The Chi Square Difference for the Moderating Effect of Firm Age on Developmental Culture/ Lean Technical Practices Path

	X^2	DF	p-value
Unconstrained Path	1007.19	740	0.003**
Constrained Path	1010.221	741	
Chi square difference ΔX^2	3.031	1	

**p < 0.01

Source: Author's calculations

Furthermore, table 9.16 shows that the regression estimate of developmental culture/ lean technical practices path across the two groups is significant in new firms (β= 0.711, p < 0.05) while it is not significant in the old firms group (β= 0.205, p> 0.05). This result means that the effect of developmental culture on lean technical practices is positively stronger when the firm age is new than when it is old. Thus, **H18b** is accepted.

Table 9-16 Effect of Firm Age on Developmental Culture/ Lean Technical Practices Path

Structural Path	Old		New	
DeveCulture → Leantech	St. regression weight	t-value	St. regression weight	t-value
	0.205	1.769(n.s)	0.711	3.271**

** p < 0.01, p > 0.05 (n.s.)

DeveCulture: Developmental Culture, Leantech: Lean technical practices

Source: Based on AMOS outputs

9.4.3 The Moderating Effect of Firm Age on Hierarchical Culture/ Lean Technical Practices Path

The Chi square (X^2) for the structural moderated mediated model 3: hierarchical culture is calculated before and after applying the weight constraints to the whole model. The result shows there is a significant difference between old and new firms at the model level (p-value <0.05) (see table 9.17).

Table 9-17 The Chi Square Difference for the Moderating Effect of Firm'Age on Structural Mediating Model 3: Hierarchical Culture

	X^2	DF	p-value
Unconstrained Model	1056.899	804	0.001**
Constrained Model	1117.106	836	
Chi square difference ΔX^2	60.207	32	

** $p < 0.01$

Source: Author's calculations

After proving that the firm age is a moderator at the model level; the next step is to repeat the weight constraint method on the targeted individual path (hierarchical culture/ lean technical practices) and calculating the chi square difference (ΔX^2) again. As shown in table 9.18, the analysis shows there is a significant difference (p-value < 0.05) between old and new firms in terms of the effect of hierarchical culture on lean technical practices. This means that the effect of hierarchical culture on lean technical practices is moderated by the firm age.

Table 9-18 The Chi Square Difference for the Moderating Effect of Firm Age on Hierarchical Culture/ Lean Technical Practices Path

	X^2	DF	p-value
Unconstrained Path	1060.74	804	0.001**
Constrained Path	1065.674	805	
Chi square difference ΔX^2	4.934	1	

**$p < 0.01$

Source: Author's calculations

Moreover, 9.19 shows that the regression estimate of hierarchical culture/ lean technical practices path across the two groups is greater in new firms (β= 1.00, p <0.05) than for the old firms (β= 0.466, p< 0.05). This result means that the effect of hierarchical culture on lean technical practices is positively stronger when the firm age is new than when it is old. Thus, H**18c** is accepted.

Table 9-19 Effect of Firm Age on Hierarchical Culture/ Lean Technical Practices Path

Structural Path	Old		New	
HierCulture → Leantech	St. regression weight	t-value	St. regression weight	t-value
	0.466	2.418**	1.00	2.517**

** $p < 0.01$
HierCulture: Hierarchical Culture, Leantech: Lean technical practices
Source: Based on AMOS outputs

9.4.4The Moderating Effect of Firm Age on Rational Culture/ Lean Technical Practices Path

The Chi square (X^2) for the structural mediated model 4: rational culture is calculated before and after applying the weight constraints to the whole model. The result shows there is a significant difference between old and new firms at the model level (p-value <0.05) (see table 9.20).

Table 9-20 The Chi Square Difference for the Moderating Effect of Firm Age on Structural Mediating Model 4: Rational Culture

	X^2	DF	p-value
Unconstrained Model	1120.992	818	0.000***
Constrained Model	1186.502	850	
Chi square difference ΔX^2	65.51	32	

*** $p < 0.001$
Source: Author's calculations

After proving that the firm age is a moderator at the model level; the next step is to repeat the weight constraint method on the targeted individual path (rational culture/ lean technical practices) and calculating the chi square difference (ΔX^2) again. As shown in table 9.21, the analysis shows there is a significant difference (p-value < 0.05) between old and new firms in terms of the effect of rational culture on lean technical practices. This means that the effect of rational culture on lean technical practices is moderated by the firm age.

Table 9-21 The Chi Square Difference for the Moderating Effect of Firm Age on Rational Culture/ Lean Technical Practices Path

	X^2	DF	p-value
Unconstrained Path	1124.83	818	0.002**
Constrained Path	1127.871	819	
Chi square difference ΔX^2	3.041	1	

**p < 0.01

Source: Author's calculations

Furthermore, table 9.22 shows that the regression estimate of rational culture/ lean technical practices path across the two groups is positive and significant in new firms ($\beta = 0.564$, $p < 0.05$), whereas, it is positive but not significant in old firms ($\beta = 0.151$, $p > 0.05$). This result means that the effect of rational culture to lean technical practices is positively stronger and significant when the firm age is new than when it is old. Thus, **H18d** is accepted.

Table 9-22 Effect of Firm Age on Rational Culture/ Lean Technical Practices Relationship

Structural Path	Old		New	
RatioCulture → Leantech	St. regression weight	t-value	St. regression weight	t-value
	0.151	1.518(n.s.)	0.564	2.588**

** p < 0.01, p > 0.05(n.s.)

RatioCulture: Rational Culture, Leantech: Lean technical practices

Source: Based on AMOS outputs

9.5 Chapter Summary

The chapter provides the results of eight hypotheses addressing the moderating effect of firm size and age on the relationship between organisational culture and lean technical practices. The results support the moderating effect of firm size on the relationship between group culture and lean technical practices as well as the relationship between hierarchical culture and lean technical practices. Whereas, the results do not support the moderating effect of firm size on the relationship between developmental culture and lean technical practices as well as the relationship between rational culture and lean technical practices.

Furthermore, the results provide support for the moderating effect of firm age on the relationship between all types of organisational culture and lean technical practices. The results show that new firms work better in terms of the effect of each type of organisational culture on lean technical practices than older firms. The next chapter presents discussion of the results of all the hypotheses proposed in the current study.

CHAPTER TEN: Discussion of the Findings

10.1 Introduction

This thesis investigates how the various types of organisational culture affect lean technical practices in the context of Jordanian manufacturing firms. Three lean human practices are examined as mediators when looking at the relationship between organisational culture and lean technical practices. Furthermore, the moderating effects of firm age and size have been examined to investigate their role in the relationship between organisational culture and lean technical practices.

The preceding two chapters have presented the data analysis and research findings. Eight structural models have been assessed. The first four structural models have examined the direct effect of each type of organisational culture on lean technical practices. The other four structural models have assessed the mediating role of the three lean human practices (customers' involvement, employees' involvement and suppliers' involvement) in the relationship between organisational culture and lean technical practices. The models have been used for hypotheses testing after ensuring that all of them achieved the required values of model fit indices.

This chapter takes the findings one-step further by providing more insights into the overall results and into the findings of hypotheses testing. The research findings are discussed based on the research questions. The findings for each research question are illustrated through aligning the results of hypotheses obtained from the current study with the results obtained by prior research, which have been addressed in the literature review chapter.

The first and second research questions will be discussed based on hypotheses 1, 5, 9 and 13. Those hypotheses focus on the direct effect of organisational culture on lean technical practices. The discussion of these two questions will rely on the previous studies which link between organisational culture and lean manufacturing or other related philosophies such as TOM or JIT. These previous studies have been explained in section 2.4 in the literature review chapter.

The third, fourth and fifth research questions will be discussed based on the hypotheses of the mediation effect of each lean human practice (customers' involvement, employees' involvement and suppliers' involvement) on the relationship between group culture and lean technical practices (H2a-c, H3a-c, H4a-c), between developmental culture and lean technical practices (H6a-c, H7a-c, H8a-c), between hierarchical culture and lean technical practices (H10a-c, H11a-c, H12a-c), and between rational culture and lean technical practices (H14a-c, H15a-c, H16a-c). Despite the lack of studies discussing the significant role of lean human practices in the relationship between organisational culture and lean technical practices, the discussion will rely more on theoretical arguments and prior research linking the organisational culture with lean manufacturing as explained in development of hypotheses and conceptual models chapter.

The last question will be discussed based on the last two hypotheses (H17a-d and H18a-d) which emphasize the moderating effect of firm size and firm age on the relationship between organisational culture and lean technical practices. The discussion of this question depends on aligning the results of the current study with the findings of a number of previous studies which examined the contextual factors such as the firm's age and size on lean manufacturing. These previous studies have been explained in subsection 3.3.17.

The chapter is divided into three sections. The second section discusses the findings obtained from the structural models relating to the research questions outlined in chapter 1. This will be followed by a chapter summary at the end of the chapter.

10.2 Discussion

The discussion of the study's results is organised around the research questions addressed in this thesis.

10.2.1 To What Extent Does Organisational Culture (Group Culture, Developmental Culture, Hierarchical Culture and Rational Culture) Affect Lean Technical Practices Implementation?

This first research question addresses the effect of organisational culture on lean technical practices. To answer this question four conceptual models are developed (see figures 3.1, 3.2, 3.3 and 3.4). Each conceptual model illustrates the effect of one type of organisational culture on lean technical practices. Four hypotheses are proposed (**H1, H5, H9, H13**) which address the direct effect of each type of organisational culture on lean technical practices implementation. Each hypothesis is examined in a separate structural direct model, as illustrated in chapter 8, the structural direct models take into consideration two constructs; the type of organisational culture and lean technical practices.

The first structural direct model (see figure 8.1) addresses the direct relationship between group culture and lean technical practices. The finding of the current study reveals that group culture has a significant positive effect on lean technical practices implementation with a standardised regression weight of 60 per cent. This result is consistent with previous studies (Karimi and Kadir, 2012, Kull et al., 2014, Prajogo and McDermott, 2005, Zu et al., 2010). For example, this result is consistent with Prajogo and McDermott (2005) and Haffar et al. (2013) who have found that group culture is the most significantly related culture to all practices of quality management. In addition, the result is in line with Karimi and Kadir (2012) and Zu et al. (2010) who have found that group culture has a significant positive effect on the technical side of TQM and six sigma approach. Furthermore, this result is consistent with the argument of Cassell et al. (2006) who argue that lean technical practices require the values of group culture such as the involvement and communication of all employees. This finding is also congruent with Kull et al. (2014) who have found that group culture produces a positive impact on lean manufacturing's effectiveness. This result confirms that the group culture facilitates in a moderately high extent the implementation of lean technical practices in the manufacturing firms in Jordan.

The second structural direct model (see figure 8.2) addresses the relationship between developmental culture and lean technical practices. It is found in the SEM analysis that developmental culture has a significant positive effect on lean technical practices implementation with a standardised regression weight of 67 per cent. This result is in line with previous studies (Al-Khalifa and Aspinwall, 2001, Haffar et al., 2013, Hardcopf and Shah, 2014, Naor et al., 2014, Prajogo and McDermott, 2005, Strode et al., 2009, Zammuto and O'Connor, 1992). For example, the result is consistent with Strode et al. (2009) who have found that the existence of developmental culture's values, such as innovation and risk taking, is positively associated with the effective use of agile method techniques. In addition, the result is in line with Prajogo and McDermott (2011) who have found that developmental culture facilitates process and product quality and innovation. Furthermore, the result is in line with Haffar et al. (2013) and Al-Khalifa and Aspinwall (2001) who have found that developmental culture is from the healthiest cultures in quality management. This finding is also consistent with a recent study for Hardcopf and Shah (2014) who have found that lean's effect on quality and flexibility is dependent upon having a developmental culture. Thus, this result confirms that the developmental culture affects positively lean technical practices implementation to a high extent in the manufacturing firms in Jordan.

The third structural direct model (see figure 8.3) addresses the direct relationship between hierarchical culture and lean technical practices. Consistent with previous studies (Cameron and Quinn, 2011, Cheng and Liu, 2007, Hassini et al., 2008, Mann, 2014, Mehri, 2006), the findings of the current study show that hierarchical culture has a significant positive effect on lean technical practices with a standardised regression weight of 75 per cent. This result supports the previously mentioned studies in considering hierarchical culture as one of the most important cultural types to the implementation of lean manufacturing practices. For example, this result is consistent with Cameron and Quinn (2011), who argue that the highest degrees of quality in organisations needs the existence of hierarchical culture's activities such as improving measurements, process control, and systematic problem solving. In addition, the result is in line with Hassini et al. (2008) who argue that the hierarchical culture naturally supports efficient supply chain practices that are built on mechanistic and internal control mechanisms. In addition, the result is congruent with Prajogo and McDermott (2011), who demonstrate that hierarchical culture's values, which are based on control, formalisation and stability, are positively associated with process quality improvements. However, this result contradicts the argument proposed by Kull et al.

(2014) that high emphasis on hierarchical culture has a negative effect on lean manufacturing, but the empirical analysis in Kull et al.'s (2014) study did not provide any support for this proposition. In addition, this result contradicts Haffar et al.'s study (2013) in that hierarchical culture negatively affects the implementation level of quality management practices. The difference in results between the current study and the previous two mentioned results refers to contingency theory, discussed earlier in chapter 3 (subsection 3.2.2). Contingency theory believes that a specific context can be more conducive for a specific type of organisational culture than other contexts (Drazin and Van de Ven, 1985). Contingency theory argues that there is no theory or method that can be applied in all situations (Flynn et al., 2010). This study confirms that hierarchical culture facilitates to a high extent the implementation level of lean technical practices in the Jordanian manufacturing context. This does not mean that the same type of culture will have the same effect in other contexts or countries.

The fourth structural direct model (see figure 8.4) addresses the direct relationship between rational culture and lean technical practices. The finding of the current study is that rational culture has a significant positive effect on lean technical practices with a standardised regression weight of 48 per cent. This result is in line with previous research (Karimi and Kadir, 2012, Kull and Wacker, 2010, Naor et al., 2014, Pakdil and Leonard, 2015, Stock et al., 2007, Zu et al., 2010). For example, the result is in line with Karimi and Kadir (2012), who found that rational culture has a positive significant impact on hard quality management practices. In addition, the result is consistent with Stock et al. (2007) who argue that the rational culture is well aligned to responsive supply chain practices. Furthermore, the result is consistent with Prajogo and McDermott (2011) who have found that rational culture affects positively the process quality variable. This result confirms that rational culture facilitates in a moderate extent the implementation level of lean technical practices in the Jordanian manufacturing firms.

Together, all types of organizational culture (group, developmental, hierarchical and rational) facilitate positively the implementation level of lean technical practices to a moderate to high extent in the Jordanian manufacturing firms. This means that all types are helpful in implementing lean technical practices successfully. This finding is expected and consistent with the recent work of Naor et al. (2014), who used the CVF to investigate the relationship between organizational culture and organizational effectiveness in the manufacturing industry in different regions and found that all cultural types are positively significant in East and West regions based on the effectiveness element prioritized by the firm. Each type of organisational culture has unique characteristics, which match with lean management as a philosophy.

10.2.2 What is/ are the Type(s) of Organisational Culture that Best Fit(s) with Implementing Lean Technical Practices?

The second question aims to explore the ideal type(s) of organisational culture to implement lean practices. By referring to the standardised regression weights of the structural paths in table 8.5, it is found that hierarchical culture has the highest effect on lean technical practices implementation with a standardised regression weight of 0.75. In addition, it is found that developmental culture has the second highest effect on lean technical practices implementation with a standardised regression weight of 0.67. Hierarchical and developmental cultures are followed by group culture with a standardised regression weight of 0.60 and rational culture with a standardised regression weight of 0.48. Based on contingency theory, the findings reveal that the hierarchical culture is the optimal cultural type that best fits lean technical practices in the Jordanian manufacturing firms' context. This result is consistent with the previous study of Cheng and Liu (2007) who have found that the hierarchical culture for implementing TQM philosophy in the Hong Kong construction industry is the best for criteria of success and efficiency in any organisation. In addition, the result is in line with Prajogo and McDermott (2005) and Prajogo and McDermott (2011), who found that the hierarchical culture has a significant positive relationship with certain practices of TQM such as process quality improvements.

The rationale behind finding that the hierarchical culture is the ideal type in the current study and a source of competitive advantage is that this type relies on efficiency, reliability, predictability and standardisation (Helfrich et al., 2007, Zu et al., 2011) and all of these factors are important principles in lean system (Mehri, 2006). Lean concept depends on specific and accurate principles and standards; therefore, it needs a type of organisational culture that believes in accurate measurement and respect for procedures and rules to reduce set up time and achieve the highest quality standards in the manufacturing process, so that in turn it can minimise waste, save resources and help the firm to achieve a competitive edge in the market.

Womack and Jones (2010) developed the basic principles of lean system (specifying value, mapping the value stream, creating flow, establishing pull and seeking perfection). They argue that implementing these principles requires accuracy, reliability, and control and all of these characteristics are represented in hierarchical culture.

Developmental culture is the second best cultural type for implementing lean technical practices. This refers also to the main values of developmental culture, which are fostering entrepreneurship, creativity, adaptability, flexibility and creativity (Cameron and Quinn, 2011). The emphasis of developmental culture is on being at the leading edge of new knowledge, products and services as well as the organisation's long term interest being on rapid growth and acquiring new resources (Cameron and Quinn, 2011). The characteristics of developmental culture match lean manufacturing in that both focus on minimising waste through finding new resources, which in turn achieves value to customers and competitive advantage in the market. The result is congruent with Haffar's et al (2013) study which found that developmental culture is the healthiest one with which to implement TQM in Syrian manufacturing firms. Similarly, the result is in line with Prajogo and McDermott (2011) who have found that developmental culture has a high positive impact on both product quality and product innovation. Based on the RBV, in the developmental culture there is more concentration on creating new processes and introducing new products to customers. This concentration reinforces the implementation level of lean practices to stay on the industry's leading edge by continuously pursuing new ideas and ways to perform tasks (Naor et al., 2014). For example, using SPC as one of lean technical practices needs control charts skills to detect problems. Therefore, developmental culture's values let employees feel more open to learning and applying lean technical skills. Lean is a philosophy of manufacturing focused on people development and continuous improvement, and both these concepts are implied in the developmental culture beliefs (Naor et al., 2008). This result also confirms Zammuto and O'Connor (1992) conclusion that an organisation characterised by more flexible culture such as developmental culture would show a higher level of effectiveness in advanced manufacturing technologies implementation than those that are more control-oriented.

Despite that the values in the hierarchical culture contradict those in the developmental culture on the CVF (figure 2.5), as developmental culture lies in a quadrant that emphasises flexibility and external focus, whereas the hierarchical culture lies in a quadrant focuses on control, stability and internal focus. This result confirms the importance of recognising lean as a multidimensional concept as discussed in section 2.2.2.2. The highest positive effects of developmental culture and hierarchical culture on lean technical practices implementation reinforce the combination of flexibility and control suggested by Sitkin et al. (1994).

10.2.3 To What Extent Does Organisational Culture (Group Culture, Developmental Culture, Hierarchical Culture and Rational Culture) Affect Lean Human Practices (Customers' Involvement, Employees' Involvement and Suppliers' Involvement)?

The third research question addresses the relationship between organisational culture and lean human practices. Lean human practices are customers' involvement, employees' involvement and suppliers' involvement. Twelve hypotheses are proposed to answer this question **(H2 (a-c), H6 (a-c), H10 (a-c), H14 (a-c)).** The twelve hypotheses address the positive direct effect of each type of organisational culture (group culture or developmental culture or hierarchical culture or rational culture) on the three lean human practices: customers' involvement, employees' involvement and suppliers' involvement. All hypotheses are tested using SEM through developing four structural mediated models as shown in figures 8.6, 8.7, 8.8 and 8.9. In each structural mediated model, there are three structural paths that address the effect of organisational culture on customers' involvement, employees' involvement, and suppliers' involvement respectively. The findings of the current study reveal that each type of organisational culture has a positive effect on the three lean human practices (customers' involvement, employees' involvement and suppliers' involvement). Beginning with the first lean human practice, which is customers' involvement. It is found that the hierarchical culture has the highest significant positive effect on customers' involvement with a standardised regression weight of 0.59 (table 8.10). This result is in line with the study of Lee et al. (2006) who have found that the consistency and coordination cultural traits of hierarchical culture has critical effects on customers. By referring to the structural path between developmental culture and customers' involvement, it is noticed that developmental culture has the second highest positive significant effect on customers' involvement with a standardised regression weight of 0.43 (table 8.8). Consistent with previous studies (Ahire and Dreyfus, 2000, Al-Khalifa and Aspinwall, 2001, Braunscheidel et al., 2010, Kaynak, 2003, Zu et al., 2010), this finding shows that emphasizing the values of developmental culture such as creating flexibility and diversity would motivate organisations to build strong relationships with customers. It is known that continuous improvement is one important dimension in developmental culture (Naor et al., 2008) and this result confirms that lean practices provide customers with their exact requirements without waste through continuous improvement (Heizer and Render, 2013). Therefore, developmental culture affects positively the involvement of customers.

Consistent with previous studies (Flynn et al., 1994, Karimi and Kadir, 2012, Naor et al., 2008, Zu et al., 2010, Womack and Jones, 2010), the results of this study reveal that group culture has also a significant positive effect on customers' involvement with standardised regression weight of 0.38 (table 8.6). This result is in line with the empirical study of Karimi and Kadir (2012) and Zu et al. (2010) who have found that group culture affects not just the technical practices in quality management philosophy but also the soft human practices such as customer focus. This result means that more emphasis on the values of group culture such as communication and participation will lead to more involvement by customers in organisations.

Finally, by referring to the structural path of rational culture/ customer' involvement, it is noted that the rational culture has the least positive significant effect on customers' involvement with a standardised regression weight of 0.30 (table 8.12). This finding is in line with previous studies (Abdulmalek and Rajgopal, 2007, Flynn et al., 1994, Karimi and Kadir, 2012, Kaynak and Hartley, 2008, Naor et al., 2008, Zu et al., 2010). The rational culture values focus on the external market and customer satisfaction (Quinn and Robert, 2011). Thus, this result confirms that adopting rational culture will facilitate collaborating with customers to gain competitive advantage.

The values of standardised regression weights related to customers' involvement reveal that the four types of organisational culture affect customers' involvement positively in a high to moderate extent (0.30- 0.59).

According to the second lean human practice, which is employees' involvement, the findings of the current study show that each type of organisational culture has a positive effect on employees' involvement. By referring to the standardised regression weight of hierarchical culture/ employees' involvement structural path, the result reveals that hierarchical culture has the greatest positive significant effect on employees' involvement with a standardised regression weight of 0.46 (table 8.10). This result is in line with Cameron and Quinn (2011) who claim that emphasizing hierarchical culture with its formalised and structured environment let people work collectively according to procedures. The focus in hierarchical culture is on stability, efficiency and consistency, and all these values are applied in Toyota culture system which adopts the "job security" policy to make people feel secure which in turn they feel trust and motivated to follow the formal procedures (Toyota, 2005).

Followed by the hierarchical culture is the group culture's effect on employees' involvement with a standardised regression weight of 0.33 (table 8.6). It is expected to reach this result because the essence of group culture is collaboration, communication and participation among organisational members (Cameron and Quinn, 2011). This result is in line with previous studies (Flynn et al., 1994, Kaynak, 2003, Lee and Choi, 2006, Zu et al., 2010, De Treville and Antonakis, 2006) in that the values of group culture which relies on employees' participation and collaboration facilitate the involvement of employees in organisations.

Moreover, the developmental culture has a significant positive effect on employees' involvement with a standardised regression weight of 0.30 (table 8.8). Developmental culture encourages the creative orientation, innovation, flexibility and entrepreneurship (Cameron and Quinn, 2011) and hence, this result is in line with Sohal and Egglestone (1994) who have found that implementing changes and producing high quality products to be first in the market motivates the involvement of all organisational members not just the senior management but also the lower levels. Therefore, this result confirms that adopting developmental culture leads to higher degrees of employees' involvement.

The least influential cultural type on employees' involvement is the rational culture. The structural path of rational culture/ employees' involvement shows that the rational culture affects positively employee's involvement with a standardised regression weight of 0.19 (table 8.12). This type has the least effect because the values of rational culture focus more on the external environment not the internal (Cameron and Quinn, 2011). Despite the low effect but it is still positive and this is in line with Karimi and Kadir (2012) who have found that rational culture affects not just the hard practices of lean management but also the soft practices such as the interaction and involvement with employees.

The values of standardised regression weights related to employees' involvement reveal that organisational culture affects positively employees' involvement in a moderate to low extent (0.19- 0.46).

With respect to the third lean human practice, which is suppliers' involvement, the findings of the current study show that each type of organisational culture has a positive effect on the use of suppliers' involvement. Again, the hierarchical culture has the greatest positive significant effect on suppliers' involvement with standardised regression weight of 0.65 (table 8.10). This finding is consistent with Hassini et al. (2008) who have found that hierarchical culture naturally supports efficient supply chain practices that are built on mechanistic and internal control mechanism. Thus, this result supports that emphasizing hierarchical culture facilitate the implementation of suppliers' involvement such as JIT delivery which requires a controlled and standardised schedule to deliver the required materials in the right place and right time.

Furthermore, group culture has a significant positive effect on suppliers' involvement with a standardised regression weight of 0.50 (table 8.6). This result is in line with previous studies (Karimi and Kadir, 2012, Kaynak, 2003, Naor et al., 2008, Zu et al., 2010) and supports the proposition of Kaynak (2003) and Zu et al. (2010) who have found that building relationships with suppliers means selecting suppliers based on quality, requesting supplier certification, involving suppliers in product design and improvement of manufacturing processes and all these factors require communication and collaboration which are represented in group culture's values.

Moreover, developmental culture has a significant positive effect on suppliers' involvement with standardised regression weight of 0.48 (table 8.8). This result is consistent with previous studies (Braunscheidel et al., 2010, Holcomb and Hitt, 2007, Kaynak, 2003, Zu et al., 2010). For instance, this result supports the empirical study of Braunscheidel et al. (2010) who have found that the developmental culture affects adopting the external integration with key suppliers. Also this result confirms the argument made by Holcomb and Hitt (2007) that the strategic partnerships with suppliers allow the organisation to obtain access to valuable capabilities from the suppliers. Thus, developmental culture which focuses on continuously seeking new resources and growth (Denison and Spreitzer, 1991) facilitates the collaboration with key suppliers.

The effect of developmental culture on suppliers' involvement is followed by rational culture which has the least significant positive effect on suppliers' involvement with a standardised regression weight of 0.43 (table 8.12).This finding is in line with previous research (Flynn et al., 1994, Kaynak and Hartley, 2008, Naor et al., 2008, Zu et al., 2010) in that organisations who emphasize rational culture focus on the external stakeholders such as suppliers to achieve competitiveness (Zu et al., 2010). In addition, this result is in line with Zu et al. (2010) who have found that adopting rational culture allow organisations to collaborate with key suppliers through strategic partnerships

The values of standardised regression weights related to suppliers' involvement reveal that the organisational culture affects suppliers' involvement in a moderate to high extent (0.43- 0.65).

The results of this study show that the effect of organisational culture on both customers' involvement and suppliers' involvement is greater than the effect of organisational culture on employees' involvement. This result is in line with previous arguments and studies (Flynn et al., 1994, Kaynak, 2003, Naor et al., 2008, Zu et al., 2010, Braunscheidel et al., 2010, Holcomb and Hitt, 2007, Karimi and Kadir, 2012) who argue that both customers and suppliers are outside the boundaries of the organisation, but they are the key parties in the whole supply chain. The results of this study add a new insight into the role of organisational culture in that it does not just affect the behaviours of organisational members or the internal work processes, but also the effect of organisational culture extends to the external parties such as suppliers and customers.

10.2.4 To What Extent Do Lean Human Practices (Customers' Involvement, Employees' Involvement and Suppliers' Involvement) Affect Lean Technical Practices Implementation?

The fourth research question addresses the effect of lean human practices on lean technical practices implementation in all types of organisational culture. Twelve hypotheses are proposed to answer this question **(H3 (a-c), H7 (a-c), H11 (a-c), H15(a-c)**). The twelve hypotheses address the positive direct effect of each lean human practice (customers' involvement, employees' involvement and suppliers' involvement on lean technical practices implementation in each type of organisational culture (group culture, developmental culture, hierarchical culture, rational culture). All hypotheses are tested using SEM through developing four structural mediated models (see figures 8.6, 8.7, 8.8 and 8.9). In each structural mediated model, there are three structural paths that address the effects of customers' involvement, employees' involvement, and suppliers' involvement respectively on lean technical practices. The discussion of the results of this research relies on the literature regarding the relationship between human or soft side of lean and the technical or hard side of lean. The reason is the lack of studies which investigate the impact of lean human practices on lean technical practices in the context of organisational culture. Therefore, the discussion here will focus on each lean human practice and its effect on lean technical practices in the four cultural types. Beginning with the first lean human practice, which is customers' involvement, by referring to tables 8.6, 8.8, 8.10 and 8.12, the findings reveal that customers' involvement has a significant positive effect on lean technical practices with a standardised regression weight of 0.43 in rational culture, followed by a standardised regression weight of 0.41 in group culture, a standardised regression weight of 0.34 in developmental culture**,** and a standardised regression weight of 0.25 in hierarchical culture respectively. The results reveal that customers' involvement positively affects lean technical practices to a moderate to low extent (0.25-0.43) in all types of organisational culture. These results are in line with previous studies (Bakås et al., 2011, Demir et al., 2011, Kaynak, 2003, Pakdil and Leonard, 2015, Rahman and Bullock, 2005, Sadikoglu and Zehir, 2010, Shah and Ward, 2007) in that customers are an influential group affecting the implementation of technical manufacturing practices such as quality management practices (Rahman and Bullock, 2005).

Contrary to expectations, the effect of employees' involvement as a second lean human practice on lean technical practices is statistically positive but insignificant in all types of organisational culture. By referring to tables 8.6, 8.8, 8.10 and 8.12, the findings reveal that the p-values of all the structural paths of employees' involvement/ lean technical practices relationship is above the cut off p-value (0.05) in all types of organisational culture. This result contradicts previous studies (Baird et al., 2011, Cheng and Liu, 2007, Dean and Bowen, 1994, Liker and Hoseus, 2008, Raja, 2011, Sadikoglu and Zehir, 2010) in that employees' involvement does not have an effect on implementing the technical practices of lean. The insignificant relationship can be attributed to the argument of Moyano-Fuentes and Sacristán-Díaz (2012), who claim that there is no consensus in the literature about the nature of the relationship between lean production and human resources. Also, one major critique of the lean system is that it is generally weak concerning the employees' perspective (Mi Dahlgaard-Park and Pettersen, 2009). Some opponents of lean production (Berggren, 1993, Slaughter, 2000) usually have a strong instrumental and managerial perspective, discussing human resources in terms of components in the production system. For example (Slaughter, 2000) has found that lean places workers in highly limiting and alienating conditions. Mi Dahlgaard-Park and Pettersen (2009) argue that lean literature is generally weaker on the human behaviour side compared to other manufacturing philosophies such as TQM. They claim that TQM is focused on stimulating creativity and individual efforts for improvement, whereas lean puts more focus on the standardisation of work. Mi Dahlgaard-Park and Pettersen (2009) argue that there is a slight difference in perspective between TQM and lean concepts. That difference is that whereas TQM has a strong focus on the internal structure and integration of departments within the organisation, lean emphasises a supply chain perspective, not an internal perspective, seeing the internal production activities as a part of a value stream from the sub-suppliers to the end customer. This difference is also confirmed by Womack and Jones (2010). Therefore, this result is in line with a small number of arguments (Mi Dahlgaard-Park and Pettersen, 2009, Slaughter, 2000) in that employees' involvement has no significant effect on lean technical practices implementation. Additionally, this result can be explained by the large power distance and the centralisation problem which are the main features of Arab management represented in Hofstede's power distance dimension. The large power distance which is considered to be characteristic of Arab culture leads to the lack of involvement of employees in work (Obeidat et al., 2012).

By referring again to tables 8.6, 8.8, 8.10 and 8.12, the results show that the last lean human practice which is suppliers' involvement has a significant positive effect on lean technical practices implementation with a standardised regression weight of 0.33 in rational culture, a standardised regression weight of 0.29 in group culture, a standardised regression weight of 0.26 in developmental culture and a standardised regression weight of 0.13 in hierarchical culture respectively**.** These results reveal that suppliers' involvement positively affects lean technical practices to a moderate to low extent (0.13-0.29) in all types of organisational culture. The results are in line with previous studies (Baird et al., 2011, Hsu et al., 2009, Pakdil and Leonard, 2015, Rahman and Bullock, 2005, Romano and Formentini, 2012, Yang et al., 2009) in that suppliers' involvement plays a critical role in facilitating the implementation of lean technical practices. For example, this result is in line with the arguments of Romano and Formentini (2012) and Hsu et al. (2009), who argue that supplier integration is important in lean system as without strong supplier support, the technical practices cannot be effective.

10.2.5 How Do Lean Human Practices (Customers' Involvement, Employees' Involvement and Suppliers' Involvement) Mediate the Relationship Between Each Type of Organisational Culture (Group Culture, Developmental Culture, Hierarchical Culture and Rational Culture) and Lean Technical Practices?

The fifth research question address the mediating effects of lean human practices (customers' involvement, employees' involvement and suppliers' involvement) on the relationship between organizational culture and lean technical practices. This question is answered through testing twelve hypotheses **(H4 (a-c), H8 (a-c), H12 (a-c), H16 (a-c).** In each conceptual model, the three lean human practices (customers' involvement, employees' involvement and suppliers' involvement) are posited to mediate the effect of organizational culture on lean technical practices. Current theory shows a lack of previous studies investigated the mediating role of lean human practices in the relationship between organizational culture and lean technical practices. Therefore, the discussion in this subsection relies on few numbers of recent studies that support the link between organizational culture and lean manufacturing.

The first predicted mediator is customers' involvement. The current study supports the direct significant positive effect of all types of organizational culture on customers' involvement. Based on Baron and Kenny (1986) mediation's model which was illustrated in figure 8.5, the first condition to conclude that a variable is a mediator entails that the independent variable (organisational culture) should have a significant effect on the mediator (customers' involvement). The first condition has been met in this thesis as presented in chapter 8 (subsection 8.2.3).

The second condition entails that the mediator (customers' involvement) must have a significant effect on the dependent variable (lean technical practices). Again, this condition has been met because the current thesis supports the direct significant positive effect of customers' involvement on lean technical practices implementation (section 8.2.4). The third and last condition is that the effect of independent variable (organisational culture) on the dependent variable (lean technical practices) must be less or zero in the existence of mediator (customers' involvement). In other words, if the path between organizational culture and lean technical practices is reduced to zero with the existence of customers' involvement, a perfect or full mediation happens. If just a significant reduction happens, this will be a partial mediation (Baron and Kenny (1986). In the current study, the direct positive effect of organisational culture on lean technical practices decreased in size when customers' involvement entered the four structural mediated models. In the group culture the standardised regression weight decreased from 0.60 to 0.30. In the developmental culture, the standardised regression weight decreased from 0.67 to 0.43. In the hierarchical culture, the standardised regression weight decreased from 0.75 to 0.58. In the rational culture, the standardised regression weight decreased from 0.48 to 0.24. These results give evidence that customers' involvement partially mediates the link between organizational culture and lean technical practices. To verify the mediating role of customers' involvement, the Sobel test has been used as a technique to test the mediation effect for each mediator separately. The results of Sobel test confirm the significant positive effect of each type of organisational culture on lean technical practices through customers' involvement. This demonstrates that the organisational culture facilitates the involvement of customers, which is turn result in a positively higher implementation level of lean technical practices. This result means that customers' involvement as a lean human practice plays an important mediating role in the relationship between organisational culture and lean technical practices implementation. This result is in line with prior arguments (Flynn et al., 1994, Holcomb and Hitt, 2007, Naor et al., 2008, Naor et al., 2010, Yang et al., 2009, Zu et al., 2010).For example, this result is consistent with Fullerton and Wempe (2009) who have presented an evidence that non-financial performance measures (such as customers' involvement) partially mediate the lean production- financial performance relationship. Also, this result is consistent with Jayaram et al.' s (2008) who have found that closer relationships with customers has a positive influence on lean design and lean manufacturing. Finally, this result is in line with Sadikoglu and Zehir (2010) who claim that keeping close contact with customers in order to identify their needs will result in fewer defective items.

The second predicted mediator is employees' involvement. The current study supports the direct significant positive effect of all types of organizational culture on employees' involvement. Based on Baron and Kenny’s (1986) mediation requirements, the first condition to conclude a variable function as a mediator is met in the current thesis as presented in chapter 8 (subsection 8.2.3). The independent variable (organisational culture) has a significant effect on the mediator (employees' involvement).

However, the second condition is that the mediator (employees' involvement) must have a significant effect on the dependent variable (lean technical practices) is not met. An insignificant relationship has been found between employees' involvement and lean technical practices (subsection 8.2.4). In this case, based on Baron and Kenny's (1986) assumptions, employees' involvement cannot be considered as a mediator between organisational culture and lean technical practices. This result is verified through using Sobel test to ensure whether the relationship between organisational culture and lean technical practices is still significant with the existence of employees' involvement as a mediator. By referring to tables 8.7, 8.9, 8.11 and 8.13, the standard errors (p-values) are found insignificant ($p > 0.05$) in the four cultural types. This means that the effect of each type of organisational culture on lean technical practices is insignificant with the existence of employees' involvement. This result demonstrates that the organisational culture affects employees' involvement, but this effect does not necessarily lead to a higher implementation level of lean technical practices. Employees' involvement does not play any mediating role in the relationship between organisational culture and lean technical practices in the Jordanian manufacturing firms. The reasons behind this result has been discussed earlier in the previous subsection (10.2.4).

The last predicted mediator is suppliers' involvement. The current study supports the direct significant positive effect of all types of organizational culture on suppliers' involvement. Referring again to Baron and Kenny (1986), the first condition is met in that the independent variable (organisational culture) has a significant effect on the mediator (suppliers' involvement). The second condition is also met in that the mediator (suppliers' involvement) has a significant effect on the dependent variable (lean technical practices). The current study supports the direct significant positive effect of suppliers' involvement on lean technical practices implementation as presented in chapter 8 (subsection 8.2.4). The third and last condition is also met in that the direct positive effect of the independent variable (organisational culture) on the dependent variable (lean technical practices) decreased in size when suppliers' involvement enters the four structural mediated models. This means that suppliers' involvement partially mediates the relationship between organisational culture and lean technical practices. To verify the mediating role of suppliers’ involvement, the Sobel test has been used to identify if the relationship between the independent variable (organisational culture) and the dependent variable (lean technical practices) through the mediator (suppliers' involvement) is still significant. By referring to tables 8.7, 8.9, 8.11 and 8.13, the standard errors (p-values) are found significant ($p < 0.05$). This means that the results of Sobel test confirm the significant positive effect of each type of organisational culture on lean technical practices through suppliers' involvement. This demonstrates that the organisational culture enhances suppliers' involvement which is turn positively lead to a higher implementation level of lean technical practices. This thesis confirms that supplier’s partnership plays an important mechanism in the relationship between organisational culture and lean technical practices. This result is consistent with previous studies (Flynn et al., 1994, Holcomb and Hitt, 2007, Naor et al., 2008, Naor et al., 2010, Yang et al., 2009, Zu et al., 2010, Shah and Ward, 2007) in that improving suppliers relationships is affected by the dominant organisational culture and in the same time suppliers' involvement enhance the implementation of lean technical practices.

It is worthwhile noting that both customers' involvement and suppliers' involvement have the highest magnitude of mediation effect in the rational culture whereas both have the lowest magnitude of mediation effect in the hierarchical culture. The results of the proportion of mediation test summarised in table 8.15 reveal that the indirect path of the rational culture to lean technical practices via both customers' involvement and suppliers' involvement accounted for 74.3 per cent, followed by 66.6 per cent in the group culture, 47.6 per cent in the developmental culture and 32.8 per cent in the hierarchical culture. This means that both customers' involvement and suppliers' involvement are important direct contributors to lean technical practices and important indirect contributors to organisational culture/ lean technical practices relationship in a moderate to high extent levels (0.328- 0.743). The highest mediating effect of customers' involvement and suppliers' involvement in rational culture refers to the characteristics of this type of culture. The organisation which emphasizes the rational culture functions as a market itself. It is oriented toward the external environment instead of internal affairs. It is focused on conducting transactions with external constituencies such as customers and suppliers to create competitive advantage (Cameron and Quinn, 2011).Therefore, it is expected to find both customers' involvement and suppliers' involvement play as two necessary mechanisms through which the rational culture affects lean technical practices implementation in the Jordanian manufacturing firms. Whereas, the least mediating effect of customers' involvement and suppliers' involvement in hierarchical culture refers also to the characteristics of this type of culture. The environment in the hierarchical culture is relatively stable, and all workers and jobs are under control. The major focus in hierarchical culture is to generate efficiency through clear lines of decision making authority, standardised rules and procedures, and control and accountability mechanisms are valued as the keys to success (Cameron and Quinn, 2011). Thus, the managers in this type depend on rules and standards more than involving the external parties such as customers and suppliers in the manufacturing process.

10.2.6 Do Firm Size and Firm Age Moderate the Relationship between Organisational Culture (Group Culture, Developmental Culture, Hierarchical Culture and Rational Culture) and Lean Technical Practices?

The sixth research question addresses the moderating effects of firm size and age on the relationship between organisational culture and lean technical practices. This question is answered through testing eight hypotheses. The first four hypotheses **(H17a, b, c, d)** examined the moderating effect of firm size on the relationship between organisational culture and lean technical practices via customers' involvement and suppliers' involvement. The results provide support for the moderating effect of firm size on the relationship between group culture and lean technical practices, as well as the relationship between hierarchical culture and lean technical practices. However, the results do not support the moderating effect of firm size on the relationship between developmental culture and lean technical practices, as well as the relationship between rational culture and lean technical practices. This result is expected because both group and hierarchical culture emphasize an internal orientation, integration and unity. At the same time, the firm's size which is represented by the number of employees is an internal issue.

Furthermore, the results show that the effect of firm size differs per the type of organisational culture. On the one hand, it is found that small sized firms in group culture/ lean technical practices relationship works better than large sized firms. This refers to the characteristics of group culture in which organisations seem more like extended families than economic entities. Managers focus on empowering employees and facilitate their participation and loyalty (Cameron and Quinn, 2011). Therefore, it is expected that small sized organisations give more chance for organisations who emphasize group culture to work more closely with workers and in turn to facilitate the implementation level of lean technical practices. On the other hand, it is found that large sized firms in hierarchical culture/ lean technical practices relationship works better than small sized firms. This refers to the characteristics of hierarchical culture. Large organisations are generally dominated by hierarchical culture, as evidenced by large numbers of standardised procedures, multiple hierarchical levels and an emphasis on rule reinforcement (Cameron and Quinn, 2011). Therefore, it is expected that organisations who emphasize hierarchical culture prefer big number of employees work in a structured and formalised place to maintain a smoothly process of lean manufacturing in the organisation.

The other four hypotheses **(H18a, b, and c, d)** have examined the moderating effect of firm age on the relationship between organizational culture and lean technical practices. The results provide support for the moderating effect of firm age on the relationship between all types of organisational culture and lean technical practices. The results show that new firms work better in terms of their effect on the relationship between organisational culture and lean technical practices, which enables them to run lean technical practices more efficiently than older firms. The results of the current study validate the arguments of previous studies (Coad et al., 2013, González-Benito, 2005, Shah and Ward, 2003, Wagner et al., 2012) in that the newer manufacturing firms have a natural advantage in implementing new lean practices because of a younger, arguably less cynical workforce and because of fewer physical barriers to lean practices such as set up time reduction, cross-functional work force, cycle time reduction, continuous flow production, maintenance optimization, reengineered production process and self-directed work teams.

10.3 Chapter Summary

A discussion of the six main research questions and the results of the hypotheses are provided in this chapter. The findings are largely consistent with the findings published in the literature about the link between organisational culture and lean management practices. On the one hand, out of forty direct and indirect structural paths included in eight direct and mediated structural models, the results provide support for thirty-two paths. The direct positive effect of all types of organisational culture on lean technical practices is supported. Also, the direct positive effects of all types of organisational culture on three lean human practices (customers' involvement, employees' involvement and suppliers' involvement) are supported. Furthermore, the direct positive effect of both customers' involvement and suppliers' involvement is verified. On the other hand, the effect of employees' involvement on lean technical practices is not supported in all types of organisational culture.

Furthermore, the mediation analysis confirms the mediating role of customers' involvement and suppliers' involvement in the relationship between organisational culture and lean technical practices. Both mediators are considered as two important mechanisms showing how the organisational culture affects positively the implementation level of lean technical practices. Although the mediation type of both customers' involvement and suppliers' involvement is partial rather than complete, the proportion of mediation for both is considered high to moderate in all types of organisational culture. The mediation effect for customers' involvement and suppliers' involvement is the highest in rational culture, followed by group culture, developmental culture and hierarchical culture respectively.

Additionally, the moderation analysis confirms the moderating role of firm size in two types of organisational culture: group culture and hierarchical culture. The small sized firms work better in group culture/ lean technical practices relationship, whereas, the big sized firms work better in hierarchical culture/ lean technical practices relationship. As well as, the results show that firm age moderates the relationship between all types of organisational culture and lean technical practices, whereas, new firms work better than old firms in all types of organisational culture.

Following the discussion presented in this chapter, the next and final chapter of this study will present the overall conclusion, limitations, implications and recommendations for future research.

CHAPTER Eleven: Conclusions, Contributions and Limitations

11.1 Introduction

This chapter summarises the thesis and presents the conclusions of the study drawing from the findings in the preceding chapters. The chapter also highlights the key contributions to theory and practice and outlines the research limitations and areas of possible future research. Section two provides a summary of the thesis. Section three provides the research conclusions in relation to each research question. The theoretical contributions of the study and its managerial implication are then outlined in section four. The study's limitations and areas of possible future research are provided in section five. Finally, a chapter summary is presented in section six.

11.2 Summary of the Thesis

This thesis sets out to examine the effect of organisational culture on lean technical practices and to investigate the mediating role of customers' involvement, employees' involvement and suppliers' involvement. In line with this aim, six research questions were raised. First, to what extent do organisational culture (group culture, developmental culture, hierarchical culture and rational culture) affect lean technical practices implementation? Second, what type(s) of organisational culture(s) best fit with implementing lean technical practices? Third, to what extent does organisational culture (group culture, developmental culture, hierarchical culture and rational culture) affect lean human practices (customers' involvement, employees' involvement and suppliers' involvement)? Fourth, to what extent do lean human practices (customers' involvement, employees' involvement and suppliers' involvement) affect lean technical practices implementation? Fifth, how do lean human practices (customers' involvement, employees' involvement and suppliers' involvement) mediate the relationship between each type of organisational culture (group culture, developmental culture, hierarchical culture and rational culture) and lean technical practices? Finally, does firm size and firm age moderate the relationship between organisational culture (group culture, developmental culture, hierarchical culture and rational culture) and lean technical practices?

An extensive review of the extensive literature was carried out based on socio-technical system theory, contingency theory and resource based view. Based on solid theoretical foundation, four conceptual models comprising forty-eight hypotheses have been developed. Each conceptual model involved the interdependent relationships among one independent variable (one type of organisational culture), three mediating variables (customers' involvement, employees' involvement and suppliers' involvement) and one dependent variable (lean technical practices). To empirically test the research conceptual models, a structural equation modelling (SEM) techniques using AMOS has been adopted to analyse a dataset of over 200 manufacturing firms in Jordan, collected by using a self-administered survey.

The findings of this study indicate that the hierarchical culture and the developmental culture have the highest significant positive effect on lean technical practices. In addition, it is found that each type of organisational culture (group, developmental, hierarchical and rational) affects positively lean human practices in different statistical levels. For example, all types of organisational cultures affect suppliers’ involvement more than customers’ involvement and employees’ involvement respectively. Moreover, it is found that customers’ involvement and suppliers’ involvement have the highest positive effect on lean technical practices in the rational culture and the least positive effect in the hierarchical culture. Furthermore, it is found that the positive effect of each type of organisational culture on lean technical practices is partially mediated by customers' involvement and partially mediated by suppliers’ involvement. The highest mediation effect of customers' involvement and suppliers’ involvement lies in the rational culture/ lean technical practices link whereas the lowest mediation effect of customers' involvement and suppliers’ involvement lies is in the hierarchical culture/ lean technical practices relationship. Finally, it is found that employees’ involvement does not mediate the relationship between organisational culture and lean technical practices implementation. These findings provide new evidence from Jordan to support the hypotheses that the organisational culture can act as a crucial pre-condition for lean technical practices to be fully effective. Additionally, the findings reinforce the notion that emphasizing the human side of lean especially for customers' involvement and suppliers' involvement can promote the effectiveness of lean implementation. The following section, will present the research conclusions made on the findings to answer the six research questions.

11.3 Research Conclusions

In the light of the research findings that are outlined in the SEM results and explained in the discussion of findings' chapter, this section presents the major research conclusions made in relation to each research question.

11.3.1 Conclusion to the First Research Question

To what extent does organisational culture (group culture, developmental culture, hierarchical culture and rational culture) affect lean technical practices implementation?

The empirical findings assert the capability of the various types of organisational culture to affect the implementation level of lean technical practices. All types of organizational culture (group, developmental, hierarchical and rational) affect significantly and positively the implementation level of lean technical practices to a high to moderate extent. Hierarchical culture and developmental culture respectively have the highest effect on lean technical practices, followed by group culture and rational culture respectively.

It is concluded that lean practices can be applied not just in either small or big companies (Shah and Ward, 2003), in a manufacturing firm (Naor et al., 2013) or service firms (Abdi et al., 2006). Lean philosophy can be applied in various manufacturing industries (Taj, 2008, Fullerton and Wempe, 2009) and in different countries (Yang et al, 2011, Demeter and Matyusz, 2011, Rahman et al 2010). This study concludes that lean practices can also be applied in different types of organisational cultures. For example, fostering the highest levels of lean implementation in manufacturing firms requires the application of hierarchical cultural activities such as improving accurate measurements, statistical process control using lean tools and techniques such as quality charts, fishbone diagramming and variance plots. Furthermore, lean organisations require the application of rational culture activities such as measuring customers' needs and preferences, improving productivity, creating partnerships with suppliers and customers and striving to achieve competitiveness by involving customers in the production process. Moreover, to increase the implementation of lean practices, the manufacturing firms can apply the activities of developmental culture such as creating new standards of manufacturing, engaging in continuous improvement, and implementing creative solutions to problems that produce new customers' preferences. Finally, to facilitate the implementation of lean practices, the manufacturing firms can apply group cultural activities such as empowering and involving the human resources in the manufacturing process.

11.3.2 Conclusion to the Second Research Question

What is/ are the type(s) of organisational culture that best fit(s) with implementing lean technical practices?

The empirical findings assert that hierarchical culture is the best type to implement lean technical practices effectively. The values and attitudes of the hierarchical culture which focus on following procedures, control, stability, respect formal hierarchy, efficiency and standardisation are the best values to implement lean technical practices effectively. In addition, the empirical findings assert that developmental culture is the second-best type to implement lean technical practices effectively. The values of developmental culture which emphasizes flexibility, continuous growth, acquisition of new resources, experimenting, taking risks, innovation and entrepreneurship facilitates the implementation of lean technical practices. Even though the values in hierarchical culture contradicts those in developmental culture on the CVF, these findings confirm the multi-dimensional perspective of lean manufacturing which is considered as a philosophy (Bhasin and Burcher, 2006), a way of thinking (Womack and Jones, 2010) and a cultural issue (Atkinson, 2010). The high effect of both hierarchical culture and developmental culture on lean technical practices reinforces the combination of flexibility and control; hence, there is a necessity of a balanced understanding of lean as a multidimensional philosophy.

11.3.3 Conclusion to the Third Research Question

To what extent does organisational culture (group culture, developmental culture, hierarchical culture and rational culture) affect lean human practices (customers' involvement, employees' involvement and suppliers' involvement)?

The findings of this study reveal that the four types of organisational culture affect positively and significantly the implementation of all lean human practices in different levels. Suppliers' involvement factor is affected positively and significantly by hierarchical culture, group culture, developmental culture and rational culture respectively. The levels of effect range from high to moderate extent. Furthermore, customers' involvement is affected positively and significantly by hierarchical culture, developmental culture, group culture and rational culture respectively. The levels of effect range from high to moderate extent. Finally, employees' involvement is affected positively and significantly by hierarchical culture, group culture, developmental culture and rational culture respectively. The levels of effect range from moderate to low extent.

The results of this question are consistent with the results of the first question in that hierarchical culture is the most influential cultural type for implementing lean manufacturing practices. Furthermore, rational culture is the least influential cultural type for implementing lean manufacturing practices. It is concluded that in spite of the different nature of lean human practices than the technical one, but this study confirms that all lean practices are inter-related and inter-dependent as suggested by Shah and Ward (2007).

The results of this study show that the level of effect of all types of organisational culture on both customers' involvement and suppliers' involvement range from high to moderate extent. Meanwhile, the level of effect of all types of organisational culture on employees' involvement range from moderate to low. This thesis concludes that the organisational culture affects not just the organisational members but also affects customers' involvement and suppliers' involvement. This conclusion adds a new insight into the role of organisational culture in that it does not affect only the behaviours of organisational members or the internal work processes, but also its effect extends to the external parties such as suppliers and customers.

11.3.4 Conclusion to the Fourth Research Question

To what extent do lean human practices (customers' involvement, employees' involvement and suppliers' involvement) affect lean technical practices implementation?

The empirical results reveal that not all lean human practices affect the implementation level of lean technical practices. Two lean human practices, customers' involvement and suppliers' involvement, facilitate significantly and positively the implementation level of lean technical practices in all types of organisational culture. This thesis concludes that the effect of customers' involvement on lean technical practices implementation is greater than the effect of suppliers' involvement on lean technical practices. This conclusion confirms that lean manufacturing must start with a conscious recognition of involving customers in the manufacturing process in terms of specific products, specific capabilities, and specific prices (Womack and Jones, 2010). This conclusion confirms that the essence of lean concept is to maximize *customer value* while minimizing waste because lean simply means creating more value for customers with fewer resources. Therefore, a lean organization should understand the meaning of value in the eyes of customers, and focus its key processes to continuously increase this value. The end goal for any lean organisation is to provide perfect value to the customer through a perfect value creation process that has zero waste (Lean Enterprise, 2016).

As far as the proposed conceptual models are concerned in the current thesis, this study does not empirically support the effect of employees' involvement on lean technical practices. This result could be partially explained by the characteristics of the Jordanian context which includes a national culture that respects hierarchy in work and high power distance. Additionally, this finding reinforces the fact that in order to understand the link between employees' involvement and lean technical practices, it is necessary to include other mediating variables (Carlos Pinho, 2008).

11.3.5 Conclusion to the Fifth Research Question

How do lean human practices (customers' involvement, employees' involvement and suppliers' involvement) mediate the relationship between organisational culture and lean technical practices?

The findings of the fifth question reveal that customers' involvement and suppliers' involvement play mediating roles in the relationship between all types of organizational culture and lean technical practices. The direct effect of organisational culture on lean technical practice decreases in magnitude when customers' involvement and suppliers' involvement enters the SEM, thus concluding that customers' involvement and suppliers' involvement partially mediate the organisational culture/ lean technical practices relationship. This study concludes that the dominant organisational culture reinforces customers' involvement and suppliers' involvement, which in turn will result in higher effective implementation of lean technical practices. Customer's involvement and suppliers' involvement are two critical mechanisms through which the organisational culture affects lean technical practices implementation.

The mediation effect size for customers' involvement and suppliers' involvement on all types of organisational culture ranges from high to moderate extent. The mediation effect size of both customers' involvement and suppliers' involvement is greatest in the rational culture and lowest in the hierarchical culture. In contrast to customers' involvement and suppliers' involvement, the direct effect of employees' involvement on lean technical practices is statistically insignificant. Therefore, employees' involvement does not play a mediating role in the relationship between organisational culture/ lean technical practices relationship.

11.3.6 Conclusion to the Sixth Research Question

Do firm size and firm age moderate the mediated relationships between organisational culture (group culture, developmental culture, hierarchical culture and rational culture) and lean technical practices?

The results show that the effect of firm size differs significantly according to the type of organisational culture. The results provide support for the moderating effect of firm size on the relationship between group culture and lean technical practices and on the relationship between hierarchical culture and lean technical practices. It is concluded that small sized firms in group culture/ lean technical practices relationship works better than large sized firms. Whereas, large sized firm in hierarchical culture/ lean technical practices relationship work better than small sized firms.

Additionally, the results provide support for the moderating effect of firm age on the relationship between all types of organisational culture and lean technical practices. The results conclude that new firms work better than old firms in terms of their effect on the relationship between all types of organisational culture and lean technical practices.

11.4 Contributions of the Thesis

This study demonstrates several important contributions to knowledge at theoretical and practical levels. Such theoretical contributions and practical implications are presented in the following two subsections respectively.

11.4.1 Theoretical Contributions

This study contributes to the organisational culture and lean manufacturing literature in different ways. First, several past contributions have provided interesting guidelines for and hints on the role of organisational culture in lean manufacturing (Atkinson, 2010, Hogan, 2009, Naor et al., 2008, Pakdil and Leonard, 2015, Spear and Bowen, 1999). Differently from those works, this study provides a better understanding of the organisational culture/ lean technical practices relationship through a comprehensive assessment of the interaction between each type of organisational culture, lean human practices and lean technical practices. On the one hand, this study relies on a well-established organisational culture model which is the CVF (Cameron and Quinn, 2011), which includes four different organisational culture types with different dimensions. On the other hand, while several previous studies focused on subsets of lean manufacturing practices (Chavez et al., 2013, Fullerton and Wempe, 2009, Jayaram et al., 2008, Rahman et al., 2010, Taj and Morosan, 2011, Yang et al., 2011), this study considers various lean practices and differentiates them according to its nature (human and technical), thus embracing a systematic view of lean manufacturing.

Second, the findings of the study build on previous studies on organisational culture and lean manufacturing (Ahmad, 2013, Atkinson, 2010, Badurdeen et al., 2011, Bortolotti et al., 2015, Naor et al., 2014, Wiengarten et al., 2015, Yauch and Steudel, 2002) by demonstrating the positive interaction between the different types of organisational culture, lean human practices and technical practices. This interaction can be interpreted in two ways. First, the interaction suggests that building a specific cultural type and developing relationships with customers and suppliers will lead to an effective implementation of lean technical practices. Second, the positive interaction suggests that the extent of implementing lean technical practices is dependent upon the extent of customers' involvement and the usage of suppliers' involvement in the firm. At the same time, customers' involvement and suppliers' involvement may need to be supported by the organisational culture in the sense that the effect of the organisational culture on implementing lean technical practices depends partly on customers' involvement and suppliers' involvement.

Third: the current study is the first one in the Jordanian context which has explored empirically the ideal types of organizational culture to implement lean practices effectively. The previous literature on the organisational culture/ lean manufacturing link has focused on TPS and the Toyota way (Spear and Bowen, 1999, Liker, 2004) in terms of rules and principles that guide designing, operating and improving activities and processes at Toyota. These contributions focus on TPS and did not use a well-established organisational culture model to identify specific cultural characteristics for implementing lean technical practices. This study provides a more comprehensive explanation about the effect of different cultural dimensions as represented in the CVF on lean technical practices implementation.

Fourth: This study is one of the first, to our knowledge, that highlights the effect of lean human practices on lean technical practices. Although customers' involvement, employees' involvement and suppliers' involvement are recognised in the lean manufacturing literature as an essential part of lean (Shah and Ward, 2007), no previous studies have investigated the direct effect of lean human practices on lean technical practices. As hypothesized in this study, developing cooperative relationships with suppliers and customers reinforce the implementation of lean technical practices. The findings of this study confirm that customers' involvement and suppliers’ involvement are important antecedents for the effective implementation of lean technical practices.

Fifth: Introducing lean human practices as an underlying mediating factors in the relationship between organisational culture and lean technical practices is an original theoretical contribution. Previous literature provides explanations about how lean practices function through using contextual factors such as firm age and size (Shah and Ward, 2003). Furthermore, it provides few examples about some mediating variables such as inventory leanness or non-financial measures to examine their effect on the relationship between lean manufacturing and performance (Fullerton and Wempe, 2009, Hofer et al., 2012). This study is one of the first, on our knowledge, that investigates the dynamics of lean practices implementation through providing an evidence showing how the organisational culture and lean human practices interact together to support each other and mutually contribute to the successful implementation of lean technical practices.

Finally, this study is an answer to the call to research which focuses on the interaction between operations management and human behavioural research. The empirical conceptual models developed in this study have examined the integrated approach by including the effects of different types of organisational culture on three lean human practices (customers' involvement, employees' involvement and suppliers' involvement) as well as, the effects of the lean human practices on the implementation of technical practices.

11.4.2 Practical Implications

Based on the analysis and findings of the current thesis, managers need to first understand their organisation's prominent culture and then make changes based on the competing values framework to know which dimensions affect the implementation of lean practices in their context and try to develop an organisational culture that will support implementing and sustaining lean efforts. The challenge that Jordanian managers encounter does not lie in the proper use of lean tools and techniques. The challenge lies in the need to identify the organisational culture infrastucture that will allow lean practices which were first used by Japanese managers to operate well in the Jordanain context. Managers should recognise that the norms and values that underlie lean practices may create conflict with the dominant organisational culture that already exists within their firms; such divergence may lead to increasing costs and wasted effort.

The findings of this study suggest managers should invest in developing and incorporating the characteristics of hierarchical culture into organisational processes and routines such as stability and formalization, or developing the values of the developmental culture such as by encouraging innovation and creativity to increase the level of implementing lean technical practices. Those two cultures are the best types to implement lean technical practices in the Jordanian manufacturing firms. Based on contingency theory, managers can choose the hierarchical culture or the developmental based on the nature of their manufacturing sector and the product they manufacture.

It is important to mention that designing organisational culture is beyond the scope of this study, but developing a strategy for change is an important feature of any organisational change. However, designing the culture that enables the best implementation of lean technical practices takes time and effort, but has been found to be worthwhile and meaningful. For further or deeper organisational changes, we suggest that managers need to view the work of Schein (2010), who is arguably one of the foremost specialists in the area of organisational culture change.

An interesting implication of this study for managers relates to the positive interaction between the organisational culture and lean human practices in affecting lean technical practices. This study confirms the socio-technical system theory in that the focus on involving customers and integrating suppliers in the production process will improve lean technical practices implementation and in turn leads to achieving a competitive edge in the marketplace. The findings of this study provide managerial guidelines for focusing the firm's resources to achieve better external integration with customers and suppliers, as this study found that customers' involvement and suppliers' involvement lead to improving lean technical practices in all types of organisational culture. Managers who are operating in an increasingly competitive marketplace and have dominant cultural values should place greater emphasis on the development and improvemement of cutomers' involvement and suppliers' collaboration. Managers should recognise that building strong strategic partnerships with customers and suppliers will facilitate understanding and anticipation of customers' needs so that this leads to greater responsiveness to customers through better product design and reduced non-value added activities. Managers should be aware that customers' involvement and suppliers' involvement act as two critical mechanisms that affect the organisational culture/ lean technical practices relationship. The findings of this study indicate that the proportion of mediation for cutomers's involvement and suppliers' involvement reaches around 55 percent (lowest in hierarchical culture (32.8 per cent) and highest in the rational culture (74.3 per cent)). Therefore, it is necessary for manufacturers to understand the important role of lean human practices in the manufacturing process.

In examining the moderating effect of firm size on the relationship between organisational culture and lean technical practices, it is noted that the firm size moderates the effect of group culture and hierarchical culture on lean technical practices. For managers who work in small firms and adopt the group culture, they have to recognise that the effect of group culture on lean technical practices can increase by 10 per cent because of the small size. This result indicates that if the firm size is small and the dominant culture is group one, managers have an opportunity to increase the level of lean technical practices. If not they have to consider other moderating factors or try to change their dominant culture to hierarchical culture.

Moreover, the firm's size moderates the effect of hierarchical culture on lean technical practices. For managers who work in big firms and adopt the hierarchical culture, they have to be aware that the effect of hierarchical culture on lean technical practices can increase by 20 per cent because of the big size. This result indicates that if the dominant organisational culture in any firm is a hierarchical culture and managers want to increase the level of lean technical implementation, they can benefit from the big size of their organisation. If the size is big there is an opportunity to increase the level of lean technical practices.

In examining the moderating effect of a firm's age on the relationship between organisational culture and lean technical practice, it is found that new firms works better than old firms in terms of the effect of all types of organisational culture on lean technical practices. For managers who work in new firms, the implemenation of lean technical practices can increase by 23 percent in group culture, 28 per cent in developmental culture, 42 percent in hierarchical culture, and 32 per cent in rational culture. These results provide an indication for managers who work with new firms that if they notice an improvement in the implemnation level of lean practices without changing the type of culture, this will refer to the neweness of their organisations. If managers work in old firms, these results do not mean that they cannot improve lean implementation, but they have to be aware that they have to consider other factors for improvement because the firm's age may not help them.

Finally, the results of this study can explain for managers why lean manufacturing practices are not improving in their firms despite the different effors and resources dedicated for improvement. Managers should bear in mind that the successful lean organisations do not differ in the use of lean technical practices, as these practices are order qualifier activities (necessaruy but not differentiating). Instead, the organisational culture and the human practices of lean are strategic "order winners", dimensions that create the competitiveness in lean implementation. Therefore, managers who face difficulties in improvement through lean practices should wonder whether they have dedicated adequate time and attention to lean human practices and whether the firm's organisational culture facilitates the implementation level of lean technical practices.This study recommends managers to analyse their context in terms of organisational culture and invest effort in lean human practices. This study advises managers to strive to fully understand what implementing lean means, by suggesting that they go beyond the technicalities and experience the potential of cultural and human factors.

Jordan is considered a resource scarce country and it has long suffered from a severe imbalance between resources and population (Jordan's Economic Outlook Report, 2015). Therefore, the first national objective established by the Jordanian government is developing the Jordanian economy to be properous and open to regional and global markets (Jordanian Ministry of Industry and Trade, 2016). To achieve this objective, the public policy emphasizes the importance of introducing the concept of comprehensive quality management and quality performance programs such as lean management (Jordanian Ministry of Industry and Trade, 2016) to increase the productivity and cometitiveness of Jordanian firms especially the manufacturing firms. This study provides new guidelines for the government to achieve its objectives through focusing on the culural and human factors to promote the level of lean implementation. If the government wants to advance the success of lean in the manufacturing sector in Jordan to develop the Jordanian economy, it needs to provide or promote the awareness of the balanced view of lean. For example, the public policy should motivate the decision makers in the manufacturing sector to balance between focusing on tools and methods versus developing the inherent human potential. These two sides are both important and work synergistically to increase the productivity and competitiveness of this sector which will lead to increasing the domestic product levels in the manufacturing firms and strengthening the economic situation of Jordan. Another example, the governemnt can encourage the manufactuirng firms to evaluate their supplier partnerships related policies to be more trusted, more reliable, and last longer times because the partnerships with suppliers play a critical role to improve the effectiveness of lean technical practices.

Furthermore, the government should cooperate with the industrial sector to create new policies taking into consideration the importance of organisational culture in lean implementation. It is important to create policies identifying the charactersitics of the appropriate values and behaviours which lead to a higher implementation of lean technical practices. Based on the results of this study, the new policy should focus of adopting the characteristics of hierarchical culture in the manufacturing sector in Jordan such as standardisation of work processes, improving measurements and systematic problem solving. Developing such a policy will provide a clear guidelines for managers to evaluate their current cultural values and try to change them to best fit the implementation of lean philosophy.

The Jordanian government can play an important role in building a quality- based environment. For example, by establishing an annual award for lean management to those who implement lean practices successfully in their firms. This will encourage the managers to seek continuous improvement through the involvement of employees, customers and suppliers, raise the awareness of lean system and eliminate the fear of changing the management style or the dominant cultural values to be more convenient with lean philosophy.More importantly, the governemnet needs to expand their trade agreements with class-world manufacturing countries such as Japan. This will happen through the cooperation with Japanese benchmark companies in lean philosophy.This then allows the Jordanian organisations undertands how the Japanese culture facilitate lean practices implementation and to develop new policies to make improvements based on the best mangerial practices implemented in the benchmark companies.

11.5 Research Limitations and Areas for Future Research

Despite the keen concern, that has been taken on board in developing and carrying out the present study, as with any behavioural research, this study is believed to have some limitations offering promising areas for future research.

First, the research setting could limit the generalizability of the findings since the sample is restricted to the manufacturing sector in Jordan. A replication of the study in different countries or different industries could present an opportunity for future research. For example, it might be interesting to understand whether the different types of organisational culture have the same effect in other contexts. Based on the contingency theory, this study reveals that the hierarchical culture is the best one to implement lean practices. This may or may not mean that it is the best in other countries.

A second limitation is associated with the nature of the present study as a Ph.D. research project. This study has investigated the role of organisational culture and lean human practices in lean technical practices using a cross-sectional manner. However, addressing such a topic using longitudinal research could complement the findings of this study by involving a limited number of firms and including responses provided by a representative sample of respondents could be useful for investigating how changing the type of organisational culture may affect lean practices implementation over a specific period of time.

Another limitation is the adoption of the CVF with its four types to examine the effect of organisational culture on lean manufacturing practices. There is an assumption that there is no universal organisational culture profile that always guarantees the success of lean (Bortolotti et al., 2015). For this reason, future studies could better use different frameworks for organisational culture such as Hofstede's cultural dimensions to investigate its effect on lean technical practices as well as their synergistic effect with lean human practices.

A further limitation of this study is the use of a single key respondent for collecting data. However, the use of a single respondent's approach to rate a diverse questions items related to organisational culture and lean manufacturing may generate some inaccuracy and more than the usual amount of random error (Cao and Zhang, 2011).Future research should seek to utilise multiple respondents in each participating organisation in order to improve the accuracy and reduce the random error. (Shah and Ward, 2003).

Moreover, there are two possible directions which the relationship between organizational culture and lean manufacturing could take. On the one hand, lean practices should fit to the existing culture to succeed; on the other hand, lean practices implementation may change an organization's culture. This study assumes the first relationship as Naor et al. (2008), Bortolotti et al. (2015), Hassini et al. (2008),and Pakdil and Leonard (2015), that organisational culture affects lean practices implementation. When an organisation begins to adopt lean manufacturing practices, whether and how its existing culture can support the implementation of these practices is important. However, we acknowledge the potential reciprocal nature; that with continuously implementing the lean practices, the values and attitudes of organisational members may be changed because of using lean practices in their tasks, which may lead to changes in the organisation's culture. Future research is desired to explore the causal direction and possible reciprocal relationship between lean practices implementation and organisational culture.

Another limitation is related to research strategy. This study has used a straightforward survey analysis to investigate the relationship between the organisational culture and lean practices. This study may not clearly answer questions such as how a specific type of organisational culture result in better implementation of lean practices. Case studies can be conducted to validate the empirical findings in this study and offer in-depth insight on how organisational culture facilitates lean implementation.

Another important limitation is associated with the insignificant effect of employees' involvement on lean technical practices. This result can be attributed to the high power distance in the Jordanian manufacturing context. Therefore, future research in a different context using quantitative (e.g. survey) and qualitative (e.g. unstructured interviews) techniques will be beneficial to better understand the precise effect of employees' involvement on lean technical practices It cannot be concluded that employees' involvement is an exclusive lean human practice of successful lean implementation.

Furthermore, the aim of this thesis is to examine the effect of organisational culture on lean manufacturing practices. To achieve this aim, the effect of each type of organisational culture has been tested separately not simultaneously with other types. The limitation of testing each cultural type separately happened in order to reach a good model fit match the sample size in the current study. The researcher tried to examine the effect of all cultural types together on lean technical practices but there was a difficulty because of the big number of variables and the complexity of the model which led to impossibility to run the model successfully. A future research is required to examine the effect of the four types of organisational culture on lean manufacturing practices implementation simultaneously but using a larger sample size. In addition, Quinn (1988) suggested that since all organisations exist in dynamic environments, no one dominant culture would be able to provide an organisation with all the values and beliefs necessary to be successful. Therefore, examining the four types together will be useful for investgating the viability of effectively achieving balance among different culture types in one organization to implement lean practices successfully. It could be the balance among different cultural types is better than one dominant type in achieving lean practices. This can be done by testing models including the interaction terms between pairs of culture types (e.g. hierarchy × group, group × rational) and examining if the interaction terms yield any significant improvement in the variance explained for lean technical practices, compared to the simultaneous model which include the four culture types.

Additionally, the results of the moderating effect of firm size on the relationship between organisational culture and lean technical practices are mixed and different from cultural type to another. Future exploratory research can be conducted to understand in depth the role of firm size in lean manufacturing implementation. Semi-structured interviews can be conducted with managers in different cultural types and different firms' size to explain why SMEs firms work better than large firms in the group culture, whereas, the large firms work better than SMEs in the hierarchical culture.

Finally, the results of the current study are based on the operations managers' perspectives. The operations managers in the current study have evaluated the level of lean human practices (customers, employees, and suppliers' involvement) based on their attitudes and viewpoints. Therefore, a future research is needed to investigate the role of each lean human practice (e.g. suppliers' involvement) on the relationship between organisational culture and lean technical practices based on other respondents' perspectives (e.g. suppliers' attitudes).

11.6 Chapter Summary

This study crosses the disciplines to draw on both organizational culture and lean manufacturing practices to build on existing theory. The norms and values characterised by different types of culture, as conceptualised in the competing values framework, should be considered in theories of lean management functioning.

This concluding chapter presents a summary of the thesis and the research conclusions in relation to the research questions. The contributions of this study to theory and practice are discussed. Finally, the chapter concludes with the limitations of this study and directions for possible future research.

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Appendix A: Cover letter

Theme and Covering Letter

A) Introduction: My name is Lubna Baqlah. I am a PhD student at School of Management and Business, Aberystwyth University, UK, under the supervision of Professor Nishikant Mishra. You are invited to participate in a research project entitled: The Impact of Organizational Culture on Lean Technical Practices in the Jordanian Manufacturing Firms. The purpose of this survey to explore the ideal organizational cultural characteristics for the effective implementation of lean manufacturing practices. The following questionnaire will take approximately 15 to 20 minutes to complete.

B) Why: The following survey has been developed to seek answers to some questions regarding lean manufacturing practices and the impact of organizational culture on these practices. It is our hope that this information will help us develop a framework for an effective implementation of lean system through aligning the different organizational culture types in Jordanian manufacturing firms.

C) Contact:

Lubna Baqlah	Professor Nishikant Mishra
School of Management and Business	School of Management and Business
Aberystwyth University	Aberystwyth University
Email:lsb13@aber.ac.uk	Email:nim4@aber.ac.uk
Tel: 0790718182	

D) Assurance of confidentiality: Participation in this research process is completely voluntary and you may refuse to participate without consequence. Responses to the survey will only be reported in aggregate form to protect the confidentiality of the participating company and the respondent. Completion and return of the questionnaire will indicate your willingness to participate in this study.

Thank you for taking the time to assist me in my educational endeavours. Your help is greatly appreciated.

Appendix B: Questionnaire (English Version)

Section 1: Background information:

This section includes 10 questions. It aims to build up general image about the characteristics of the study's sample. Please tick (√) in the appropriate box that applies to you and your organization:

1. Gender: ☐ male ☐ Female

2. Age:

☐ Under 30 years ☐ 30- 40

☐ 40-50 ☐ 50 and above

3. Your educational level:

☐ Master's/ PhD degree ☐ Bachelor's degree

☐ Diploma ☐ High school

4. Your job title (tick the closest job title that applies):

☐ Plant Manager/ CEO/ General Manager ☐ Production / Operation Manager

☐ Quality/ Quality Control Manager ☐ Inventory Manager

☐ Industrial Engineer ☐ Other (Please specify) …………

5. Total years of your experience in this organization:

☐ Less than 3 years ☐ 3-5 years

☐ 10 years ☐ More than 10 years

6. Which of the following describes your manufacturing sector?

☐ Food/ beverages ☐ Plastics and rubber

☐ Printing/ packing/packaging/ paper ☐ Pharmaceutical and Medical

☐ Chemical and Cosmetics ☐ Furniture/ kitchens and wooden

☐ Engineering (Metal and electric) ☐ Construction

☐ Leather/ Cotton/ Garments ☐ Other (please specify) ……………

7. is your organization ISO 9000 certified?

☐ Yes ☐ No

8. Who is the owner of your organization?

☐ Local (Jordan)

☐ Arab (Except Jordan)

☐ Foreign (please specify) …………………….

☐ Joint Venture

☐ Other (please specify) ………………………

9. The age of your organization:

☐ Less than 5 years old ☐ 5-10 years

☐ 11-15 years ☐ More than 15 years

10. Number of employees in your organization:

☐ Less than 50 ☐ 50-99

☐ 100-250 ☐ more than 250

11- Are you aware of the lean system/ concept?

☐ Yes ☐ No

12- Did you receive any type of training about lean system/ concept?

☐ Yes ☐ No

Section 2: Lean manufacturing Practices

This section describes ten main practices that constitute effective lean manufacturing. The aim of this section is to explore the level of implementation of the lean manufacturing philosophy in manufacturing firms in Jordan.

Please put a circle around the number (1-5) that best reflects the real level of implementation for each statement where:

1= No implementation
2= Little implementation
3= Some implementation
4= Extensive implementation
5= Complete implementation

Item Code	**Suppliers' Feedback**	**No implementation**	**Little implementation**	**Some implementation**	**Extensive implementation**	**Complete implementation**
SF1	We are frequently in close contact with our suppliers.	1	2	3	4	5
SF2	We usually visit our supplier's plants	1	2	3	4	5
SF3	Our suppliers usually visit our organization.	1	2	3	4	5
SF4	Suppliers are provided with feedback on quality and delivery performance.	1	2	3	4	5
SF5	We strive to build long-term relationship with our suppliers.	1	2	3	4	5

Item Code	**Just in time Delivery (JIT Delivery)**	**no implementation**	**Little implementation**	**Some implementation**	**Extensive implementation**	**Complete implementation**
JIT1	Our suppliers are directly involved in the new product development.	1	2	3	4	5
JIT2	We produce only what is demanded by customers when needed.	1	2	3	4	5

Item Code	Suppliers' Development	No implementation	Little implementation	Some implementation	Extensive implementation	Complete implementation
SD1	Our suppliers are contractually committed to annual cost reductions.	1	2	3	4	5
SD2	Our main suppliers are in close distance to our organization.	1	2	3	4	5
SD3	We have corporate level communication on important issues with key suppliers.	1	2	3	4	5
SD4	We take active steps to decrease the number of suppliers in each category.	1	2	3	4	5
SD5	Our key suppliers manage our inventory.	1	2	3	4	5
SD6	We evaluate our suppliers based on the total cost not on the price per unit.	1	2	3	4	5

Item Code	Customers' Involvement	No implementation	Little implementation	Some implementation	Extensive implementation	Complete implementation
CI1	We are in close relationship with our customers.	1	2	3	4	5
CI2	Our customers visit our organization to give them some ideas about quality control that the company can follow.	1	2	3	4	5
CI3	Our customers are actively or directly involved in current and future product offerings.	1	2	3	4	5
CI4	Our customers frequently share current and future demand information with marketing department.	1	2	3	4	5
CI5	We frequently administer customer satisfaction surveys.	1	2	3	4	5
CI6	Our customers give us feedback on quality and delivery performance.	1	2	3	4	5

Item Code	Pull System	No implementation	Little implementation	Some implementation	Extensive implementation	Complete implementation
PS1	We use a production system in which units are produced only in required quantities (no more and no less).	1	2	3	4	5
PS2	Production at a workstation is performed based on the current demand of the next workstation.	1	2	3	4	5
PS3	Products are not produced unless orders for them are received from customers.	1	2	3	4	5
PS4	We use Kanban*, squares, or containers of signals for production control.	1	2	3	4	5

*Kanban: A Japanese manufacturing system which depends on using visual signal or card in the production process.

Item Code	Continuous Flow	No implementation	Little implementation	Some implementation	Extensive implementation	Complete implementation
CF1	Products are categorised into groups with similar processing requirements.	1	2	3	4	5
CF2	Machines are arranged in relation to each other to produce a continuous flow of families of products.	1	2	3	4	5
CF3	Families of products determine our factory layout.	1	2	3	4	5

Item Code	Set up Time* reduction	No implementation	Little implementation	Some implementation	Extensive implementation	Complete implementation
ST1	Our employees practice set ups to save time.	1	2	3	4	5
ST2	We are aggressively working to reduce set up times in our plant.	1	2	3	4	5
ST3	We have low set up times of equipment in our plant	1	2	3	4	5

Item Code	Statistical process Control*(SPC)	No implementation	Little implementation	Some implementation	Extensive implementation	Complete implementation
SPC1	Large number of equipment/ processes on shop-floors are currently under SPC	1	2	3	4	5
SPC2	Statistical techniques are used to identify and reduce process variance.	1	2	3	4	5
SPC3	Charts showing defect rates are used as tools on the shop floor.	1	2	3	4	5
SPC4	We use Fishbone type diagrams to identify causes of quality problems.	1	2	3	4	5
SPC5	We conduct process capability studies before product launch.	1	2	3	4	5

*SPC: is a method of quality control which uses statistical methods and it is applied to monitor and control a process.

Item Code	Employees' Involvement	No implementation	Little implementation	Some implementation	Extensive implementation	Complete implementation
EI1	Our shop-floor employees are key to problem solving teams.	1	2	3	4	5
EI2	Our shop-floor employees lead product/ process improvement efforts.	1	2	3	4	5
EI3	Our shop-floor employees drive suggestion programmes.	1	2	3	4	5
EI4	Our shop-floor employees undergo cross-functional training.	1	2	3	4	5
EI5	Employee involvement through quality circles and continuous improvement teams is encouraged and supported.	1	2	3	4	5
EI6	Employees are empowered to stop the production line if abnormalities occur.	1	2	3	4	5
EI7	We implement actions to increase the level of knowledge of our employees about lean system.	1	2	3	4	5

Item Code	Total Productive Maintenance (TPM)	No implementation	Little implementation	Some implementation	Extensive implementation	Complete implementation
TPM1	We dedicate a specific time to planned equipment maintenance related activities every day.	1	2	3	4	5
TPM2	We maintain excellent records of all equipment maintenance related activities.	1	2	3	4	5
TPM3	We post equipment maintenance records on shop floor for active sharing with employees.	1	2	3	4	5
TPM4	We maintain all our equipment regularly.	1	2	3	4	5

Section 3: Organizational Culture

This section includes 16 statements aimed to explore the dominant type of organisational culture in your organization. **Please put a circle around the number (1-5) that best reflects your degree of agreement where:**

1= Strongly disagree
2= Disagree
3= Neutral
4= Agree
5= Strongly agree

Item Code	Developmental culture	Strongly disagree	disagree	neutral	Agree	Strongly agree
DC1	Our organization is a very dynamic and entrepreneurial place. People are willing to stick their necks out and take risks.	1	2	3	4	5
DC2	Leaders in our organization are generally considered to exemplify in entrepreneurship, innovation or risk taking.	1	2	3	4	5
DC3	The management style in the organization is characterised by individual risk taking, innovation, freedom and uniqueness.	1	2	3	4	5
DC4	The glue that holds our organization together is commitment to innovation and development. There is an emphasis on being first.	1	2	3	4	5
DC5	We emphasize growth, acquiring new resources and creating new challenges.	1	2	3	4	5

	Trying new things and prospecting for opportunities are valued.					
DC6	We define success based on having unique or the newest products.	1	2	3	4	5
Item Code	**Hierarchical Culture**	**Strongly disagree**	**disagree**	**neutral**	**Agree**	**Strongly agree**
HC1	Our organization is a very controlled and structural place. People pay attention to formal procedures to get things done.	1	2	3	4	5
HC2	Leaders in our organization are generally considered to exemplify coordinating, organizing, or smooth-running efficiency.	1	2	3	4	5
HC3	The management style in our organization characterised by security of employment, conformity, predictability, and stability in relationships.	1	2	3	4	5
HC4	The glue that holds our organization together is formal rules and policies. People feel that following rules is important.	1	2	3	4	5
HC5	We emphasize permanence and stability. Efficiency, control, and smooth operations are important.	1	2	3	4	5
HC6	We define success based on efficiency. Dependable delivery. Smooth scheduling and low-cost production are important.	1	2	3	4	5

Item Code	Group Culture	Strongly disagree	disagree	neutral	Agree	Strongly agree
GC1	Our organization is a very personal place. It is like an extended family. People seem to share a lot about themselves with others.	1	2	3	4	5
GC2	Managers in our organization are warm and caring. They seek to develop employees' full potential and act as their mentors or guides.	1	2	3	4	5
GC3	The management style in our organization is characterised by teamwork, consensus and participation.	1	2	3	4	5
GC4	The glue that holds our organization together is loyalty and mutual trust. Commitment to this organization runs high.	1	2	3	4	5

GC5	We emphasize human development. High trust, openness, and participation are important.	1	2	3	4	5
GC6	We define success based on the development of human resources, teamwork, employee commitment and a concern for people.	1	2	3	4	5

Item Code	**Rational Culture**	**Strongly disagree**	**disagree**	**neutral**	**Agree**	**Strongly agree**
RC1	Our organization is a very production-oriented place. A major concern is with getting the job done. People are very competitive and achievement oriented.	1	2	3	4	5
RC2	Managers in our organization are considered to exemplify a no-nonsense, aggressive, results oriented focus.	1	2	3	4	5
RC3	The management style in our organization is characterised by hard-driving competitiveness, high demands, and achievement.	1	2	3	4	5
RC4	The glue that holds our organization together is an emphasis on tasks and goal accomplishment.	1	2	3	4	5
RC5	We emphasize competitive actions and achievement. Measurable targets and winning in the marketplace are important.	1	2	3	4	5
RC6	We define success based on winning in the marketplace and outpacing the competition. Competitive market leadership is key.	1	2	3	4	5

Thank you for your time and willingness to participate. If you wish to receive a summary of the research findings, please indicate so by writing your name and e-mail address below

Name…………………………………………………………...

Email………………………………………………………….

Appendix C: Questionnaire (Arabic Version)

القسم الأول: معلومات عامه

يشمل هذا القسم 12 سؤال. ويهدف الى بناء معرفه عامه عن عينة الدراسه. الرجاء وضع اشارة (√) في المكان الذي ينطبق عليك أنت شخصيا أو على منظمتك.

اسم الشركه (لأغراض البحث العلمي)...

1. الجنس: ☐ ذكر ☐ أنثى

2. العمر: ☐ أقل من 30 عام ☐ 30-39
☐ 40-49 ☐ 50 فأكثر

3. المستوى التعليمي:
☐ شهادة الماجستير أو الدكتوراه ☐ بكالوريوس
☐ دبلوم ☐ الثانويه العامه أو ما دون

4. المسمى الوظيفي (ضع اشارة √ بجانب اللقب الوظيفي الأقرب اليك):
☐ مدير عام / رئيس تنفيذي
☐ مدير الانتاج/ مدير العمليات
☐ مدير الجوده/ مدير ضبط الجوده
☐ مدير المخزون
☐ مهندس صناعي
☐ أخرى (الرجاء التحديد)...

5. عدد سنوات الخبره في هذه المنظمه:
☐ أقل من 3سنوات ☐ 3-5
☐ 6- 10 ☐ أكثر من 10 سنوات

6. هل منظمتك حاصله على شهادة الايزو 9001؟
☐ نعم ☐ لا

7. أي من التالي يصف القطاع الصناعي الذي تعمل فيه:
☐ الصناعات الغذائيه (طعام أو شراب)
☐ الصناعات البلاستيكيه والمطاط
☐ الطباعه والتعبئه وصناعة الورق
☐ الصناعات الدوائيه والطبيه
☐ الصناعات الكيماويه/ أدوات التجميل
☐ الأثاث والمطابخ والخشب
☐ الصناعات الهندسيه (كهربائيه ومعدنيه)
☐ الصناعات الانشائيه
☐ الصناعات الجلديه/ القطن/ الألبسه

أخرى (الرجاء التحديد)..

8. من هو المالك لهذه المنظمه؟

محلي (أردني فقط)

عربي (باستثناء الاردن)

أجنبي (الرجاء التحديد)..

شراكه

أخرى (الرجاء التحديد)....................................

9. عمر المنظمه الذي تعمل فيها:

أقل من 5 سنوات

5- 10

11 -15

أكثر من 15 عام

10. عدد العاملين في هذه المنظمه:

أقل من 50

50 -99

100- 250

أكثر من 250

11. هل لديك ادراك ومعرفه عن نظام / مبدأ التصنيع الرشيق؟

نعم

لا

12. هل تلقيت أي نوع من التدريب عن نظام أو مبدأ التصنيع الرشيق؟

نعم

لا

القسم الثاني: ممارسات التصنيع الرشيق Lean Practices

هذا القسم يهدف الى وصف عشر ممارسات أساسيه للتصنيع الرشيق. يهدف هذا القسم الى استكشاف مستوى تنفيذ فلسفة التصنيع الرشيق في الشركات الصناعيه في الأردن.

الرجاء وضع دائرة حول الرقم (1-5) الذي يعكس المستوى الحقيقي لتنفيذ كل جمله من الجمل التاليه حيث ان:

1=غيرمنفذ no implementation
2= تنقيذ بدرجه قليله little implementation
3= هناك بعض التنفيذ some implementation
4= تنفيذ بشكل مكثف Extensive implementation
5= تنفيذ كامل complete implementation

الرمز	التغذيه الراجعه للموردين Supplier Feedback	لا تنفيذ	تنفيذ بدرجه قليله	هناك بعض التنفيذ	تنفيذ بدرجه مكثفه	تنفيذ كامل
SF1	نحن على تواصل مستمر ودائم مع الموردين.	1	2	3	4	5
SF2	نحن نقوم بزيارة مواقع عمل الموردين بشكل اعتيادي.	1	2	3	4	5
SF3	يقوم موردينا بزيارة مصنعنا بشكل اعتيادي.	1	2	3	4	5
SF4	يتم تزويد الموردين بتغذيه راجعه عن جودة السلعه وعملية التسليم.	1	2	3	4	5
SF5	نحن نسعى لبناء علاقه طويلة المدى مع موردينا.	1	2	3	4	5

الرمز	التسليم في الوقت المحدد Just In Time Delivery	لا تنفيذ	تنفيذ بدرجه قليله	هناك بعض التنفيذ	تنفيذ بدرجه مكثفه	تنفيذ كامل
JIT1	يشارك الموردون معنا في تطوير المنتج الجديد بشكل مباشر.	1	2	3	4	5
JIT2	نحن ننتج فقط ما يتم طلبه عند الحاجه من قبل الزبائن.	1	2	3	4	5

الرمز	تطوير الموردين Supplier Development	لا تنفيذ	تنفيذ بدرجه قليله	هناك بعض التنفيذ	تنفيذ بدرجه مكثفه	تنفيذ كامل
SD1	يتعهد الموردون بالالتزام بتخفضات سنويه تتعلق بالتكاليف.	1	2	3	4	5
SD2	يعمل موردونا الأساسيون في مواقع قريبه جغرافيا من مصنعنا.	1	2	3	4	5
SD3	لدينا تواصل مع موردينا الأساسيين على مستوى المنظمه العام بشأن القضايا الهامه.	1	2	3	4	5
SD4	نحن نتخذ خطوات فعاله لتقليل عدد الموردين للحصول على كل جزء/ صنف.	1	2	3	4	5
SD5	يتحكم موردونا بادارة المخزون في مصنعنا.	1	2	3	4	5
SD6	نحن نقيم موردينا على اساس الكلفه الاجماليه وليس على اساس السعر للوحده الواحده.	1	2	3	4	5

الرمز	مشاركة الزبائن Customer Involvement	لا تنفيذ	تنفيذ بدرجه قليله	هناك بعض التنفيذ	تنفيذ بدرجه مكثفه	تنفيذ كامل
CI1	نحن على علاقه وطيده مع زبائننا.	1	2	3	4	5
CI2	يزورون زبائننا مصنعنا لتزويدهم ببعض الافكار عن طرق ضبط الجوده التي يتبعها المصنع.	1	2	3	4	5
CI3	يشارك الزبائن بشكل مباشرو فعال بالعروض الحاليه والمستقبليه.	1	2	3	4	5
CI4	يشارك زبائننا احتياجاتهم الحاليه والمستقبليه من المنتج مع دائرة التسويق بشكل مستمر.	1	2	3	4	5
CI5	نقوم بدراسات عن رضا الزبائن بشكل مستمر.	1	2	3	4	5
CI6	يقدم زبائننا لنا تغذيه راجعه عن جودة المنتج وعملية التسليم.	1	2	3	4	5

الرمز	نظام السحب Pull System	لا تنفيذ	تنفيذ بدرجه قليله	هناك بعض التنفيذ	تنفيذ بدرجه مكثفه	تنفيذ كامل
PS1	نستخدم نظام انتاج بحيث يتم تصنيع الوحدات فقط بالكميات المطلوبه (لا أكثر ولا أقل).	1	2	3	4	5
PS2	التصنيع في ورشة العمل يتم على أساس الطلب الحالي لورشة العمل التاليه.	1	2	3	4	5
PS3	المنتجات لا يتم انتاجها الا بطلبات يتم استقبالها من قبل الزبائن.	1	2	3	4	5
PS4	نستخدم نظام الكانبان*/ البطاقات او الحاويات كنظام اشارات للسيطره على كميات الانتاج.	1	2	3	4	5

*كانبان: نظام تصنيع ياباني يعتمد على استخدام اشارات مرئيه او بطاقات للسيطره على عملية الانتاج.

تنفيذ كامل	تنفيذ بدرجه مكثفه	هناك بعض التنفيذ	تنفيذ بدرجه قليله	لا تنفيذ	التدفق المستمرللتصنيع **Continuous Flow**	الرمز
5	4	3	2	1	يتم تصنيف المنتجات ضمن مجموعات تتشابه فيها الأجزاء في متطلبات عملية التصنيع.	CF1
5	4	3	2	1	تنظم الآلات بشكل مترابط لبعضها البعض لتنتج بتدفق مستمر من المنتجات المتماثله.	CF2
5	4	3	2	1	مجموعة الأجزاء المتشابهه تحدد الترتيب الداخلي للمصنع.	CF3

تنفيذ كامل	تنفيذ بدرجه مكثفه	هناك بعض التنفيذ	تنفيذ بدرجه قليله	لا تنفيذ	التحكم في العمليات الاحصائيه* **Statistical Process Control**	الرمز
5	4	3	2	1	عدد كبير من المكائن أو العمليات هي حاليا ضمن التحكم في العمليات الاحصائيه.	SPC1
5	4	3	2	1	الطرق الاحصائيه تستخدم لتحديد وتقليل التباين في عملية التصنيع.	SPC2
5	4	3	2	1	تستخدم الرسوم البيانيه التي تحدد نسبة العيوب في المنتج كأدوات لضبط الجوده.	SPC3
5	4	3	2	1	نستخدم مخططات عظم السمكه لتحديد الاسباب المحتمله للمشاكل المتعلقه في الجوده.	SPC4
5	4	3	2	1	نقوم بادارة دراسات قدرة العمليه Process capabilityقبل طرح المنتج للسوق.	SPC5

تنفيذ كامل	تنفيذ بدرجه مكثفه	هناك بعض التنفيذ	تنفيذ بدرجه قليله	لا تنفيذ	تخفيض وقت الاعداد* **Set Up time Reduction**	الرمز
5	4	3	2	1	يمارس العاملون وقت الاعداد للآلات لتوفير الوقت.	ST1
5	4	3	2	1	نسعى بكل جهدنا لتخفيض وقت الاعداد في المصنع.	ST2
5	4	3	2	1	لدينا وقت اعداد قصير لتشغيل الالات في مصنعنا.	ST3

*وقت الاعداد: الوقت المطلوب لاعداد وتحضير الآلات أو ورشة العمل من أجل أن تكون على استعداد للانتاج.

*رقابة العمليات الاحصائيه: طريقه لضبط الجوده تستخدم الطرق الاحصائيه وتطبق بهدف مراقبة ومتابعة العمليه الانتاجيه.

الرمز	مشاركة العاملينEmployee Involvement	لا تنفيذ	تنفيذ بدرجه قليله	هناك بعض التنفيذ	تنفيذ بدرجه مكثفه	تنفيذ كامل
CI1	يعتبر كل عامل في المصنع عضو مهم في فريق حل مشاكل العمل.	1	2	3	4	5
CI2	العاملون في المصنع يقودون الجهود المتعلقه بتحسين/ تطوير العمليه الانتاجيه أو المنتج.	1	2	3	4	5
CI3	العاملون في المصنع يقودون الاقتراحات لتطوير العمل.	1	2	3	4	5
CI4	يخضع العاملون في المصنع لتدريبات على الوظائف المتعدده Cross functional training	1	2	3	4	5
CI5	يتم دعم وتشجيع مشاركة العاملين خلال دوائر الجوده وفرق التحسين المستمر.	1	2	3	4	5
CI6	يتم اعطاء صلاحيات للعاملين لتوقيف خط الانتاج عند حدوث أمور غير طبيعيه.	1	2	3	4	5
CI7	يتم تطبيق أنشطه لزيادة مستوى معرفة العاملين عن نظام الانتاج الرشيق.	1	2	3	4	5

الرمز	الصيانه الانتاجيه الشامله Total Productive Maintenance	لا تنفيذ	تنفيذ بدرجه قليله	هناك بعض التنفيذ	تنفيذ بدرجه مكثفه	تنفيذ كامل
TPM1	نحن نكرس وقت مخصص للنشاطات المتعلقه بصيانة المعدات بشكل يومي.	1	2	3	4	5
TPM2	نحتفظ بسجلات مميزه عن النشاطات المتعلقه بصيانة المعدات.	1	2	3	4	5
TPM3	نقوم بتعليق سجلات صيانة المعدات في مكان العمل لهدف المشاركه الفعاله مع العاملين.	1	2	3	4	5
TPM4	نقوم بصيانة كل المعدات بشكل منتظم.	1	2	3	4	5

القسم الثالث: ثقافة المنظمهOrganizational Culture

يشمل هذا القسم 24 جمله تهدف لاكتشاف النوع السائد من ثقافة المنظمه في منظمتك. الرجاء وضع دائره حول الرقم (5-1) الذي يعكس بالشكل الأفضل درجة موافقتك حيث أن:

1= غيرموافق بشده
2= غير موافق
3= محايد
4= موافق
5= موافق بشده

الرمز	ثقافة التطور والابتكار Developmental Culture	غير موافق بشده	غير موافق	محايد	موافق	موافق بشده
DV1	تعتبر منظمتنا مكان ريادي وديناميكي. أعضاء المنظمه لديهم رغبه بالمخاطره.	1	2	3	4	5
DV2	القاده في منظمتنا يعتبرون مثال في الرياده والابداع واتخاذ المخاطر.	1	2	3	4	5
DV3	النمط الاداري في المنظمه يتمثل بالمخاطره الفرديه والابداع والحريه والتميز.	1	2	3	4	5
DV4	الالتزام بالتطوير والابداع هو ما يجمع أعضاء المنظمه ويجعلها متماسكه.هناك اهتمام بأن نكون الأول .	1	2	3	4	5
DV5	نركز على التوسع واكتساب موارد جديده وخلق تحديات جديده. تجريب أمور جديده وتوقع الفرص أمور لها قيمه.	1	2	3	4	5
DV6	نعرف النجاح على أساس امتلاك المنتجات الأحدث والأكثر تميزا.	1	2	3	4	5

الرمز	ثقافة التسلسل الهرميHierarchical Culture	غير موافق بشده	غير موافق	محايد	موافق	موافق بشده
HC1	منظمتنا مكان منظم جدا ويعتمد على هيكل تنظيمي واضح.الأفراد يعيرون اهتمام شديد لاجراءات العمل الرسميه لأداء الأعمال.	1	2	3	4	5
HC2	القاده في منظمتنا يعتبرون مثالا في التنسيق والتنظيم وكفاءة العمل بشكل مرن.	1	2	3	4	5
HC3	النمط الاداري في منظمتنا يتمثل بالامن الوظيفي والانسجام والقدره على التنبؤ والاستقرار في العلاقات.	1	2	3	4	5
HC4	السياسات والقواعد الرسميه هي ما تجعل المنظمه متماسكه. يشعر الأفراد أن اتباع القواعد أمر هام جدا.	1	2	3	4	5
HC5	نركز على الاستمراريه والثبات. الكفاءه والرقابه ومرونة العمليات أمور هامه.	1	2	3	4	5
HC6	نعرف النجاح على أساس الكفاءه. التسليم المعتمد وجدولة العمل الواضحه والانتاج بكلفه قليله أمور هامه للنجاح.	1	2	3	4	5

موافق بشده	موافق	محايد	غير موافق	غير موافق بشده	ثقافة التعاونGroup Culture	الرمز
5	4	3	2	1	منظمتنا مكان دافئ للأفراد. تعتبر منظمتنا كعائله ممتده. يتشارك الأفراد مع بعضهم البعض بأمورهم الشخصيه.	GC1
5	4	3	2	1	المدراء في منظمتنا يتميزون بالدفء والاهتمام بالآخرين. يبحثون عن تطوير طاقات الأفراد ويلعبون دور المرشدين والموجهين.	GC2
5	4	3	2	1	النمط الاداري في منظمتنا يتمثل بفرق العمل والمشاركه والمشوره الجماعيه.	GC3
5	4	3	2	1	الثقه المتبادله والولاء أمران يجعلان المنظمه متماسكه. الالتزام لهذه المنظمه يعتبر بدرجه عاليه.	GC4
5	4	3	2	1	نركز على تطوير الفرد. الثقه العاليه والانفتاح والمشاركه أمور هامه.	GC5
5	4	3	2	1	نعرف النجاح على أساس تطوير الموارد البشريه وفرق العمل والالتزام والاهتمام بالأفراد.	GC6

موافق بشده	موافق	محايد	غير موافق	غير موافق بشده	ثقافةالسوق (المنافسه)Rational Culture	الرمز
5	4	3	2	1	منظمتنا مكان موجه نحو الانتاج. الاهتمام الرئيسي هو بانجاز العمل. الأفراد منافسين ويرغبون بالانجاز.	RC1
5	4	3	2	1	المدراء في منظمتنا يركزون على الأمور العقلانيه وتحقيق النتائج.	RC2
5	4	3	2	1	النمط الاداري في منظمتنا يتمثل بالتنافسيه الشديده ومستوى الطلبات العاليه والانجاز.	RC3
5	4	3	2	1	التركيز على انجاز المهام وتحقيق الأهداف هو ما يجعل المنظمه متماسكه.	RC4
5	4	3	2	1	نركز على النشاطات التنافسيه والانجاز.الأهداف القابله للقياس والفوز في سوق العمل أمور هامه.	RC5
5	4	3	2	1	نعرف النجاح على أساس الفوز في سوق العمل والتميز في المنافسه.القياده التنافسيه في السوق مفتاح هام للنجاح.	RC6

نشكرك على وقتك ورغبتك في المشاركه. اذا لديك رغبه لمعرفة ملخص نتائج هذه الدراسه، أرجو كتابة اسمك وعنوانك الالكتروني في الأسفل.

الاسم...

الايميل...

Appendix D: Common Methods Bias- Group Culture

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.171	27.790	27.790	9.171	27.790	27.790
2	2.509	7.603	35.393	2.509	7.603	35.393
3	2.097	6.354	41.747	2.097	6.354	41.747
4	2.082	6.309	48.056	2.082	6.309	48.056
5	1.845	5.592	53.648	1.845	5.592	53.648
6	1.521	4.609	58.257	1.521	4.609	58.257
7	1.372	4.159	62.416	1.372	4.159	62.416
8	1.117	3.384	65.799	1.117	3.384	65.799
9	1.017	3.081	68.880	1.017	3.081	68.880
10	.868	2.630	71.510			
11	.783	2.373	73.883			
12	.755	2.287	76.171			
13	.659	1.998	78.169			
14	.640	1.939	80.108			
15	.598	1.813	81.921			
16	.560	1.697	83.618			
17	.505	1.529	85.147			
18	.482	1.460	86.607			
19	.468	1.418	88.025			
20	.444	1.346	89.371			
21	.413	1.253	90.624			
22	.388	1.177	91.801			
23	.371	1.125	92.925			
24	.347	1.053	93.978			
25	.336	1.018	94.996			
26	.286	.868	95.864			
27	.257	.777	96.642			
28	.249	.756	97.398			
29	.231	.701	98.099			
30	.187	.567	98.666			
31	.177	.536	99.202			
32	.149	.453	99.654			
33	.114	.346	100.000			

Extraction Method: Principal Component Analysis.

Appendix E: Common Methods Bias- Developmental Culture

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.508	27.445	27.445	8.508	27.445	27.445
2	2.287	7.379	34.824	2.287	7.379	34.824
3	2.112	6.815	41.638	2.112	6.815	41.638
4	1.866	6.021	47.659	1.866	6.021	47.659
5	1.599	5.158	52.817	1.599	5.158	52.817
6	1.484	4.786	57.603	1.484	4.786	57.603
7	1.319	4.255	61.858	1.319	4.255	61.858
8	1.124	3.626	65.484	1.124	3.626	65.484
9	.994	3.205	68.689			
10	.862	2.780	71.470			
11	.780	2.516	73.986			
12	.740	2.386	76.372			
13	.662	2.136	78.508			
14	.601	1.940	80.448			
15	.571	1.843	82.291			
16	.544	1.754	84.045			
17	.514	1.659	85.704			
18	.491	1.584	87.288			
19	.453	1.461	88.749			
20	.429	1.383	90.132			
21	.400	1.291	91.423			
22	.377	1.215	92.639			
23	.347	1.119	93.757			
24	.335	1.079	94.837			
25	.318	1.027	95.863			
26	.298	.961	96.824			
27	.272	.876	97.700			
28	.234	.755	98.455			
29	.197	.637	99.092			
30	.174	.562	99.654			
31	.107	.346	100.000			

Extraction Method: Principal Component Analysis.

Appendix F: Common Methods Bias- Hierarchical Culture

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.850	27.655	27.655	8.850	27.655	27.655
2	2.271	7.096	34.752	2.271	7.096	34.752
3	2.102	6.568	41.319	2.102	6.568	41.319
4	1.881	5.879	47.198	1.881	5.879	47.198
5	1.689	5.277	52.475	1.689	5.277	52.475
6	1.496	4.676	57.150	1.496	4.676	57.150
7	1.378	4.306	61.456	1.378	4.306	61.456
8	1.120	3.500	64.956	1.120	3.500	64.956
9	1.008	3.149	68.105	1.008	3.149	68.105
10	.861	2.689	70.794			
11	.795	2.484	73.278			
12	.768	2.400	75.678			
13	.669	2.090	77.768			
14	.584	1.824	79.592			
15	.577	1.803	81.395			
16	.548	1.712	83.107			
17	.533	1.667	84.774			
18	.507	1.585	86.359			
19	.487	1.520	87.880			
20	.458	1.432	89.312			
21	.444	1.387	90.699			
22	.409	1.277	91.976			
23	.362	1.132	93.108			
24	.343	1.071	94.180			
25	.309	.965	95.144			
26	.297	.927	96.071			
27	.283	.883	96.954			
28	.271	.846	97.800			
29	.235	.733	98.533			
30	.200	.625	99.159			
31	.159	.496	99.655			
32	.110	.345	100.000			

Extraction Method: Principal Component Analysis.

Appendix G: Common Methods Bias- Rational Culture

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.483	26.508	26.508	8.483	26.508	26.508
2	2.282	7.131	33.639	2.282	7.131	33.639
3	2.106	6.581	40.220	2.106	6.581	40.220
4	2.035	6.358	46.578	2.035	6.358	46.578
5	1.837	5.740	52.319	1.837	5.740	52.319
6	1.557	4.866	57.185	1.557	4.866	57.185
7	1.368	4.274	61.459	1.368	4.274	61.459
8	1.116	3.487	64.946	1.116	3.487	64.946
9	1.069	3.342	68.288	1.069	3.342	68.288
10	.887	2.772	71.060			
11	.783	2.446	73.506			
12	.748	2.336	75.842			
13	.680	2.126	77.968			
14	.638	1.994	79.962			
15	.578	1.805	81.767			
16	.564	1.762	83.529			
17	.503	1.573	85.101			
18	.498	1.556	86.657			
19	.467	1.461	88.118			
20	.443	1.385	89.503			
21	.408	1.276	90.779			
22	.384	1.201	91.979			
23	.353	1.102	93.081			
24	.346	1.081	94.162			
25	.331	1.035	95.197			
26	.311	.973	96.170			
27	.273	.852	97.022			
28	.254	.792	97.815			
29	.229	.715	98.529			
30	.189	.590	99.119			
31	.168	.526	99.645			
32	.114	.355	100.000			

Extraction Method: Principal Component Analysis.

Appendix H: Independent Sample T-Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
We are frequently in close contact with our suppliers.	Equal variances assumed	.049	.825	.547	38	.587	.15000	.27410	-.40489	.70489
	Equal variances not assumed			.547	37.949	.587	.15000	.27410	-.40491	.70491
We usually visit our supplier's plants	Equal variances assumed	.462	.501	-.272	38	.787	-.10000	.36814	-.84526	.64526
	Equal variances not assumed			-.272	36.511	.787	-.10000	.36814	-.84626	.64626
Our suppliers usually visit our organization.	Equal variances assumed	.311	.580	.428	38	.671	.15000	.35075	-.56006	.86006
	Equal variances not assumed			.428	37.131	.671	.15000	.35075	-.56060	.86060
Suppliers are provided with feedback on quality and delivery performance.	Equal variances assumed	2.065	.159	.737	38	.466	.25000	.33931	-.43690	.93690
	Equal variances not assumed			.737	36.844	.466	.25000	.33931	-.43761	.93761
We strive to build long-term relationship with our suppliers.	Equal variances assumed	2.343	.134	1.800	38	.080	.45000	.25000	-.05610	.95610
	Equal variances not assumed			1.800	31.638	.081	.45000	.25000	-.05946	.95946
Our suppliers are directly involved in the new product development.	Equal variances assumed	1.526	.224	1.385	38	.174	.55000	.39719	-.25408	1.35408
	Equal variances not assumed			1.385	36.048	.175	.55000	.39719	-.25551	1.35551

We have a formal supplier certification programme.	Equal variances assumed	9.443	.004	.975	38	.336	.45000	.46155	-.48435	1.38435
	Equal variances not assumed			.975	34.309	.336	.45000	.46155	-.48767	1.38767
Our suppliers are contractually committed to annual cost reductions.	Equal variances assumed	1.626	.210	.000	38	1.000	.00000	.36128	-.73138	.73138
	Equal variances not assumed			.000	35.899	1.000	.00000	.36128	-.73279	.73279
Our main suppliers are in close distance to our organization.	Equal variances assumed	.565	.457	-.345	38	.732	-.15000	.43453	-1.02966	.72966
	Equal variances not assumed			-.345	37.790	.732	-.15000	.43453	-1.02982	.72982
We have corporate level communication on important issues with key suppliers	Equal variances assumed	1.545	.222	.945	38	.351	.35000	.37045	-.39995	1.09995
	Equal variances not assumed			.945	36.717	.351	.35000	.37045	-.40081	1.10081
We take active steps to decrease the number of suppliers in each category.	Equal variances assumed	1.599	.214	.769	38	.447	.25000	.32505	-.40803	.90803
	Equal variances not assumed			.769	37.881	.447	.25000	.32505	-.40810	.90810
Our key suppliers manage our inventory.	Equal variances assumed	.338	.564	1.022	38	.313	.35000	.34240	-.34315	1.04315
	Equal variances not assumed			1.022	35.645	.314	.35000	.34240	-.34466	1.04466
We evaluate our suppliers based on the total cost not on the price per unit.	Equal variances assumed	.048	.828	-.115	38	.909	-.05000	.43453	-.92966	.82966
	Equal variances not assumed			-.115	37.948	.909	-.05000	.43453	-.92970	.82970

We are in close relationship with our customers.	Equal variances assumed	1.563	.219	.804	38	.426	.20000	.24868	-.30343	.70343
	Equal variances not assumed			.804	32.565	.427	.20000	.24868	-.30620	.70620
Our customers visit our organization to give them some ideas about quality control that the company can follow.	Equal variances assumed	2.662	.111	1.043	38	.304	.45000	.43149	-.42351	1.32351
	Equal variances not assumed			1.043	36.334	.304	.45000	.43149	-.42482	1.32482
Our customers are actively or directly involved in current and future product offerings.	Equal variances assumed	.037	.848	1.812	38	.078	.70000	.38628	-.08198	1.48198
	Equal variances not assumed			1.812	37.683	.078	.70000	.38628	-.08219	1.48219
Our customers frequently share current and future demand information with marketing department.	Equal variances assumed	9.820	.003	1.297	38	.202	.45000	.34698	-.25242	1.15242
	Equal variances not assumed			1.297	30.147	.205	.45000	.34698	-.25848	1.15848
We frequently administer customer satisfaction surveys.	Equal variances assumed	1.312	.259	.831	38	.411	.30000	.36092	-.43064	1.03064
	Equal variances not assumed			.831	36.936	.411	.30000	.36092	-.43134	1.03134
Our customers	Equal variances assumed	3.680	.063	-1.360	38	.182	-.35000	.25726	-.87080	.17080

give us feedback on quality and delivery performance.	Equal variances not assumed			-1.360	37.376	.182	-.35000	.25726	-.87109	.17109
We use a production system in which units are produced only in required quantities (no more and no less).	Equal variances assumed	.472	.496	.334	38	.740	.15000	.44883	-.75861	1.05861
	Equal variances not assumed			.334	36.927	.740	.15000	.44883	-.75947	1.05947
Production at a workstation is performed based on the current demand of the next workstation.	Equal variances assumed	.314	.579	.000	38	1.000	.00000	.40750	-.82493	.82493
	Equal variances not assumed			.000	36.217	1.000	.00000	.40750	-.82627	.82627
Products are not produced unless orders for them are received from customers.	Equal variances assumed	2.168	.149	.447	38	.657	.20000	.44721	-.70534	1.10534
	Equal variances not assumed			.447	36.066	.657	.20000	.44721	-.70693	1.10693
We use Kanban*, squares, or containers of signals for production control.	Equal variances assumed	.150	.701	2.048	38	.057	.95000	.46382	.01104	1.88896
	Equal variances not assumed			2.048	37.877	.058	.95000	.46382	.01094	1.88906
Products are categorised into groups with similar processing requirements.	Equal variances assumed	.029	.865	1.031	38	.309	.30000	.29110	-.28929	.88929
	Equal variances not assumed			1.031	37.478	.309	.30000	.29110	-.28956	.88956

Machines are arranged in relation to each other to produce a continuous flow of families of products.	Equal variances assumed	1.421	.241	-1.018	38	.315	-.30000	.29469	-.89657	.29657
	Equal variances not assumed			-1.018	34.446	.316	-.30000	.29469	-.89860	.29860
Families of products determine our factory layout.	Equal variances assumed	.394	.534	.800	38	.429	.25000	.31267	-.38297	.88297
	Equal variances not assumed			.800	37.389	.429	.25000	.31267	-.38331	.88331
Our employees practice set ups to save time.	Equal variances assumed	.111	.741	.147	38	.884	.05000	.34009	-.63847	.73847
	Equal variances not assumed			.147	37.614	.884	.05000	.34009	-.63870	.73870
We are aggressively working to reduce set up times in our plant.	Equal variances assumed	1.155	.289	1.798	38	.080	.50000	.27815	-.06309	1.06309
	Equal variances not assumed			1.798	33.334	.081	.50000	.27815	-.06569	1.06569
We have low set up times of equipment in our plant	Equal variances assumed	.832	.367	-.403	38	.689	-.15000	.37258	-.90425	.60425
	Equal variances not assumed			-.403	37.217	.690	-.15000	.37258	-.90477	.60477
Large number of equipment/ processes on shop-floors are currently under SPC	Equal variances assumed	1.082	.305	.880	38	.385	.35000	.39786	-.45542	1.15542
	Equal variances not assumed			.880	36.928	.385	.35000	.39786	-.45619	1.15619
Statistical techniques are used to identify and reduce process variance.	Equal variances assumed	.498	.485	1.789	38	.082	.70000	.39135	-.09225	1.49225
	Equal variances not assumed			1.789	37.946	.082	.70000	.39135	-.09229	1.49229

Charts showing defect rates are used as tools on the shop floor.	Equal variances assumed	.668	.419	1.819	38	.077	.80000	.43980	-.09032	1.69032
	Equal variances not assumed			1.819	36.948	.077	.80000	.43980	-.09115	1.69115
We use Fishbone type diagrams to identify causes of quality problems.	Equal variances assumed	6.169	.018	.927	38	.360	.40000	.43164	-.47382	1.27382
	Equal variances not assumed			.927	35.497	.360	.40000	.43164	-.47584	1.27584
We conduct process capability studies before product launch.	Equal variances assumed	5.186	.028	-1.987	38	.054	-.75000	.37749	-1.51419	.01419
	Equal variances not assumed			-1.987	33.338	.055	-.75000	.37749	-1.51772	.01772
Our shop-floor employees are key to problem solving teams.	Equal variances assumed	1.325	.257	-1.342	38	.188	-.30000	.22361	-.75267	.15267
	Equal variances not assumed			-1.342	35.896	.188	-.30000	.22361	-.75354	.15354
Our shop-floor employees lead product/ process improvement efforts.	Equal variances assumed	6.535	.015	-.888	38	.380	-.25000	.28168	-.82023	.32023
	Equal variances not assumed			-.888	32.616	.381	-.25000	.28168	-.82333	.32333
Our shop-floor employees drive suggestion programmes.	Equal variances assumed	.147	.703	-.784	38	.438	-.20000	.25495	-.71612	.31612
	Equal variances not assumed			-.784	37.518	.438	-.20000	.25495	-.71634	.31634
Our shop-floor	Equal variances assumed	5.332	.026	.545	38	.589	.20000	.36707	-.54308	.94308

employees undergo cross-functional training.	Equal variances not assumed			.545	34.146	.589	.20000	.36707	-.54585	.94585
Employees are empowered to stop the production line if abnormalities occur.	Equal variances assumed	3.555	.067	-.130	38	.897	-.05000	.38371	-.82679	.72679
	Equal variances not assumed			-.130	36.447	.897	-.05000	.38371	-.82788	.72788
We implement actions to increase the level of knowledge of our employees about lean system.	Equal variances assumed	.152	.699	.000	38	1.000	.00000	.34641	-.70127	.70127
	Equal variances not assumed			.000	37.353	1.000	.00000	.34641	-.70167	.70167
Quality circles and continuous improvement teams is encouraged and supported.	Equal variances assumed	5.155	.029	1.515	38	.138	.50000	.33007	-.16820	1.16820
	Equal variances not assumed			1.515	30.224	.140	.50000	.33007	-.17389	1.17389
We dedicate a specific time to planned equipment maintenance related activities every day.	Equal variances assumed	.691	.411	1.745	38	.089	.65000	.37258	-.10425	1.40425
	Equal variances not assumed			1.745	36.458	.089	.65000	.37258	-.10530	1.40530
We maintain excellent	Equal variances assumed	.008	.930	1.542	38	.131	.60000	.38899	-.18748	1.38748

records of all equipment maintenance related activities.	Equal variances not assumed			1.542	37.779	.131	.60000	.38899	-.18763	1.38763
We post equipment maintenance records on shop floor for active sharing with employees	Equal variances assumed	.000	1.000	1.612	38	.115	.65000	.40311	-.16606	1.46606
	Equal variances not assumed			1.612	37.829	.115	.65000	.40311	-.16618	1.46618
We maintain all our equipment regularly.	Equal variances assumed	.021	.886	.283	38	.779	.10000	.35355	-.61573	.81573
	Equal variances not assumed			.283	37.957	.779	.10000	.35355	-.61576	.81576
Our organization is a very dynamic and entrepreneurial place. People are willing to stick their necks out and take risks.	Equal variances assumed	.024	.878	.900	38	.374	.30000	.33325	-.37462	.97462
	Equal variances not assumed			.900	37.694	.374	.30000	.33325	-.37480	.97480
Leaders in our organization are generally considered to exemplify in entrepreneurship, innovation or risk taking.	Equal variances assumed	.090	.765	.909	38	.369	.25000	.27506	-.30683	.80683
	Equal variances not assumed			.909	37.928	.369	.25000	.27506	-.30686	.80686
The management style in the organization	Equal variances assumed	3.587	.066	.433	38	.667	.15000	.34622	-.55089	.85089
	Equal variances not assumed			.433	33.616	.668	.15000	.34622	-.55390	.85390

is characterised by individual risk taking, innovation, freedom and uniqueness.										
The glue that holds our organization together is commitment to innovation and development. There is an emphasis on being first.	Equal variances assumed	.907	.347	1.740	38	.090	.55000	.31602	-.08975	1.18975
	Equal variances not assumed			1.740	33.703	.091	.55000	.31602	-.09244	1.19244
We emphasize growth, acquiring new resources and creating new challenges. Trying new things and prospecting for opportunities are valued.	Equal variances assumed	.776	.384	1.258	38	.216	.40000	.31789	-.24353	1.04353
	Equal variances not assumed			1.258	36.419	.216	.40000	.31789	-.24445	1.04445
We define success based on having unique or the newest products.	Equal variances assumed	4.783	.035	2.292	38	.128	.65000	.28354	.07600	1.22400
	Equal variances not assumed			2.292	32.212	.129	.65000	.28354	.07260	1.22740
Our organization	Equal variances assumed	.778	.383	.657	38	.515	.20000	.30435	-.41613	.81613

is a very controlled and structural place. People pay attention to formal procedures to get things done.	Equal variances not assumed			.657	36.474	.515	.20000	.30435	-.41698	.81698
Leaders in our organization are generally considered to exemplify coordinating, organizing, or smooth-running efficiency.	Equal variances assumed	.531	.471	1.662	38	.105	.40000	.24061	-.08710	.88710
	Equal variances not assumed			1.662	35.688	.105	.40000	.24061	-.08813	.88813
The management style in our organization characterised by security of employment, conformity, predictability, and stability in relationships.	Equal variances assumed	.502	.483	.545	38	.589	.15000	.27506	-.40683	.70683
	Equal variances not assumed			.545	36.819	.589	.15000	.27506	-.40742	.70742
The glue that holds our organization together is formal rules and policies. People feel that following rules is important.	Equal variances assumed	1.761	.192	-.728	38	.471	-.15000	.20616	-.56734	.26734
	Equal variances not assumed			-.728	37.276	.471	-.15000	.20616	-.56761	.26761

We emphasize permanence and stability. Efficiency, control, and smooth operations are important.	Equal variances assumed	.065	.800	-.238	38	.813	-.05000	.20995	-.47502	.37502
	Equal variances not assumed			-.238	37.983	.813	-.05000	.20995	-.47503	.37503
We define success on the basis of efficiency. Dependable delivery. Smooth scheduling and low-cost production are important.	Equal variances assumed	.618	.437	-.246	38	.807	-.05000	.20359	-.46214	.36214
	Equal variances not assumed			-.246	37.305	.807	-.05000	.20359	-.46239	.36239
Our organization is a very personal place. It is like an extended family. People seem to share a lot about themselves with others.	Equal variances assumed	.939	.339	.375	38	.710	.10000	.26656	-.43962	.63962
	Equal variances not assumed			.375	34.500	.710	.10000	.26656	-.44142	.64142
Managers in our organization are warm and caring. They seek to develop employees'	Equal variances assumed	.040	.843	1.406	38	.168	.35000	.24895	-.15396	.85396
	Equal variances not assumed			1.406	34.024	.169	.35000	.24895	-.15590	.85590

full potential and act as their mentors or guides.										
The management style in our organization is characterised by teamwork, consensus and participation.	Equal variances assumed	.218	.643	.224	38	.824	.05000	.22331	-.40207	.50207
	Equal variances not assumed			.224	37.101	.824	.05000	.22331	-.40243	.50243
The glue that holds our organization together is loyalty and mutual trust. Commitment to this organization runs high.	Equal variances assumed	.522	.475	1.013	38	.318	.25000	.24682	-.24966	.74966
	Equal variances not assumed			1.013	35.022	.318	.25000	.24682	-.25106	.75106
We emphasize human development. High trust, openness, and participation are important.	Equal variances assumed	.029	.865	.954	38	.346	.20000	.20964	-.22439	.62439
	Equal variances not assumed			.954	34.641	.347	.20000	.20964	-.22574	.62574
We define success based on the development of human resources, teamwork, employee commitment	Equal variances assumed	.026	.873	1.097	38	.280	.25000	.22798	-.21152	.71152
	Equal variances not assumed			1.097	36.318	.280	.25000	.22798	-.21222	.71222

and a concern for people.										
Our organization is a very production-oriented place. A major concern is with getting the job done. People are very competitive and achievement oriented.	Equal variances assumed	.011	.917	1.177	38	.247	.25000	.21244	-.18007	.68007
	Equal variances not assumed			1.177	35.293	.247	.25000	.21244	-.18115	.68115
Managers in our organization are considered to exemplify a no-nonsense, aggressive, results oriented focus.	Equal variances assumed	1.238	.273	1.505	38	.141	.35000	.23255	-.12077	.82077
	Equal variances not assumed			1.505	36.958	.141	.35000	.23255	-.12121	.82121
The management style in our organization is characterised by hard-driving competitiveness, high demands, and achievement.	Equal variances assumed	.293	.592	-.417	38	.679	-.10000	.24007	-.58599	.38599
	Equal variances not assumed			-.417	33.526	.680	-.10000	.24007	-.58813	.38813

The glue that holds our organization together is an emphasis on tasks and goal accomplishment.	Equal variances assumed	.194	.662	-.483	38	.632	-.10000	.20711	-.51927	.31927
	Equal variances not assumed			-.483	34.968	.632	-.10000	.20711	-.52047	.32047
We emphasize competitive actions and achievement. Measurable targets and winning in the marketplace are important.	Equal variances assumed	2.721	.107	1.170	38	.249	.30000	.25649	-.21925	.81925
	Equal variances not assumed			1.170	32.210	.251	.30000	.25649	-.22233	.82233
We define success based on winning in the marketplace and outpacing the competition. Competitive market leadership is key.	Equal variances assumed	.062	.805	-1.244	38	.221	-.25000	.20098	-.65687	.15687
	Equal variances not assumed			-1.244	33.324	.222	-.25000	.20098	-.65875	.15875