ANALYSIS OF LEAN AND AGILE MANUFACTURING PRACTICES UNDER UNIVERSAL, CONTINGENCY AND CONFIGURATIONAL PERSPECTIVES IN APPAREL EXPORT INDUSTRY OF PAKISTAN AND DEVELOPMENT OF A STRATEGIC FRAMEWORK FOR IMPROVING ITS PERFORMANCE

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Tahir Iqbal
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DEDICATIONS

This Research Work is dedicated to:

My Father Mian Sakhi Muhammad (late) and Mother Jamila Begum
My Brother Mian Tabassum Iqbal and Sisters Rubina, Rukhsana, Nagina and Asfa
My Wife Asma, daughter Rafia and sons Hamza, Abdullah and Ibrahim

And
My Dearestt Friends
Chaudhry Muhammad Naeem Akbar
&
Ahsan Rana

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LIST OF ABBREVIATIONS

AMOS	Analysis of Moments Structures
AM	Agile Manufacturing
Bns	Billions
BPR	Business Process Reengineering
CAD	Computer-Aided Design
CAM	Computer-Aided Manufacturing
CAT	Computer Aided Testing
CAE	Computer Aided Engineering
CAIP	Computer Aided Inspection Planning
CAPP	Computer Aided Process Planning
CB-SEM	Covariance Based - Structural Equation Modelling
Ct	Cronbach's Coefficient Alpha
CEO	Chief Executive Officer
CIM	Computer Integrated Manufacturing
CAGR	Compound Annual Growth Rate
CM	Cellular Manufacturing
CE	Concurrent Engineering
CEO	Chief Executive Officer
CI	Common Infrastructure
CII	Common Internal Infrastructure
CEI	Common External Infrastructure
CFA	Confirmatoy Factor Anlaysis
CFI	Comparative Fit Index
CIP	Common Infrastructure Practices
CITC	Corrected Item to Total Correlation
CNC	Computer Numerical Control
CP	Change Proficiency, Core Practices
CR	Composite Relaibility
CT	Contingency Theory
CWQC	Company Wide Quality Control
DF	Degree of Freedom

DNC	Direct Numerical Control
EI	Employees Invovlement
EDI	Elctronic Data Interchange
EFA	Exploratory Factor Analsysis
e.g.	Exempli Gratia (for example)
EMP	Environmental Management Practices
EP	Environmental Performance
ERP	Enterprise Resource Planning
etc.	Et Cetera (and so forth)
FAS	Flexible Assembly System
FF	Focused Factory
FMEA	Failure Mode and Effect Analysis
FMS	Flexible Manufacturing Systems
GDP	Gross Domestic Production
GFI	Goodness of Fit Index
AGFI	Adjusted Goodness of Fit Index
AVISC	Average Inter Scale Correlation
GLS	General Living System
GM	General Manager
HRM	Human Resource Management
HS	Harmonized Commodity Description and Coding System
i.e.	id est (that is)
IFI	Incremental Fit Index
IM	Integrated Manufacturing
IT	Institutional Theory, Information Technology
JIT	Just in Time
KM	Knowledge Management
LC	Lean Culture
LO	Lean Organization
LP	Lean Production
Lph	Lean Philosophy
LSE	Largest Structural Equation
LT	Lean Thinking

Mns	Millions
MP	Mass Production
MRP	Manufacturing Resource Planning
NC	Numerical Control
NFI	Normed Fit Index
NNFI	Non-Normed Fit Index
NPO	National Productivity Organization
OM	Operations Management
PGFI	Parsimony goodness of Fit Index
PLS-SEM	Partial Least Squares - Structural Equation Modelling
PNFI	Parsimony Normed of Fit Index
PRGMEA	Pakistan Readynade Garment Manufatueres and Exporters Association
PHMA	Pakistan Hoisery Manufacturers Associations
RMR	Root Mean Residual
RMSEA	Root Mean Square Error Of Approximation
SCM	Supply Chain Managemnt
SD	Standard Deviation
SE	Standard Error
SEM	Structural Equaltion Model / Modelling
Ser.	Serial
SFL	Standardized Factor Loading
SIC	Standard Industrial Classification
SMEDA	Small and Medium Enterprise Development Authority
SMES	Small and Medium Enterprises
SPC	Statistical Process Control
SQRT	Square Root
TLI	Tucker-Lewis Index
ToC	Theory Of Constraints
ToS	Theory of Systems
TPM	Total Productive Maintenance
TPS	Toyota Production System
TQC	Total Quality Control
TQM	Total Quality Management

USA	United States Of America
UK	United Kingdom
VIF	Variance Inflation Factor
UNIDO	Unites Nations Industrial Development Organizations
WCM	World Class Manufactueres, World Class Manufacturing
WCO	World Customs Organization
WTO	World Trade Organizations

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α	Cronbach's Alpha Coefficient
β	Beta Coeficient
γ	Gamma Coefficient
λ	Lambda Coefficient
ξ	Zeta Coefficient
χ^2	Chi-Square
η	Etta
ρ	Rho
Δ	Delta
ε	Epsilon
θ	Theeta
n	Sample Size

ABSTRACT

This research study explores the integration, the degree of implementation of Lean and Agile improvement initiatives and their impact on business performance in Apparel export industry of Pakistan. Lean and Agile improvement initiatives have emerged as 21st century manufacturing paradigms. Lean and Agile Manufacturing are well recognized as improvement initiatives in the field of Operations' Management that organizations pursuit to achieve competitiveness. An explicit understanding of inter-relationship of these improvement initiatives still lacks in the field of Operations Management and vagueness exists, whether Lean (Total Quality Management & Just-in-Time) and Agile Manufacturing are mutually supportive, mutually exclusive or one is antecedent to the other. Moreover, if antecedent to each other, then question arises which component is antecedent to the other? A 3-Stage Conceptual Framework is proposed to investigate the inter-relationship between Lean (Total Quality Management & Just-in-Time) and Agile Manufacturing and their impact on business performance in Apparel export industry of Pakistan. The proposed conceptual framework incorporates management and common infrastructure (internal and external) practices required to enable core Lean (Total Quality Management & Just-in-Time) and Core Agile Manufacturing. Stage-1 is organization culture stage, stage-2 is core manufacturing and stage-3 constitutes of business performance measures.

A set of Management, Common Infrastructure (internal and external) practices, and Core Total Quality Management, Core Just-in-Time and Core Agile Manufacturing practices is identified through literature review. The proposed framework fit is assessed by employing three forms (Universal, Contingency and Configurational perspectives) of fit. A survey from 248 Apparel export firms of Pakistan is performed to test empirical validity of the conceptual framework. Multi-items constructs already developed are used to measure these practices. Moreover, Core Agile Manufacturing construct comprising three sub-dimensions (Change Proficiency, Knowledge Management and Advance Manufacturing Technology) is developed and its psychometric properties are empirically validated.

The proposed framework fitness, employing five forms of fit (Direct Covariation, Mediation, Moderation, Profile Deviation and Gestalt), is tested using multiple analysis methods like Structural Equation Modeling (Covariance Base and Partial Least Squares) for direct covariation, indirect covariation (mediation) and moderation fit, multiple regression analysis for profile deviation fit and discriminant analysis for gestalt fit. At macro level, the

proposed framework is partially modified as Core Just-in-Time practices fail to directly link with Core Agile Manufacturing practices. However, the same is redirected through common external infrastructure practices based on theoretical justification. Moreover, core Total Quality Management and Core Just-in-Time practices fail to contribute directly in Operational Performance, nonetheless, Core Agile Manufacturing practices positively mediate the same relationship.

At micro level, top management commitment, inward focus (strategic vision and planning, employees training and empowerment, information system), outward focus (relationship with customer and suppliers), and Core Agile Manufacturing (change proficiency, knowledge management and advance manufacturing technology) significantly differentiate between high and low performers. Modified framework is also tested under organizational and business environmental contexts. Firm size, ISO-9001 Registration, competitive pressures, market dynamics and technological turbulence moderate the mutual relationship among management, common infrastructure (internal and external), and core manufacturing practices and impact on business performance.

The final 3-stage empirically validated framework provides a strategic direction, at macro (system) and micro (sub-system) level, to the managers of Apparel export industry of Pakistan in particular, and manufacturing managers in general, to remain competitive and achieve business performance milestones (Operational Performance, Market Performance & Financial Performance). Overall, this research study resolves the long outstanding and conflicting issue in the field of Operations' Management and provides a detailed theoretical and empirical justification for Lean (Total Quality Management & Just-in-Time) and Agile Manufacturing implementation under universal, contingency and configurational perspectives in Apparel export industry of Pakistan. Moreover, this study contributes in the field of Operations' Management explicitly establishing that Core Lean (Total Quality Management & Just-in-Time) is antecedent to Core Agile Manufacturing and both paradigms in combination increase business performance.

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION AND THEORETICAL BACKGROUND

Dynamic nature of competition prevailing in the market is primarily due to globalisation, enriched sophistication in demand from customers due to market changes awareness, rapid technological progressions, social aspects and organizations' will of business expansion irrespective of their size to stay competitive. These market trends have reshaped the challenges being faced by modern era organizations. Diverse nature of these challenges virtually has eliminated the geographical boundaries. The World's market has been transformed into new dimensions, where competition boundaries have taken a hyper-dynamic shape (Sarwar, Ishaque, Ehsan, Pirzada, & Nasir, 2012). These competitive pressures have established an environment where changing customer preferences become driving force for continuous improvement in products and services. Manufacturers are taking new improvement initiatives to remain part of the continuously changing market (Inman, Sale, Green Jr, & Whitten, 2011). These improvement initiatives have evolved over time and kept on changing with respect to market requirements (Jin-Hai, Anderson, & Harrison, 2003). Organizational strategic planning and forecasting remained core strategic focus in 1950s and 1960s respectively. Organizational strategic focus, in addition to planning and forecasting, shifted to productivity and quality in 1970s and in 1980s respectively. All these improvement initiatives eventually resulted in convergence to adaptability and responsiveness in 1990s (Vokurka & Fliedner, 1998). Lean and Agile improvement initiatives have emerged as 21st century manufacturing paradigms (Shah & Ward, 2003; Yusuf & Adeleye, 2002). Lean and Agile manufacturing (AM) are often viewed in the literature through the lenses of isolation or joint venture (Gunasekaran, 1999a). Harrison (1997) expressed his reservations over compatibility of companies following Lean initiatives and moving towards agility, whereas, Papadopoulou and Özbayrak (2005) claim that Lean is a holistic approach and contains all essential elements of AM and there is nothing like Agility or Leagile (Shah & Ward, 2003). On the other hand, Gunasekaran, Lai, and Edwin Cheng (2008) and Ramesh and Devadasan (2007) argue that critical elements required for agile performance are part of Lean (JIT) manufacturing (Bottani, 2010). Moreover, Shah and Ward (2003) considered AM as part of Lean bundles (JIT).

Literature does not spell out which initiative is superior to the other. Generally, there are three different, yet interrelated, schools of thoughts are being sponsored in the literature. These schools are categorised as following:

(a) **MUTUALLY EXCLUSIVE**

(1) Who consider that these initiatives are "Competing or Mutually Exclusive" (Hallgren & Olhager, 2009).

(2) Who consider that these initiatives have entirely different approaches, but can be assimilated as a concept of "Leagility" (Christopher & Towill, 2001; Krishnamurthy & Yauch, 2007; Naylor, Naim, & Berry, 1999) in the supply chain of an organization.

(3) Who consider that these initiatives have different performance objectives employing same set of practices (Bottani, 2010; Narasimhan, Swink, & Kim, 2006).

(b) **MUTUALLY SUPPORTIVE**

(1) Who consider that both are "Mutually Supportive or Complementary" to each other (Krishnamurthy & Yauch, 2007).

(2) Who consider that over all, these initiatives are same things, where one is "Sub-Class" of the other (Bottani, 2010; Shah & Ward, 2003).

(c) **ANTECEDENT RELATIONSHIP**

(1) Who consider that both are mutually supportive in a way that Lean (TQM & JIT) is antecedent to the AM (Inman et al., 2011; Zelbst, Green Jr, Abshire, & Sower, 2010).

Lean is antecedent to achieve agility from performance perspective reported by Narasimhan et al. (2006, p. 440) as, "pursuit of agility might presume Leanness, pursuit of Leanness might not presume agility". Ambiguity still exists in the OM literature from practices' perspective whether Lean and AM are mutually supportive and complement each other or are competing in nature. Nonetheless, if these initiatives are mutually supportive or complement each other, then question arises about employment of management, infrastructure and core Lean and AM practices' sequence, which, is yet require answer by OM literature.

Lean focuses towards waste elimination of all sorts in the process and continuously improve it (Womack, Jones, & Roos, 1990). Agility is a business wide capability that rests on four pillars (1) "Virtual Enterprise", (2) "Flexible Systems", (3) "Technology Advancement", and (4) “Skilled and Empowered Workforce”. There are significant numbers of research studies, which show that implementation of these improvement initiatives, have positive impact on the organizational performance (Fullerton, McWatters, & Fawson, 2003; Matsui, 2007; Yang, Hong, & Modi, 2011). Conversely, at the same time few failures are also reported (Biggart & Gargeya, 2002; Jayaram, Vickery, & Dröge, 2008).

Lean and Agile both pursue the same competitive capabilities i.e., cost, quality service and lead-time. Naylor et al. (1999, p. 111) identify that quality, service and lead time are market essentials for Leanness, whereas, cost is ascribed as market winner. On the other hand, Mason-Jones, Naylor, and Towill (2000, p. 55) ascribed service level as market winner and cost, quality and lead time as market essentials for AM. Narasimhan et al. (2006, p. 443) proposed the definition of Lean and Agile as; “Production is Lean if it is accomplished with minimal waste due to unneeded operations, inefficient operations, or excessive buffering in operations”. Whereas, “Production is agile if it efficiently changes operating states in response to uncertain and changing demands placed upon it”.

Lean and AM are the improvement initiatives that organization pursuit to achieve their organizational objectives i.e to improve competitiveness and enhance market share. Goldman and Nagel (1993) argu that AM is not only virtully improved state of flexible manufacturing, but at the same time also incorporates the essential element of Total Quality Management (TQM), Just-in-Time (JIT) (classified as Lean bundles by Shah and Ward (2003)) and Lean production system. Whereas, Dal Pont, Furlan, and Vinelli (2008) and Furlan, Vinelli, and Dal Pont (2011b) classified TQM and JIT as Core Lean manufacturing bundles and HRM as enabler to Core Lean (TQM & JIT) bundles. There is no agreement among researchers, academicians, and practitioners that what are the exact practices and techniques that actually define LM as whole. For the purpose of this study, TQM and JIT are considered as core bundles of Lean manufacturing.

A number of studies have been conducted to evaluate the relationship between Lean and AM and their impact towards achievement of organizational objectives. Most of these studies are anecdotal and case studies type (Krishnamurthy & Yauch, 2007; Naylor et al., 1999), a few efforts have also been made to test their relationship empirically on large scale (Bottani, 2010; 2011; Narasimhan et al., 2006; Yusuf & Adeleye, 2002). Moreover, these studies have been conducted in developed and industrialized countries and covering generally elctronics, machineray and transportaion sector. A very less concern has been shown towards other industries like Textile and Clothing (Apparel) products (Hodge, Ross, Joines, & Thoney, 2011; Shah & Ward, 2003) and even these studies are conducted in developed countires like United States of America (USA) and United Kingdom (UK). Moreover, two comparative studies were undertaken to check the impact of internal key factors, management perception and marketing strategy on export performance in Apparel industry of Italy and Spain (Eusebio, Andreu, & Belbeze, 2007a, 2007b). However, in developing countries, two studies relevent to Textile and Apparel sector are also reported. First study, from Sri-Lanka, tested the performance difference between TQM (32 firms) and Non-TQM (35 firms) in Apparel Sector (Kapuge & Smith, 2007). Second study, from India, is undertaken to check the implementation of technology adoption in apparel industry of Tiripur town, India (Varukolu & Park-Poaps, 2009). Similalry, three PhD studies, relevent to Texttile and Clothing sector, are reported, with titles as, (1) “Impact of capacity building interventions towards employees development in the garments and apparel organizations of Pakistan” (Awan, 2008), (2) “Implementation of quality management practices in cotton yarn industry of Pakistan ” (Hussain, 2009), and (3) “Effect of female employees empowerment on labour productivity of apparel (garment) industry of Pakistan ”, (Nawaz, 2010). Another endeavour was also undertaken at governmant level to identify the critcal success and failure factors of this sector (SMEDA, 2005). No study, to the best knowledge of the researcher is yet available, in OM literature, to provide evidence to test the implementation of Lean (TQM & JIT) and AM and their impact on export performance in the Apparel sector in developed as well as in developing countries, in general, and in Paskitan particulary.

The success of any improvement program is ascribed to the effectiveness of Top Management Commitment (Cua, McKone, & Schroeder, 2006), Employees’ Involvement (Furlan et al., 2011b), Strategic Implemetation of Integrated Manufacturing Programs (Dean Jr & Snell, 1996), Organizational Context (Shah & Ward, 2003; Sila, 2007), Organization Structure (Krishnamurthy & Yauch, 2007), Organization’s country and culture (Kuei, Madu, Lin, & Lu, 1997; Rungtusanatham, Forza, Filippini, & Anderson, 1998) environmental dynamism (Vázquez-Bustelo, Avella, & Fernández, 2007; Z. Zhang & Sharifi, 2007), and most important the configuration of all these aspects under different perspectives (Ahmad, Schroeder, & Sinha, 2003). There is a dire need to assess the effect of Lean (TQM & JIT) and AM practices and their impact on the organizational (export) performance in the Appparel Sector of Pakistan. This sector is seemingly charaterised with an organizational culture, organization structure, management style, employees empoverment, strategic relationship building, and many others managerial aspects.

1.2 INDUSTRY BACKGROUND AND NEED OF STUDY

Pakistan is the 4th largest (13.59 Millions Bales) producer of cotton (Pakistan Economic Survey, 2012-13), after China (33 Mns Bales), India (27 Mns Bales) and USA (18 Mns Bales) (National Cotton Council of America - Rankings, 2012) and aslo the 3rd largest consumer of cotton (Pakistan Economic Survey, 2012-13). Textile and Clothing Industry is the backbone of Pakistan's manufacturing industry with a share of 46%, being a labour intensive industry it has 38% manufactuirng industry employment share, accounts for 55-60% of the total export share and has major contribution i.e., 8.5% in Gross Domestic Production (GDP). However, this industry is losing its share in the country overall export primarily due to focus on conventional products, outmoded technology, poor labour productivity and power shortage are major contributors to industry shut down (Iqbal & Khan, 2012).

Textile and Clothing Value Chain can be generally divided into five sub groups, i.e., Ginning, Spinning, Weaving, Knitting, Apparel Made-Ups, whereas Dyeing and Printing is a common value addition process to both knitting and weaving (Figure 1.1). The value addition process starts from raw cotton. Raw cotton is passed through ginning process before it is used in spinning process. Processed raw cotton and man-made fibre are two main inputs for spinning process. Yarn is the outcome of spinning process. Yarn is common source for weaving and knitting process. The woven and knitted raw cloth is outcome of weaving and knitting process respectively. Then this raw cloth passes through printing and dyeing process as per the customer specifications. Finally, the most value-added products like Apparels and Made-ups are manufactured from processed fabrics.

Pakistan's Textile and Clothing Sector, on the basis of capability, unique characteristics and requirements, is further subdivided into five sub-sectors as shown in Table 1.1 (SMEDA, 2005). Ginning Sector is a seasonal business sector and remains functional from July to February due to its strict dependence on cotton crop (raw material). Spinning, Weaving and Processing segments of the industry are technology and capital intensive sectors. Whereas, Apparel sector is extremely technology and labour intensive sector and provides solid foundation for implementation of Lean (TQM & JIT) and AM practices in true spirit as integration of technology advancements, skilled and empowered labour workforce, knowledge based and virtually integrated organizations are the prime characteristics of Lean (TQM & JIT) and AM practices (Bottani, 2010; Gunasekaran, 1999a, 1999b; Narasimhan et al., 2006; Shah & Ward, 2003, 2007; Yusuf & Adeleye, 2002).

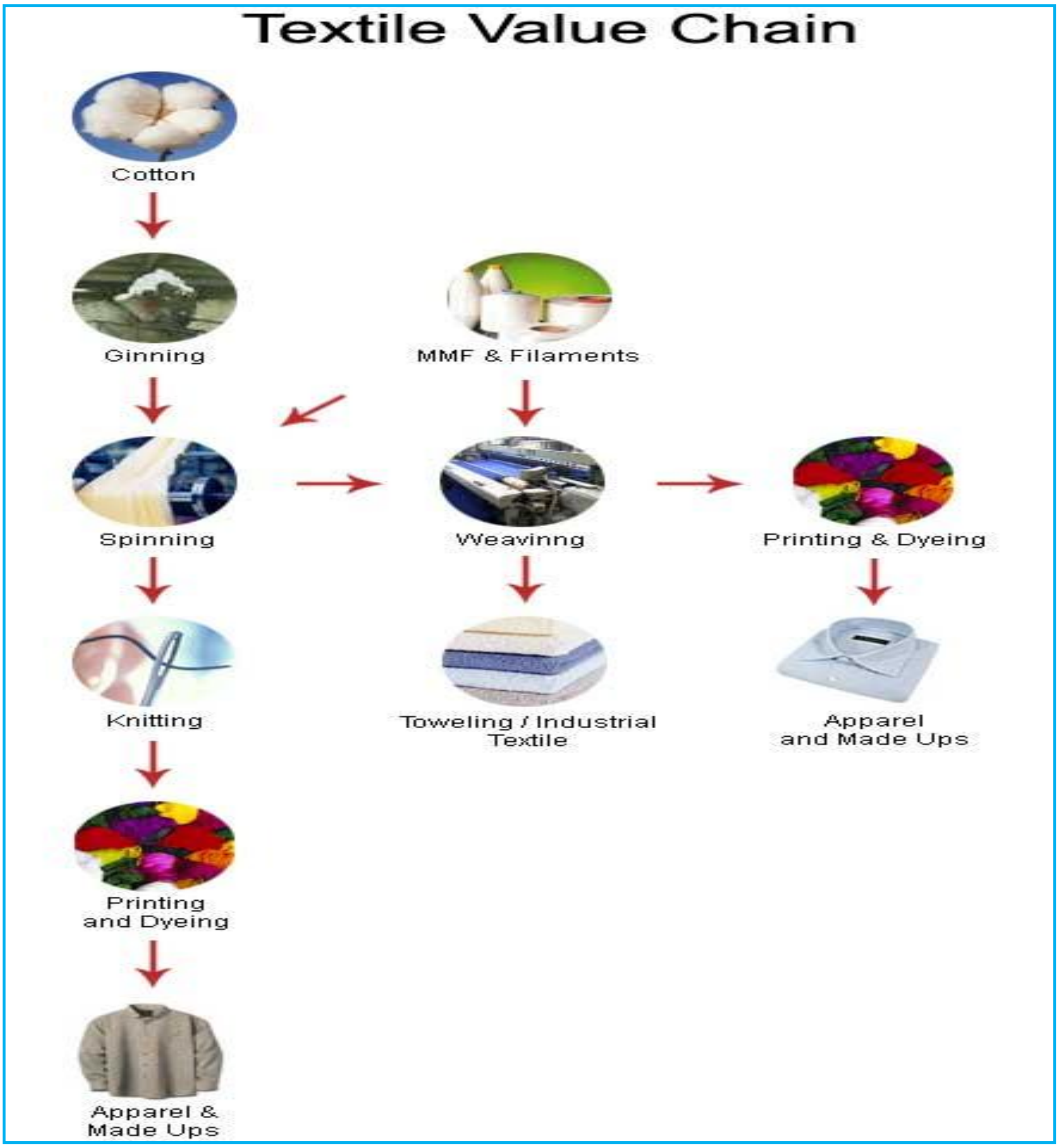

Figure 1.1. Textile and Clothing Value Chain Process
Source: Adapted from (SMEDA, 2005)

Table 1.1. Textile Sub-Sectors and their Charateristics
Source: (SMEDA, 2005)

Ser No	Textile Sub-sectors	Characteristics
1	Ginning	Seasonal business - July to February
2	Spinning	Technology and Capital intensive
3	Weaving/knitting	Technology and Capital intensive
4	Processing	Technology and Capital intensive
5	Apparel & Made-ups	Technology and Labour intensive

The World Textile and Clothing Industry export performance for the period from 2005-2012 is shown in Figure 1.2. Similalry, Pakistan's export performance of Textile and Clothing Industry for the period from 2005-2012 is shown in Figure 1.3. (Pakistan Economic Survey, 2012-13).

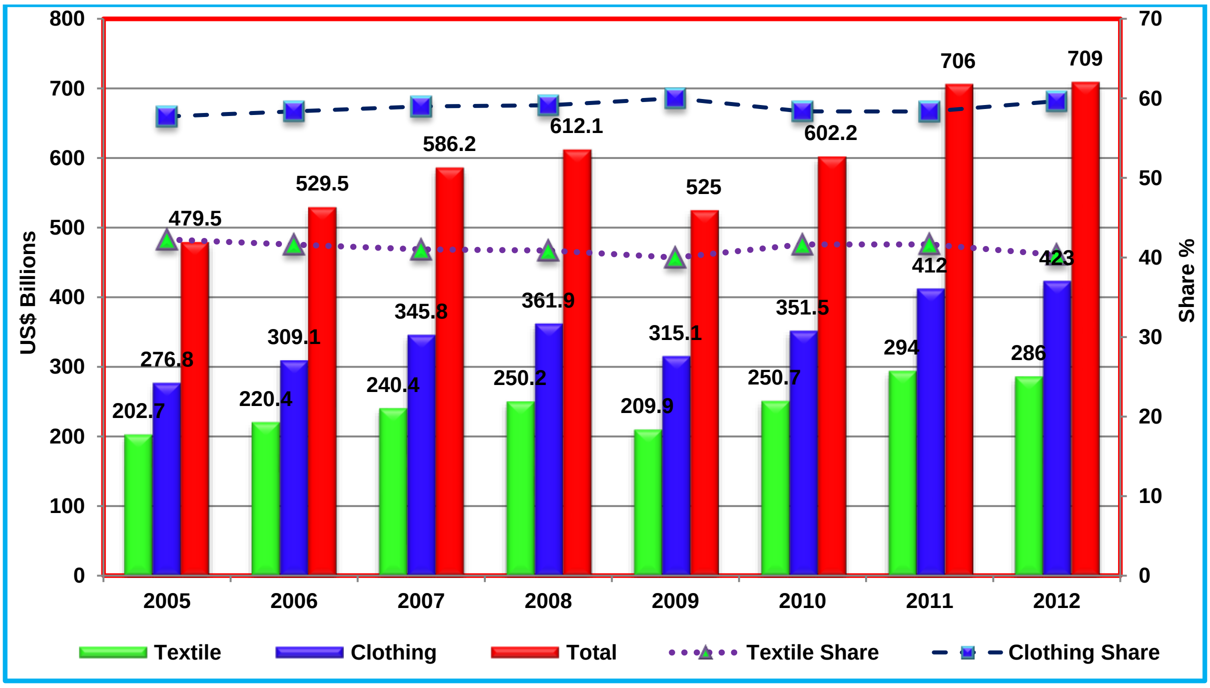

Figure 1.2. World Textile and Clothing Export Market Share 2005 – 2012
Source : (Pakistan Economic Survey, 2012-13; WTO, 2006 - 13)

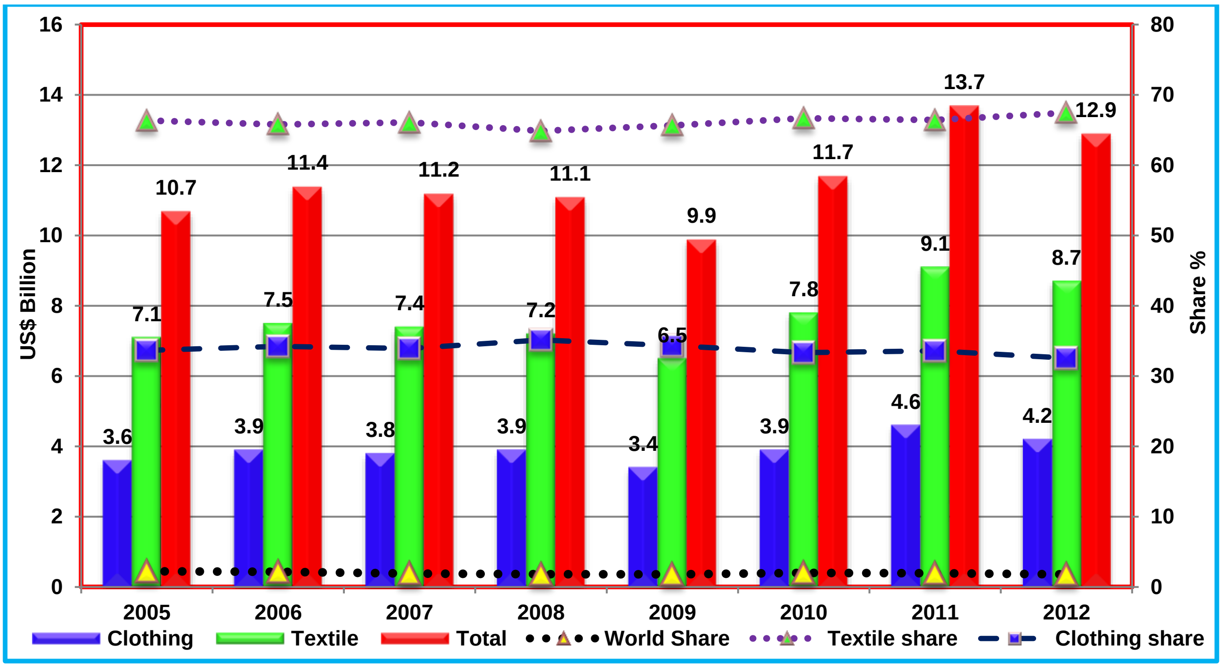

Figure 1.3. Pakistan Textile and Clothing Export Market Share 2005 – 2012

Source: (Pakistan Economic Survey, 2012-13; WTO, 2006 - 13)

World Textile and Clothing trade has reached upto 709 Billions (Bns) US$ in 2012 from 479.5 Bns US$ in 2005 at Compound Annual Growth Rate (CAGR) of **5.63**%. World Clothing trade reached upto to 423 Bns US$ in 2012 from 276.8 Bns US$ in 2005 at CAGR of **6.12**%, whereas, Textile export grew upto 286 Bns US$ in 2012 from 202.7 Bns US$ in 2004 at CAGR **4.94**%. World Clothing products trade is progressing at a faster rate CAGR **5.63**% as compared to Textile products CAGR **4.94**%. Pakistan Textile and Clothing trade has increased from 10.7 Bns US$ in 2005 to 12.9 Bns US$ in 2012 at CAGR of **2.65**%. Textile trade reached upto 8.7 Bns US$ in 2012 from 7.1 Bns US$ in 2005 at CAGR of **2.89**%, whereas, clothing trade showed a slight better growth rate and reached upto 4.2 Bns US$ in 2010 form 3.6 Bns US$ in 2005 at CAGR of **2.18**%. Pakistan has a meagre share in World Textile and Clothing export trade which is almost negligible and ranges between **1.8** to **2.23%**. Moreover, Textile and Clothing share in overall export decreased to **54%** in 2011-12 from **64%** in 2006-07 at CAGR of (**-3.1%**) (Pakistan Economic Survey, 2011-12). Pakistan's Textila and Clothing sectors share in respective group is oppsoite to the World Textile and Clothing export share trend. As in world export, on average Clothing sector **(60%)** is leading as compared to Textile products **(40%)**. Whereas, in Pakistan export on average Textile sector (**65%**) is leading as compare to Clothing (**35%**) sector. It reveals that Pakistan's Textile and Clothing export sector focus is on low value added products. Moreover, Pakistan clothing export trade compound growth is slow (**2.18**% as compare to **6.12**% i.e., **65**% less than world compound growth rate). The focus of this study is limited to Pakistan's Apparel export sector.

China, Bangladesh and India are major regional competitors of Pakistan in clothing export business. Clothing exports critical inidicators i.e., world clothing export volume (Bns US$) and volume CAGR, world export share and export share CAGR, World and Regional Exporters Rank 2005 & 2012, comparison with regional players from 2005-2012 is presented in Table 1.2.

China is the leading World, and Regional, clothing export business competitor with an export business volume of 160 Bns US$. Bangladesh is second major regional competitor with an export business volume of 20 Bns US$. India is the third major regional competetior with an export business volume of 14 Bns US$. Whereas, Pakistan is far behind from regional competitors with export volume of only 4.2 Bns US$. China, Bangladesh and India showed a positive export business share improvement with a CAGR of **3.68%**, **10.52%** and **1.34%** respectively. Whereas, Pakistan's overall world clothing exports share declined with a

CAGR of **(-1.3%)**. Bangladesh showed an extra ordinary performance and improved World leading exporters rank from 7 to 4 and regional leading exporters rank from 3 to 2.

Table 1.2. Pakistan Clothing Exports Comparison with Regional Players from 2005 - 2012 Source: (WTO, 2006 - 13)

Category	World	China	Bangladesh	India	Pakistan
Export Volume 2005	276.8	80.35	6.42	8.29	3.6
Export Volume 2006	309.1	95.4	7.8	10.2	3.9
Export Volume 2007	345.8	115.2	10.1	9.7	3.8
Export Volume 2008	361.9	120	10.9	10.9	3.9
Export Volume 2009	315.1	107	11	11	3.4
Export Volume 2010	351.5	130	16	11	3.9
Export Volume 2011	412	154	20	14	4.6
Export Volume 2012	423	160	20	14	4.2
Export Volume CAGR	**6.12**	**10.12**	**17.24**	**7.61**	**2.18**
World Export Share 2005	-	**29.2**	**2.3**	**3.0**	**1.3**
World Export Share 2012	-	**37.8**	**4.7**	**3.3**	**1**
World Export Share CAGR	-	**3.68**	**10.52**	**1.34**	**(-3.60)**
World Exporter Rank 2005	-	**2**	**7**	**5**	**13**
World Exporter Rank 2012	-	**1**	**4**	**7**	**14**
Regional Exporter Rank 2005	-	**1**	**3**	**2**	**4**
Regional Exporter Rank 2012	-	**1**	**2**	**3**	**4**

Textile and Clothing Sector based on export performance can be further sub-divided into eight sub-sectors, (1) Cotton Yarn, (2) Cotton Cloth, (3) Ready-Made Garments, (4) Bed wear (5) Knitwear (6) Towels and (7) Raw Cotton and (8) others comprising of, Carpets, Canvas, Tents, Synthetic Articles, etc (Iqbal & Khan, 2012). The first seven sub-sectors accounts for 85-90% of the Pakistan's total Textile and Clothing exports. These seven sub-groups based on export business share with-in Textile and Clothing sector can be categorised as, Low (50-1000 Mns US$), Medium (1001-1800 Mns US$) and High (> 1800 Mns US$), can be easily identified as shown in Figure 1.4. Sub-sector Cotton yarn showed a better performance in 2010-11 and crossed the class boundary.

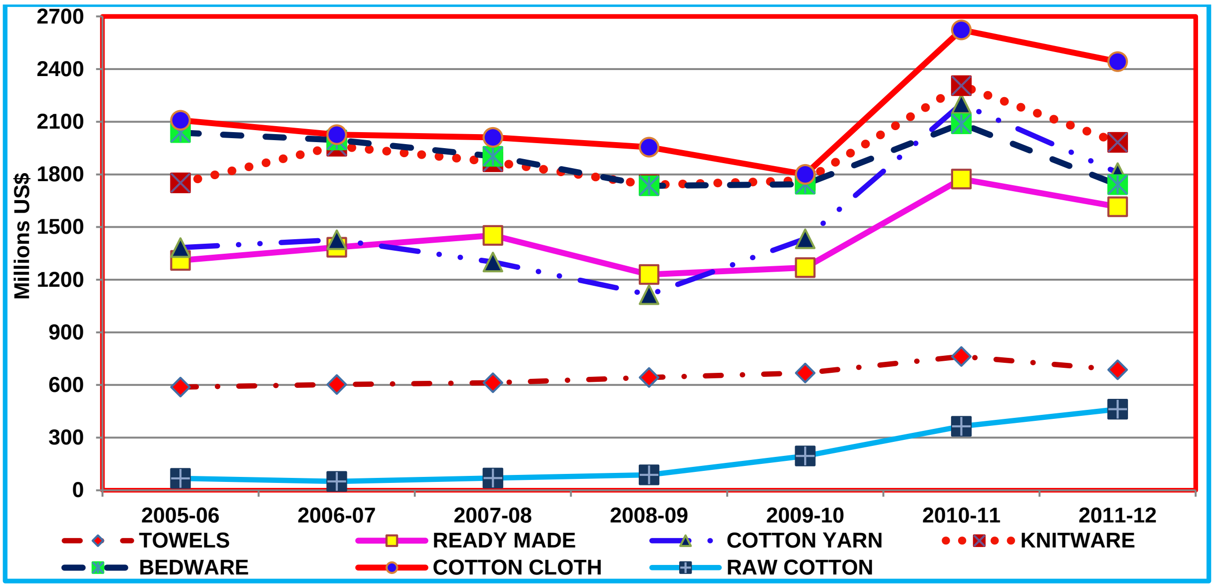

Figure 1.4. Sub-Sectors Export Market Share 2005 - 06 to 2011 - 12

Source: Adapted from (Iqbal & Khan, 2012; TDAP, 2013a)

Lowest group (500-1000 Mns US$) includes Towels and Raw Cotton sub-sectors, Medium (1000-1800 Mns US$), group includes Readymade and Cotton Yarn sub-sectors. Whereas, High group includes Knitwear, Bed-wear and Cotton Cloth sub-sectors. Apparel sector (Readymade and Knitwear) is a part of medium and high group having total business share of approximately 4.2 Bns US$. Moreover, in-depth review of Apparel (Readymade Garments and Knitwear & Hosiery) seven years export performance from 2005-06 to 2011-12 is shown in Figure 1.5 and Figure 1.6 respectively.

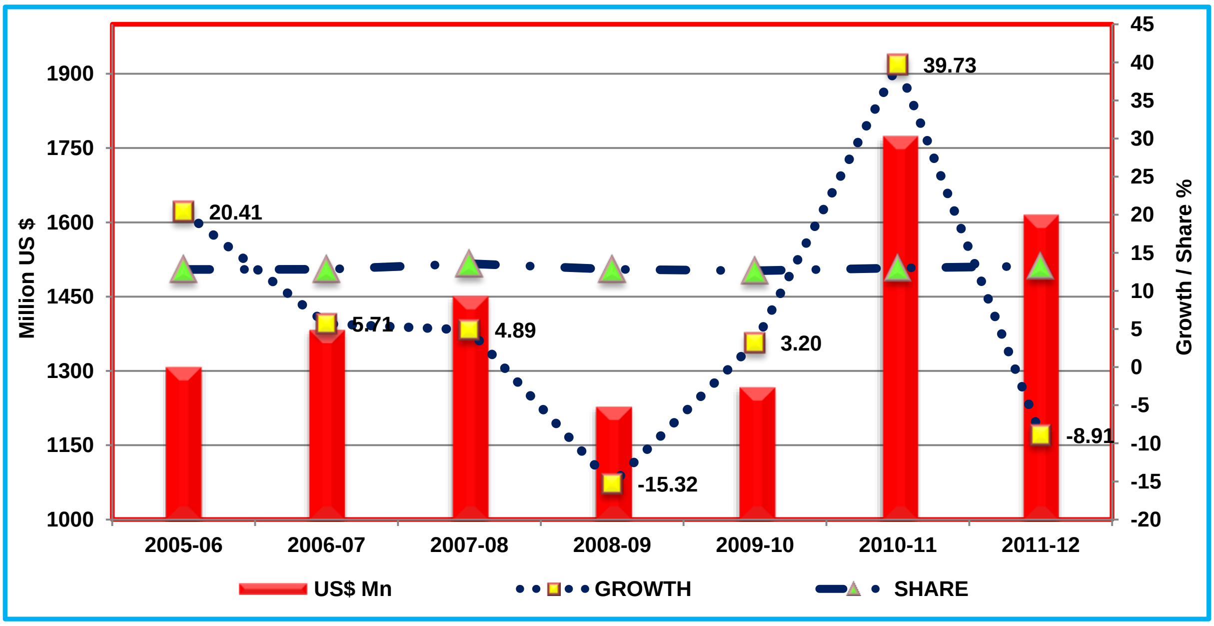

Figure 1.5. Readymade Export Performance 2005 - 06 – 2011 - 12
Source: (Iqbal & Khan, 2012; TDAP, 2013a)

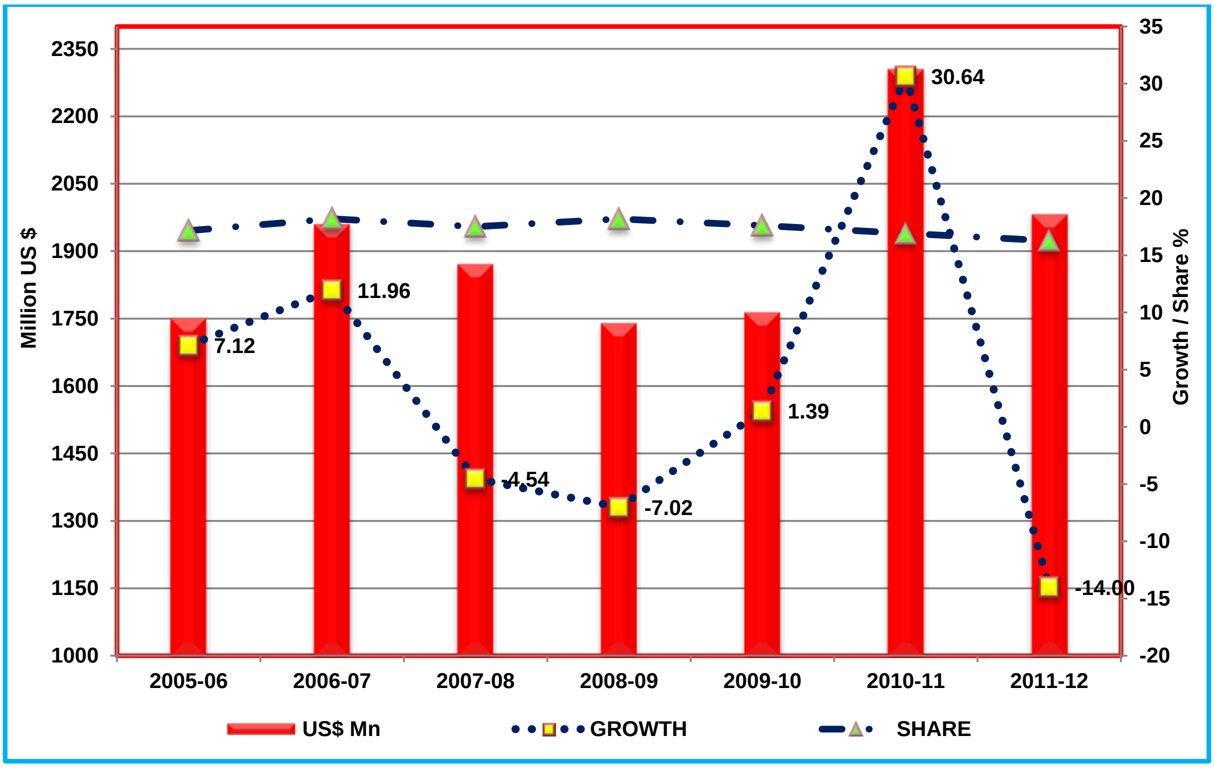

Figure 1.6. Knitwear Export Performance 2005 - 06 – 2011 - 12

Source: (Iqbal & Khan, 2012; TDAP, 2013a)

Readymade and Knitwear sectors hold **12 – 13.5%** and **17 – 18.5 %** export share of the Textile and Clothing sector respectively. Both sectors declined from 2005-06 until 2008-09 and then an improvement was echoed by both groups in 2009-10 and again a big dip in 2011-12 (Iqbal & Khan, 2012; TDAP, 2013a). Readymade has a CAGR of **3.4%** whereas, Knitwear has a marginal positive CAGR of **2.0%**, much below of World Clothing export performance **6.12%** which clearly reflects the undesirable health of these two sub sectors (Iqbal & Khan, 2012). Textile and Clothing Sector is generally characterized with three main inputs (1) Capital, (2) Skilled workforce, (3) Technology. Whereas Apparel sector depends upon skilled workforce and technology (see Table 1.1). Investment in Textile and Clothing machinery import for the period from 2001-2002 to 2010-2011 is shown in Figure 1.7 (N. A. Memon, 2011). Textile and Clothing Sector future business plans mind-set is reflected by machinery import trend. The primary investment incurred in Weaving and Spinning Sectors followed by Processing (Dyeing, Printing and Finishing) sector. However, Apparel sector, as far as technology investment i.e., **7.02%** is concerned, remained neglected. Moreover, a negative machinery investment trend from 20005-2006 to 2008-2009, especially during post quota regime (after 2004), plausibly contributed a lot towards negative growth of the entire sector for the same period.

The increase in world clothing trade is attributed to high value added products and decreased lead time. Pakistan, being a developing country, is facing serious challenges in meeting the market requiremnets. Weak performance is primarily attributed to inherent focus on functional products, low product quality, less value added products, weak market knowledge, low product mix, lack of skilled labour/workforce, weak marketing, high final product cost, outmoded technology, timeworn manufacturing techniques, lack of government interest to develop this sector as world class manufacturing industry and electricity & gas shortage. Moreover, a severe competition is being faced from major players like China (Apparel export volume of 160 Bns US$ for the year 2012) (WTO, 2006 - 13), after its integration into World Trade Organizations (WTO) structures on termination of post quota regime (Iqbal & Khan, 2012; Pakistan Economic Survey, 2012-13).

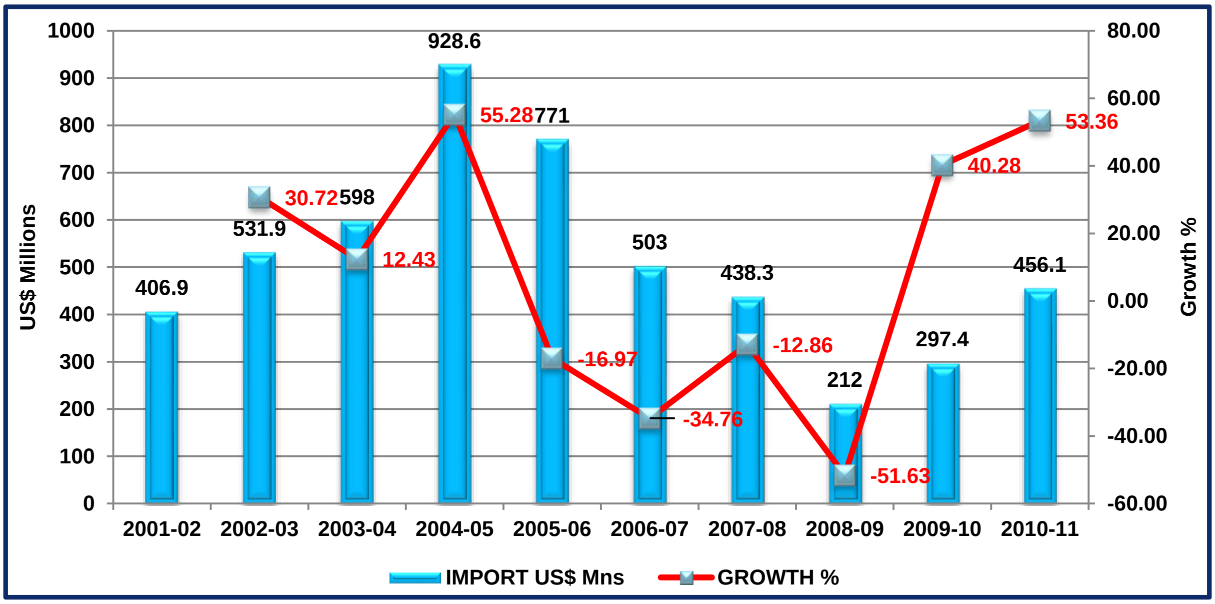

Figure 1.7. Investment in Machinery from 2001 - 2002 to 2010 - 2011
Source: (Iqbal & Khan, 2012, p. 3821; N. A. Memon, 2011, p. 34)

There is a dire need to investigagte poor export performance of Textile Sector in general, and Apparel Sector in particular, being a high value added industry. As World Apparel export sector is growing at a much faster pace (CAGR of **6.12%**) than Textile products (CAGR **4.94%**). Whereas, Pakistan Apparel Sector growth for the period from 2005-06 to 2011-12 (Readymade CAGR of **3.4%** and Knitwear a marginal CAGR of **2.0%**) is much below than World Apparel growth (CAGR of **6.12%**). This poor performance scenario provides a strong foundation to undertake this study to investigate, how export performance of Apparel Sector of Pakistan can be improved through effective implementation of managerial aspects (Lean (TQM & JIT) and AM). This study results will help to develop a strategic framework to improve the export performance of this highly potential industrial sector.

1.3 RESEARCH QUESTIONS

The discussions made in sections 1.1 and 1.2 leads to the following research theme. **“What level of Lean (TQM & JIT) and Agile Manufacturing (AM) practices are being implemented in Apparel Export Industry of Pakistan, and how their integration can be effective in improving the export performance of Apparel Export Industry of Pakistan?”**

To address the main theme, main research was re-defined into nine questions to check the implementation of Lean (TQM & JIT) and Agile manufacturing practices, their interplay and impact on Export Performance with in the Context of Export Business Environment of Apparel Indsutry of Pakistan.

(a) **RESEARCH QUESTION - 1**

What are the Management, Common Infrastructure (internal and external), Core Lean (TQM & JIT) and Core Agile Manufacturing practices reported in the literature and how these can be integrated in a single conceptual framework in the export environment of Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan?

(b) **RESEARCH QUESTION - 2**

What level of Management, Common Infrastructure (internal and external), Core Lean (TQM & JIT) and Core Agile Manufacturing practices are being implemented in the export environment of Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan?

(c) **RESEARCH QUESTION - 3**

How do Management, Common Infrastructure (internal and external), Core Lean (TQM & JIT) and Core Agile Manufacturing practices interrelate in the export environment of the Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan?

(d) **RESEARCH QUESTION - 4**

Are Core Lean (TQM & JIT) and Agile Manufacturing practices Mutually Supportive, or Complementary, to each other in the export environment of Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan?

(e) **RESEARCH QUESTION - 5**

Are Core Lean (TQM & JIT) Manufacturing and Core Agile Manufacturing competing, thus, the two are 'Mutually Exclusive or Competing' in the export environment of Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan?

(f) **RESEARCH QUESTION - 6**

Are Core Lean (TQM & JIT) antecedent to Core Agile Manufacturing, in the export environment of Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan?

(g) **RESEARCH QUESTION - 7**

How do Organizational Contextual factors (Firm Size, ISO-9001 Registration, Industry Type, and Information Technology) moderate the Management, Common Infrastructure (internal and external), Core Lean (TQM & JIT) and Core Agile Manufacturing practices implementation and impact on export performance in the export environment of Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan?

(h) **RESEARCH QUESTION - 8**

How do Business Environmental Contextual factors (market dynamics, competitive pressures and technological dynamics) moderate the Management, Common Infrastructure (internal and external), Core Lean (TQM & JIT) and Core Agile Manufacturing practices implementation and impact on export performance in the export environment of Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan?

(i) **RESEARCH QUESTION - 9**

What are the different configurations of Macro and Micro Management, Common Infrastructure (internal and external), Core Lean (TQM & JIT) and Core Agile Manufacturing practices which significantly differentiate between high and low performance measures i.e., OP, MP and FP.

1.4 AIM AND OBJECTIVES OF RESEARCH

Research aim is "**To investigate the mutual relationship of Lean (TQM & JIT) and Agile Manufacturing (AM) practices and impact on export performance of Apparel Export Industry of Pakistan**". To address the main research theme and research questions following research objectives are set to undertake this research study in the organizational (internal) and business environmental (external) contexts of Apparel (Readymade Garments, Knitwear and Hosiery) Export Indsutry of Pakistan. Research Objective **1 & 2** provides answer to Research Question **1**. Whereas, Research objectives from **3 to 10** are set to answer the Research Questions from **2 to 9** respctively.

(a) **RESEARCH OBJECTIVE - 1**

To identify a set of Management, Common Infrastructure (internal and external), Core Lean (TQM & JIT) and Core Agile Manufacturing practices through extensive review of the Operations' Management literature.

(b) **RESEARCH OBJECTIVE - 2**

To develop a conceptual framework linking Management, Common Infrastructure (internal and external), Core Lean (TQM & JIT) and Core Agile Manufacturing practices with export performance within the boundaries of organizational and business environmental context in the Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan?

(c) **RESEARCH OBJECTIVE - 3**

To assess the level of Management, Common Infrastructure (internal and external), Core Lean (TQM & JIT) and Core Agile Manufacturing practices being implemented in the Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan.

(d) **RESEARCH OBJECTIVE - 4**

To unfold the Management, Common Infrastructure (internal and external), Core Lean (TQM & JIT) and Core Agile Manufacturing practices inter-relationship in the Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan?

(e) **RESEARCH OBJECTIVE - 5**

To explore, whether Core Lean (TQM & JIT) Manufacturing practices are mutually supportive, or complementary, to Core Agile Manufacturing, in order to establish, that the two paradigms are "Mutually Supportive" in the Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan.

(f) **RESEARCH OBJECTIVE - 6**

To explore, whether, Core Lean (TQM & JIT) Manufacturing and Core Agile Manufacturing are competing, in order to establish, that the two paradigms are "Mutually Exclusive or Competing" in the Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan.

(g) **RESEARCH OBJECTIVE - 7**

To explore whether, Core Lean (TQM & JIT) are antecedent to Core Agile Manufacturing, in the export environment of Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan?

(h) **RESEARCH OBJECTIVE - 8**

To investigate the Organizational Contextual factors (Firm Size, ISO-9001 Registration, Industry Type, and Information Technology) moderating effects on management, common infrastructure (internal and external), Core Lean (TQM & JIT) and Core Agile Manufacturing practices implementation and impact on export performance in the Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan.

(i) **RESEARCH OBJECTIVE - 9**

To investigate the Business Environmental Contextual factors (market dynamics, competitive pressures and technological dynamics) moderating effects on management, common infrastructure (internal and external), Core Lean (TQM & JIT) and Core Agile Manufacturing practices implementation and impact on export performance in the Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan.

(j) **RESEARCH OBJECTIVE - 10**

To identify the different configurations of Macro and Micro Management, Common Infrastructure (internal and external), Core Lean (TQM & JIT) and Core Agile Manufacturing practices that significantly differentiate between high and low performance measures i.e., OP, MP and FP.

1.5 RESEARCH APPROACH

A systematic research approach, to address research questions and objectives, followed in this research study is depicted in Figure 1.8. It comprises seven sequential steps. At Step-I, research topic is introduced including Theoretical (Research) and Industrial Background. Research Questions and Research Objectives are outlined and research scope with respect to Research Questions is defined. At Step-II, through literature review, Management, Common Infrastructure (internal and external), Core Lean (TQM & JIT), and Core AM practices are identified. At Step-III, conceptual framework is proposed. Respective research hypotheses are defined to investigate the Research Questions. Independent and dependent variables are defined. Survey questionnaire is developed and pilot study is conducted to test its suitability to undertake further quantitative analysis. At Step-IV, data is

INTRODUCTION

- Topic Introduction
- Introduction to Industry
- Research Questions
- Research Aim and Objectives
- Research Approach
- Research Scope
- Research Novelty and Contributions

LITERATURE REVIEW

- Literature review
- Identification of management, common infrastructure (internal and external), core Lean (TQM & JIT) and core Agile manufacturing factors through literature review
- Development of a Theoretical framework on the basis of gap analysis identified through literature review

RESEARCH METHODOLOGY

- Development of a conceptual framework
- Research Hypotheses are developed regarding implementation of management, common infrastructure (internal and external), core Lean (TQM & JIT) and core Agile Manufacturing practices and their impact on export performance under universal, contingency and configurational perspectives
- Independent and dependent variables are defined
- Preparation of **Survey Questionnaire**
- Research design to undertake the research study is described

DATA COLLECTION, PROCESSING AND ANALYSIS

- Population and research survey sampling design
- Data collection from Apparel industry of Pakistan through Survey Questionnaire
- SPSS-19, AMOS-16 and Smartpls-2.0 soft-wares are used to undertake the quantitative analysis of the collected data
- Data processing to ascertain the reliability and validity of the data

HYPOTHESIS TESTING

- Testing of Research Hypotheses to answer Research Questions and Research Objectives
- Checking of results against the Proposed Hypotheses

RESULTS AND DISCUSSIONS

- Development of strategic framework to improve the export performance of apparel export industry of Pakistan
- Results, Findings and Discussions

RECOMMENDATIONS AND CONCLUSIONS

- Future Research Recommendations
- Conclusions

Figure 1.8. Research Study Approach

collected from Apparel Export Industry of Pakistan. At Step-V, Research Hypotheses are tested to answer research questions. At Step-VI, results and findings are discussed and a strategic framework to improve export performance of Apparel Export Industry of Pakistan, duly validated, is proposed. Finally, at Step-VII, conclusions and future research recommendations are provided.

1.6 SIGNIFICANCE OF RESEARCH

Pakistan is the fourth largest producer of cotton in the world, but the business share, of Textile and Clothing Sector, in the world export is negligible i.e., **1.8 to 2%,** especially Clothing Sector share is **1%** only. Readymade and Knitwear holds **12-13%** and **17-18.5%** export share of the Textile and Clothing group respectively. Pakistan’s Clothing export share grew at CAGR of **2.18%,** whereas, World clothing trade grew at a faster CAGR of **6.12%** for a period from 2005 - 2012. The increase in the World Clothing (Apparel) trade is attributed to high value added products and decreased lead time. The weak performance of Pakistan Apparel (Readymade and Knitwear) Export Industry is primarily attributed to low quality products, increased lead time, less value added products, lack of skilled labour workforce, weak marketing, high final product cost, obsolete technology, especially timeworn manufacturing techniques and termination of post quota regime.

Government has plausibly failed to develop this sector as world-class manufacturing industry like Bangladesh, moreover, electricity and gas shortage have increased industry problems manifold. The slow growth of Apparel Sector of Pakistan as compared to World growth warrants an in-depth analysis to identify the critical success factors. This study, based on comprehensive Apparel industry analysis, explores the effects of Lean (TQM & JIT) and AM practices impact on the organizational (export) performance of Pakistan’s Apparel Sector. An effective performance improvement strategic framework is derived from results that might help to improve the export performance of Apparel Sector of Pakistan. This empirically validated framework can be benchmarked by Apparel Export Sector to face severe market competition presented by regional market players like China, Bangladesh, and India.

1.7 RESEARCH SCOPE

This research study is limited to analyse the effects of Lean (TQM & JIT) and AM practices implementation and their impact on export performance in Apparel (Readymade Garments and Knitwear and Hosiery) export industry of Pakistan. This research study is industry specific i.e., Apparel (Readymade Garments and Knitwear and Hosiery) export Industry of Pakistan. The results cannot be generalized neither to the other sub-sectors of Textile value chain nor to the other manufacturing industries of Pakistan or to the Apparel industry in other countries of the world because of the industry and country bound research. However, future research be undertaken, to fill the gap provided by this study by incorporating other sub-sectors of textile value chain. Similarly, this study can be replicated, in Apparel Industry of other regional countries like China, Bangladesh, India, etc., to test the applicability of theory proposed in this research study.

The population under study is constituted of the Apparel manufacturers registered with All Pakistan Readymade Garment Manufacturers & Exporters Association (PRGMEA)[1] and Pakistan Hosiery Manufacturers Associations (PHMA)[2] and non-members are not considered in this research study. The PRGMEA and PHMA are classified based on Harmonized Commodity Description and Coding System (HS). The "HS of tariff nomenclature is an internationally standardized system of names and numbers for classifying traded products developed and maintained by the World Customs Organization (WCO) (formerly the Customs Co-operation Council), an independent intergovernmental organization with over 170 member countries based in Brussels, Belgium" (Wikipedia, 2013). The HS code for Knitwear and Hosiery products is (HS code 61) and for readymade garments is (HS code 62) (TDAP, 2013b, p. 4).

1.8 RESEARCH NOVELTY AND CONTRIBUTIONS

The primary objective of this study is to contribute to a better understanding of the implementation of Lean (TQM & JIT) and AM their interaction, from mutually exclusive or mutually supportive or Lean (TQM & JIT) as antecednt to AM aspects, and impact on export performance within the context of Apparel (Readymade Garments and Knitwear and Hosiery) export indsutry of Pakistan. This is the first most comprehensive study that unfolds the mutual relationship of Lean (TQM & JIT) and AM under universal, contingency and configurational perspectives and impact on export performance in Apparel Export Industry of Pakistan. This study contributes by providing a strategic roadmap for improvement of Apparel Sector export performance. This study also developed an empirically validated Lean

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[1] "PRGMEA is the premier trade organization representing the readymade garment industry in Pakistan. PRGMEA provides advice and service to manufacturers and exporters and to promote a better environment for trade. As a trade organization, it is recognized by the Government of Pakistan and affiliated with the Federation of Pakistan Chamber of Commerce & Industry and with the Employers' Federation of Pakistan".

[2] "Pakistan Hosiery Manufacturers Association (PHMA) is the premier trade organization representing the hosiery and knitwear industry accelerating and providing growth in all sectors of the economy, generating immense employment and promoting national self-reliance".

(TQM & JIT) and AM (TQM & JIT as antecedent to AM) integration theory in the research field of Operations's Management. This research study succefully achieves the following theoretical and practical (industrial) objectives:

(a) This study identified management, common infrastructure (internal and external), Core Lean (TQM & JIT), Core AM practies. Internal and external infrastructure practices common to Core TQM, Core JIT and Core AM practices are segregated. Moreover, core change proficiency practices consruct is devleloped and validated through confirmation of psychometric properties which will help researchers to measure Core AM in future in the field of OM.

(b) This study proposes and empirically validates a theoretical 3-stage framework that provides a classical mechanism for integrated (Anecedent approach) implementation of management, Common Infrasturcture (internal and external), Core Lean (TQM & JIT) and Core AM practices to improve the export performance (OP, MP & FP) of Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan.

(c) Descriptive statisitcs results reveal that management, infrastructure (internal and external), Lean (TQM & JIT) and Agile Manufacturing practices are moderately being implemented to improve the export performance (Operational, Market, and Financial) in Apparel (Readymade Garments, Knitwear and Hosiery) export Industry of Pakistan.

(d) Correlation results reveal that management, infrastructure (internal and external), Lean (TQM & JIT) and AM practices significantly positively corelate with each other to improve the export performance (operational, market, and financial) of Apparel (Readymade garments, Knitwear and Hosiery) export Industry of Pakistan.

(e) Direct covariation results discard the theoretical notion that Lean (TQM & JIT) and AM are mutually supportive (complementary) or mutually exclusive (competing).

(f) Indirect covariation (mediation fit) results resolve the theoretical relationship conflict between Lean (TQM & JIT) and AM and empirically confirm that Core Lean (TQM & JIT) alongwith management and infrastructure (internal and external) are antecendents to AM.

(g) Gestalt fit results provide explicit implememtaion of different Macro and Micro-sytems' configurations to the Managemnt of Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan for setting different performance (OP, MP & FP) objectives.

(h) Moderation results provide better understanding of organizational and environmental contextual factors moderating effects on implementiaon of Management, common infrastructure (internal and external), Core Lean (TQM & JIT), Core AM and impact of these practices on deffierent export performance (OP, MP & FP) measures.

This research study is an endeavour to resolve the long conflicting issue in the field of OM research between Lean (TQM & JIT) and AM relationship and joint impact of these initiatives on business performance. From societial (industrial) point of view, this will be mainly valuable to Apparel Export Sector of Pakistan, however, other developing countries with similar environmental pressures and organizational culture, and facing similar problems, may benefit from this study. The outcomes of this study may help them to identify bottlenecks and critical success factors for successful implementation of these improvement initiatives. Avenues for the future research studies are also covered in the recommendations, which shall provide lead to researchers for future research studies.

1.9 THESIS REPORT STRUCTURE

APA referencing style is followed in this research study. The outcome of research study is recorded in chapters as thesis report as follows.

(a) Chapter-1, provides introduction to the theory and industry background. Research Questions and Research Study Objectives are set. Research Approach is defined to adddress Research Questions and Achieve Research Objectives. Moreover, chapter 1 also draws the boundaries of research scope of this study.

(b) Chapter-2, provides a comprehensive literature review on Lean and AM practices, critical issues in their implementation, their impact on organizational performance. Chapter-2 also describes the findings of the previous empirical research studies conducted to evaluate the effectiveness of Lean (TQM & JIT) and AM practices, their inter-relationship in delivering the promised organizational performance outcomes in diversified industries around the world. Based on in-depth literature review research framework of this research study is also developed.

(c) Chapter-3, proposes the conceptual research framework based on literature review and systematically discusses the Research Methodology adopted in the present research study, sampling procedures, data collection method, and data analysis to test the defined research questions.

(d) Chapter-4, describes the Data for empirical analysis used to investigate the level of implementation of Lean (TQM & JIT) and AM practices in the Apparel Export

Industry of Pakistan, interrelationship of Lean and Agile manufacturing practices in context of work environment of Apparel Industry of Pakistan and the effect of Lean (TQM & JIT) and AM practices on the organizational and business performance of Apparel Industry of Pakistan.

(e) Chapter-5, describes the analysis methods used to test the proposed research hypotheses. This chapter also provides the detailed justification on each research hypotheses proposed in the research.

(f) Chapter-6 discusses each Research Question and respective Research Objective in detail. These Research Questions, about the Implementation of Lean (TQM & JIT) and AM practices in the Apparel (Readymade Garment, Knitwear and Hosiery) Export Industry of Pakistan are discussed in the light of research results obtained in chapter-5.

(g) Chapter-7, provides recommendatins for Apparel export managers of Pakistan. This chapter also discusses, this research study limitations and also provides future research guidleines. Finally, the conclusions, regarding this research study, are provided.

Thesis Report Structure from Chapter-1 to Chapter-7 is presented in Figure 1.9.

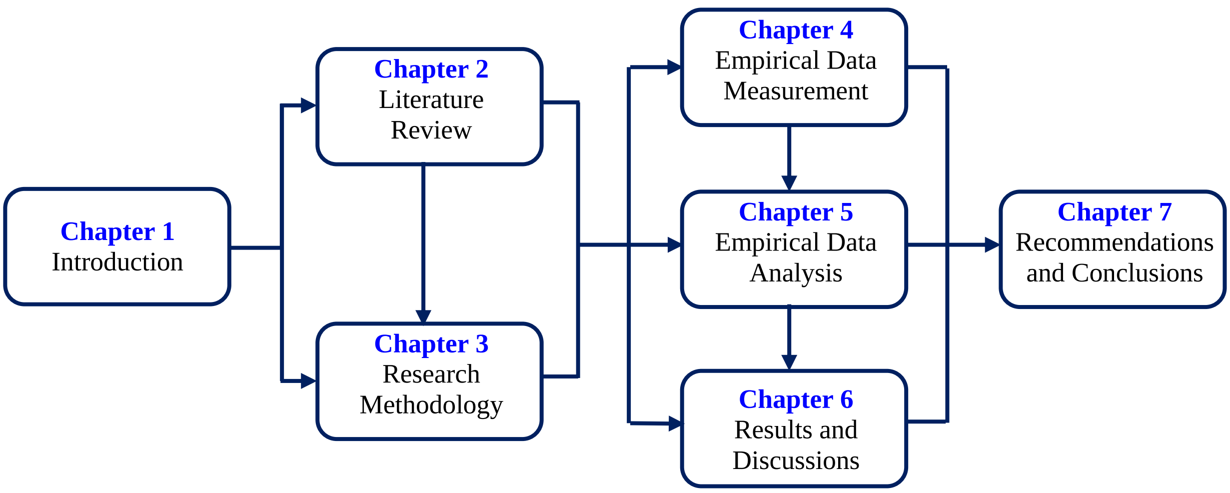
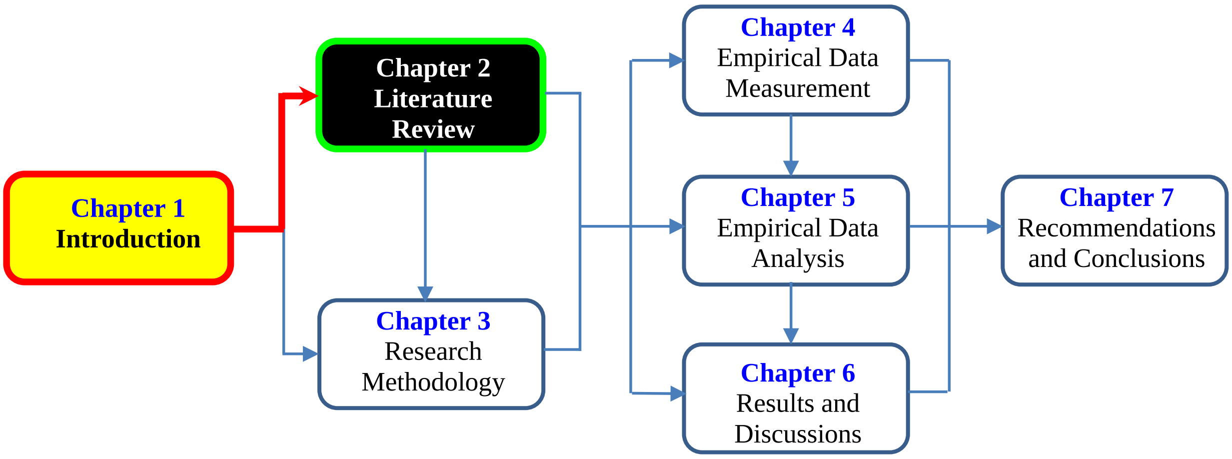


Figure 1.9. Thesies Report Strucutre

Chapter-1 Direction to the Chapter-2



CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This Chapter meticulously reviews the extant literature on Lean (TQM & JIT) and AM paradigms, their interaction, implementation and impact on organizational and business performance. The perceived importance of these manufacturing practices to achieve organizational competitiveness have been rationally understood, well appreciated by both manufacturing as well as service industries, and have been well documented in the literature. Literature review is carried out in seven sequential phases. Phase-I comprises Sections 2.2 to 2.4. These Sections cover existing literature on Lean (TQM & JIT). Phase-II comprises Sections 2.5 to 2.7. These Sections cover existing literature on AM. Phase-III comprises sections 2.8 to 2.10. These Sections cover existing literature on Lean (TQM & JIT) and AM relationship and finally a set of management, common internal and external infrastructure practices, Core TQM, Core JIT and Core AM practices are identified. Phase-IV comprises Section 2.11 and 2.12. Section 2.11 identifies organizational and environmental contextual factors. Section 2.12 provides literature on Lean (TQM & JIT) and AM implementation in configurational approach. Phase-V comprises Section 2.13. This section identifies set of performance variables to be used in this study. Phase-VI, section 2.14 proposes a theoretical framework. Phase-VII comprises sections 2.15 to 2.17. These Sections briefly describe awareness of Lean (TQM & JIT) and AM practices in Pakistan and finally literature review findings and the summary of the Chapter is provided. Phase and Section wise chapter description is represented in Table 2.1.

Skyttner (2005) in his book “General Systems Theory: Problems, Perspectives, Practice” explained “Theory of Systems (ToS)”. ToS resembles with “General Living System (GLS)” theory, which is universally applicable across social sciences sand biological systems. GLS theory explains that it is the inbuilt capability of living systems that they are sensitive to the environmental changes and can adapt and modify themselves as per the changes in the environment. It is an interdisciplinary theory and is equally applicable to any system of this universe; irrespective of their size, type, behaviour, nature or environment etc. (Malone & Crowston, 1994). Johnson, Kast, and Rosenzweig (1963) are accolade, as the pioneer, who explored the applicability of GLS theory in management sciences. ToS explains that sub-system integrated with other sub-systems, and these sub-systems integrate and depart (under special requirements) from each other to achieve superior organizational results, which, if applied in isolation cannot be attained, as per the changing needs of the organization (Jayaram & Xu, 2013). Sub-systems also modify and adapt themselves to establish their best suitability in the systems (Crowston, 1997). Sub-systems not only synchronise with other sub-systems but also synchronise with in sub-system to generate synergy effects.

Table 2.1. Chapter Overview

Section	Description
Phase I	
Section 2.2	Explicitly describes the origin and characteristics of Lean Manufacturing (TQM & JIT) Paradigm
Section 2.3	Describes different frameworks previously developed by different researchers and academicians for effective implementation of Lean (TQM & JIT) Manufacturing
Section 2.4	Describes the relationship between Lean (TQM & JIT) and organizational performance
Phase II	
Section 2.5	Explicitly describes the origin and the characteristics of AM
Section 2.6	Describes different frameworks previously developed by different researchers and academicians for effective implementation of AM
Section 2.7	Describes the relationship between AM and organizational performance
Phase III	
Section 2.8	Explores the relationship, whether Lean (TQM & JIT) and Agile paradigms are mutually exclusive, mutually supportive / antecedents to each other
Section 2.9	Describes the relationship between Lean (TQM & JIT) and Agile manufacturing practices and their projected impact on business performance
Section 2.10	Synthesizes the management, common infrastructure practices, Core TQM, JIT & AM practices
Phase IV	
Section 2.11	Explores the literature on Contingency approach of Lean (TQM & JIT) and AM implementation
Section 2.12	Explores the literature on Configurational approach of Lean (TQM & JIT) and AM implementation
Phase V	
Section 2.13	Provides summary of performance variables being used in OM.
Phase VI	
Section 2.14	Theoretical framework is developed to explain the theoretical link among management, infrastructure and core manufacturing practices with performance.
Phase VII	
Section 2.15	Provides a brief overview of management initiatives Lean (TQM & JIT) and

	AM awareness in general and particularly in Apparel Sector of Pakistan
Section 2.16	Literature review findings are summarized
Section 2.17	Briefly summarizes the chapter

Senge (2000), supported the micro systems synergy theory and confronted the illusion "that the world is created of separate, unrelated forces". Similarly, Z. Zhang and Sharifi (2007), also proposed that micro systems like environment, manufacturing tasks and manufacturing choices integrate to form a macro system and the most important thing is the sequence in which these sub-systems are applied. Organizations must understand their capability as well as limitations and place these sub-systems where they can produce the best results.

Strategic elements network of a business wide well-integrated at macro level relationship among organizational environment, culture, context, strategy, strategic objectives, internal operations, external functions, competitive priorities and business performance is shown in Figure 2.1 (Jajja, Brah, & Hassan, 2012).

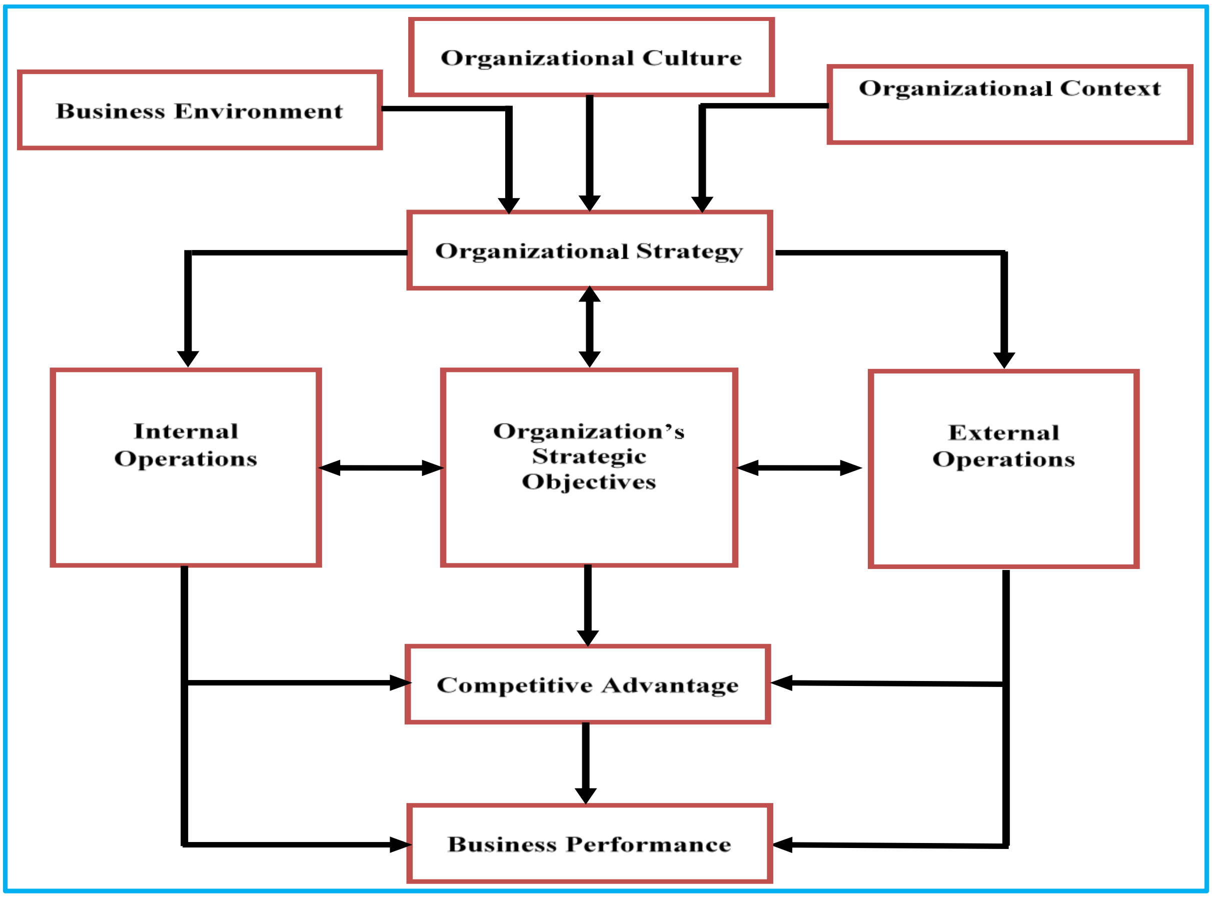


Figure 2.1. Strategic Elements Network of a Business
Source: Adapted from (Jajja et al., 2012, p. 5)

Organizational environment elucidates the nature of organizational business environment like its dynamism and hostility, organizational culture reflects the top management commitment, strategic vision, employee's empowerment and training, strategic commitment towards suppliers and customer focus. Organizational context indicates the structural issues of organization like its size, industry type, business type like, domestic or export, equipment status, unionization, ISO-9001 certifications etc. Organizational strategy includes organization competitive strategy (how organization will approach to market) either low cost or differentiation strategy, improvement initiatives (internal and external operations) also known as managerial initiatives includes Lean and AM Practices.

Competitive advantage comprises organization capability to achieve low manufacturing cost, flexibility (volume and variety), delivery (speed and reliability), lead time and most important quality, finally organizational performance includes market performance like market share growth, sales volume growth and financial performance like Return on Investment (ROI), Return on Asset ROA and Profit (Jajja et al., 2012). Organizations need to know their business environment and should maintain a continuous strategic alignment between environment, organization strategy, structure and design, as mostly organizations keep on operating without appreciating this critical link (Skinner, 1969), as two organizations yet having the same strategy, same environment and operating in the same market cannot perform similarly (Hayes & Pisano, 1994).

Astley and Ven (1983, p. 248), accentuated the management responsibility of system structural view as: *"*According to the system-structural view, the manager's basic role … is [one] of fine tuning the organization according to the exigencies that confront it. Change takes the form of 'adaptation'; it occurs as the product of exogenous shifts in the environment. The manager must perceive, process, and respond to a changing environment and adapt by rearranging internal organizational structure to ensure survival or effectiveness".

Manager's role seems to be only reactive to the environment changes. Further, Benson, Saraph, and Schroeder (1991), described the system-structure combination as three stage implementation process as shown in the Figure 2.2.

(a) **Stage-I.** Organizational quality context refers to manager's perception about market's present quality demands, organization quality performance milestones achieved in past, management orientation towards quality, available resources amelioration and the competitive hostility which can influence quality results.

(b) **Stage-II.** Managers based on stage I, find out the gap between quality demands and organizational capability to meet those demands.

(c) **Stage-III.** Managers respond to market needs, acquire, and maintain new quality values.

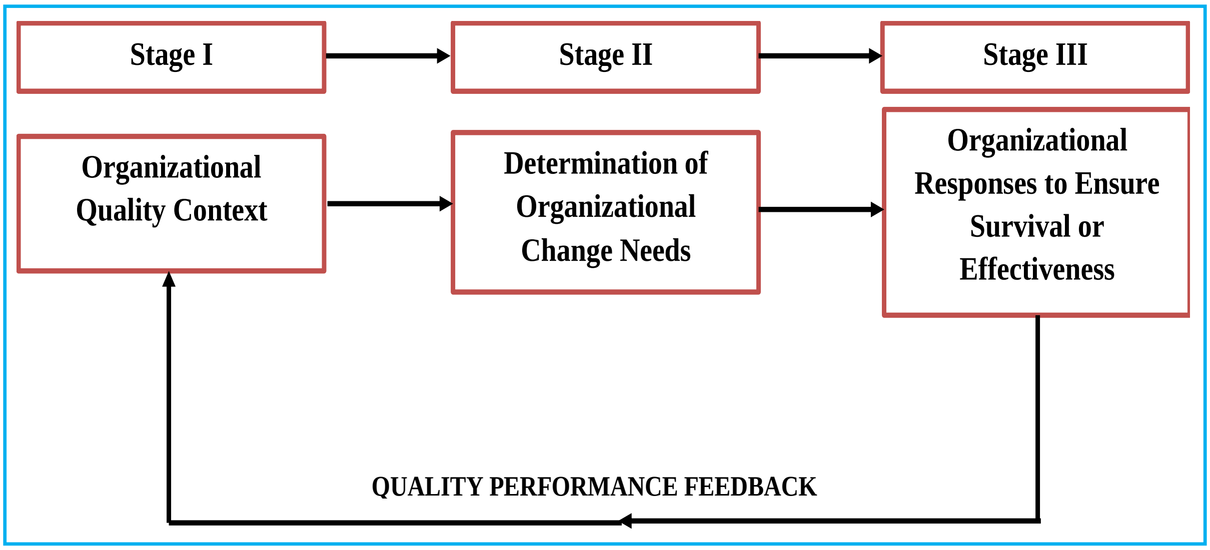


Figure 2.2. Quality Management III-Stage System-Structure View
Source: (Benson et al., 1991, p. 1108)

Benson et al. (1991), further proposed a "II-stage" more abridged quality gap analysis model as shown in Figure 2.3. It is proactive in nature. Skinner (1974, p. 114) also emphasised that managers should not seek problem as "How can we increase productivity?" but as "How can we compete?". It has two paths. First path 'A' one leads to problem formulation and second Path 'B' leads to problem solving. Mangers continuously keep on tracking the gap between ideal quality demands and actual quality provided. If the difference is not significant, organization do not need to make major structural shifts. On the other hand, if difference is significant then organizational structure incorporate new strategic level changes in the system to meet the new competitive requirements.

PHASE - I

2.2 LEAN (TQM & JIT) MANUFACTURING PARADIGM

The term "Lean" in working environments is recognised with various names like "Lean Philosophy (LPh)", "Lean Production (LP)", "Lean Thinking (LT)", "Lean Culture (LC)", Lean Manufacturing (LM) and "Lean Organization (LO)" due to its versatility and unified compatibility in various setups other than manufacturing like health-care, and banking etc (Putnik & Putnik, 2012, p. 248).

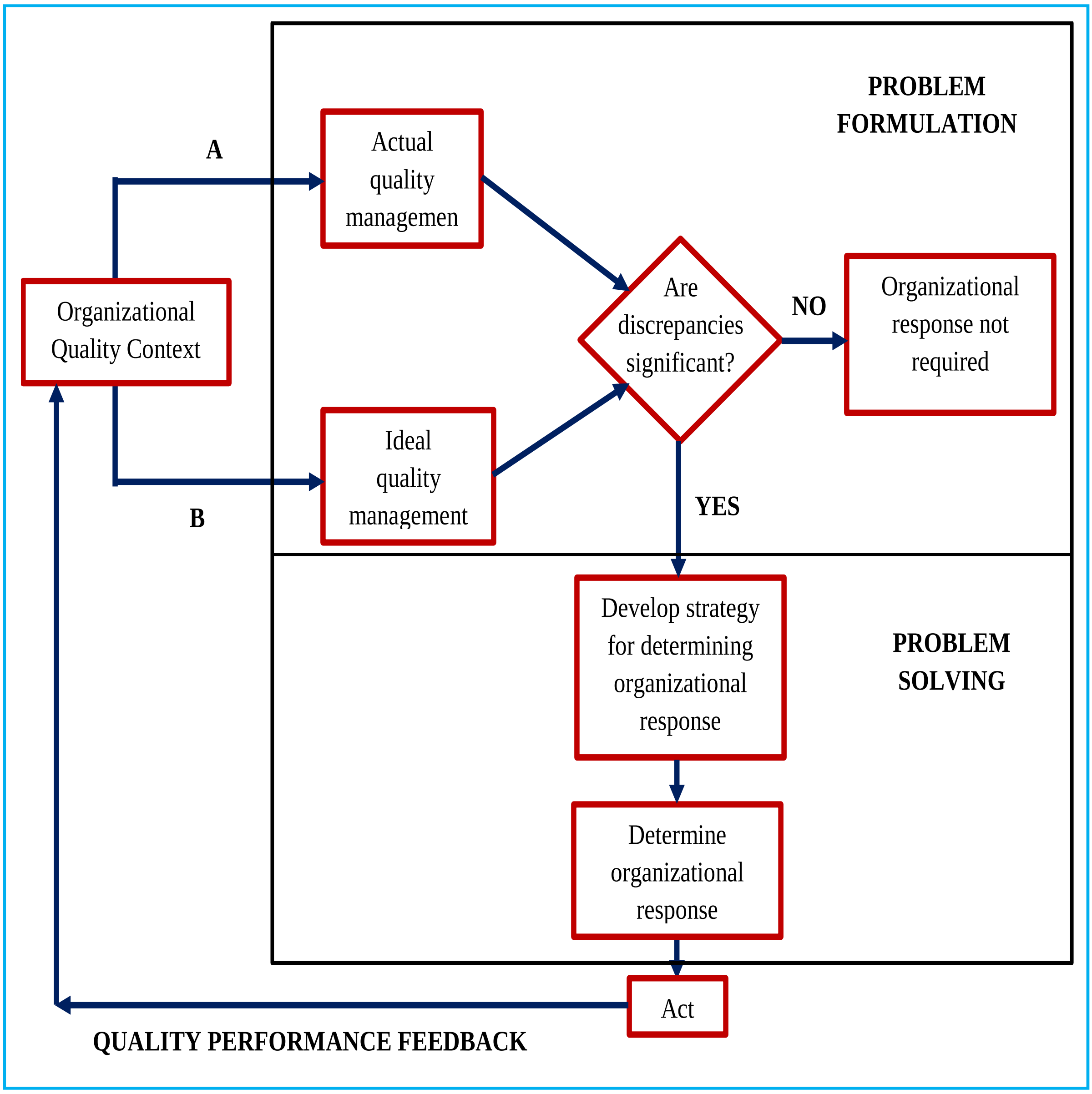


Figure 2.3. Quality Management II-Stage System-Structure View

Source: (Benson et al., 1991, p. 1109)

Generally, "Lean" means Lean Manufacturing (LM) or Lean Production (LP). Lean Manufacturing has been defined in the literature as a set of interrelated practices primarily focusing towards reduction and, ultimately elimination of waste and non-value added activities from firms operations thus causing organizations to achieve sustainability (Holweg, 2007; Shah & Ward, 2003, 2007; Shimokawa & Fujimoto, 2009; Womack et al., 1990). The term Lean was first introduced to the literary world by Womack et al. (1990) in their book "The Machine that Changed the World". Womack et al. (1990) further acknowledged the roots of this term to the Krafcik "(International Motor Vehicle Program (IMVP) researcher" (Krafcik, 1988). Krafcik (1988) define it as, "Lean because it uses less of everything as compared with 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" (Womack et al., 1990, p. 13). This production strategy as a comprehensive system was introduce to US automotive manufacturers against their Japanese counterparts who were using Toyota Production System (TPS) developed by Toyota Automotive Japan. This book highlighted the major difference between two manufacturing systems Mass Production (MP) adopted by western world and TPS used by the Japanese automotive firms. Sequel to their first book, in their second book "Lean Thinking: Banish Waste and Create Wealth in your Organization" Lean principles were introduced (Womack & Jones, 1996). Five basic customer value driven Lean principles are well accredited in the literature due to their applicability in manufacturing as well service setups as given in the Table 2.2 (Womack & Jones, 1996).

These principles are generally applied to eliminate cardinal waste, which are categorized as following (1) inventory, (2) over processing, (3) waiting, (4) defects, (5) over production, (6) unnecessary motion, (7) transportation (8) un-skilled workforce (Putnik & Putnik, 2012; Taj & Berro, 2006; Womack & Jones, 1996). Their description is given in Table 2.3.

Table 2.2. Description of Lean Principles

Source: (Womack & Jones, 1996)

Principle	Description
Customer Focus	Customer value is the driving force.
Value Stream Analysis	Processes are continuously evaluated against their value contribution, and if they are not contributing in the present process they should be eliminated or best use of those be made through business process reengineering.
Flow	Manage continuous flow through the production process by moving parts.
Pull	Products are produced and moved from upstream to downstream only, and when required by the downstream.
Continuous Improvement	There is no limit to improvement for perfection through reducing cost, space, mistakes and most importantly time spent on non-value added activities, so non-value added activities detection and elimination process should be continuous.

Table 2.3. Waste Types and Description
Source: (Womack & Jones, 1996)

Waste	Description
Inventory	Material over and above of the requirement, and in hand parts which are over and above of the customer demand.
Over processing	Parts that cause additional cost in terms of storage and damage, as readily not required by the customer.
Waiting	The idle time due to non-availability of man, machine or material primarily due to unorganised activities.
Defects	It includes rework due to poor workmanship.
Over Production	Producing without appreciating customer demands.
Unnecessary Motion	Worker's movement adding no-value.
Transportation	Undesired parts movement.
Un-skilled workforce	Waste added due to workers weak skill.

The flow of value to the customer is describe as organization wide activity and integrates all the departments as presented in Figure 2.4. It starts with the customer order. As the order is received, product development team, engineering team, production department and engineering team start designing product and process as per the specifications asked by the customer. Engineering team makes manufacturing facility available through scheduling to manufacture the product. All the required resources in terms of man, machine and material are provided to the production team and product is manufactured as per the order. Finally, order is delivered to the customer.

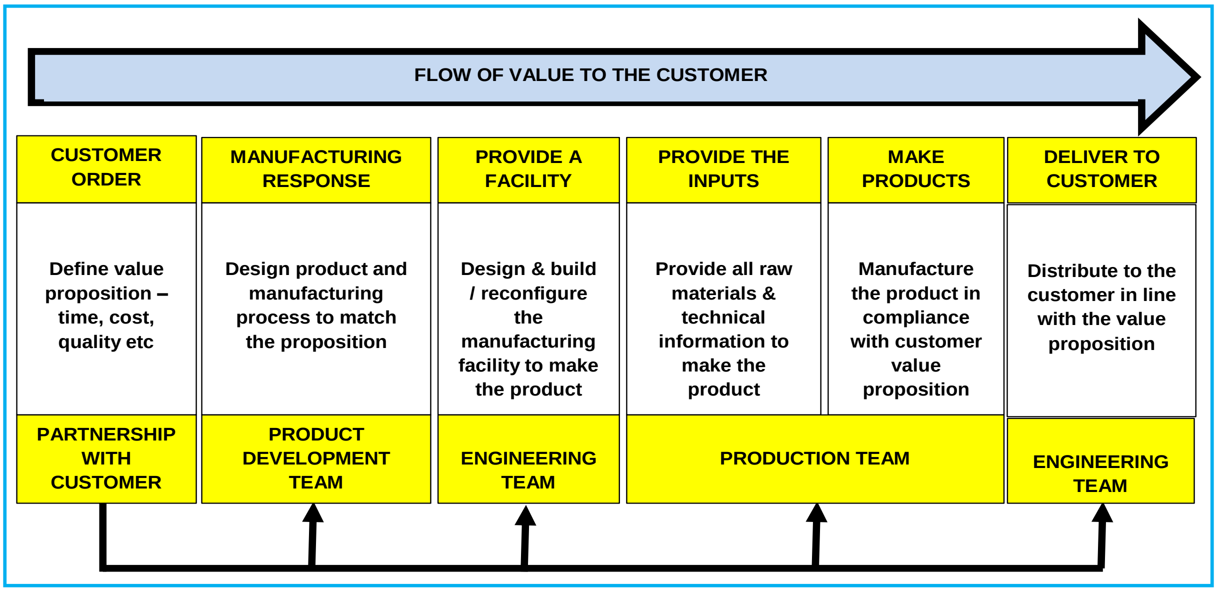


Figure 2.4. Value Flow to the Customer
Source: (Melton, 2005, p. 667)

Taiichi Ohno was the pioneer to start Toyota Production System (TPS) at Toyota Automotive Industry Japan in 1940s and kept on improving this process until late 1980s. Ohno implemented TPS and brought complete Toyota's supply chain to Lean in 1970s and the complete distribution system also accomplished this milestone in early 1980s (Melton, 2005). Manufacturing core objectives since inception of manufacturing practices and TPS have been efficiency (Holweg, 2007). Lean purely based on TPS, which focus on waste reduction due to non-value added activities elimination, improved throughput decreased lead-time, and respect for employees who are self-directed to identify process limitations and suggest solutions to fix those.

Lean attain synergistic effect through the implementation of a set of inter-related socio-technical manufacturing practices to develop and produce products and services as per customer needs (MacDuffie, 1995; Shah & Ward, 2003, 2007; Womack et al., 1990). Lean production is a multi-facet management initiative approach and includes a vast range of management practices like, Total Quality Management (TQM), Cellular Manufacturing (CM), Human Resource Management (HRM), Supply Chain Management (SCM), Just-in-time (JIT), Focused Factory (FF), Total Productive Maintenance (TPM), Concurrent Engineering (CE) etc., in an integrated way to have their synergy effects. The core concept behind their synergic implementation is to deliver products to the customer with high quality (Shah & Ward, 2003). Literature is replete with evidence of implementation of these practices and their contribution to achieve the organizational competitiveness. Researchers have approached differently in application of these management initiatives, few have tested it with only one management initiative like JIT (McLachlin, 1997; Nakamura, Sakakibara, & Schroeder, 1998; Sakakibara, Flynn, Schroeder, & Morris, 1997), TPM (McKone, Schroeder, & Cua, 2001), TQM (Powell, 1995; Terziovski & Samson, 1999), HRM (MacDuffie, 1995) etc, few have tried simultaneous (integrated manufacturing) implementation of two management initiatives programs like TQM and JIT (Dean Jr & Snell, 1996; Flynn, Sakakibara, & Schroeder, 1995a; Furlan, Dal Pont, & Vinelli, 2011a; Lau, 2000; Sriparavastu & Gupta, 1997). However, few have tested simultaneous (integrated manufacturing) implementation of three improvement initiative programs and checked their contribution in organizational performance TPM, TQM and JIT (Cua, McKone, & Schroeder, 2001; Cua et al., 2006) TQM, JIT and HRM (Dal Pont et al., 2008; Furlan et al., 2011a) with an exception of Shah and Ward (2003) who tested simultaneous (integrated manufacturing) implementation with four management programs (JIT, TQM, TPM and HRM). These programs can be implemented in any combination but the core aim is to achieve superior performance in order to capture, maintain and enhance the market share. However, researchers findings on implementation of these management initiatives and performance results are inconclusive as there are success stories of Lean implementation (Anderson, Rungtusanatham, Schroeder, & Devaraj, 1995; Cua et al., 2001; Kaynak, 2003; Terziovski & Samson, 1999), as well as few failures are also reported (Dow, Samson, & Ford, 1999; Jayaram et al., 2008; Powell, 1995; Samson & Terziovski, 1999) which question the universal applicability of the Lean Manufacturing Practices. (Galbraith (1973), 1977)) explains the plausible reason for this aspect as, organizations attempt to apply standard improvement programs without understanding their organizational structure complexity, therefore organizations must refrain from applying new improvement programs without substantial improvement in their organization structure design (Hayes & Pisano, 1994; Skinner, 1969). This leads to a scenario, which can be characterised as organizational environment influence where these improvement systems are applied and needs further exploration.

TQM and JIT are the two major revolutionary management programs, which were introduced to manufacturing arena after World War-II. Powel argued that: “TQMs origins can be traced back to 1949, when the Union of Japanese Scientists and Engineers formed a committee of scholars, engineers, and government officials devoted to improve Japanese firms productivity, and enhancing their post-war quality of life”, whereas, “American firms began to take serious notice of TQM around 1980”. TQM evolved over a period of time from Total Quality Control (TQC), to CWQC (companywide quality control) (Powell, 1995, p. 16). Feigenbaum (1961) in his book first time defined TQC as, “an effective system for integrating the quality development, quality maintenance, and quality-improvement efforts of the various groups in an organization so as to enable production and service at the most economical levels which allow for full customer satisfaction”. As per Garvin (1988), CWQC term first time was sounded in Japanese manufacturing industry in 1968. CWQC includes four principal elements: (1) the involvement of functions other than manufacturing in quality activities, (2) the participation of employees at all levels, (3) the goal of continuous improvement, (4) careful attention to “customer’s definitions of quality”. Ishikawa defined CWQC as, “Quality control consists of developing, designing, producing, marketing, and servicing products and services with optimum cost-effectiveness and usefulness, which customers will purchase with satisfaction. To achieve these aims, all the detached parts of a company must come into integration"(Garvin, 1988). Moreover, Deming (1982) introduced inspection free culture and Crosby (1979), pointed out that defect free environment does not require any control mechanism. Nevertheless, TQM as a term and philosophy got mature in 1980s (Martinez-Lorente, Dewhurst, & Dale, 1998). Snell and Dean Jr (1992, p. 470) encapsulate TQM, "total quality is characterized by a few basic principles-doing things right the first time, striving for continuous improvement, and fulfilling customer needs as well as a number of associated practices".

Eruption of oil crisis in 1970s introduced JIT along with TQM as production way of life to the Japanese industry. JIT production and TQM philosophy have wide acceptance in Japanese as well as western countries like, US and European. However, TQM and JIT journey is contrary in both competing blocs (Japanese and Western). TQM leads and JIT follows in Japanese bloc, whereas, JIT leads and TQM follows in western bloc as shown in Figure 2.5 and Figure 2.6. Western bloc initially only focused on shop floor efficacy but later on grasped that these are not merely practices, broadly, it is a cultural revolution just moving from traditional manufacturing to TQM and JIT philosophy. However, emerging economies (Less Developed Countries) are still struggling to get full benefits of these improvement programs (Mersha, 1997). Hayes and Pisano (1994) highlighted the limitations of these programs. They stressed it is not merely enough to apply either TQM or JIT and get the solution to every problem. It is the managers responsibility to make best use of these, as these are just "stepping stones" in the envisioned direction and cannot guarantee solution to every problem (Hayes & Pisano, 1994, p. 78).

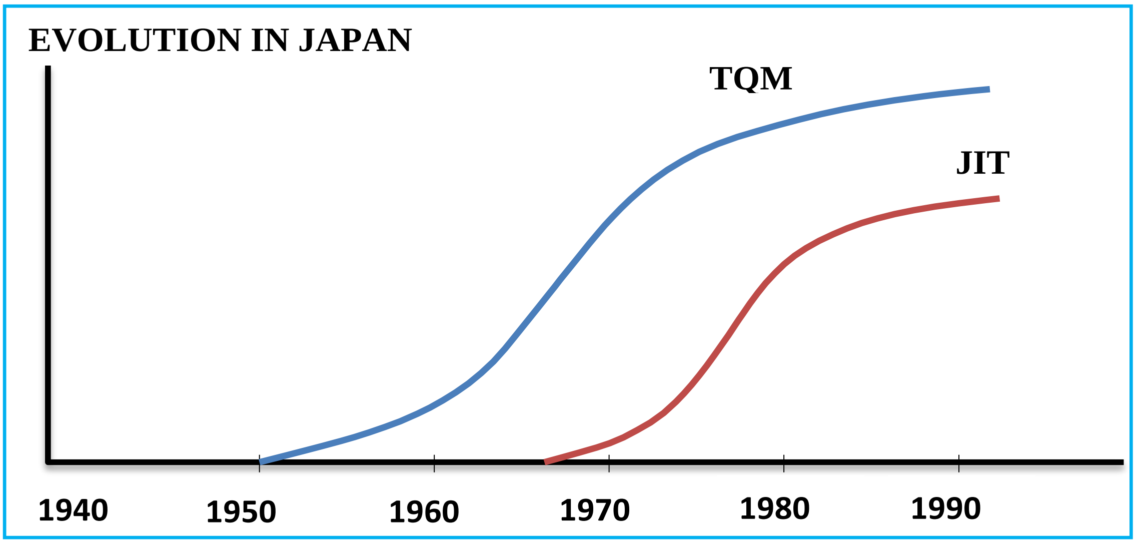


Figure 2.5. TQM and JIT Evolution Journey in Japan

Source: (Vuppalapati, Ahire, & Gupta, 1995, p. 91)

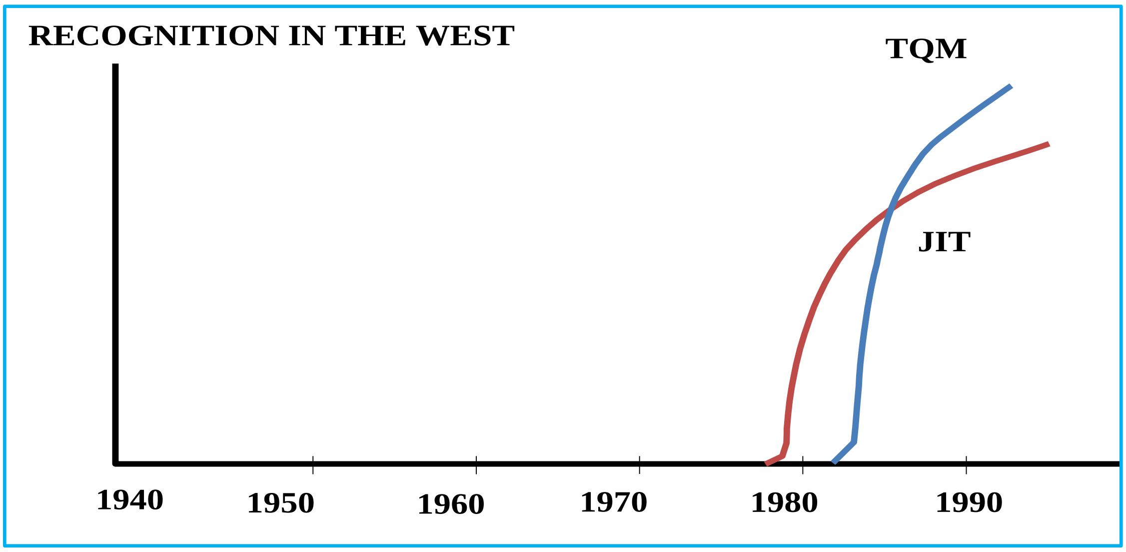


Figure 2.6. TQM and JIT Evolution Journey in Western Bloc

Source: (Vuppalapati et al., 1995, p. 91)

For the purpose of this study, two Lean bundles i.e. TQM and JIT along with common infrastructure (HRM, information system, employees' involvement, cross training, empowerment, technology etc.) practices are considered as both have received well acceptance in the literature as organization wide comprehensive improvement systems. Both systems have inter-related sets of practices, comprise few core practices and associated infrastructure practices (Flynn et al., 1995a). Core Practices should be implemented in harmony with associated infrastructure practices to achieve organizational objectives through enhanced customer satisfaction. JIT emphasises on waste reduction through elimination of inventory buffers. Small lot sizes leads to minimum inventory levels thus eliminate inventory buffers and expose process problems, whereas, TQM emphasises on quality improvement through continuous process improvement and both (TQM and JIT) jointly reduce the production cost, decrease lead-time and improve product quality, delivery (dependability) and flexibility.

Section 2.2 provided a brief history of Lean Manufacturing (LM), its core theme, and how LM can be accomplished by using different management initiatives like, TQM, JIT and TPM, etc. There is no agreement among researchers, academicians, and practitioners that what are the exact practices and techniques that actually define LM as whole. Everyone has addressed LM differently applying different sets of initiatives. Moreover, it also shed light on the environmental context, which matter in which these sub-systems are operating. Section 2.3 explores the different existing theoretical frameworks, which have been developed and implemented to transform one organization from traditional way of production to Lean (TQM & JIT).

2.3 LEAN (TQM & JIT) THEORETICAL FRAMEWORKS

Market turbulence, environmental uncertainty, unpredicted customer demands and continuously shrinking product-life-cycle have forced organizations to be more vigilant and proactive to improve their process and product quality as compare to their competitors than ever. (Hayes and Wheelwright (1979), 1984)) in OM literature, are acknowledged to be the first one who developed first "Product-Process Matrix" and also lay the foundation of new era through introduction of "World Class Manufacturing (WCM)" in the manufacturing arena. introduced simultaneous implementation of interrelated set of manufacturing practices in the field of OM. WCM program was introduced to US automotive manufacturers, as a solution to achieve better results. Six sub-sets of WCM programs introduced were as (1) "Workforce skills and capabilities", (2) "Management Technical Competence", (3) Competing through Quality", (4) "Rebuilding Manufacturing Engineering", (5) "Workforce Participation" (6) Incremental Improvement Approaches". It has been empirically validated that these practices once assimilate produce better performance (Flynn, Schroeder, & Flynn, 1999), than if employed separately. Along with these practices they also presented new concept of synergy vis-à-vis trade-off between competitive priorities and cautioned organizations to maintain a competitive advantage as per their organizational strength, instead of pursuing all at once as earlier mentioned by (Hayes and Wheelwright (1984); Skinner (1969)).

Flynn, Sakakibara, and Schroeder (1994) presented "A framework for quality management research and an associated measurement instrument" as shown in Figure 2.7. (Flynn et al. (1994, p. 342)) defined Quality management practices as, "An integrated approach to achieve and sustaining high quality output, focusing on the maintenance and continuous improvement of processes and defect prevention at all levels and in all functions of the organization, in order to meet or exceed customer expectations". It can be easily identified from Figure 2-7 that quality management is the core of WCM having strong association with all other practices. Two-way arrows indicate that they all complement to each other and generate synergy effects. Quality management has strong association with JIT manufacturing, as inventory levels gets lowered when confidence level in product quality is high thus causing elimination of unnecessary inventory buffers. These inventory buffers cost organization like storage, damage etc, increase overall production cost. On the other hand reduced inventory exposes process flaws (Sakakibara, Flynn, & Schroeder, 1993; Sakakibara et al., 1997).

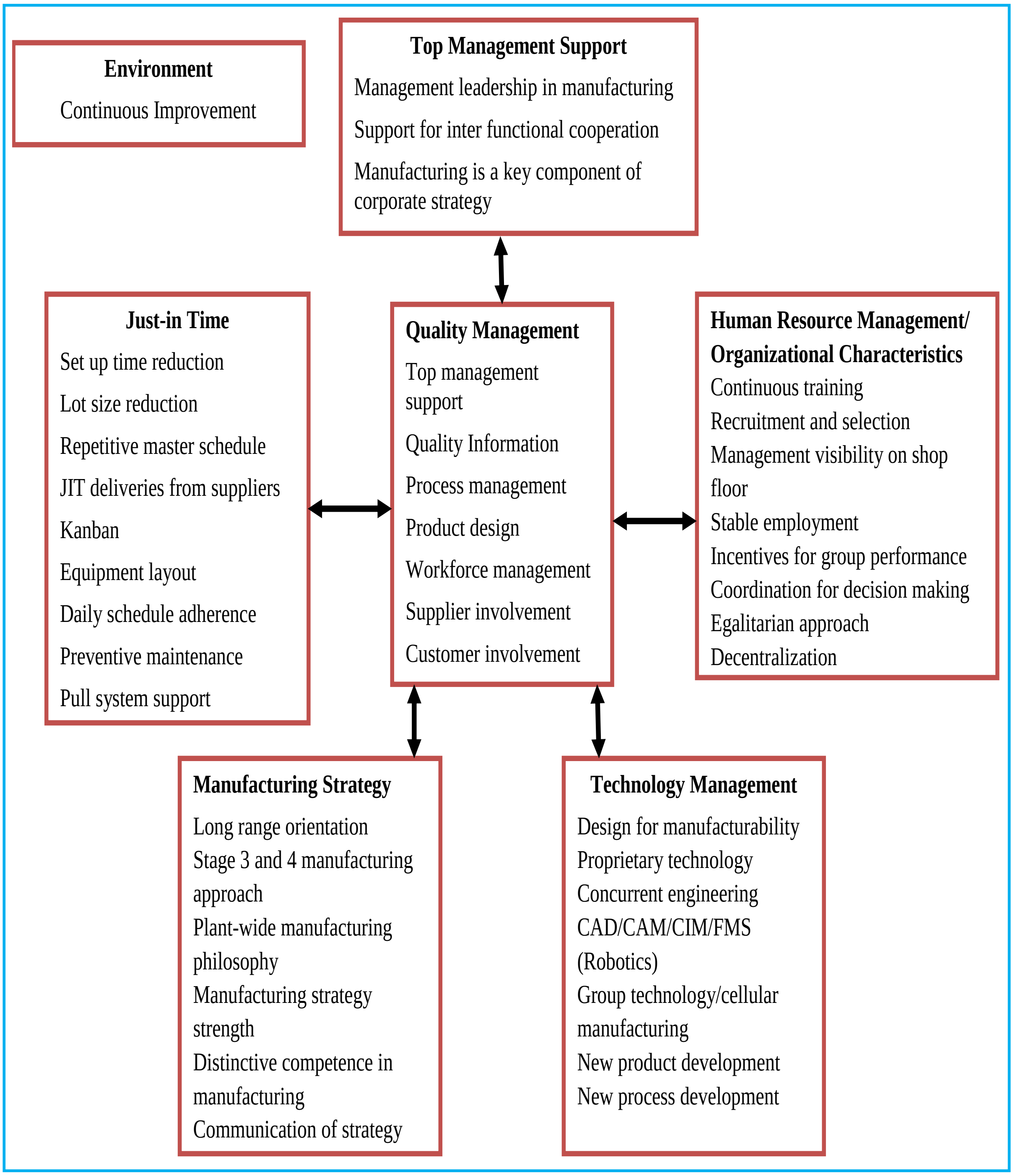


Figure 2.7. Quality Management Relationship with World Class Manufacturing
Source: (Flynn et al., 1994, p. 343)

This figure is only showing quality management linkages with other sub systems (JIT, Top Management Support, Human Resource Management/Organizational Characteristics, Manufacturing Strategy and Technology Management). However, all the sub systems are also inter-linked with each other, not shown in Figure 2.7, the way quality management practices are connected with others and forms a shape of web.

Other links have not been shown in this figure to keep this framework simple and easily understandable. All these practices, strongly synchronize with each other and work in an environment of continuous process improvement, and contribute to the successful achievement of common goals. The two Lean bundles TQM and JIT having unique inbuilt competence of process improvement are categorized as Core Lean sub systems, whereas, other sub-systems like; human resource/organizational characteristics, top management support, technology and strategy, provide a foundation to enhance value for customer.

Lean (JIT) alone has been advocated as organization wide philosophy due to its resemblance with TPS. JIT has been endeavoured in literature to eliminate waste and non-value added activities. Ohno (1982) defined JIT as a function of time. He emphasised the availability of the right parts in right numbers, exactly whenever are needed on the shop floor. Sugimori, Kusunoki, Cho, and Uchikawa (1977) tributed Ohno for successful development and implementation of “TPS” and “Kanban” at Toyota Motors Japan. Sugimori et al. (1977) further emphasised that employees involvement plays a vital role in JIT accomplishment. Monden further in a series of his publications defined “JIT philosophy” (Monden, 1981d), “Kanban value to JIT” (Monden, 1981c), “smooth production” (Monden, 1981d) and “small lot sizes and setup time reduction” (Monden, 1981d). Monden further emphasized that it is impossible to implement JIT without motivated and skilled workforce, as machines only cannot achieve any results until and unless man working on it is not committed to those objectives associated with the machine. Schonberger (1982) defined process simplification is the key to success of JIT. He emphasised process simplification as it enhances process visibility and easy for employees to understand and practice it.

Davy, White, Merritt, and Gritzmacher (1992) based on empirical research made an attempt to find underlying JIT constructs. The research respondents were from three major US professional organizations working in south-western state: “American Production and Inventory Control Society (APICS, N=91), “American Society of Quality Control (ASQC, N=182)”, “National Association of Purchase Management (NAPM. N=73)”, and three main constructs were found named as (a) “Operating Structure and Control (9 items)” (b) “Product Scheduling (4 items)” (c) “Quality Implementation (4 items)”, as shown in Figure 2.8.

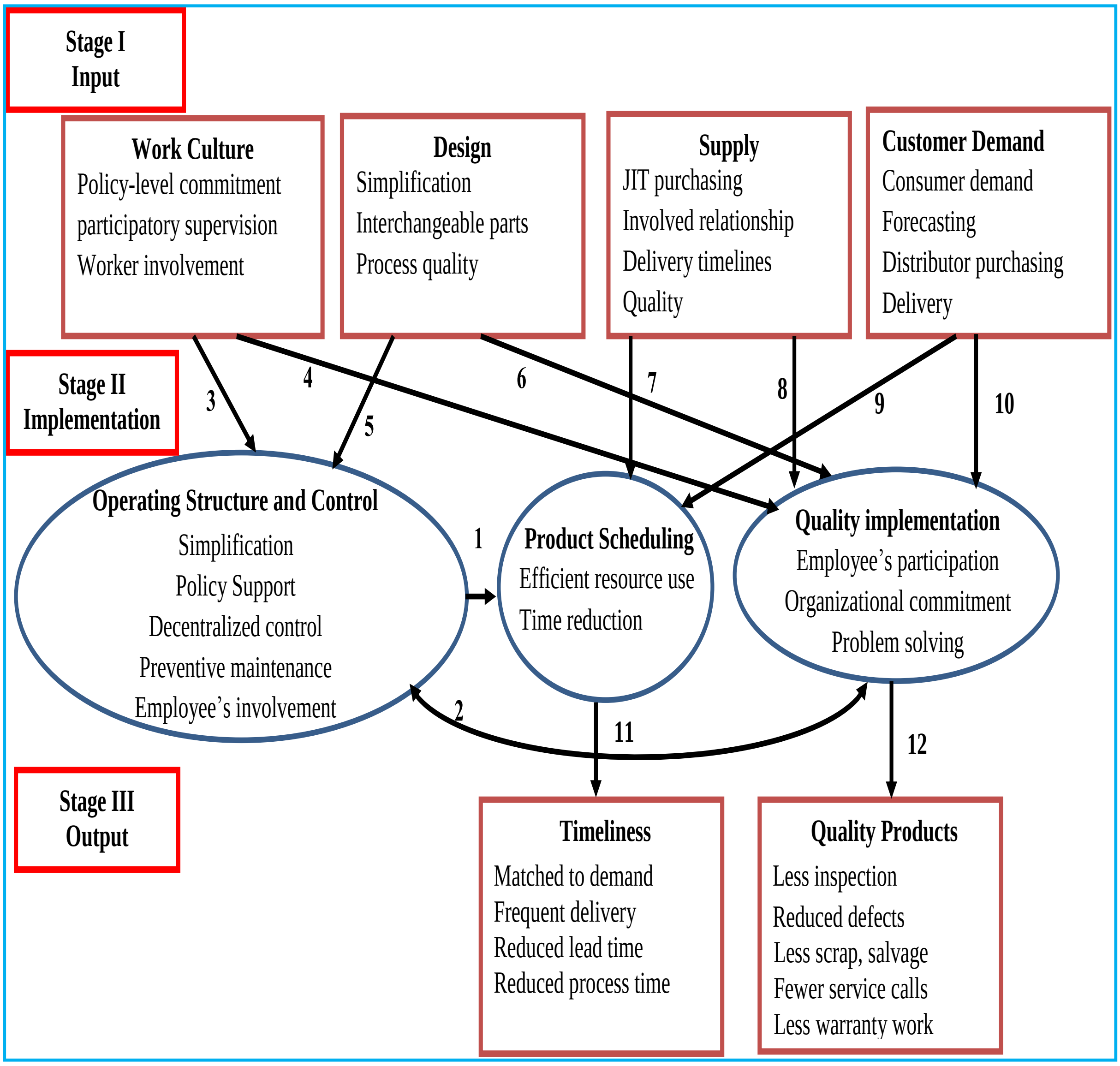


Figure 2.8. JIT III-Stage (Input, Implementation and Output) Framework

Source: (Davy et al., 1992, p. 662)

The complete JIT implementation framework comprises of three stages i.e., stage-I (inputs), stage-II (implementation) and stage-III (outputs). Moreover, there are 12 paths between different sub-systems, out of which 11 paths are one way with an exception (path 2) at stage-II (implementation) of two-way path between quality implementation practices and operating structure and control. Organization first developed operating structure and organizational control mechanism and then focus on quality implementation.

The first factor explains how the organization structure will be and, up-till what level control will be transferred to employees (Schonberger, 1982). Moreover, people are motivated to contribute maximum through building a confidence measures by allowing them to give suggestions how process can be further improved. Equipment maintenance enhances through employee's involvement thus curtailing machine breakdowns. The second factor focuses on scheduling, maximum capacity utilization through developing and maintaining optimized schedule, setup time and lot sizes are reduced to keep work load uniform for product processing (Arnold & Bernard, 1989). The third factor quality implementation focuses to achieve quality output, through employees' training, small group suggestions to solve the problems and involving employees not only at shop floor but also participate in organizational level decisions-making process. Such practices will increase their confidence in top management, and will enhance organization productivity (Mefford, 1989). Two-way path (Path 2) between JIT and quality management supports joint implementation of Lean (TQM and JIT bundles).

Inputs (stage-I) are double edge weapons, they are the sole reasons for successful implementation of JIT but at the same time can also be characterised as impediments to the implementation process if are not available on time. Work culture and product design are input to organizational structure/control and quality management, whereas supply and customer demands relate to scheduling and quality management. Once organization achieves efficiency in product scheduling, it results in two ways. First, it meets the products delivery time-lines. Moreover, when process time is improved it leads to efficient process management and organization can deliver frequently to the customer and secondly can decrease throughput and lead-time. On the other hand, quality practices eliminate inspection process, as employees are motivated to produce defect free products. It reduces rework, warranty claims and enhance customer satisfaction supporting Crosby (1979) claim that "Quality is free". However, there are two missing links identified in this framework as following. First, the correlation between output (timelines and quality products) as both complement each other. If the quality of the product is high, it means timelines can easily be meet due to elimination of time wastage, due to poor workmanship, resulting in defects and rework and vice versa. Second information feedback loop is missing which is the key to successful implementation of any system.

Liker (2003) in his book, "The Toyota Way" presented TPS in the form a house as shown in Figure 2.9. The house is an exhibition of Lean manufacturing structure blocs. The house foundation based on effective establishment of principles (Toyota Way Philosophy, visual management, stable and standardised process, level scheduling (Heijunka)). It starts with the organization willingness to transform from traditional way of working to TPS. Management and workers commitment to adapt TPS as organization wide philosophy is a key to implement TPS. Visual system is designing the system using 5S (sorting- separate needed items from un-needed items, set in desired order- place items in a way they are required during operations, shining- shop floor must be neat and cLean, standardized- colour coding, visual marks, and labelling, sustaining – maintain the system). Process should be standardised so workers' training and flow of material becomes convenient. Process scheduling should be done frequently to switch between different product demands to achieve process flexibility capacity utilization optimization.

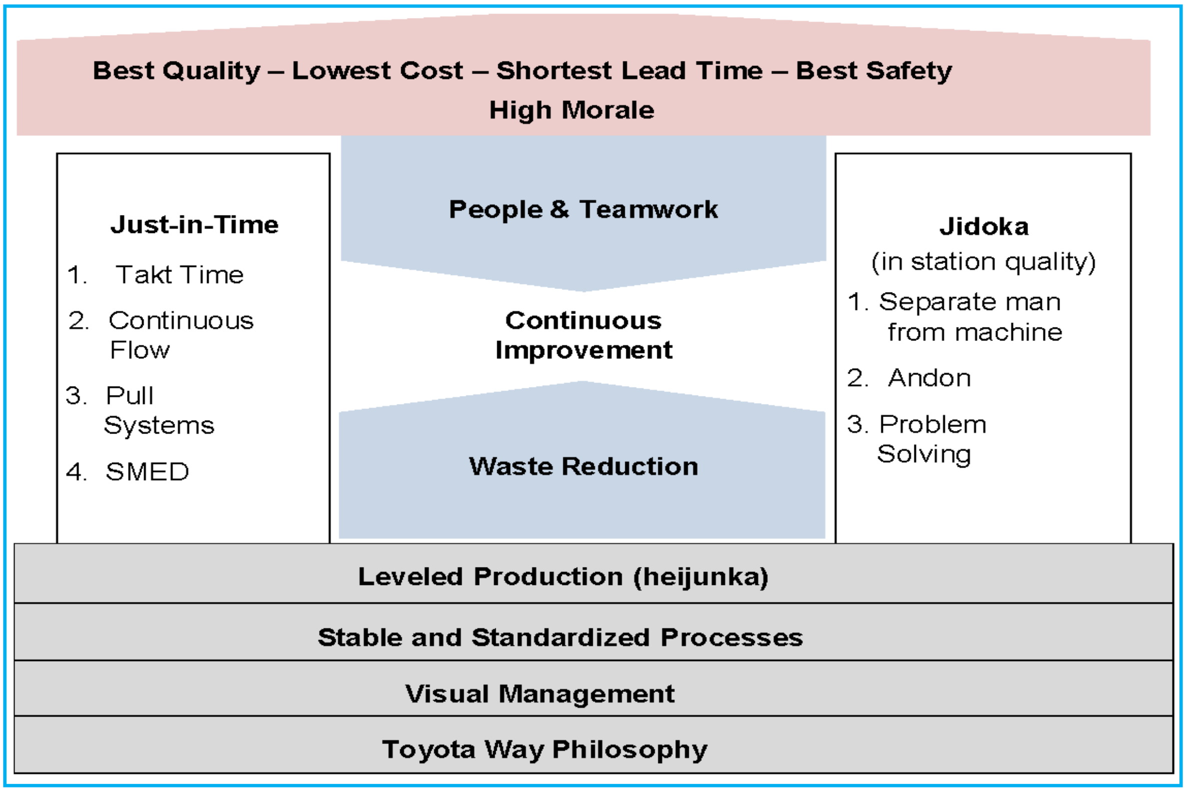


Figure 2.9. Toyota Production House
Source: (Liker, 2003, p. 34)

The house comprises two main pillars JIT production and Jidoka (Quality at Source) and the relationship between these two pillars and house-top (performance) variable is positively mediated through waste reduction, teamwork and continuous improvement cycle. JIT concentrates on Takt Time, making continuous production flow preferably one part flow, the parts move downstream once asked by the customer using "Pull production system". This customer can be organization end customer, or, a person at downstream on the shop floor also act as a customer, to the person standing in the upstream. SMED (single minute exchange of dies) enables the rapid switching among different product configurations while maintaining a continuous flow (Shingō, 1986).

The second pillar is Jidoka (Quality at source). It means that no defective article should move throughout the organization supply chain within and outside as well. Its application is not limited to shop floor only rather is extended to the whole supply chain. A defective part in no case should be delivered to the customer in the downstream at shop floor or to the end customer. Suppliers are trained and developed to a level, where, supplies are delivered inspection free. It is consummated through the application of Poka-yoke (fool-proof) technique. “Autonomation” maintain a close harmony with operator and the machine. “Andon” is a production stoppage technique, it means a production-stopping signal. It was borrowed by Toyota from power loom industry, as when a single thread breaks the whole production process stops (Holweg, 2007), and hence one man can control many machines at one time. Lean is a set of tools and techniques, but at the same time, it is a philosophy and human element is core for its implementation. Once all these techniques are implemented, organization achieves its competitive objectives, (1) high quality (2) low production cost (3) decrease in lead-time (4) guaranteed worker’s safety (5) high moral. It is evident from above discussion that JIT and TQM both are complementary and helps organizations in acquiring their strategic advantages through the involvement of workforce, waste reduction and continuous improvement.

(Sakakibara et al. (1993, p. 183); & Sakakibara et al. (1997, p. 1249)) developed and tested research framework for JIT implementation as shown in Figure 2.10. They argued that JIT is an organization-wide strategy and alone can produce results along with its connected infrastructure. The common infrastructure includes quality management practices, workforce management, organization manufacturing strategy, organizational characteristics and product design. The authors proposed three different scenarios:

(a) JIT alone can make significant contribution in manufacturing performance.

(b) JIT along with its joint inter connected infrastructure can make significant contribution in manufacturing performance

(c) Common inter related infrastructure alone jointly can make significant contribution in manufacturing performance.

The proposed research framework empirically tested on US firms from three major industrial sectors (transportation and parts, machinery and electronics). 822 participants from 41 plants participated in this research study. Multiple respondents from one plant technique were employed to increase the study reliability and reduce respondent’s potential bias.

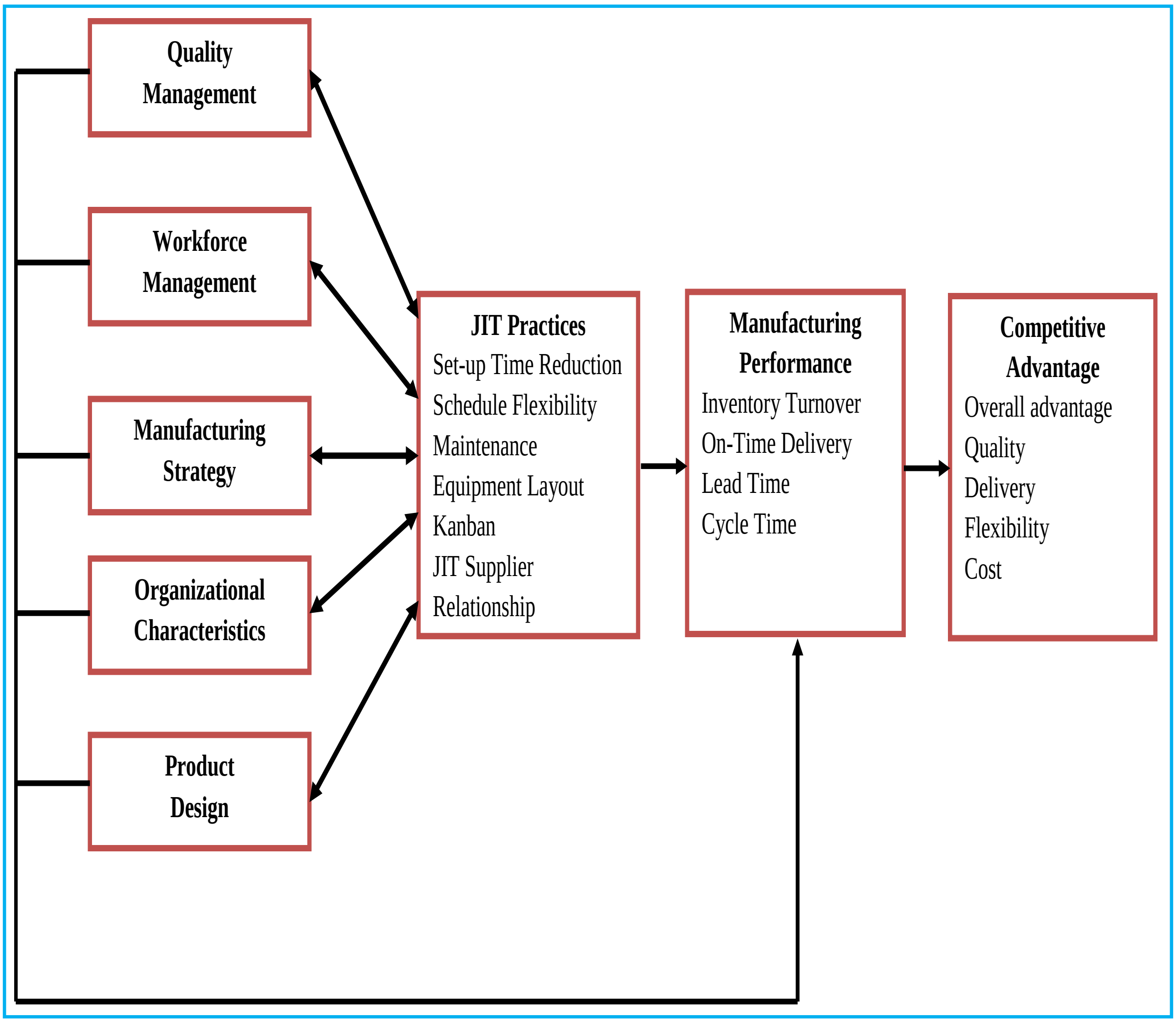


Figure 2.10. A Framework for Research in JIT Implementation

Source: (Sakakibara et al., 1997, p. 1249)

Few interesting, though not surprising, results were observed. First, JIT Practices alone did not contribute in manufacturing performance. Second, JIT along with its connected infrastructures made positive contribution in manufacturing performance. Third, common infrastructure practices alone made positive contribution in manufacturing performance. The authors argued that quality management practices alone along with its infrastructure like organization strategy and product design etc., is sufficient to acquire and maintain competitive advantage. Quality initiatives complement JIT through instituting a process in control. JIT Practices reduce inventory buffers thus expose process limitations providing a room for its improvement. Therefore, TQM and JIT can be regarded as complementary to each other as also empirically established by Furlan et al. (2011b). Further, deductions can be drawn with caution that both act as enablers to each other.

Empirically, it has been established, that TQM and JIT when implemented jointly increase process effectiveness (Furlan et al., 2011b). Vuppalapati et al. (1995) proposed a JIT and TQM three stage integrated framework as shown in Figure 2.11. Framework presented following three scenarios.

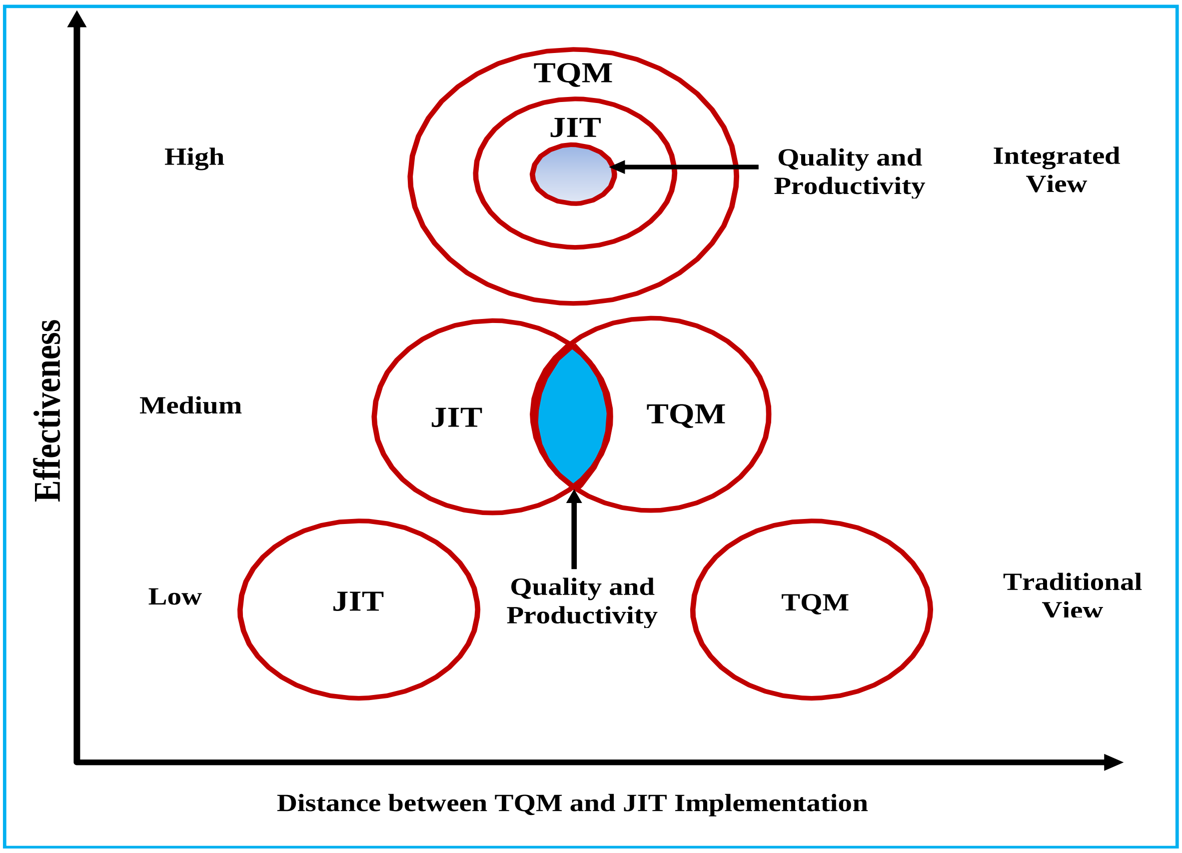


Figure 2.11. A Framework for TQM and JIT Joint Implementation

Source: (Vuppalapati et al., 1995, p. 92)

(a) **Stage I**. JIT and TQM are mutually exclusive. It is also known as traditional view. Organizational effectiveness level is low and quality and productivity gains are not attained.

(b) **Stage II**. JIT and TQM are partially integrated. Productivity and quality gains are very meager and organizations achieve medium level of effectiveness.

(c) **Stage III**. When JIT is diffused in TQM, it is also recognized as integrated view. Productivity and quality gains fully materialized and organizations manage highest level of effectiveness.

Vuppalapati et al. (1995) using focus group methodology identified a set of Principles and Practices of TQM and JIT and relative focus on these paradigms as shown in Table 2.4.

Table 2.4. A Set of TQM and JIT Principles / Practices
Source: (Vuppalapati et al., 1995, p. 89)

key: ✓ = relative importance

Principles / Practices	**Relative Importance of Various Elements in JIT in Comparison To TQM**		
	LOW	**EQUAL**	**HIGH**
Focus on overall business performance	✓		
Role of quality function deployment	✓		
Role of designing quality into products	✓		
Role of information gathering and analysis	✓		
Use of other cross-functional teams such as specific task teams	✓		
Top management commitment	✓		
Role of human resource management	✓		
Role of marketing and R&D in design	✓		
Role of finance and accounting	✓		
Importance of participative management		✓	
Role of customer satisfaction tracking		✓	
Role of manufacturing process control		✓	
Focus on manufacturing employees' development		✓	
Focus on preventive maintenance		✓	
Focus on purchasing function		✓	
Focus on manufacturing performance		✓	
Use of quality circles			✓
Focus on inventory reduction			✓

It can be make out from the Table 2-3 that TQM has much higher focus on most of the practices also known as TQM Core Practices (CP). JIT has higher focus towards efficiency through inventory reduction and quality circle use also known as JIT Core Practices (CP). It clearly indicates that TQM is an organization-wide philosophy (top management commitment, product quality, human assets management etc) and JIT is embedded in it. There are few central practices where both TQM and JIT have equal emphasis like; customer focus, participative management, preventive maintenance etc., can also be regarded as peripheral or common infrastructure.

2.4 LEAN (TQM & JIT) AND ORGANIZATIONAL PERFORMANCE

This Section will provide a brief summary of Lean (TQM/JIT) joint implementation and relationship to business performance. Flynn et al. (1995a) made an endeavour to check the relationship between TQM and JIT. The study sample comprises total 42 manufacturing plants.

(a) US-owned traditional (N=12, 29%)
(b) US-owned WCM (N=17, 40%)
(c) Japanese-owned (N=13, 31%)

These plants were from three major manufacturing sectors as following:

(a) Transportation parts (12 plants, 29%)
(b) Electronics (17 plants, 40%)
(c) Machinery (13 plants, 31%)

These plants were randomly selected from "Honor Roll" for US-plants and "Dun Industrial Guide" for Japanese plants (Schonberger, 1986). 706 respondents (plant managers, production and inventory managers, quality managers, direct labours, human resource managers and process engineers) from these plants participated in this survey. Multi-respondents' technique was used to diminish any possible chance of respondent's bias. This technique also helps to enhance the study reliability (McKone, Schroeder, & Cua, 1999). The questionnaire comprised two main parts, one practices and second outcomes. First part (Practices) was further divided into three sub-sections as following:

(a) TQM Core Practices
    (1) Customer focus
    (2) SPC
    (3) Product design
(b) JIT Core Practices
    (1) Kanban
    (2) Lot size reduction
    (3) Setup time reduction
    (4) JIT scheduling
(c) Common Infrastructure Practices (CIP)
    (1) Management support
    (2) Information system

(3) Plant environment

(4) Workforce management

(5) Supplier relationship

Second section comprised two performance groups.

(a) Quality Outcomes i.e., Product quality and customer satisfaction

(b) JIT Outcomes i.e., Cycle time reduction

Perception based questionnaire was circulated to check the degree of compliance of above mentioned practices and their outcomes. Multiple regression analysis was applied to test the study hypothesis. TQM and JIT were found to be positively associated with their respective outcomes. TQM and JIT alone did contribute towards quality and cycle time reduction respectively, but once jointly implemented produce higher variance in expected outcomes as compare to independent employment. Interestingly CIP alone were able to explain significant variance in outcomes. It was difficult to segregate between TQM and CIP joint impact as compare to independent implementation. The authors further argued that there is no perfect solution to all the glitches, it is management strategic vision and capability to use these practices to attain best results. Moreover, Kanban did not add any value to JIT, primarily due to its fatigue impact on employees in US plants (Hall, Production, & Society, 1983). The study lacks in few areas like; quality was only measured as one item as contrary to Garvin (1987), who empirically validated eight critical aspects of product quality. Similarly, JIT impact was measured as cycle time reduction ignoring inventory turnover etc. Moreover, CIP impact was checked as whole it could have been more conclusive if CIP could have been broken into two groups like internal CIP (management support, plant environment, information system, workforce management) and external CIP (supplier relationship).

Flynn, Sakakibara, and Schroeder (1995b) using the same set of data sets, as mentioned above, also explored organization-wide quality management model comprised management practices, infrastructure practices, core quality practices and outcomes through path analysis. Management link with product design was strongly confirmed directly and indirectly through supplier relationship, whereas, surprising did not confirm through customer relationship. The authors attributed this insignificant relationship to inaccurate measurement of customer satisfaction scale. Work attitudes also did not contribute to product design and it was linked to its application domain at organization level, rather than plant level. The link between Product design and process flow management was also found insignificant primarily due to process management was limited to SPC. Overall, top management organization-wide commitment philosophy proved to be effective through infrastructure and core quality practices resulting in better competitive advantage.

Integrated manufacturing (IM) has got mixed acceptance, success (Cua et al., 2006; Shah & Ward, 2003) as well as few failures are also reported (Gerwin & Kolodny, 1992; Zipkin, 1991). Snell and Dean Jr (1992, p. 472) argued, “The elimination of barriers is the heart of IM”. Dean Jr and Snell (1996) conducted a study to check the integrated manufacturing impact using Advance Manufacturing Technologies (AMT), TQM, and JIT Practices under the context of competitive intensity and manufacturing strategy. A large sample 160 managers from 92 firms participated in this study. The firms were selected from “Harris Pennsylvania Industrial Directory” mainly from metal working industry under Standard Industrial Classification (SIC) as following:

(a) Primary metals (SIC 33)
(b) like Fabricated metal products (SIC 34)
(c) Industrial and metal-working machinery (SIC 35)
(d) Transportation equipment (SIC 36)
(e) Precision instruments (SIC 37)

The study was conducted in two waves, employing longitudinal approach, with a gap of one and half year making the results of this study more robust. The relationship between IM and organizational performance was tested in the context of organizational strategy and competitive intensity. The study clinched that TQM was most robust and remained significant in all environments, whereas, JIT did not contribute. Moreover, AMT influenced only in low competitive intensity environment as in high competitive intensity it becomes the basic unit of the industry. Moreover, low cost strategy moderates the relationship between IM and performance, whereas, flexibility and quality strategy did not.

Sriparavastu and Gupta (1997) conducted a survey study to check the TQM and JIT acquiescence among US manufacturing industries. 153 companies having employees (50-3000) from 50-states of USA participated in the study. Companies based on JIT and TQM implementation were branded into four distinctive groups as following:

(a) TQM and JIT both (N=77, 50.03%)
(b) TQM only (N=19 12.4%)
(c) JIT only (N=15, 9.8%)

(d) None (N=42, 27.05%)

Their stance on implementation of TQM and JIT against six performance (productivity and quality) clusters was assessed using a 1-5 Likert scale. These six groups are as following:

(a) Production associated
(b) Employee associated
(c) Management associated
(d) Supplier associated
(e) Cost associated
(f) Quality associated

ANOVA (pairwise t-test) was used to test the difference among groups. Salient outcomes of the studies are as following:

(a) Companies implementing both TQM and JIT have better outcomes than other three groups
(b) Companies implementing TQM have better quality outcomes
(c) Companies implementing JIT have better productivity outcomes
(d) Production related practices were invariant between JIT only or both
(e) For supplier-employee-quality associated practices were invariant between TQM only and both (TQM & JIT)
(f) Management associated practices were invariant between three groups
(g) Information technology played important role in JIT implementation
(h) ISO certification is easy to achieve for companies implementing TQM

JIT have positive association with production related practices even without TQM which is contrary to earlier studies (Flynn et al., 1995b; Sakakibara et al., 1997). Moreover, performance lag in US manufacturing against Japanese sector may be endorsed to reverse sequence of JIT and TQM implementation. US manufacturers first adopted JIT and later moved to TQM contrary to Japanese production philosophy (Vuppalapati et al., 1995).

Complementary research has deep roots in operation management sciences (Antonio, Richard, & Tang, 2009; Arora & Gambardella, 1990; Cassiman & Veugelers, 2006; Dhebar, 1995; Furlan et al., 2011a; Furlan et al., 2011b). McKone et al. (1999) conducted a study to check the relationship between different contexts to Lean bundle (TPM) (Shah & Ward, 2003) implementation as shown in Figure 2.12.

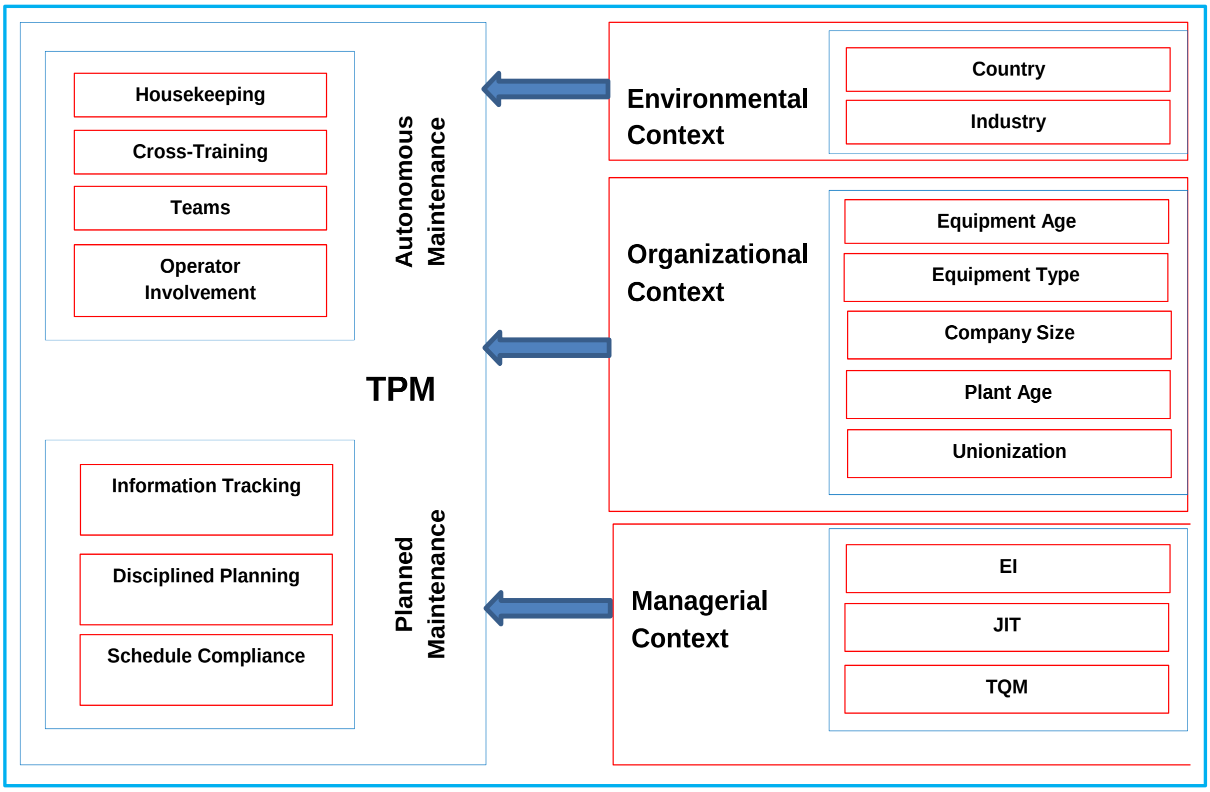


Figure 2.12. TPM through the Lens of Contexts

Source: (McKone et al., 1999, p. 127)

Sample comprised 97 plants from Japan, Italy and USA. The manufacturing firms were form electronics, machinery and automobile sector. 23 respondents from each plant participated to enhance the results consistency. TPM implementation was investigated under following contexts:

(a) **Environmental Context**

(1) Country

(2) Industry

(b) **Organizational Context**

(1) Equipment age

(2) Equipment type

(3) Company size

(4) Plant age

(5) Unionization

(c) **Managerial Context**

(1) Employees involvement (EI)

(2) TQM

(3) JIT

These contextual variables explained significant variation ranging from minimum 25% to maximum 63% in TPM implementation and opening an avenue that these managerial practices are context dependent. Environmental contextual variables explained a significant variation in TPM. Italy has weakest autonomous maintenance as compare to Japan and USA. Japan and USA were at par for teams, housekeeping and cross-training. Japan found to be leading in most of the practices' implementation, this can be ascribed to cultural differences and may be due to much customised equipment in case of USA.

TQM and TPM accompaniment each other as skill development, teamwork and process control are inter-woven with autonomous and planned maintenance. To improve the product quality and to keep process in controls, organizations need to keep their equipment in best working conditions. JIT found to have an association with planning and information system to maintain process scheduling, catering for equipment with extra ordinary down time. EI contributed only in cross-training and teams. Organizational context did not make any significant contribution in TPM except disciplined planning and housekeeping.

Ravichandran and Rai (2000), conducted a study to test the quality management practices organization-wide implementation. Using a sample of 123 executives from information system units through Partial least square structural equation modelling, they found that top management leadership positively influence management infrastructure sophistication, which drive process efficacy to acquire better performance. Top management does not directly influence stakeholders' participation and process management, however, the same is mediated through management infrastructure sophistication. Moreover, stakeholder participation and performance link is also mediated through process management efficacy.

Lau (2000) to test the synergic impact of TQM and JIT, conducted a survey based study in US computer and electronics industry. 379 firms participated in this study. These firms were divided into four groups as following:

(a) TQM / JIT (N=116, 30.6%) – Group 1
(b) TQM only (N=68, 17.9%) – Group 2
(c) JIT only (N=51, 13.4%) – Group 3
(d) None (N=144, 37.9%) – Group 4

Author tested the degree of enactment of workforce-related practices (employees' involvement, communication and relationship) and performance (quality, time-based, business) in firms. ANOVA (t-test) methodology was used to test the suggested hypothesis. Mixed results were observed. Group-1 outperformed group-4 in compliance of workforce practices as well as on all performance measures. Group-1 outperforms group 2 only in employee's involvement. There were no differences observed between group-1 and group-2 on all performance measures. Group-1 outperformed group-3 on time-based performance, whereas, gain on quality and business performance was marginal.

Technically and socially oriented practices exhibit high performance if jointly implemented than in isolation. TQM, JIT and TPM have inherited capability of continuous process improvement and waste elimination (Nakajima, 1988; Ohno, 1988; Powell, 1995), however, much has not been explored on their mutual relationship. Cua et al. (2001) developed and tested a socio-technical integrated framework as shown in Figure 2.13.

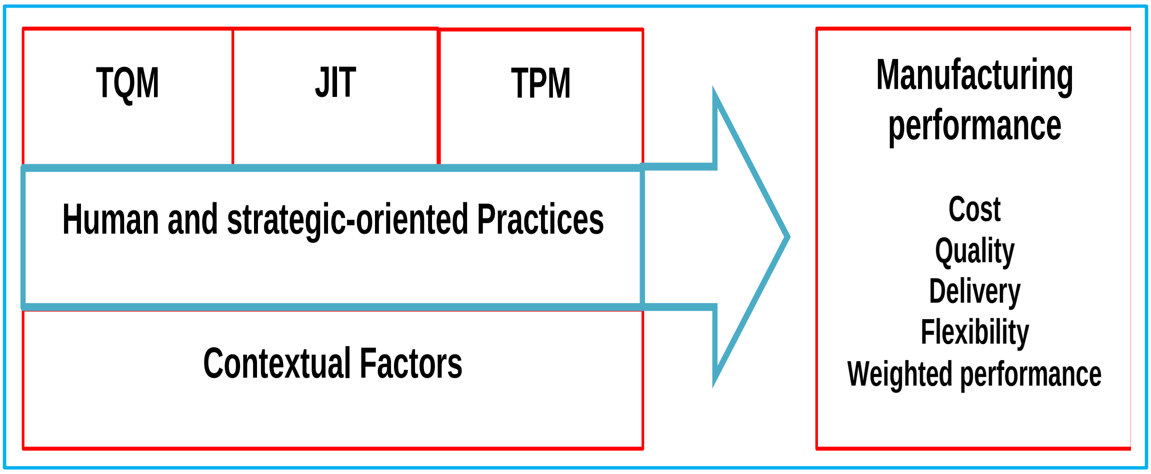


Figure 2.13. Socio-Technical Integrated-Framework

Source: (Cua et al., 2001, p. 679)

The data was acquired as a part of WCM program (Flynn et al., 1994) to empirically validate the model. A sample of 163 plants was randomly selected from WCM database. Plants were from five (5) countries (USA, Uk, Germany, Japan and Italy) and three industrial sectors (electronics, transportation parts and machinery). 26 respondents (14 managers and 12 workers) from each plant participated in this study as a reliability enhancing measure (McKone et al., 1999). Discriminant analysis was used to check the significance between low and high performers. Fitness of model was conducted in three steps.

In First step, TQM, JIT and TQM super-scales and contextual factors variation was verified. At Second step TQM, JIT and TQM sub-scales alone impact was tested. Committed leadership and technology focus positively loaded on all discriminant functions fulfilling cut-off criteria of factor loading ≥ 0.4. At third step TQM, JIT and TQM sub-scales and contextual factors fit was tested. Common Infrastructure Practices at super scale level explain significant variation in all performance measures, however, few exceptions were also observed at sub-scale level against flexibility and weighted performance. Plant size and capacity utilization did not explain much variation towards high performance, however, process type did make much contribution to weighted performance and volume flexibility against cut-off criteria of factor loading ≥ 0.4, If this criteria is further relaxed to ≥ 0.3, it also explains variation in delivery and conformance to quality.

Organizational context have been a missing consideration in the OM research resulting in indecisive results of TQM and JIT on performance. Shah and Ward (2003) through their exploratory study converted a number of assorted practices into four distinct, yet strongly interrelated, Lean bundles (TQM, JIT, TPM and HRM). TQM and TPM are two major operational practices, whereas TPM and HRM can be regarded as auxiliary set of practices. Interestingly AM loaded on JIT factor. A large sample of 1748 manufacturing plants from 20 numerous sectors (SIC 20-39), to enhance study generalizability, was taken to check the contextual effects of unionization, plant age and plant size. Industry data was drawn from "Industry Week's Census of Manufacturers". Industry and contextual variables explained a meagre variation in operational performance. However, a significant contribution (23%) was observed, once Lean bundles were entered in the model resulted in synergistic effects (Cua et al., 2001; McKone et al., 2001). Plant age and plant size have negative bearing on operational performance, whereas, unionization did not have much effect on operational performance. Similarly, Jayaram, Ahire, and Dreyfus (2010) also conducted a study on similar lines to identify the contextual impact of different contextual factors like TQM duration, plant size, unionization and industry types. Contextual variables strongly moderate the relationship between infrastructure (culture), quality design (core practices) and their relationship to performance outcomes. The strongest moderating total effects were observed by industry type (discrete/process) followed by plant size and TQM duration, however, unionization partial moderating total effects were also observed.

Kaynak (2003), using a sample of 214 manufacturing firms from 48 states of USA, also shed light on relationship between TQM & JIT Core Practices along with management leadership and infrastructure practices like training and employees' relations. She concluded that Core Quality Management Practices (product design, process management and quality data and reporting) significantly directly/indirectly contribute to inventory management quality, quality performance and market/financial performance through top management support, effective implementation of infrastructure practices like training and employees' relations and supplier quality management (Core JIT). One missing link was customer relationship factor, which was not included in the model.

Ahmad et al. (2003), endeavoured to explore an in-depth contribution of infrastructure practices between Core JIT Practices and plant competitiveness. Using a sample of 110 manufacturing plants from USA, Italy and Japan, they tested the model with contingency and configurational perspective. In contingency perspective, all infrastructure practices, less manufacturing strategy, individually positively moderate the relationship between Core JIT practices and plant competitiveness. However, in configurational perspective significant synergy effects between infrastructure practices (including or excluding manufacturing strategy) and Core JIT Practices were found.

Organizations attempt to achieve competitiveness without realizing their own competitive capabilities and weaknesses (Skinner, 1969). When they fail to align relationship between their strategy and operational decisions, they end up in inefficient and non-cost effective production structure. Skinner described it as "Millstone effect" (Skinner, 1969, p. 136). JIT, TQM and SCM are managerial tools to make organization more effective and efficient simultaneously. Kannan and Tan (2005) in their study unveiled the strategic link between SCM, TQM and JIT. 556 respondents who were members of either "Institute of Supply Chain Management (ISM)" or "American Production and Inventory Control Society (APICS)". Respondents were either material or operations' managers from Europe and North America.

Underlying common factors were extracted using principal component method with varimax rotation. Correlation analysis was conducted to check association between factors and performance measures. Mixed results were found. Most significant performance relation was found with product quality, customer service and competitiveness. A triad pairing technique was used to test the relation among JIT, SCM and TQM factors. 7 (seven) out of 36 triads were found significant. Close association was found between supply management, material flow (JIT), product quality (TQM) and supply chain development and integration (SCM). It shows that to produce high quality products timely availability of material, through well-integrated supply chain, is crucial to success. Moreover, strategically and operationally, reliance on suppliers and customers in an outsourcing intensive environment will increase manifold when organizations will be focusing on core competencies and outsourcing non-core business. Their assimilation is not delimited only to organization's suppliers or customers rather protracted to the entire supply chain e.g. supplier's suppliers and customer's customers. It can be safely said that Lean (TQM and JIT) is an "Overarching" strategy and is well-suited to any operational system (Katayama & Bennett, 1999, p. 46).

Lakhal, Pasin, and Limam (2006) categorised the quality practices into three groups, (1) management, (2) infrastructure, (3) core practices. A sample of 133 plastic transforming Tunisian companies participated in the study. Using SEM, authors found that management practices support effective functioning of infrastructure practices, which in turn influence product quality, through core practices. Moreover, also directly influence operational/financial performance independently without core practices supporting earlier study (Samson & Terziovski, 1999). They found that organizations, not implementing TQM, can also perform well, provided, management and infrastructure practices are followed consistently (Ahire & Golhar, 1996d). Surprisingly, "supplier quality management, continuous improvement, and SPC" were eliminated from the TQM group (Lakhal et al., 2006, p. 632), contrary to TQM already established constructs (Ahire, Golhar, & Waller, 1996a; Flynn et al., 1994; Saraph, Benson, & Schroeder, 1989). Similarly, Kapuge and Smith (2007) through a survey, from Sri-Lanka Apparel Sector, between TQM (32 firms) and Non-TQM (35 firms) found that TQM companies out-perform their opponents group (Non-TQM) on all TQM aspect less employees involvement. This weak link was ascribed to management attitude toward employees. Moreover, low quality products were attributed to out-dated technology.

Zu, Fredendall, and Douglas (2008) endeavoured to check the boundaries overlapping between traditional quality management practices and six sigma. Data was collected from 266 US manufacturing plants. TQM and six sigma traditional infrastructure and core practices were identified through the literature review as following:

(a) **COMMON TOP MANAGEMENT PRACTICES**

(b) **TQM INFRASTRUCTURE**

  (1) Customer relationship

  (2) Supplier relationship

  (3) Workforce management

(c) **SIX-SIGMA INFRASTRUCTURE**

  (1) Six-sigma role structure

(d) **TQM CORE**

(1) Quality data and reporting

(2) Process management

(3) Product design

(e) **SIX-SIGMA CORE**

(1) Six sigma structured procedure

(2) Six sigma focus on metrics

Using path analysis, they found that traditional quality management practices are explicitly distinct from management practice. However, six sigma infrastructure and core practices provide leverage to quality management infrastructure and core practices to acquire better competitive advantage and business performance.

Lean bundles generate synergy effects, at the same time it is possible that these bundles may suppress each other's effects. Cua et al. (2001, p. 689) advocate that "there exist different configurations of practices that are best suited for improving specific performance dimensions". Dal Pont et al. (2008) made an endeavour to disentangle these effects. They conducted a study as a part of "High Performance Manufacturing Round III". Sample comprised from nine countries and three manufacturing segments. Lean bundles (TQM, JIT & HRM comprising of 20 items) were measured using 1-7 point Likert scale, whereas performance measures were measured on 1-5 point Likert scale. It is worth noting that preventive maintenance (housekeeping, proprietary equipment development) (McKone et al., 1999) was include in TQM construct. Using structural equation model (SEM) they found that HRM does not directly influence performance, however, the relationship was mediated through JIT and TQM. It can be argued with caution that HRM is a common capacity building measure for JIT and TQM. Once HRM positively contributes in JIT and TQM, it directly actuates their contribution in performance. TQM and JIT work like pillars as suggested by Liker (2003) and complement to each other. Although plant size and age effects are incorporated in the model, though environmental context (technology, competitive hostility, innovation orientation etc) is purely missing.

Similarly, Furlan et al. (2011b) also tested the complementary effects between JIT and TQM using the technique originated by Edgeworth (1881) and developed by Milgrom and Roberts (1995) in the field of OM. This technique explains that when one improvement program (e.g. TQM) intensity increases it automatically increase the marginal gain of parallel improvement initiative (e.g. JIT). 266 plants, participated in this study, were also from "High

Performance Manufacturing Round III", from nine countries and three industries similar to Dal Pont et al. (2008). Same scale developed by Dal Pont et al. (2008) was used. Sample was divided into four distinctive groups, based on performance as following. ANOVA (pairwise t-test) was used to test the performance significance among high and low groups.

(a) High JIT High TQM (N=68, 29%) – Group 1

(b) High TQM Low JIT (N=47, 20%) – Group 2

(c) High JIT low TQM (N=47, 20%) – Group 3

(d) Low JIT Low TQM (N=75, 31%) – Group 4

Group 4 (Low JIT Low TQM) has the highest frequency followed by first, second and third group. Group 1 was significantly different from other three groups. Group 2, group 3 and group 4 were invariant to each other, but significantly different from group 1. Using regression complementarity effects were found between TQM and JIT. HRM moderating effects were also checked. Similarly, sample was divided into two groups based on high HRM and low HRM implementation. Significant difference between these two groups was observed using t-test. Using regression again, complementarity effect were found between TQM and JIT in High HRM group, however, Low HRM failed to demonstrate complementarity effects. It confirmed the notion that HRM is common to JIT and TQM implementation and HRM system should be in place to achieve full returns. It can be affirmed that organization not capitalizing in HRM will be out of competition in the long-run. It also supports the notion that learning organizations exploit HRM, a source of organizational capabilities, to become more competitive in new business opportunities (Ulrich & Lake, 1990). Moreover, plant size and age effects were insignificant in all the models. Authors also propose that, "A firm trying to exploit the synergistic effects among several Lean initiatives has to develop them hand in hand"(Furlan et al., 2011b, p. 845). Similar to Dal Pont et al. (2008), this study proposed, though not explored, the complementarity effects under organizational external context (technology, competitive hostility, innovation orientation etc).

Lean, due to its "overarching" capability and inherited strength, to eliminate waste and non-value activities, positively contributes to environmental performance. Yang et al. (2011) in their study explored a significant relation among Lean (JIT, EI & TQM), environment practices and performance, and business performance (financial and market). To test the proposed hypothesis data from "International Manufacturing Strategy Survey (IMSS-

IV) 2005" was used. Sample comprised 309 manufacturing firms from Europe (developed/non-developed countries) and Non-Europe (developed/non-developed countries) was as following:

(a) **Europe**

(1) Developed countries (N= 121, 39%)

(2) Developing countries (N=39, 12.6%)

(b) **Non-Europe**

(1) Developed countries (N=45, 14.5%)

(2) Developing countries (N=104, 33.6%)

Developed and non-developing countries aggregate proportion in the sample is as, (N=166, 53.7%) and (N=143, 46.3%) respectively. SEM was used to test the underlying hypothesis relation. It was found that Lean (JIT, EI, TQM) positively influences environmental management practices (EMP), market performance and financial performance. Environmental Performance (EP) is positively linked with EMP. However, Lean direct effect on EP was insignificant, rather it was fully mediated through EMP. Moreover, EMP has negative relation with market and financial performance, which is positively mediated through path between EP, market performance and financial performance.

Moreover, post-hoc analysis was undertaken to check the contextual difference of firm size, regional and GDP per capita. GDP per capita found significant difference on all the paths, firm size found partial difference on some paths and no regional difference were observed. Research study successfully established that Lean (JIT, TQM, EI) is antecedent to EMP. It can be concluded that Lean due to its process focus, continuous improvement, waste elimination and strong human involvement, is compatible with any system like SCM (Kannan & Tan, 2005), flexible manufacturing system (Katayama & Bennett, 1999; Sarkis, 2001) and agile manufacturing (Inman et al., 2011).

D. Y. Kim, Kumar, and Kumar (2012) made an effort to explore the QM practices contribution to organizational learning process. They found that process management positively relates to all types of radical/incremental product/process innovations including an administrative innovation. However, quality data and reporting does not directly improve any sort of organizational learning, but indirectly contribute through effective process management and process design management. Moreover, it was found that no single QM practice can contribute to organizational learning process it is a chain effect of all QM practices once applied in a proper sequence to improve organizational learning.

Apart from success stories, mentioned above, few failures have also been reported. Sakakibara et al. (1997) through a survey of 42 plants (US/Japanese) found that JIT did not explain variation in the manufacturing performance. However, once applied in combination with infrastructure practices, like quality management, organization strategy, workforce management, product design and organizational characteristics, significant results were observed. Moreover, quality practices alone without JIT practices did produce results. Similarly, Nakamura et al. (1998) also through a survey of 40 plants (US/Japanese) from electronics, machinery and auto-parts found mixed results. Regression analysis was used to test the hypothesis. Sample firms were split into two groups full JIT (100% JIT implementation) and limited JIT (partial implementation). Both groups (Full and limited JIT) without quality management practices have significant influence only on "%" down time, lead-time and cycle time performance. However once quality management practices are assimilated with JIT significant variation in customer satisfaction and "%" pass final inspection was also observed. Significant industry effects were found but interestingly author failed to provide any justification for it.

Samson and Terziovski (1999) in a study found mixed results of quality management practices impact on organizational performance. Through a survey, of 1024 manufacturing firms, from Australia and New Zealand, tested the universalistic contribution of quality management practices in organizational performance. Surprisingly, only soft elements (leadership, workforce management, and customer focus) proved to be significantly associated with quality performance whereas, hard factors like planning, process management and information system were unable to explain significant variation in performance. Results are in line with Womack and Jones (1996) that human elements are core to Lean implementation. Similarly, Dow et al. (1999) also conducted a survey based study. 698, manufacturing firms participated in the study. Out of nine quality management practices only soft elements of quality management practices (''workforce commitment, shared vision, and customer focus'') positively links with quality results. Whereas, remaining six hard quality practices ("benchmarking, personnel training, AMT, JIT, cellular work teams, and close supplier relations'') relation with quality outcomes was found insignificant. Powel findings are also in line with (Dow et al., 1999; Samson & Terziovski, 1999). The authors found that only those organizations remain competitive who adequately focus more imitable, social and tacit practices such as "open culture, employee empowerment, and executive commitment" irrespective of that they have adopted TQM or not.

Jayaram et al. (2008) also found a negative relationship between Lean manufacturing (design) and business performance. The author proposed a path relation between strategic relationship building (customer/supplier) with organizational performance through Lean design ("standardisation, design for manufacturability (DFMA), value analysis") and Lean manufacturing ("JIT, cellular manufacturing, concurrent engineering, set-up time reduction"). 57 first tier auto-suppliers participated in the study. All the relations were found positively significant, except, Lean design relation to business performance was not only insignificant, rather it was negative as well. Jayaram et al. (2008, p. 5646) offered the justification, that Lean assures manufacturing performance only (Shah & Ward, 2003; Womack et al., 1990), and for business performance, it has to be integrated with some other systems like AM (Zelbst et al., 2010).

From discussion made in Section 2.5, Lean (TQM & JIT) and performance literature review revealed that researchers are inconclusive on Lean (TQM & JIT) and performance relation. A mix of positive, negative and insignificant results is reported in the literature. Therefore, it can be argued with caution, that only some improvement initiative implementation is not enough to produce results. Research boundaries need expansion up to organizational culture (Rungtusanatham et al., 1998), context, strategy, strategic relationship building with supplier's suppliers and customer's customers (Curkovic, Vickery, & Dröge, 2000), technological innovation (Z. Zhang & Sharifi, 2007) and business environment (Douglas & Judge Jr, 2001). These programs are not solution to all the problems, managers need to understand these programs limitations and should align their organizational structure, culture and competitive strategy with continually changing business environment (Hayes & Pisano, 1994; Skinner, 1969, 1974).

Management, infrastructure practices, and Core TQM and JIT practices identified from discussions made in Sections 2.2 to 2.4 are as following:

(a) Top management commitment
(b) Empowered teams
(c) Cross training
(d) Strategic vision & planning
(e) Plant environment

(f) Information system
(g) Relationship with suppliers
(h) Relationship with customers
(i) Process management
(j) Product design
(k) Continuous improvement
(l) JIT scheduling
(m) Lot size reduction
(n) Set-up time reduction
(o) Pull production system

The literature summary of major empirical studies on TQM & JIT relationship with organizational performance is presented in Table 2.5.

PHASE - II

2.5 AGILE MANUFACTURING (AM) PARADIGM

Agile Manufacturing (AM) roots can be traced back to 1991. In 1991, a meeting sponsored by “Department of Defence and National Science Foundation” held to know the market limitations to meet the demands (Iacocca Institute, 1991). Primarily, the sole reason established, was the management inability to respond to impulsive and erratic market changes (Nagel & Dove, 1991). To further dig out this issue funding was required which was refused by US-Senate, as already few initiatives (Lean) were in the pipeline. However, “Advance Research Project Agency (**APRA**) known for its high-risk high-payoff projects” took initiative and established “Agility Forum at Lehigh University's Iacocca Institute” (Goranson, 1999). The scope of the project was to study the dynamic forces of new market, continuously changing customer preferences, technology invasion, shortened product life cycle, enhanced customer-market awareness and, most importantly, how to counter the Japanese competitors vis-à-vis the available manufacturing capabilities (Mass Production, Lean, FMS, etc.). Executives from thirteen major industrial players from USA participated in this project. Moreover, a series of workshops was also organised to evaluate the different contexts where the traditional businesses were unable to keep up the pace with continuously shifting business requirements (Hormozi, 2001), in order to thoroughly evaluate the different available paradigms.

Table 2.5. Lean (TQM / JIT) and Organizational Performance – Summary of Major Empirical Studies

Studies	Sample	Industry	Contextual Variables	Core TQM Practices	Core JIT Practices	Common Infrastructure Practices	Performance Outcomes	Method	Findings
Flynn et al. (1995a)	706 respondents from 42 plants 1. US-owned 2. US-owned WCM 3. Japanese-owned	1. Electronics 2. Machinery 3. Transportation	-	1. Customer focus 2. Product design 3. SPC	1. Kanban 2. JIT scheduling 3. Lot size reduction 4. Setup time reduction	1. Management support 2. Plant environment 3. Workforce management 4. Supplier relationship 5. Information feedback	1. Customer satisfaction 2. Product quality 3. Cycle time	Regression	TQM and JIT produced synergy effects. Common infrastructure practices significantly influence performance. JIT does not require Kanban.
Flynn et al. (1995b)	706 respondents from 42 plants 1. US-owned 2. US-owned WCM 3. Japanese-owned	1. Electronics 2. Machinery 3. Transportation	-	1. Customer focus 2. Product design 3. SPC	-	1. Management support 2. Customer relationship 3. Workforce management 4. Supplier relationship 5. Work attitudes	1. Perceived quality market outcomes 2. Percent passed final inspection with no rework 3. Competitive advantage	Path analysis	Top management support proved to be critical for infrastructure and core quality practices, which confirm its organization-wide application leading to better performance outcomes.
Dean and Snell (1996)[a]	92 Firms (160 General Managers)	1. Primary metals 2. Fabricated metal products 3. Industrial and metal-working machinery 4. Transportation equipment 5. Precision instruments	1. Competitive intensity 2. Organizational strategy • Quality • Low cost • On time delivery • Flexibility • Customer satisfaction • Economies of scale	1. Management devotion to quality improvement 2. Supplier quality improvement 3. Cost of quality measurement 4. Quality product focus 5. SPC 6. Employee's involvement 7. Information feedback 8. Quality function deployment (QFD) 9. Taguchi methods 10. Continuous process improvements	1. Number of suppliers 2. Supplier's deliveries size 3. Product runs length 4. Number of total parts 5. Buffer stock level	1. Manufacturing resource planning (MRP II) 2. Computer-Aided Design (CAD) 3. Numerical Control (NC) 4. Computer Numerical control (CNC) 5. Direct Numerical Control (DNC) 6. Flexible Manufacturing Systems (FMS) 7. Robotics 8. Automated materials handling 9. Computer-aided test/inspection 10. Computer-aided process planning	1. Product quality 2. Employee morale 3. On-time delivery 4. Inventory management 5. Employees' productivity 6. Equipment utilization 7. Production lead-time 8. Scrap minimization	Regression	TQM significantly affects performance. AMT does not make difference if competitive intensity is high. JIT did not contribute in performance

Continued (Table 2.5)

Studies	Sample	Industry	Contextual Variables	Core TQM Practices	Core JIT Practices	Common Infrastructure Practices	Performance Outcomes	Method	Findings
Sriparavastu and Gupta (1997)[a]	153 Plants	SIC 20-39	ISO-9000 Certification	Four Groups 1. TQM pilot 2. TQM abandoned 3. TQM fully implemented 4. Did not implement		-	1. Production related 2. Employee related 3. Management related 4. Supplier related 5. Cost related 6. Quality related	ANOVA Pair-Wise t-test	JIT and TQM have positive contribution in all the 6 performance measurement groups. TQM and JIT have better quality and productivity gains than TQM and JIT alone respectively.
Sakakibara et al. (1997)	42 plants 822 Respondents 1. US-owned general 2. US-owned WCM 3. Japanese-owned	1. Electronics 2. Machinery 3. Transportation	-	Quality Management Practices	1. Setup time reduction 2. Kanban 3. Schedule flexibility 4. Maintenance 5. Plant layout 6. JIT supplier relation	1. Organizational characteristics 2. Workforce management 3. Product design 4. Manufacturing strategy	**Manufacturing Performance** • Cycle time reduction • Inventory turnover • Lead time • On time delivery **Competitive Advantage** • Cost • Quality • Flexibility • Delivery • Overall advantage	Canonical correlation	JIT did not affect performance. However, once applied in combination with infrastructure practices like quality management, organization strategy, workforce management, product design and organizational characteristics significant results were observed. Moreover, quality practices without JIT practices did produce results.
Nakamura et al. (1998)[a]	40 plants 1. US-owned general 2. US-owned WCM 3. Japanese-owned	1. Electronics 2. Machinery 3. Auto Parts	-	1. Quality Practices	1. Setup time reduction 2. Kanban 3. Schedule flexibility 4. Maintenance 5. Plant layout 6. JIT supplier relation	1. Workers training 2. Machine breakdown charts 3. Team approach	1. % downtime 2. % pass final inspection 3. % orders shipped 4. Cycle time 5. Lead time 6. Inventory turnover	Regression	Firms were split into two groups full JIT (100% JIT implementation) and limited JIT (partial implementation). Both groups (Full and limited JIT) without quality management practices have significant influence only on % down time, lead-time and cycle time performance. However once quality management practices are assimilated with JIT significant variation in customer satisfaction and % pass final inspection was also observed. Significant industry effects were found but interestingly author failed to provide any justification for it.

Continued (Table 2.5)

Studies	Sample	Industry	Contextual Variables	Core TQM Practices	Core JIT Practices	Common Infrastructure Practices	Performance Outcomes	Method	Findings
Mckone et al. (1999)	97 Plants 1. Japan 2. Italy 3. Usa 23 Respondents From Each Plant 11 Managers 12 Workers	1. Electronics 2. Machinery 3. Automobiles	1. Environmental • Country • Industry 2. Organizational • Equipment age • Equipment type • Company size • Plant age • Unionization 3. Managerial • EI • TQM • JIT	1. Customer involvement 2. Rewards for quality 3. Supplier quality management 4. Top management leadership for quality	1. JIT deliveries by suppliers 2. JIT link with customers 3. Pull system production 4. Repetitive nature of master schedule 5. Setup reduction	1. Centralization for authority	1. Housekeeping 2. Cross training 3. Teams 4. Operators 5. Disciplined planning 6. Information tracking 7. Schedule compliance	Regression	TQM and TPM complement each other due to close interaction of process control, skill development and teamwork with autonomous/planned maintenance. JIT is associated with planning and information tracking. EI contribute in teams and cross training. Organizational context fail to explain variation in TPM implementation.
Samson and Terziovski (1999)[a]	1024 Manufacturing firms 1. Australia 2. New Zealand	-	-	1. Leadership 2. Customer focus 3. People management 4. Strategic planning	-	1. Process management 2. Information and analysis	1. Customer satisfaction 2. Employees moral 3. Productivity 4. Defects 5. Warranty claims 6. Cost of quality 7. On time delivery	Regression	Mixed results are observed. Soft factors like; leadership, workforce management and customer focus were found significant contributor of performance, whereas, planning, information system and process management were unable to explain variation in performance.
Dow et al. (1999)[a]	698 Manufacturing Plants (Plant Managers)	-	-	1. Personnel training 2. Benchmarking 3. Advanced manufacturing systems 4. Use of ‘‘Just in Time’’ Principles	-	1. Shared vision 2. Customer focus 3. Co-operative supplier relations 4. Use of teams 5. Workforce commitment	1. Defects percentage 2. Warranty claims COST 3. Quality total cost 4. Defect rate with reference to competitors	Structural equation modelling	‘‘Workforce commitment, shared vision, and ‘‘customer focus’’, positively associates with quality outcomes. Whereas, other ‘‘hard’’ quality practices, such as ‘‘Personnel training, Benchmarking, Cellular Work Teams, AMT, JIT, and close supplier relations’’, were found insignificant.

Continued (Table 2.5)

Studies	Sample	Industry	Contextual Variables	Core TQM Practices	Core JIT Practices	Common Infrastructure Practices	Performance Outcomes	Method	Findings
Ravichandran & Rai (2000)	123 Information System business unit's executives from USA	• Manufacturing • Insurance • Utilities • Transportation • Bank • Financial services • Government • Div. Services • Retail	-	1. **Process Management Efficacy** • Formalization of analysis and design • formalization of reusability in systems development • Process control • Fact based management 2. **Stakeholder Participation** • Employees empowerment • Vendor participation • User participation	-	1. Management support for quality 2. **Management Infrastructure Sophistication** • Quality policy and goals • Commitment to skill development • Quality orientation of reward schemes	Product quality Process efficiency	Structural equation modelling using partial least square method	Top management leadership positively influence management infrastructure sophistication, which drive process efficacy and ultimately leading to better performance. Top management does not directly influence with stakeholders' participation and process management, however, the same is mediated through management infrastructure sophistication. Moreover, stakeholders' participation and performance link is also mediated through process management efficacy.
Lau (2000)	382 firms	1. Computers 2. Electronics	**1. Four groups** • JIT implement-ation only • TQM implement-ation only • TQM & JIT implement-ation jointly • TQM & JIT no implement-ation	1. **Workforce practices** • Involvement • Relationship • Communication		-	1. Quality performance 2. Time based performance 3. Business performance	ANOVA (pairwise t-test)	TQM/JIT firms outperform non-TQM/JIT in compliance of workforce practices as well as on all performance measures. TQM/JIT firms outperform TQM firms only in employee's involvement. No differences were observed between TQM/JIT firms and TQM firms on all performance measures. TQM/JIT firms outperform JIT firms on time-based performance, whereas, gain on quality and business performance was marginal.
Cua et al. (2001)	163 Plants USA UK Japan Italy Germany 26 - Respondents 14 managers 12 workers	1. Electronics 2. Machinery 3. Transportation parts	1. Process orientation 2. Capacity utilization 3. Number of employees	1. Process management 2. Cross functional product design 3. Supplier quality management 4. Customer involvement	1. Set-up time reduction 2. Pull system production 3. JIT deliveries by suppliers 4. Equipment layout 5. Schedule adherence	1. Committed leadership 2. Strategic planning 3. Cross-functional training 4. Employee involvement 5. Information and feedback	1. Conformance quality 2. Cost efficiency 3. On-time delivery 4. Volume flexibility 5. Weighted manufacturing performance	Discriminant analysis	There is a great deal of association between technically oriented programs (JIT, TQM,TPM) and socially oriented practices(management support, employees training and involvement, strategic planning and information system) when implemented in assimilation. Common practices have significant association with all performance measures. Only process type explains variation to most of the performance variables.

Continued (Table 2.5)

Studies	Sample	Industry	Contextual Variables	Core TQM Practices	Core JIT Practices	Common Infrastructure Practices	Performance Outcomes	Method	Findings
Shah and Ward (2003)	1748 plants US Manufacturing Plants	(SIC 20–39)	1. Plant Size 2. Plant Age 3. Unionization	1. Competitive benchmarking 2. Quality management programs 3. Total quality management 4. Process capability measurements 5. Formal continuous improvement program	1. Lot size reductions 2. JIT/continuous flow production 3. Pull system 4. Cellular manufacturing 5. Cycle time reductions 6. Focused factory production systems 7. Agile manufacturing strategies 8. Quick changeover techniques 9. Bottleneck/constraint removal 10. Reengineered production processes	1. Predictive or preventive maintenance 2. Maintenance optimization 3. Safety improvement programs 4. Planning and scheduling strategies 5. New process equipment or technologies 6. Self-directed work teams 7. Flexible, cross-functional workforce	1. Finished-product first-pass quality yield 2. Scrap and rework costs 3. Productivity, defined as dollar volume of shipments per employee 4. Per unit manufacturing costs, excluding purchased material 5. Manufacturing cycle time 6. Customer lead-time	Regression / ANOVA	Industry and contextual variables explained a meagre variation in operational performance. However, Lean bundles made a significant contribution (23%), once entered in the model generating synergistic effects, but individual contribution by each bundle was not tested. Plant age and plant size have negative bearing on operational performance, whereas, unionization did not have much effect on operational performance.
Kaynak (2003)[a]	214 manufacturing business units from 48 US states		-	1. Product /service design 2. Process management 3. Quality data and reporting	1. Supplier quality management	**1. Management leadership** **2. Infrastructure** • Training • Employees relation	1. Inventory management 2. Quality performance 3. Market / financial performance	Structural equation modelling	Core Quality Management Practices (Product Design, Process Management and Quality Data and Reporting) significantly directly/indirectly contribute to inventory management quality, quality performance and market/financial performance through top management support, effective implementation of infrastructure practices like training and employees' relations and supplier quality management (Core JIT). One missing link was customer relations, which was not included in the model.
Ahmad et al. (2003)	110 plants USA Japan Italy	1. Electronics 2. Machinery 3. Transportation	1. Plant Size 2. Plant Utilization 3. Product Customisation	-	1. Daily schedule adherence 2. Equipment layout 3. JIT delivery by suppliers 4. JIT link with customers 5. The "Kanban" system 6. Setup time reduction	1. Quality management 2. Manufacturing strategy 3. Product technology 4. Work integration system 5. HRM policies	1. Cost 2. Quality conformance 3. On time delivery 4. Flexibility product mix	Regression / Euclidean distance	In contingency perspective, all infrastructure practices less manufacturing strategy, individually positively moderate the relationship between Core JIT practices and plant competitiveness. However, in configurational perspective significant synergy effects between infrastructure practices (including or excluding manufacturing strategy) and Core JIT practices were found.

Continued (Table 2.5)

Studies	Sample	Industry	Contextual Variables	Core TQM Practices	Core JIT Practices	Common Infrastructure Practices	Performance Outcomes	Method	Findings
Kannan and Tan (2005)[a]	556 Senior Operational And Material Managers	-	-	1. Product design 2. Strategic commitment to quality 3. Supplier capability	1. Material flow 2. Commitment to JIT 3. Supply management	1. Supply chain integration 2. Supply chain coordination 3. Supply chain development 4. Information sharing	5. Market share 6. Return on asset 7. Product quality 8. Competitiveness 9. Customer service	Correlation	JIT, SCM and TQM are internally well connected and can be utilized as a collaboration tactic to achieve strategic objectives. Moreover, strategically and operationally, dependency on suppliers and customers in an outsourcing intensive environment will increase manifold when organizations will be converging on core competencies and subcontracting non-core business
Lakhal et al. (2006)	133 Tunisian Firms	Plastic Transforming Industry		1. Quality system improvement 2. Information and analysis 3. Statistical quality techniques	-	1. Top management support 2. Organization for quality 3. Employee training 4. Employees' participation 5. Supplier quality management 6. Customer focus 7. Continuous support	1. Operational performance 2. Product quality 3. Financial performance	Path analysis	Management practices support effective functioning of infrastructure practices, which in turn influence product quality, through core practices. Moreover, also directly influence operational/financial performance independently without core practices. Surprisingly, "supplier quality management, continuous improvement, and SPC" were eliminated from the TQM group
Zu et al. (2008)[a]	226 US Manufacturing Plants	• Transportation equipment • Electrical equipment • Appliance, and component • Fabricated metal product • Miscellaneous manufacturing • Chemical manufacturing • Machinery manufacturing • Plastics and rubber products • Primary metal manufacturing • Other industries	-	1. **TQM core** • Quality data and reporting • Process management • Product design 2. **Six sigma core** • Six sigma structured procedure • Six sigma focus on metrics	-	1. **Top management support** 2. **TQM infrastructure** • Supplier relationship • Customer relationship • Workforce management 3. **Six sigma infrastructure** • Six sigma role structure	1. **Quality performance** • Quality • Delivery • Process variability • Scrap and rework cost • Cycle time • Equipment down time • Customer satisfaction 2. **Business performance** • Market share growth • Operating income • Sales growth • ROI	Structural equation modelling	TQM practices are explicitly distinct from six sigma practices; however, six sigma practices provide leverage to TQM implementation in order to improve performance.

Continued (Table 2.5)

Studies	Sample	Industry	Contextual Variables	Core TQM Practices	Core JIT Practices	Common Infrastructure Practices	Performance Outcomes	Method	Findings
Dal Pont et al. (2008)[a]	266 manufacturing plants Finland Austria United States Germany Italy Spain South Korea Sweden Japan	1. Electronics 2. Machinery 3. Transportation parts	1. Plant size 2. Plant age	1. Proprietary equipment 2. Statistical quality control 3. housekeeping 4. Small group sessions 5. Processes are “fool proof”	1. Schedule adherence 2. Plant layout 3. Frequently deliver by suppliers 4. JIT deliveries to customers 5. Kanban 6. Low setup times 7. Small lot sizes	1. Team work 2. Management support 3. Flat organization 4. Cross training 5. Engineers availability on shop floor 6. Small group sessions 7. Employees capacity building 8. Process and product improvement	1. Unit cost of manufacturing 2. Conformance to product specifications 3. On time delivery 4. Fast delivery 5. Flexibility to change product mix 6. Flexibility to change volume	Structural equation modelling	HRM effect on performance is mediated through JIT and TQM where as JIT and TQM directly influence performance.
Jayaram et al. (2010)	394 plants	• Industrial, commercial machinery • Computers • Electronic, electrical equipment • Fabricated metal products • Instruments • Rubber and plastics • Transportation equipment • Chemicals • Food and kindred • Paper and allied products • Primary metals • Others	1. TQM duration 2. Firm size 3. Unionization 4. Industry type	1. Design management 2. Quality information usage 3. Process quality management	-	1. Top management support 2. Trust 3. Training 4. Empowerment 5. Supplier relationship 6. Customer focus	1. Design performance 2. Process quality 3. Product quality 4. Customer satisfaction	Structural equation modelling (Total effects only)	Contextual variables strongly moderate the relationship between infrastructure (culture), quality design and their relationship with performance outcomes. The strongest moderating effects were observed by industry type followed by size and TQM duration, however, unionization partial moderating effects were also observed.

Continued (Table 2.5)

Studies	Sample	Industry	Contextual Variables	Core TQM Practices	Core JIT Practices	Common Infrastructure Practices	Performance Outcomes	Method	Findings
Furlan et al. (2011)[a]	266 Manufacturing plants Finland Austria United States Germany Italy Spain South Korea Sweden Japan	1. Electronics 2. Machinery 3. Transportation parts	1. Plant size 2. Plant age	1. Proprietary equipment 2. Statistical quality control 3. Housekeeping 4. Small group sessions 5. Processes are "fool proof"	1. Schedule adherence 2. Plant layout 3. Frequently delivery by suppliers 4. JIT deliveries to customers 5. Kanban 6. Low setup times 7. Small lot sizes	1. Team work 2. Management support 3. Flat organization 4. Cross training 5. Engineers availability on shop floor 6. Small group sessions 7. Employees capacity building 8. Process and product improvement	1. Unit cost of manufacturing 2. Conformance to product specifications 3. On time delivery 4. Fast delivery 5. Flexibility to change product mix 6. Flexibility to change volume	Regression ANOVA (pairwise t-test)	TQM and JIT complementary effects were found. HRM was found to complementarity enabler. Contextual effects were not found.
Yang et al. (2011)[a]	309 firms	1. Fabricated metal products 2. Machinery 3. Office machinery 4. Electrical machinery 5. Electronics 6. Medical instruments 7. Watches and clocks 8. Motor vehicles 9. Transport equipment	1. Plant size 2. Plant location 3. Developed/ Undeveloped countries	1. TQM programs 2. 6 sigma projects 3. Quality circles 4. Total productive maintenance	1. Cellular layout 2. Pull production 3. Small lot size 4. Setup time 5. Kanban	1. Empowerment 2. Training 3. Autonomous teams	1. Environmental performance 2. Market performance 3. Business performance	Structural equation modelling	Lean antecedents to environmental Management Practices (EMP). EMP mediated relation between Lean and Environmental Practices (EP). Similarly EP mediated between EMP and financial/market performance. GDP per capita and size have full, and partial, significant effects, whereas, location effects were not observed.
Kim et al. (2012)[a]	223 Manufacturing / Services firms from Canada	1. Primary metal 2. Machinery 3. Transportation 4. Chemical 5. Fabricated metal 6. Computer and electronic product 7. Electrical equipment, appliance, and component 8. Construction 9. Food packaging	ISO Certified Firms	1. Quality data and reporting 2. Process management 3. Product design	-	1. Management leadership 2. Training 3. Employees relations 4. Customer relations 5. Supplier quality management	1. Radical product innovation 2. Incremental product innovation 3. Radical process innovation 4. Incremental process innovation 5. Administrative innovation	Structural equation modelling	Process management positively relates to all types of radical/incremental product/process innovations including and administrative innovation. However, quality data and reporting does not directly improve any sort of organizational learning, but indirectly contribute through effective process management and process design management. Moreover, it was found that no single QM practice alone could contribute to organizational learning process; rather it is a chain effect of all QM practices once applied in a proper sequence to improve organizational learning.

[a] Core and infrastructure practices classification is given by the Researcher as respective research study does not explicitly categorise these practices.

The study ended up as a published report "The 21st Century Manufacturing Enterprise Strategy volume 1 and 2 by Agility Forum, Lehigh University's Iacocca Institute" (Iacocca Institute, 1991). The new manufacturing strategy was baptised as "Agile Manufacturing" (Goldman & Nagel, 1993; Nagel & Dove, 1991). Graphical representation of AM origin is shown in Figure 2.14.

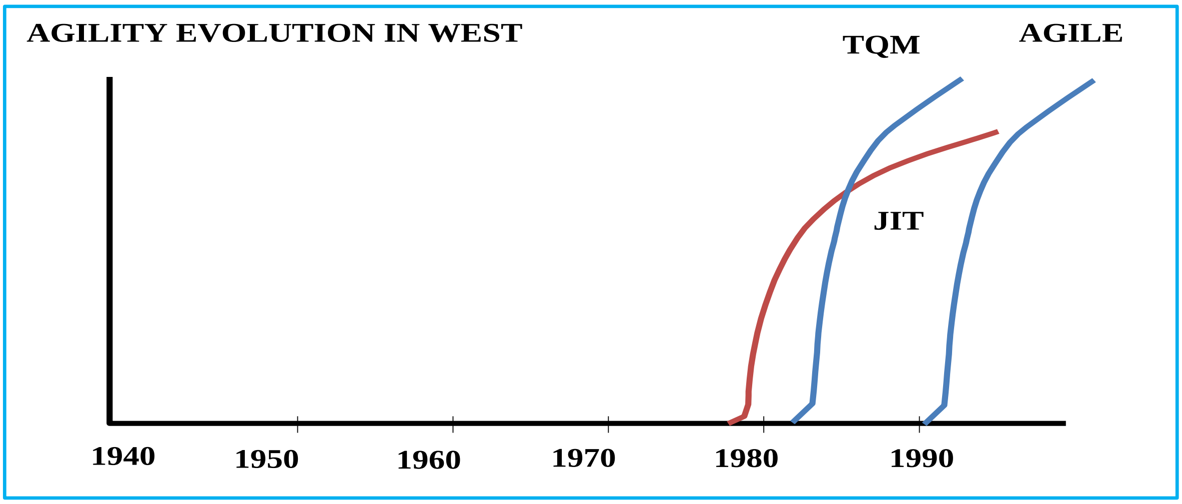


Figure 2.14. Agile Manufacturing Evolution

Source: Adapted from (Iacocca Institute, 1991; Vuppalapati et al., 1995)

Booth (1996), differentiated AM from other manufacturing paradigms as a function of economy (inverse of cost), flexibility (variety) and responsiveness (lead Time) as shown in Table 2.6. He also suggested a path for organizations to acquire agility through focusing on concurrent engineering, cellular manufacturing, information system, process unlimited adaptability to future needs and integration of sub-systems into one system.

Table 2.6. AM as a Function of Economy, Flexibility and Responsiveness

Source: (Booth, 1996, p. 106)

Manufacturing Paradigm	Economy (inverse of cost)	Flexibility	Responsiveness
Craftsman	Low	High	High
Mass production(Early)	High	Low	Low
Mass Production (Late)	Medium	Medium	Medium
Focused Factory	High	Medium	Medium
Lean Production	High	High	Medium
Time Compression	High	Medium	High
Agility	High	High	High

Goldman (1994, pp. 73-75) was the first one, who defined critical dimensions to attain agility. It comprises four inter-related business pillars.

(a) External competitive densities: impulsive change and social tenets (enablers)

(b) Inputs: collaborating to augment competitiveness

(c) Internal processes: regulating the impact of human aspects and information flow

(d) Outputs: customer satisfaction enrichment

AM has been disseminated in the OM literature as evolutionary (Hormozi, 2001), at the same time revolutionary (Jin-Hai et al., 2003) manufacturing paradigm. The core aim of AM is not just to produce required products rather to attain customer satisfaction throughout the product life cycle (Gunasekaran, 1998). There is no affirm agreement among researchers about agility concept. Different authors have defined AM differently in different perspectives. No specific definition is available to define AM (Kusiak & He, 1998). Vokurka and Fliedner (1998, p. 169), argued that, “A measurement device for agility has not been reported in the literature, so it is difficult to quantify a specific level of agility attainment. Nevertheless, agility has been described as a never-ending journey of continuous improvement”. AM being an organization-wide strategy does not focus only on service aspects (Mason-Jones et al., 2000), but at the same time also achieve cost, quality (Lean focused) objectives amicably (Crocitto & Youssef, 2003; Gunasekaran, 1998, 1999a, 1999b; Vokurka & Fliedner, 1998). An agile organization can be defined as, one whose muscles are adept enough to produce at a cost of MP, response like time-compression manufacturing and have flexibility of LP. A brief overview of agility definition offered by different authors (e.g. DeVor, Graves, & Mills, 1997; Goldman, Nagel, & Preiss, 1995; Gunasekaran, 1999a, 1999b; Quinn et al., 1997; Sharifi & Zhang, 2001; Sharp, Irani, & Desai, 1999) are summarised in Table 2.7.

2.6 AGILE MANUFACTURING (AM) THEORETICAL FRAMEWORKS

Next step in the journey of AM was to develop framework for its implementation. Though two decade have passed but very less work has been put in by the researchers and academicians for successful implementation of AM. Nevertheless, some researchers have made few efforts. Preiss, Goldman, Nagel, and Dove who were the key members of “Agility Forum at Leigh University” and pioneers of AM conception made lot of contribution towards AM development (Dove, 1999; Goldman, 1994; Goldman & Nagel, 1993; Goldman et al., 1995; Preiss, Goldman, & Nagel, 1996). Preiss et al. (1996) developed a 3-step model cooperation as core binding force between stake holders to acquire agility status, comprises "market forces, enterprise traits, agility enabling infrastructure and business process" as shown in Figure 2.15. However, a dearth left in the work, as details of these pillars were not clearly presaged.

Table 2.7. Literature Synthesis of Different Authors' Perspective about AM

Studies	Definition
Goldman and Nagel (1993, p. 25)	"AM is capable of low unit cost while producing far smaller quantities of high quality, highly customised products".
Goldman et al. (1995)	"Agility is having the following strategic dimensions: enriching the customer, cooperating both internally and externally to enhance competitiveness, organizing to both adapt to and thrive on change and uncertainty, and leveraging the impact of people and information by nurturing an entrepreneurial culture in the company".
Booth (1996, p. 107)	"Agile companies seek to combine the advantages of time compression with techniques to reduce the costs of variety while remaining adaptable to future changes. The intention is to be able to offer almost instant delivery of small quantities of goods with individual specification".
DeVor et al. (1997, p. 813)	"Agility is the ability of a producer of goods and services to thrive in the face of continuous change".
Quinn et al. (1997, p. 902)	"The ability to accomplish rapid changeover from the assembly of one product to the assembly of a different product".
Sharp et al. (1999, p.156)	"An agile company is primarily characterised as a very fast and efficient learning organization".
Gunasekaran (1999a, p. 1, & 1999b, p. 87)	"AM is the capability of surviving and prospering in the competitive environment of continuous and unpredictable change by reacting quickly and effectively to changing markets, driven by customer-designed products and services".
Zhang and Sharifi (2000, p. 496)	"Responding to changes (anticipated or unexpected) in proper ways and due time".
Sharifi and Zhang (2001, p. 774)	"Exploiting changes and taking advantage of changes as opportunities".
Sarkis (2001, p. 89)	"AM a strategy that contains Lean manufacturing and flexible manufacturing and addresses the business enterprise world".
Hormozi (2001, p. 133)	"The agile manufacturing organization integrates design, engineering, and manufacturing with marketing and sales in such a way that the products are customized to the exact needs of the consumer".
Brown and Bessant (2003, p. 708)	"Mass customisation is best viewed as a powerful example of a firm's ability to be agile".
Crocitto and Yussef (2003, p.388)	"AM offers a competitive advantage which may be maintained through a reputation for quality and innovation".
Giachetti et al. (2003, p. 47)	"AM is to cope with increased environmental uncertainty, adapt to the faster pace of change of today's markets, and react within the smaller windows of opportunity for decision-making".
Jin-Hai et al. (2003, p.170)	"Agility is a competitive response, it is enabled by cooperation. Paradoxically, it is also revolutionary in that the new integrated combination of competitive intensity and technology, which create collaborative advantage, represent a radical departure from existing systems".
Dowlatshahi and Cao (2006, p. 837)	"Agility is being able to function and compete within a state of dynamic and continuous change".
Ramesh and Devadasan (2007, p. 183)	"AM is the capability of the manufacturing enterprise to quickly respond to the market requirements".

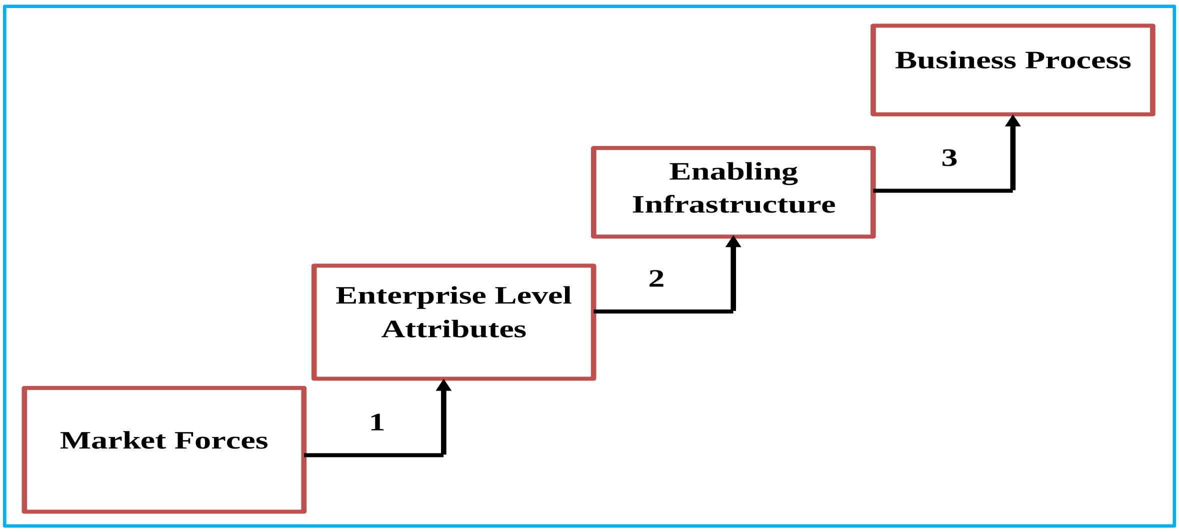


Figure 2.15. 3-Step Cooperation Model to Achieve Agility
Source: (Preiss et al., 1996)

Dove, Hartman, and Benson (1997) suggested an enterprise agile reference framework. The authors identified 24 business practices from literature that an organization must acquire to become agile. Nevertheless, the question remained unanswered how, and in which sequence, these practice should be assimilated and employed to acquire agility esteem.

Gunasekaran (1999b) developed an in-depth framework for an organization to acquire AM status. The author categorized available literature on AM in four main unified vaults (AM enablers) as shown in Figure 2.16.

(a) Strategies
(b) People
(c) Systems
(d) Technologies

The core theme of this framework is just to integrate and transform all the sub-systems into one holistic system as also proposed by Booth (1996) and integrated systems “Theory of Systems” (Skyttner, 2005). Integration purpose is to respond rapidly to the change in the customer preferences faster than competitors do. All these sub-heads further interact to form four functional zones as following:

(a) Virtual enterprise
(b) Mass customization
(c) Re-configurability
(d) Rapid partnership

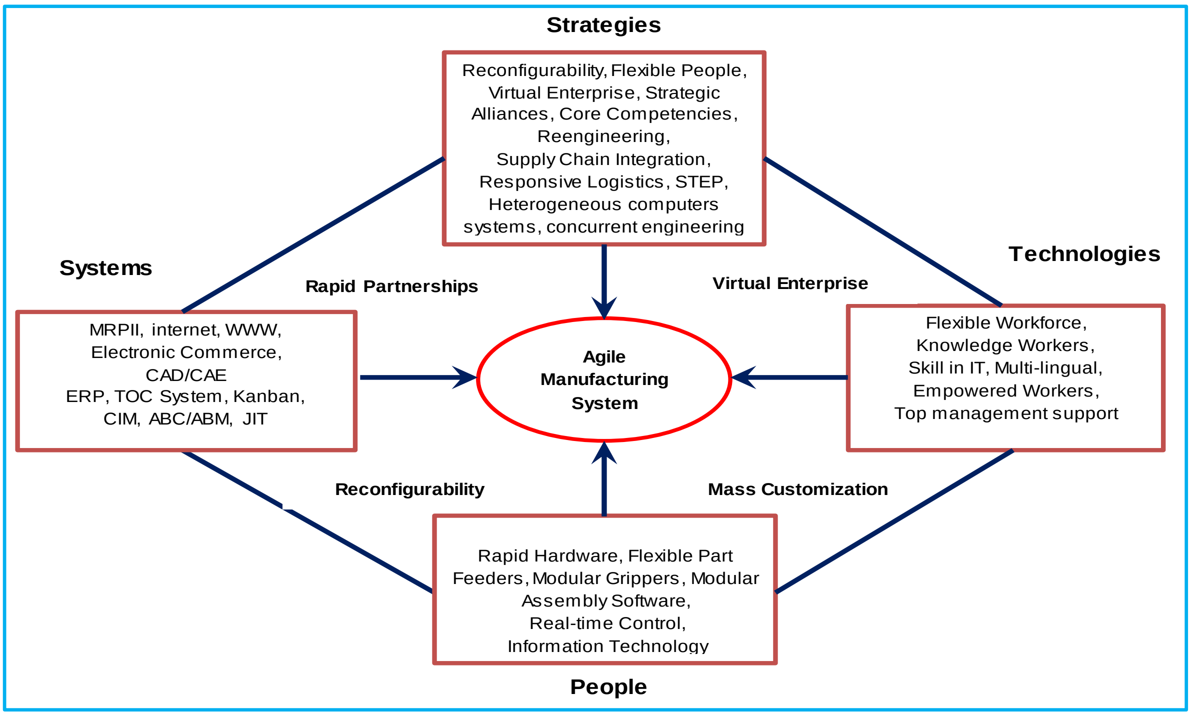


Figure 2.16. A Framework for AM System
Source: (Gunasekaran, 1999b, p. 100)

Virtual enterprise elucidates agility as paradox, as competitors may become partners (alliances) (Sharp et al., 1999, p. 159). Resource constraints limit manufacturing firms to operate effectively in all the environments (Narasimhan et al., 2006). It is impossible for any enterprise to acquire all the competencies to meet customer's versatile demands forever. To counter these challenges organizations have to go in rapid partnerships/alliances with customers and suppliers, and sometime partnership boundaries are extended to competitors as well. Therefore, suppliers, customers and competitors role may shift from their traditional role to partners shaping virtual enterprise. All the stakeholders are involved in the manufacturing process at product design stage. Information received from the customers is equally available to them as well, so they have timely information to encounter those anticipated and un-predictable changes. Jin-Hai et al. (2003) argued that in virtual organizations inter-functional coordination problems can be resolved through employees training and autonomous cross-functional teams. Nevertheless, in case of external coordination, he pointed out "improving external relationships may become more complex, relying on the use of cross-organization teams, information sharing, resource sharing, and risk sharing. Each of these aspects needs to be set up on the basis of trust" (Jin-Hai et al., 2003, pp. 186-187). They proposed a 3-stage relationship design as shown in Figure 2.17.

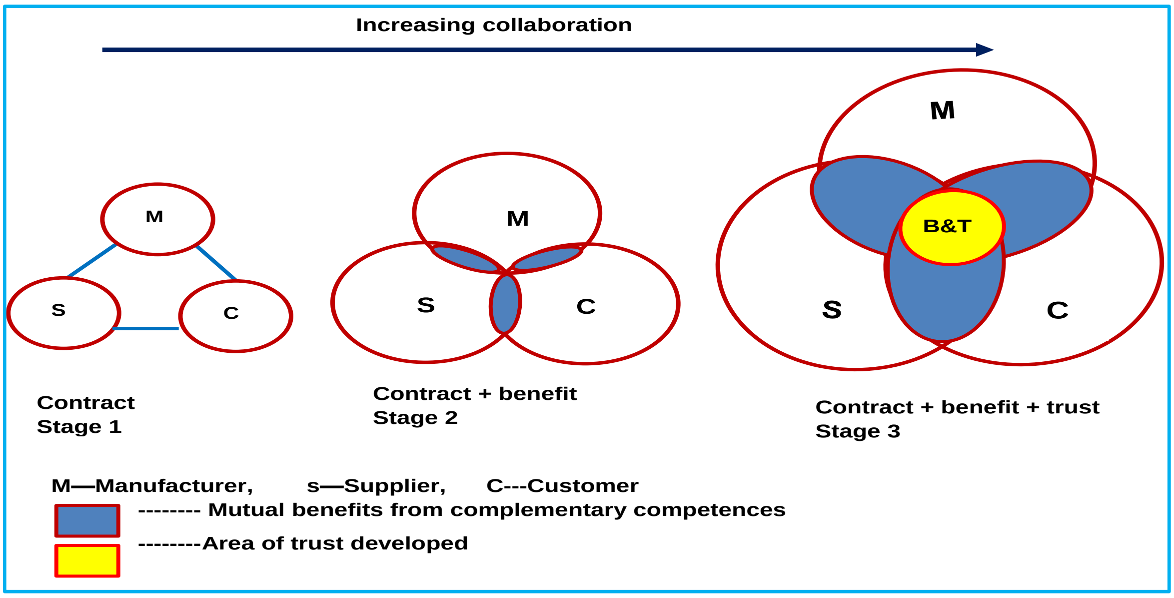


Figure 2.17. Collaboration Advantage Gain through Competencies Sharing
Source: (Jin-Hai et al., 2003, p. 179)

It is evident from Figure 2.17, when relationship strength changes from simple contract (stage 1) to collaboration (stage 3) the perceived benefits are realised and all this transpire due to mutual trust. Similarly, Frohlich and Westbrook (2001), using data base of "International Manufacturing Strategy Survey (IMSS) 1998 round", conducted a survey of 322 organizations from 23 countries. Organizations' position on supplier-manufacturer-customer integration vis-à-vis business performance, productivity and non-productivity performance was checked through a survey questionnaire as shown in Figure 2.18.

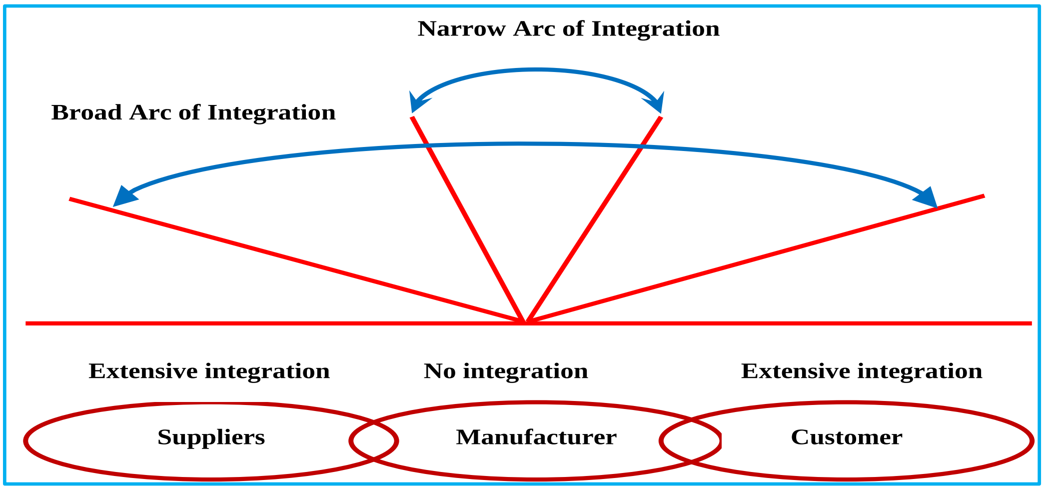


Figure 2.18. Suppliers-Manufacturers-Customers Integration Arc
Source: (Frohlich & Westbrook, 2001, p. 187)

Authors identified five different groups based on supplier-customer integration strategy as shown in Table 2.8: Using ANOVA, authors found organizations following outward strategy outperform all other groups on non-productivity, productivity and business performances.

Table 2.8. Supplier-Manufacturer-Customer Integration
Source: (Frohlich & Westbrook, 2001)

Strategy	Sample	Customer Integration		Inward Focus	Supplier Integration	
	322	Full	Partial	Full	Partial	Full
Inward	44			✓		
Periphery	137		✓	✓	✓	
Supplier	42			✓		✓
Customer	39	✓		✓		
Outward	29	✓		✓		✓
Key: ✓ = level of Implementation						

Goldman et al. (1995), noted that agility implementation is deeply interconnected with organizational context. Organizations pursuing to achieve agility must constantly watch on the type of market, customer behaviour, hostility degree vis-à-vis own strong and weak points. Empowered, skilled employees and an effective information system is prerequisite for virtual enterprise to eliminate inter-functional, communication and most important cultural barriers (Tracy et al., 1994). When information transmission is interrupted, due to human or technical failure, agility is endangered (Forsythe & Ashby, 1996). To counter this, workforce should be trained enough to have grip on technological advancements. Concurrent engineering is preferred over sequential engineering in AM to poultice the product time from design stage to the market. Gunasekaran (1998, p. 1245) argued that organizations can get succour from manufacturing systems like TQM, BPR, JIT etc. to achieve agility. The author maintained that TQM and JIT can be used as agility enablers. JIT support to poultice the product delivery time as compare to competitors (Gunasekaran, 1998, p. 1224), whereas, TQM succour in enriching the human assets of the organization (Gunasekaran, 1998, p. 1236).

Agility has been advocated as next generation manufacturing (Goldman & Nagel, 1993; Kidd, 1995a, 1997), and will be fundamental requisite of any organization (Dove, 1999). Dove (1999) introduced the agile enterprise concept and developed a framework. The framework developed based on two major pillars, “Knowledge Management (KM)” (Kidd,

1997) and "Change Proficiency (CP)" (Goldman et al., 1995) as shown in Figure 2.19. The author contended that knowledge introduces change once applied and generate value as net effect. The value resulted from change driven by new knowledge is known as "innovation" (Meredith & Francis, 2000). Knowledge, if, not learned and applied timely is counterproductive. An organization can be called "Agile", as if it has, "the ability of an organization to thrive in continuously changing, unpredictable business environment" (Dove, 1999, p. 19). Organizations have to keep balance in CP and KM. Both are co-dependent as change (proactive/reactive) provide latitude for an organization to advance in knowledge successfully, at the same time knowledge open new change landscapes. Any mismatch will be counterproductive and resource wastage. Proactive players are innovators (leader) and reactive are opportunistic. Proactive and reactive can also be called as explorer and exploiter respectively (Sitkin, Sutcliffe, & Schroeder, 1994). Proactive players always have an edge over reactive players and always enjoy market leadership. The author resembled two scenarios, spastic (confused) and catatonic (afraid) with respect to mismatch between KM and CP. Agile organizations always keep on balancing between KM, CP and organizational culture, to avoid, any failure due to mismatch. KM and CP agents and infrastructure provide concrete foundation to maintain balance.

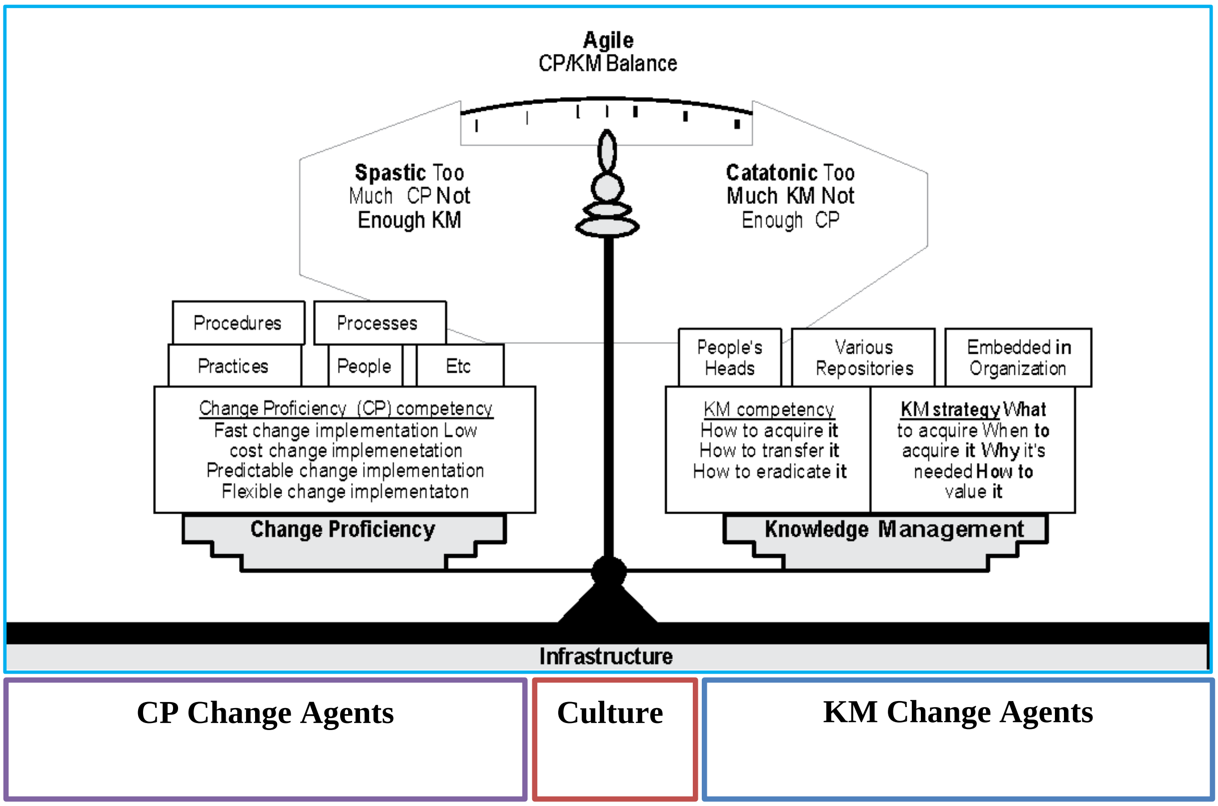


Figure 2.19. KM and CP Balance in Enterprise Agility
Source: Adapted from (Dove, 1999, p. 21)

Sharp et al. (1999) developed an agility achievement framework based on the work of Goldman, Preiss, Nagel, and Dove (1991), Kidd (1997, p. 161), Dove (1996) and Gunasekaran (1998) as shown in Figure 2.20. Sharp et al. (1999) proposed that agility house comprises foundation (WCM / Lean practices) based on the work of Kidd (1997) and Dove (1996), pillars identified by Goldman et al., (1991) and Roof (results) rest on the work of Gunasekaran (1998). The authors also validated the proposed model using a sample of 42, UK manufacturing firms. Questionnaire comprised three sections (1) market environment (2) strategy objectives (3) key enablers to achieve agility. The authors' further sub grouped these ten enablers into five groups (two in each group):

(a) Flexible and skilled people and core competencies
(b) Teamwork, empowerment, and continuous improvement
(c) Communication and information technology
(d) Rapid prototyping and concurrent engineering
(e) Change management and virtual enterprises

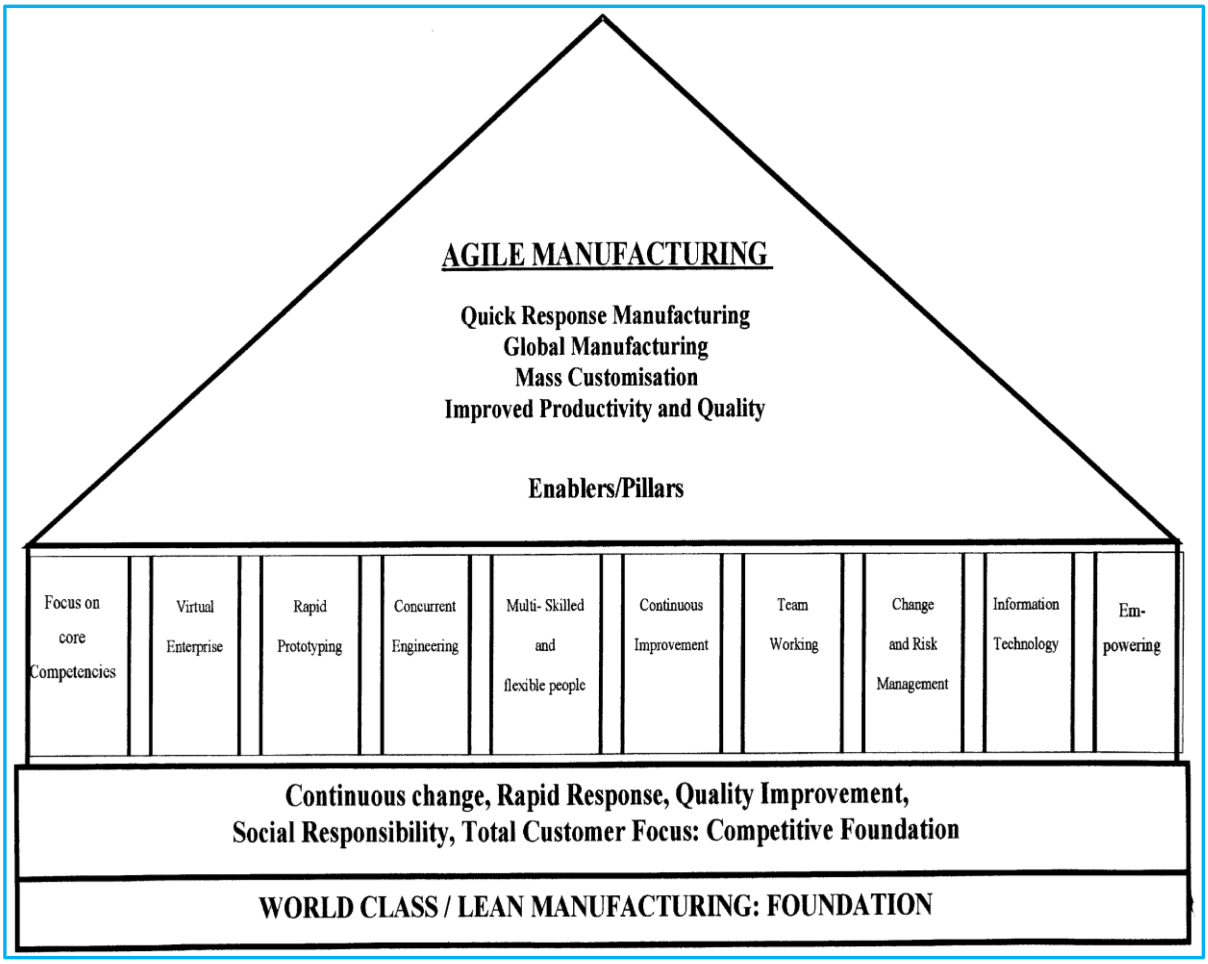


Figure 2.20. A Framework to Acquire Agility
Source: (Sharp et al., 1999, p. 161)

The surveyed results were found positive in all sub-groups. Moreover, organizations also positively supported the “temporary alliance” strategy as important agility acquiring instrument and help organizations to manage change more effectively. Most importantly, the authors did not rule out the significance of Lean manufacturing and buttressed that these two paradigms are conjointly supportive. To become agile, an organization must acquire Lean eminence first and then assimilate it with agility enablers. Nevertheless, the sample size was inadequate to allow a full-scale statistical analysis, only descriptive snapshot was evaluated.

Sharifi and Zhang (1999, p. 17) also maintain that agility is the proficiency to respond to change in corporate environment and learning organizations adapt to convert change threats into advantage using core capabilities. They also projected a systematic three change domains perspectives and respective measures required to be adopted by an organization as shown in Figure 2.21. They further explained domain boundaries and required remedies. First domain relates to current business operation and activities and if change is confronted, immediately minor changes are undertaken to counter these change spikes. The second domain relates to the change in current marketing, services and business strategies. To neutralize the effects of such change internal process and current activities are re-designed. Third domain relates to the change anticipation in future and for this, organizations may need to change complete business strategy, to keep up the pace with future unpredictable volatility in customer preferences. They also devised a generic agility assessment and strategy formulation model as shown in Figure 2.22 (Sharifi & Zhang, 2001, p. 777).

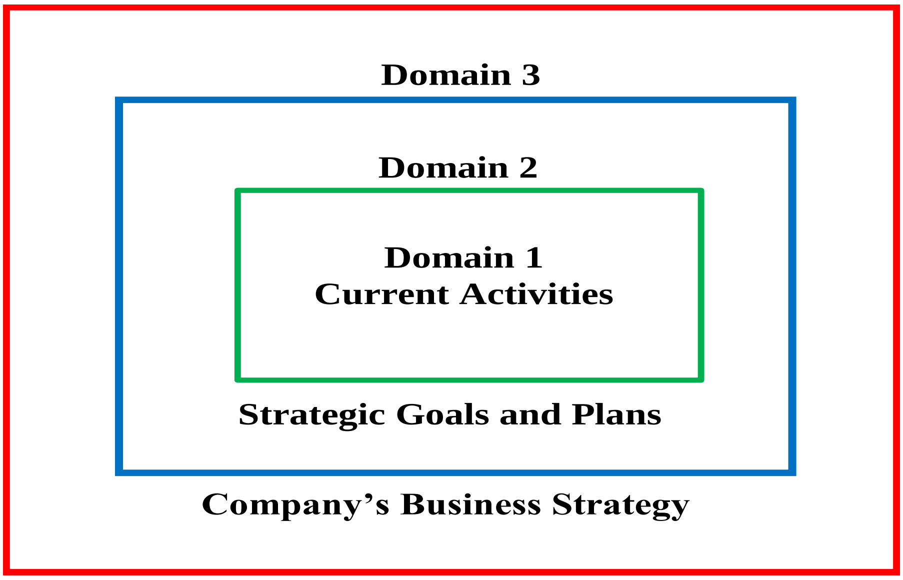


Figure 2-21. Corporate Change Domains
Source: (Sharifi & Zhang, 1999, p. 17)

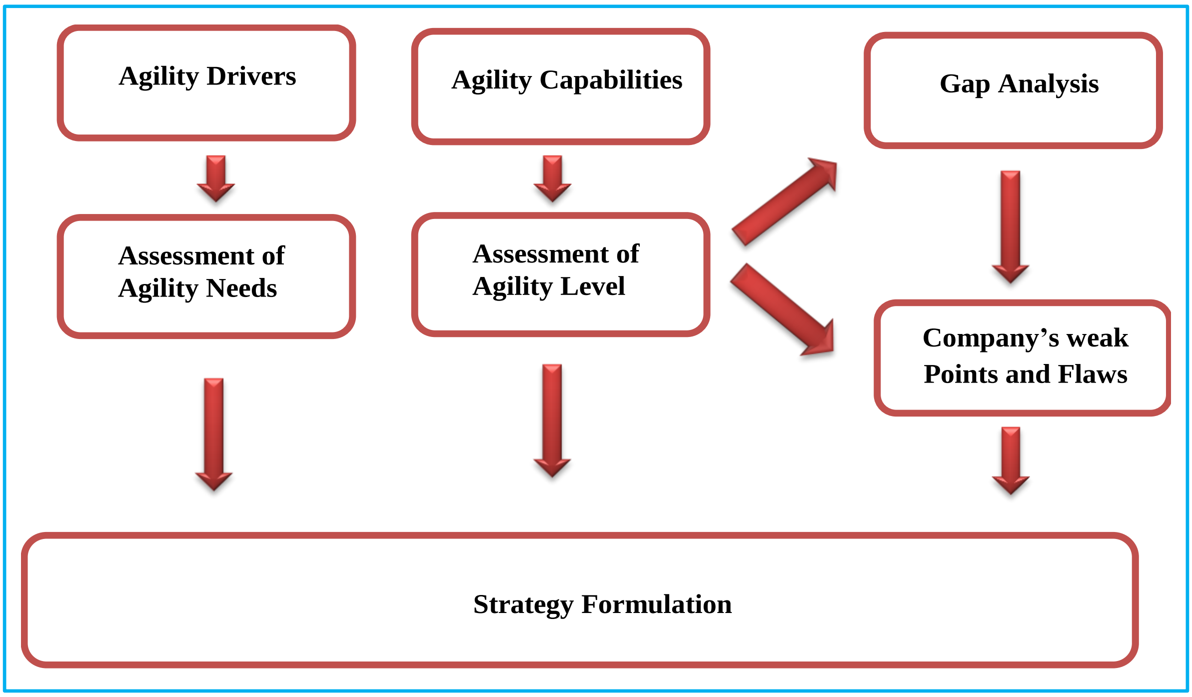


Figure 2.22. Agility Assessment and Strategy Formulation Model
Source: (Sharifi & Zhang, 2001, p. 777)

The authors argued that, agility is triggered by agility drivers, which may be external or internal to the corporate. Similarly, Christopher and Towill (2001) also upheld that market sensitivity is the key to agility strategy formulation (Van Hoek, 2000). Organizations keep on scanning variations in these drivers vis-à-vis their capabilities. At first stage, agility needs are assessed and if at all, change is required, then minor changes are assimilated. At stage-2 capabilities vis-à-vis available agility providers capacity is evaluated and if gap is found then strategy is restructured to align with the change. It is a continuous process of corporate configuration and reconfiguration with its hostile environment and time is "*essence*" of this process. Reconfiguration with respect to change will be one of the biggest challenge to the organizations in 2020 (Prince & Kay, 2003). Information is the most perilous element of agility evaluation and execution. Z. Zhang and Sharifi (2000, p. 502) classified agility drivers into seven different sub-groups as following:

(a) Marketplace
(b) Competition
(c) Customer requirements
(d) Technology turbulence
(e) Suppliers
(f) Social factors
(g) Internal complexity

The authors further classified agility providers into five groups as following (p. 498), however, information is the obligatory link between other four groups:

(a) Organization
(b) Technology
(c) People
(d) Innovation
(e) Information

With the change in global marketplace competitive environment, improvement initiatives have also taken few steps to keep up pace with new challenges. Therefore, it can be believed that new improvement paradigms are much capable than earlier ones and have multi-prong assertiveness towards competitive capabilities (Vokurka & Fliedner, 1998). The organizations' capabilities concentration reflects its "strategic intent" towards market (Hamel & Prahalad, 1994; Miller & Roth, 1994; Z. Zhang & Sharifi, 2007). Delivery, quality, flexibility and cost are generally branded as competitive capabilities. However, recent work has further sub-categorised these measures. Delivery has been further subdivided, to include dependability and speed of delivery. Similarly, flexibility has been further subdivided, to include flexibility to product volume and variety (Hallgren & Olhager, 2009). An agile player must be able to acquire competitive proficiencies mentioned above (Z. Zhang & Sharifi, 2007). Other agility related capabilities stated in the literature are summarised in Table 2.9.

Crocitto and Youssef (2003), proposed a framework (Figure 2.23) for businesses working in an environment, where, technology changes are radical, customizations are unexpected and globalization risk cannot be estimated. They suggested that organizations, working in such unanticipated working environment, must integrate their internal and external resources to attain the status of organizational agility. Internal resources include management support, internal infrastructure like empowered teams, employees' training on multiple skills, reward system, supportive culture and external infrastructure like customer early involvement in product design and redesign process and strategic partnership with suppliers. This integration process surges organizational flexibility and responsiveness. Once, top management, internal and external infrastructures are fully configured then organizations are in a position to breakthrough by capitalising the edge of advance manufacturing technologies and information technologies. Resultantly, high quality and innovative products / services are offered to customers at competitive prices.

Table 2.9. Summary of Agility Specific Capabilities

Goldman et al.(1995)	Reid et al. (1996)	Goranson (1999)	Dove (1999)	Zhang and Sharifi (2007)	Bottani (2010)	Zhang (2011)
Enriching Customer		Satisfy and be close to customer		Focusing on customer	Service level delivered to Customers	Focusing on Customer
	Ability to recover from change	Respond to anticipated change response to un-anticipated change	Change Proficiency	Responsiveness	Response to anticipated, unanticipated, and unpredictable change	Responsiveness
	Efficiency		Knowledge Management	Competency		Competency
Cooperating to enhance Competitiveness				Partnership		Partnership
	Quickness			Quickness		Quickness
	Flexibility			Flexibility	Process and Product Flexibility	Flexibility
	Innovation			Proactive	Proactivity, Innovation	Proactive

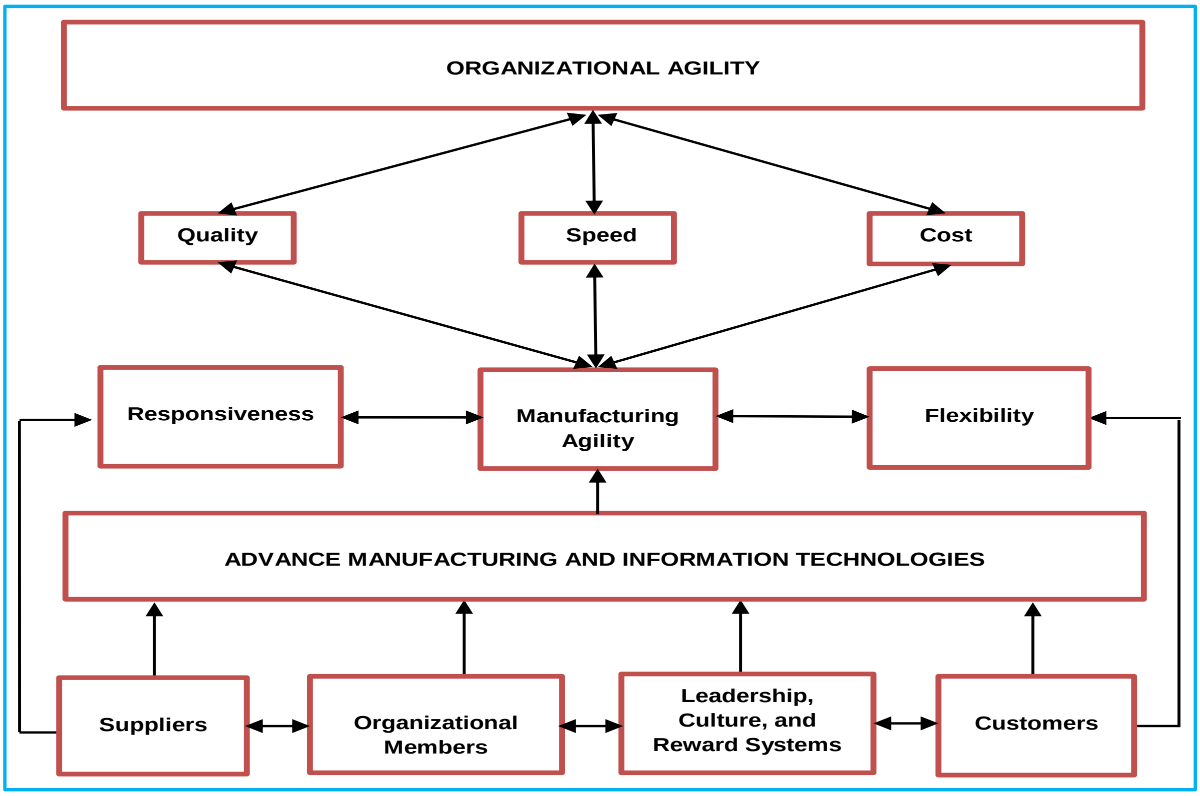


Figure 2.23. Organizational Agility Model
Source: (Crocitto & Youssef, 2003, p. 392)

Crocitto and Youssef (2003, p. 395), accentuated that leadership is the only instrumental element to acquire organizational agility and asserted that leadership has to think "outside of the box". Further they added that "it is up to leadership to create the culture that supports innovation, diffusion of information, and teamwork by marrying accepted agility practices such as advanced manufacturing technology, virtual manufacturing, speed and time, with organizational and employees' learning and rewards for agile employees".

Vázquez-Bustelo and Avella (2006) combined the work of Gunasekaran (1999b) and Gunasekaran and Yusuf (2002) (AM providers), , Z. Zhang and Sharifi (2000) agility assessment model/agility providers and Sharifi and Zhang (2001) agility drivers. The authors conducted four case studies in diverse industrial firms (1) agriculture, (2) household products, (3) General motors (auto industry) (4) Airbus (aircraft) industry. Through a series of interviews and in-depth discussions with management and functional employees, checking documental evidences and plant visits, they developed an AM implementation framework as shown in the Figure 2.24.

The model only included two agility drivers i.e., market turbulence and competitive intensity out of seven suggested by Z. Zhang and Sharifi (2000). However, agility providers were similar mentioned earlier (Dove, 1999; Gunasekaran, 1999b; Z. Zhang & Sharifi, 2000). They also empirically validated the same model on Spanish industry reported in another study (Vázquez-Bustelo et al., 2007).

This Section briefly explained the different frameworks developed by others, highlighted their strengths and weaknesses. After briefly explaining the implementation frameworks now it is logical to discuss AM implantation and its impact on organizational performance.

2.7 AGILE MANUFACTURING AND ORGANIZATIONAL PERFORMANCE

Two decades since the inception of AM paradigm to manufacturing arena have passed. yet, very less work has been undertaken, mostly anecdotal work (Brown & Bessant, 2003; Sharifi & Zhang, 2001), as far as empirical validity of this paradigm is concerned, however, few exceptions are there (Vázquez-Bustelo et al., 2007; Yauch, 2010; Z. Zhang & Sharifi, 2000). Theoretically, much has been put into it, but empirically it is yet to be explicitly explored in the research field of OM (Z. Zhang & Sharifi, 2007). Research findings are not conclusive that what actually constitute agility. Different authors have endeavoured to operationalize it from different perspective, e.g. with reference to agility drivers (Z. Zhang & Sharifi, 2000), integration of agility provider blocs (Vázquez-Bustelo et al., 2007), agility index as performance outcome (Yauch, 2010).

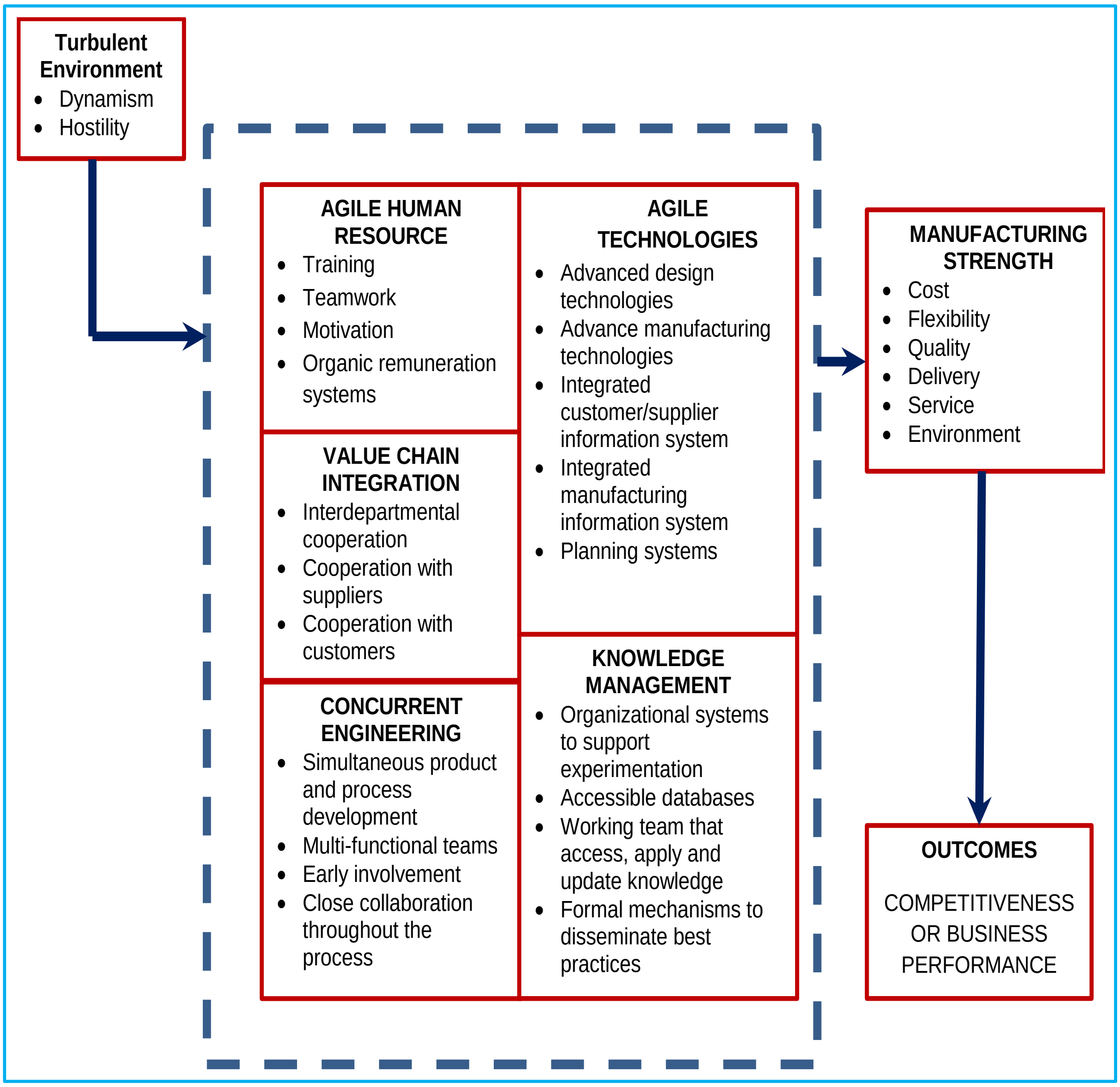


Figure 2.24. AM Business Wide Implementation Model
Source: (Vázquez-Bustelo & Avella, 2006, p. 1159)

Z. Zhang and Sharifi (2000), developed a computer based network model to assess the organizational agility. The networks based on links between agility drivers, capabilities, and providers. There are three main areas (1) agility drivers (2) capabilities in between (3) agility providers. Capabilities are the conjoint point between providers and drivers. Each sub-factor on these three main factors are interlinked with sub-factor of other main factors like a web. The only difference is that each capability link is also linked with other capability link. Network model used technique of [0, 1], "**0**" if connecting node is disabled and "**1**", if node was enabled. A questionnaire is developed through literature review and tested, using network model, on 1000 manufacturing firms from three major industrial sectors (1) electronics, (2) aerospace, (3) automotive. Further developed methodology was implemented in 12 organizations to validate it and positive results are found. A list of general practices, enabling information system and respective techniques and tools also has been suggested. Major enabling techniques/tools required to achieve agility are as following: (Z. Zhang & Sharifi, 2000, p. 509).

(1) JIT/Kanban
(2) CIM (Computer Integrated Manufacturing)
(3) TQM
(4) Concurrent Engineering
(5) Flexible Manufacturing System (FMS)
(6) Lean Manufacturing
(7) CAD / CAM / CAE (Computer-Aided Design, Manufacturing, Engineering)
(8) Robot Technology
(9) Joint Venturing
(10) Rapid Prototyping
(11) Information System

VE and IT have been propagated as founding elements to accomplish AM (Gunasekaran, 1998, 1999a, 1999b; Yusuf, Sarhadi, & Gunasekaran, 1999). Cao and Dowlatshahi (2005) and Dowlatshahi and Cao (2006) investigated the combine effect of IT and VE (agility enablers), earlier proposed by Sharp et al. (1999) on business performance (BP). VE / IT individual and alignment influence on business performance among different industrial sectors (1) "Construction, mining, and materials handling, (2) General industrial machinery and equipment, (3) Computer and office equipment, (4) Refrigeration and service industry machinery, (5) Miscellaneous industrial and commercial", was investigated. 102 respondents from these sectors participated in this study. Multiple statistical methods (ANOVA, SEM, Euclidean distance) were employed to explore/confirm the strength of the relation. The studies successfully established a positive link between VE, IT and BP. Information Technology (IT) was also found positively associated with Virtual Enterprise (VE). Moreover, it was found that their alignment impacts were much significant than their individual contribution. No significant differences were found among different industrial domains, concluding their uniform recognition by all sectors.

Technological advancements, an important agility pillar, have reshaped the customer preferences. Varukolu and Park-Poaps (2009) conducted a study to investigate the relationship between technology adoption vis-à-vis organizational factors (firm size, top management commitment, cost of capital, export orientation, technical skills, competitive advantage) in Indian Apparel sector. 108 respondents, from Apparel sector, participated in the study. All the factors were found positively associated with technology adoption, except negative impact of export orientation and cost of capital. Management perception to cost of capital negatively influences technology adoption. Surprisingly, export orientation was negative, contrary to previous studies (Mechling, Pearce, & Busbin, 1995). The author attributed this contrary results to low-cost market, as companies, sourcing Indian firms are oriented towards low-tech and high-labour intensive products. Low-cost market competition, due to free trade may also contribute to non-adoption of advance technologies.

Vázquez-Bustelo et al. (2007), initially developed an AM implementation framework through four case studies. Subsequently, the model was tested on Spanish manufacturing industry (SIC 24, 28-35). 283 respondents (generally managers) from 273 large firms having at least 100 employees participated in the model assessment. The model consists of three stages, agility drivers, AM functional enablers and performance out comes. They found that environmental hostility along with dynamism positively stimulates AM. Five different, yet interrelated and well integrated, AM enablers positively responded to change resulting in improved manufacturing strength (e.g. cost, quality, delivery, flexibility etc). Manufacturing strength positively augmented business performance (e.g. market performance, ROA etc). The model was tested through SEM (using AMOS). The model fit was satisfactory except χ^2 test value which marginally qualified probably due to number of cases vis-à-vis parameters to be measured were out of proportion. However, other model fit indices complied with the model fit standards. Few questions remained unanswered in this study. First model was not tested for process/product effects. Further, it was tested only on large organizations (employees >100) thus limiting generalizability of these results to small and medium enterprises (SMEs).

Z. Zhang and Sharifi (2007), further extended their previous research work (Z. Zhang & Sharifi, 2000) through classification of agile groups. The authors classified organizations, using cluster analysis, based on their competitive capability strength into three distinctive strategic groups (a) Responsive (b) Quick (c) Proactive. Proactive group was found highly responsive to Agility Drivers (AD) and Agility Providers (AP), however, People a sub-element of AP effects were not observed among three groups. Further using discriminant analysis two major groups were found “proficient to change” as proposed by (Dove (1996), 1999)) and “speed to customer” also suggested by Goranson (1999). No significant strategy based differences were found among industrial sectors. However, significant differences were witnessed among contextual variables, except “lead time from concepts to cash”, which qualified marginally at $p < 0.1$. However, plant size and sales turnover effects were also not tested.

Radical changes have led to much tight and trust enabled relation with customers, suppliers and competitors than ever (Bessant, Francis, Meredith, Kaplinsky, & Brown, 2001; Christopher & Towill, 2001; Maskell, 2001). To remain competitive such collaborations has been labelled as ‘‘co-opetition’’. The collaboration cum compete principle leads to ‘‘grow the cake’’, and learn ‘‘how to slice it’’, while enduring to compete. Kisperska-Moron and Swierczek (2009) developed relationship-based taxonomies of agile supply chain strategy. A sample of 96 Polish companies (from “mining sector, miscellaneous manufacturing, building sector, commerce, financial services, real estate agencies, transportation services, telecommunication and other services”) was selected. Two-stage analysis was undertaken. At first step, through factor analysis, four orthogonal set of factors were extracted. Then companies were classified based on cluster analysis. Four strategic groups were identified (1) customer relationship focus (2) supplier relationship focus (3) competitors relationship focused (4) information technology biased group. Commercial and service industries were oriented to the customer relationship strategy, whereas, manufacturing oriented group relied on supplier relationship strategy. Relationship with supply chain partners (customer and supplier) and IT were found more associated with agility as compared to relation with competitors.

Agile organizations are characterised responsive to environmental turbulence. Yauch (2010) conducted a case study to calculated organizational agility index based on organizational environmental turbulence, 13 factors, for example, mainly product/process customization, customer/supplier/competitors relations, technology, legal etc., and business objective performance (revenues, cost of goods sold, gross margin). Author proffered performance over structural results to measure agility strength. The author explained this concept as; “this is analogous to predicting success in a horse race: you can evaluate the horses and jockeys based on their structural and situational characteristics (breeding, gate position, trainer, length of race, quality of surface, weather, etc.), but that does not directly determine which horse will win; success can only be judged on the performance outcome after the race has been run”. Four companies voluntarily participated in the study. Companies were categorised into four groups, respective improvement programs being followed by the companies are also mentioned along with company environment/success standing as following:

(a) High turbulence high success (ISO 9000, ISO 14000 TQM,TPM, SCM, Lean)

(b) High turbulence low success (ISO 9000, SCM, Computer Integrated Manufacturing)

(c) Low turbulence high success (ISO 9000, kaizen)

(d) Low turbulence low success, (5S, Lean, customer relation management)

Organizations' agility index was calculated using their respective scores on turbulence and success through mathematical formula devised by the author. To construe the agility status, three threshold levels were suggested.

(a) Scores $\geq$ 36 (highly Agile)

(b) Scores ranging from >18 to < 36 (Agile)

(c) Scores ranging from 0 to 18 (not Agile)

Organization (high turbulence and high success) scored 29.4 and was declared agile. Other three organizations (b, c & d) with a score of 11.2, 12.6 and 6.7 respectively failed to qualify the status of agile organizations and were predicted to be out of business soon.

Bottani (2010), attempted to define explicit dimensions of agile companies in terms of their profiles and associated enablers with respect to different pressures. A sample of 190 companies from five different industrial segments (health-care, commercial, food, manufacturing, utilities) participated in this study. Based on 13 competitive priorities, identified from previous work, companies were distributed into three discern groups (Agile, Lean, No focus). Agile group was found inclined towards "response to change" and "production mix", whereas, Lean were more efficient in "cost". Nevertheless, all groups squarely followed "quality aspects". Change in market significantly affected all market segments, whereas, social factors were lowest (Z. Zhang & Sharifi, 2007). Agility attributes (continuous improvement, quality over product life, followed by trust-based relation with customers / suppliers, customer satisfaction) (Flynn et al., 1995b; Jayaram et al., 2010; Jin-Hai et al., 2003) were extremely followed by all industrial segments, relating their response to agility driver (changes in customer need) (Z. Zhang & Sharifi, 2007). No difference was found among agility attribute application among market segments, except, on "suppliers' relationship" by manufacturing segment and "learning organization" by health care sector. Whereas, trust based relation got maximum attention by all segments. Out of 18 enablers, only 5 were found important, e.g., ICT was ranked the highest. Agility attributes were factorised into 8 main factors, ("workers empowerment and training, technology decision, customer focus, integration, teams, partnership, quality, and aptitude to change”), out of which two main factors “workers development and technology decision” (Gunasekaran & Yusuf, 2002; Yusuf et al., 1999) with one third of total variance were regarded most important. Worker development quality, customer focus can be attributed as patent to Lean (Flynn et al., 1995a). Enablers were factorised into four factors information communication technology (ICT), TQM, AMT and time compression (JIT). TQM & time compression (JIT) are elements of Lean bundles (Shah & Ward, 2003). Moreover, organizational contextual, except market segments, were not tested due to sample size limitations. No other statistical test was undertaken to prove the relationship between different attributes and performance, moreover, enablers’ moderation effects were also not explored in this study.

Inman et al. (2011) , using a sample of 96 large (employees > 250) US manufacturing firms tested AM impact on OP and BP. They used JIT production and JIT supply as supporting infrastructure factors. The study could not find a positive relation between JIT production and AM contrary to other studies (Narasimhan et al., 2006; Zelbst et al., 2010). The justification to this, offered by the author, was that JIT might already be in place and integral part of AM, so that their marginal difference could not be differentiated. Nevertheless, JIT supply mediated the AM-JIT production relation. Interestingly, the study also failed to find the moderating impact of environmental uncertainty, a prerequisite of AM (Vázquez-Bustelo et al., 2007). The study did not provide any justification to this unusual result. However, a few plausible causes can be attributed to these unusual results. First, the sample size was too small to test the model. Second, measurement scales were inconsistent, as JIT production was measured as categorical variable, contrary to other variables, which were measured as continuous variables. Thirdly, only large similar organizations were included in the study, where it might get difficult to differentiate the difference, if at all exist, between different practices followed by these organizations as such management practices take the form of organizational culture.

Z. Zhang (2011) based on work of (Z. Zhang and Sharifi (2000), 2007)), using data set of study (Z. Zhang & Sharifi, 2007). Zhang categorised, sample of 57 firms, into three easily separable groups based on their capability strength. The author further conducted case studies, through in depth interview with management, and identified exact characteristics of three groups (Proactive, Quick and Responsive). Their specific approach to achieve agility with respect to business characteristics, Agility Drivers (AD), strategy and capabilities and respective action plans to meet predicted/un-predicted challenges were identified (Z. Zhang, 2011, p. 311) as presented in Table 2.10.

Table 2.10. Different Approaches to Agility

Strategic Area	Proactive Case	Quick Case	Responsive Case
Business Characteristics	Mature & niche market	High tech & niche market	Mature & niche amrket
	Long life cycle	Short life cycle	Long life cycle
	Market leader	Technology leader	Market follower
Drivers	Global competetion	Niche market growth	Global competetion
	Information technology	Information technology	Production technology
Strategy	Introduce change	First to market	Follow others
	Flexible and innovate	High technology	Flexible
	Proactiveness	Customer focus	Flexibility
Action Plans	Innovative and flexible	Innovate at all levels	Flexible manufacturing process
	Partners with customers and suppliers	AMT and mass customization	Integrate suppliers, involve customers
	Trust and empower people	Educate people	Continously trained people

Yusuf et al. (2014), using a sample of 96 supply chain managers from Uk upstream oil and gas industry, shed light on the relationship of core supply chain agility attributes with competitive objectives and performance measures. Using bivariate correlation, they found a significant relation among core agile practices and different business performance. However, no significant relationship, as a whole, was found between “enriching the customer” and all “business performance measures”. Moreover, a significant relationship was found between agile core practices and competitive objectives, with an exception of insignificant relationship between leveraging the impact of people and information and delivery. The study highlighted the paradigm shift of competition among firms from individual competencies to the strength of their entire supply chains because of increased market volatility, complexity and decreasing predictability. Furthermore, degree of change in agility is sturdily linked with business type and its operating environment conforming agility context dependency (Goldman et al., 1995; Goldman et al., 1991). The firms having long-term relations with suppliers enjoy high customer loyalty.

From discussions made in section 2.5 to section 2.7, it is imperative to clinch that literature is inconclusive among researchers on agility measurement. Different attempts have been made to measure agility from structural point of view (Vázquez-Bustelo et al., 2007), from capabilities angle (Z. Zhang & Sharifi, 2000) and few endeavoured to approach it from performance reference point (Bottani, 2010; Yauch, 2010). Moreover, agility measurement, under organizational context, is also moderately infrequent as, Goldman et al. (1995) noted that agility is "dynamic, context-specific, aggressively change-embracing, and growth oriented" (Vokurka & Fliedner, 1998, p. 166). Its enactment is deeply rooted into organizational context. Organizations pursuing agility must constantly watch on the market type, customer behaviour, hostility degree vis-à-vis organizational structure.

Management, infrastructure practices and Core AM practices identified from discussions made in Sections 2.5 to 2.7 are as following:

(a) Top management commitment
(b) Empowered teams
(c) Cross training
(d) Strategic vision & planning
(e) Plant environment
(f) Information system
(g) Relationship with suppliers
(h) Relationship with customers
(i) Change proficiency
(j) Knowledge management
(k) Advance manufacturing technology

The literature summary of major empirical studies on relationship between AM and organizational performance is presented in Table 2.11.

PHASE - III

2.8 LEAN (TQM & JIT) AND AGILE MANUFACTURING RELATIONSHIP

Lean and Agile as management improvement initiatives have emerged as 21st century manufacturing paradigms (Shah & Ward, 2003; Yusuf & Adeleye, 2002). Lean and AM are often viewed in the literature with the lens of isolation or in progression (1999a). Harrison (1997) expressed his "doubts" over compatibility of companies following Lean initiatives and moving towards agility, whereas, Papadopoulou and Özbayrak (2005) claim that Lean is a holistic approach and contains all essential elements of AM and there is nothing like "Agility or Leagile". On the other hand, Gunasekaran et al. (2008) and Ramesh and Devadasan (2007) argued that critical elements required for Agile performance are part of Lean manufacturing

Table 2.11. AM and Organizational Performance – Summary of Major Empirical Studies

Studies	Sample	Industry	Contextual variables	Core Agile Practices	Common Infrastructure practices	Performance outcomes	Method	Findings
Zhang and Sharifi (2000)[a]	1. 1,000 companies 2. 12 case studies	1. Electrical and Electronic Manufacturing sector 2. Aerospace Manufacturing sector 3. Vehicle Parts Manufacturing sector	1. Changes in market 2. Changes in competition criteria 3. Changes in customer requirements	1. Partnership with suppliers and/or customers 2. integrated product development process 3. Establishing virtual organization 4. Adoption of advanced technology 5. Mass-customisation 6. Sub-systems integration 7. Flexible, responsive to changes, flat, and learning organization 8. Benchmarking 9. Management training 10. Flexible manufacturing Processes 11. Concurrent team working methods 12. Continuous training and education of all people	1. JIT/Kanban 2. CIM 3. TQM 4. Concurrent Engineering 5. Flexible Manufacturing System (FMS) 6. Lean manufacturing 7. CAD/CAM/CAE 8. Robot Technology 9. Joint venturing 10. Rapid prototyping 11. Information system	1. Competency 2. Responsiveness 3. Flexibility 4. Quickness	Network modelling	The proposed methodology was validated through case studies and survey.
Cao and Dowlatshahi (2005,2006)[a]	102 Respondents	1. Construction, mining, and materials handling. 2. General industrial machinery and equipment. 3. Computer and office equipment. 4. Refrigeration and service industry machinery. 5. Miscellaneous industrial and commercial.	1. Industry type 2. No. of employees	**Virtual Enterprise (VE)** 1. Sharing infrastructures, R and D, and financial resource 2. Linking complementary core competencies 3. Reducing concept-to-cash time through information sharing 4. Expending production capabilities 5. Gaining access to markets and sharing markets or customer loyalty 6. Focusing on solutions rather than selling products **Information Technology(IT)** 1. Electronic Data Interchange(EDI) 2. Groupware 3. Intranets 4. Extranets 5. ERP	**Agility Criteria** 1. Marketplace nature 2. Competitors' circumstances 3. Technology changing situation 4. Criticality of relation with suppliers 5. Customer requirements change level and rate 6. Social/cultural changes 7. Products/processes complexity	**1. Market performance** • Market Growth • Market share gains • Sales growth • Revenue growth **2. Financial Performance** • Return on investment • Return on sales • Liquidity • Cash flow • Profitability **3. Product/Service Innovation** • Developments in business operations • Developments in products and services **4. Company Reputation**	1. ANOVA (pairwise t-test) 2. Euclidean Distance	VE and IT impacts were checked on a set of performances. It was revealed that IT and VE positively relate with performance in all industrial sectors. Moreover, it was found that their alignment impacts were more significant than individual contribution. Moreover, IT was also found positively associated with VE.

Continued (Table 2.11)

Studies	Sample	Industry	Contextual Variables	Core Agile Practices	Common Infrastructure Practices	Performance Outcomes	Method	Findings
Vázquez-Bustelo et al. (2007)	274 firms 283 respondents Spanish firms	1. fabricated metal products 2. Machinery 3. Office machinery 4. Electrical machinery 5. Electronics 6. Medical instruments 7. Watches and clocks 8. Motor vehicles 9. Transport equipment	1. Turbulent environment • Dynamism • Hostility 2. Process type 3. Product type 4. Firms with more than 100 employees	1. Agile human resources 2. Value chain integration 3. Concurrent engineering 4. Agile technologies 5. Knowledge management	–	**1. Manufacturing strength** • Cost • Flexibility • Quality • Delivery • Service • Environment **2. Business performance** ROA Sales volume Customer loyalty productivity	Structural equation modelling	Environmental turbulence triggers the AM. AM, a system integrated approach, leads to better manufacturing strength, which in turn increases business performance. However, process, product, industry and firm size effects were not checked.
Zhang and Sharifi (2007)[a] **and** Zhang (2011)[a]	1. 57 plants 2. 5 Case Studies	1. Electrical and Electronic Manufacturing sector 2. Aerospace Manufacturing sector Vehicle Parts Manufacturing sector	1. No. of employees 2. Sales turnover 3. New product success 4. % of complete innovations in new product introduction 5. Lead time from concept to cash for products	1. Relationship with supplier/customer/ competitors 2. Technology 3. Integration 4. Organization 5. People 6. Innovation 7. Relation with Customer 8. Information Systems	**Agility Drivers(AD)** 1. Changes in market 2. Changes in competition criteria 3. Changes in customer requirements 4. Changes in Technology 5. Change in Social Factors 6. Internal Drivers	1. Proactiveness 2. Competency 3. Responsiveness 4. Flexibility 5. Quickness 6. Partnership 7. Customer Focus	1. Cluster analysis 2. Discriminant analysis 3. ANOVA (pairwise t-test)	Three strategic groups based on capabilities, responsive, quick and proactive were established through cluster analysis. Proactive group was much affected by all the Agility Drivers and Agility Providers, however, people effects were not found among groups. Further using discriminant analysis two major groups were found ‘proficient to change’ and ‘quick to customer’. No strategy difference was found among industrial sectors. Significant difference was found among contextual variables, except % of complete innovations in new product introduction, which marginally qualify. However, plant size and sales turnover effects were not tested.

Continued (Table 2.11)

Studies	Sample	Industry	Contextual Variables	Core Agile Practices	Common Infrastructure Practices	Performance Outcomes	Method	Findings
Kisperska-Moron and Swierczek (2009)	96 Companies	1. Mining sector 2. Miscellaneous manufacturing 3. Building sector 4. Commerce 5. Financial services 6. Real estate agencies 7. Transportation services 8. Telecommunication 9. Other services	No. of employees	Four Major Areas 1. The relations of the company with its main customers 2. The relations of the company with its main suppliers 3. The relations of the company with its main competitors 4. Intensity of Information Technology used in the industry	–	-	Factor analysis Cluster analysis	Through factor analysis four set of factors were extracted. Then companies were separated on the basis of cluster analysis. Commercial and service industries were found close to the customer, whereas, manufacturer focused on supplier relationship. Relationship with partners (customer, supplier) and IT were found more associated with agility as compared to relation with competitors.
Yauch (2010)	4 Companies (case study)	1. Art suppliers 2. Metal stampings 3. Infrared equipment 4. Motor vehicles	**Environmental Turbulence** 1. Product customization 2. Product variety 3. Corporate parent 4. Weather 5. General economy 6. Competitive pressures 7. Government 8. International business 9. Product complexity 10. Supplier criticality 11. Technology 12. Unions 13. Stock market	-	-	1. Revenues 2. Cost of goods sold 3. Gross margin	Mathematical formula developed by author	Organizations having high agility score calculated based on turbulence and performance will remain in the business.

Continued (Table 2.11)

Studies	Sample	Industry	Contextual variables	Core Agile Practices	Common Infrastructure practices	Performance outcomes	Method	Findings
Bottani (2010)[a]	190 firms	1. Health care 2. Utilities 3. Commercial 4. Manufacturing 5. Food	**Agility Drivers(AD)** 1. Changes in market 2. Changes in competitors or competitive bases 3. Changes in customer's need 4. Technological changes 5. Social factors **Organizational Context(OC)** 1. Market segment where the company operates 2. Number of employees 3. Annual aggregate turnover 4. Average number of new products developed per year	**Agile Attributes (AA)** 1. Concurrent execution of activities 2. Enterprise integration 3. Information accessible to employees 4. Multi-venturing capabilities 5. Developed business practice difficult to copy 6. Empowered individuals working in teams 7. Cross functional teams 8. Teams across company borders 9. Decentralized decision making 10. Technology awareness 11. Leadership in the use of current technology 12. Skill and knowledge enhancing technologies 13. Flexible production technology 14. Quality over product life 15. Products with substantial value-addition 16. First-time right design 17. Short development cycle times 18. Continuous improvement 19. Culture of change 20. Rapid partnership formation 21. Strategic relationship with customers 22. Close relationship with suppliers 23. Trust-based relationship with customers/suppliers 24. New product introduction 25. Customer-driven innovations 26. Customer satisfaction 27. Response to changing market requirements 28. Learning organization 29. Multi-skilled and flexible people 30. Workforce skill upgrade 31. Continuous training and upgrade 32. Employees' satisfaction	**Agility Enablers (AE)** 1. CNC machine 2. CAD or CAM systems 3. CAT systems 4. FMS or FAS 5. CAPP / CAIP 6. Automated assembly (AA) tools 7. (TQM) systems 8. Intra-net connection 9. ERP systems 10. Extra-net connection with networked companies 11. Information and Communication Technology(ICT) tools 12. Quality Function Deployment (QFD) for integrated product/process design and development 13. Financial measures (e.g. return on investment, sales revenue, increase in market share) or non-financial measures (e.g. time to develop new products, time to market, manufacturing cycle time) to evaluate partnership performance 14. Failure Mode and Effect Analysis (FMEA) and robust design techniques 15. Time-value analysis techniques 16. Management Information Systems 17. Virtual Prototyping tools 18. Electronic Data Interchange	**Competitive Priorities(CP)** 1. Product mix 2. Response to anticipated change 3. Response to unpredictable change 4. Response to unanticipated change 5. Amount of production 6. Production costs 7. Product quality 8. Delivery lead time 9. Products flexibility 10. Process flexibility 11. Innovation 12. Proactivity 13. Service level delivered to customers **Business Performance (BP)** 1. Current market share 2. Average annual increase of turnover and market share 3. Current competitive position	1. Cluster analysis 2. Factor analysis	Based on competitive priorities companies were distributed into three differentiate-able groups (Agile, Lean, No focus). Agile group focus on response to change and production mix, Lean were more efficient in cost, and quality aspects were common in all groups. Change in market significantly affected all market segments, whereas, social factors were lowest. AA (continuous improvement, quality over product life, followed by trust-based relation with customers / suppliers, customer satisfaction) were extremely followed, relating their response to AD (changes in customer need). No difference was found among AA application among market segments, except, on suppliers' relationship by manufacturing segment and learning organization by health care sector. Whereas, trust based relation got maximum attention by all segments. Out of 18 enablers only 5 were found important, e.g., ICT got maximum ranking. AA through factor analysis were factorised into 8 main factors, (workers empowerment and training, technology decision, customer focus, integration, teams, partnership, quality, and aptitude to change), out of which two main factors with one third of total variance (i.e., workers development and technology decisions). Enablers were characterised as ICT, TQM, AMT and time compression. Moreover, organizational contextual, except market segments, were not tested due to sample size limitations.

Continued (Table 2.11)

Studies	Sample	Industry	Contextual Variables	Core Agile Practices	Common Infrastructure Practices	Performance Outcomes	Method	Findings
Inman et al. (2011)	96 large US Manufacturers	General Manufacturing	1. Environmental uncertainty 2. Firms with more than 100 employees	1. Capability to sense market change 2. Production processes' flexibility 3. Reaction to change 4. Technological capability 5. Strategic vision towards flexibility and agility 6. Skilled workforce 7. Timely products delivery	-	**Operational Performance** 1. Customer satisfaction 2. Product customization 3. Delivery speed 5. Delivery dependability 6. Responsiveness 7. Order flexibility 8. Delivery 9. Information systems support 10. Order fill capacity 11. Advance ship notification **Market performance** Market share Sales volume **Financial performance** ROA Profitability Profit growth ROS	Structural equation modelling	JIT production did not support AM. However, JIT supply mediated the path between JIT production and AM. Moreover, environmental uncertainty did not moderated the relationship between AM and OP
Yusuf et al. (2014)	95 Supply Chain Managers	Oil and Gas Industry (UK)	-	1. Enriching the customer 2. Leveraging the impact of people and information 3. Cooperating to compete 4. Mastering change and uncertainty	-	**Competitive Objectives** 1. Delivery 2. Proactivity 3. Dependability 4. Quality 5. Flexibility 6. Cost 7. Innovation 8. Speed **Business Performance** 1. Turnover 2. Net profit 3. Market share 4. Customer loyalty 5. Performance relative to competitors	Bivariate - Correlation	No significant relationship, as a whole, was found between enriching the customer and all business performance measures. Moreover, a significant relationship was found between Agile Core Practices and competitive objectives, with an exception of insignificant relationship between leveraging the impact of people and information and delivery. The study highlighted the paradigm shift of competition among firms from individual competencies to the strength of their entire supply chains because of increased market volatility, complexity and decreasing predictability. Furthermore, degree of change in agility is sturdily linked with business type and its operating environment. The firms having long-term relations with suppliers enjoy high customer loyalty.

[a]Core and infrastructure practices classification is given by the Researcher, as respective research studies does not explicitly categorised these practices.

(JIT, employees involvement/empowerment, etc.) (Bottani, 2010). Moreover, Shah and Ward (2003) considered AM as part of one of the Lean bundles (JIT).

Paradoxically, the existing literature is still clumsy to demarcate with sufficient exactitude to differentiate between Agile and Lean paradigms. Today organizations are operating in "hyper-competition" environment (D'Aveni, 1995; Veliyath, 1996), with resource constraints (Katayama & Bennett, 1999), explicitly need to know the exact compositions of these paradigms, their commonalities and differences (Narasimhan et al., 2006, p. 440). This debate has found three schools of thoughts in the literature (Krishnamurthy & Yauch, 2007).

(a) Mutually exclusive (competing)

(b) Mutually supportive (complementary)

(c) Mutually supportive (Lean (TQM & JIT) is antecedent to AM)

Ambiguity exists in OM literature on, which one is precursor to the other. Option (b) & (c) are inter-related. However, few questions need clarification. Which one is precursor to the other? Can both be employed as precursor to each other squarely or only one is precursor to the other? If yes, then which one is precursor to the other? This study will investigate thoroughly this missing theoretical link. Literature summary on Lean (TQM & JIT) and AM relationship is presented in Table 2.12 and 2.13 respectively.

2.8.1 MUTUALLY EXCLUSIVE PARADIGMS

Harrison (1997), was the first one who expressed his serious "doubts" over the compatibility of Lean with AM. The author expressed Lean limitations to adapt with environmental turbulence, shrinking life cycles, increased degree of mass-customization, market fragmentation, response to unanticipated spikes in the customer preferences, due to its consistent and stable process and SCM. The author further discerned Lean from Agile as, "Lean reduce time from order to cash", whereas, "Agile reduce time from concept to cash" (Harrison, 1997, p. 257). Z. Zhang and Sharifi (2007, p. 353) claimed AM as a business-wide manufacturing strategy. It actuates by environmental changes known as "Drivers". To respond these changes enterprise develop a set of capabilities priorities through a trade-off between capabilities required and constraints posed by the resources, known as "tasks" (Harrison, 1997). This trade-off also depicts enterprise "strategic intent" towards change (Hamel & Prahalad, 1994). To neutralize these changes organizations take certain decisions to streamline their business structure like process integrations, technology up-gradation, quality systems, workers' skill development, etc., (Gunasekaran et al., 2008).

Brown and Bessant (2003), noted that to meet market challenges a number of improvement initiatives have been devised like LP (Womack et al., 1990), Mass Customization (Bessant et al., 2001) and AM (Goldman & Nagel, 1993). These paradigms are neither identical nor are interchangeable due to peculiarity in their scope. Narasimhan et al. (2006) identified that both paradigms approach same competitive capabilities (quality, deliver, cost and flexibility) but their path to reach these goals is different (Hallgren & Olhager, 2009). The authors further found that difference from performance perspective was identifiable, whereas, from practice perspective much difference was not found, rather a few practices (JIT, flow, TQM) associated to Lean practices were found more persuading by AM. Hallgren and Olhager (2009, p. 978) stated that apart from commonalities among Lean and AM ("waste elimination, setup time reduction, continuous improvement, 5S and other quality improvement tools"), yet, Lean and AM could be clearly delineated respectively on strategy (low cost and differentiation), core practices (schedule levelling and mass customization) and competitive priorities (low cost and flexibility) (Mason-Jones et al., 2000, p. 55). Hallgren and Olhager (2009, p. 989) also found that Lean is less sensitive to market change as compare to AM and degree of change in market is directly proportion to the degree of agility achieved. Naylor et al. (1999, p. 117), contended that although these paradigms are differentiate-able. Nonetheless, it is difficult to make which one is better and which one is worse than the other, rather they complement each other within the perspective of supply chain, and are seriously influenced by organizational environment (Hayes & Pisano, 1994). Vázquez-Bustelo et al. (2007, p. 1307) also maintained that "Lean manufacturing is also identified with a production model that can operate effectively when market conditions are basically stable whereas Agile manufacturing is more appropriate for turbulent situations because of its operational and strategic responsiveness".

Moreover, Lean and Agile irrespective of organization, do exist in every organization's supply chain, and can be separated with the help of a "de-coupling point" as shown in Figure 2.25 (Naylor et al., 1999, p. 113). These five options give leverage to organizations to adjust their manufacturing (supply chain) with respect to the market demand. "Buy-to order" is only suitable where product varieties are high and customer can wait for some time for order to be delivered. This point also discourages keeping high inventory stock. "Make-to-order" focuses towards similar types of products basing on same raw material and lead-time is also high in this case. "Assemble-to-order" is next stage of manufacturing. Leverage is achieved through postponement and customization. This option is seriously threatened by overstock / obsolescence. The final two stages deal with ultimate delivery of standard products and this stage is at utmost risk, due to its serious dependence on forecast accuracy and entire inventory is at serious risk of being out-of-stock/overstock/obsolescence. Much supply line choice moves towards right side, more standardised and stable operation (Lean) will be suitable for an organization to operate. On the other hand, much supply line choice moves to upstream Agile operations are recommended to meet the customer demands with acceptable delivery speed and reliability.

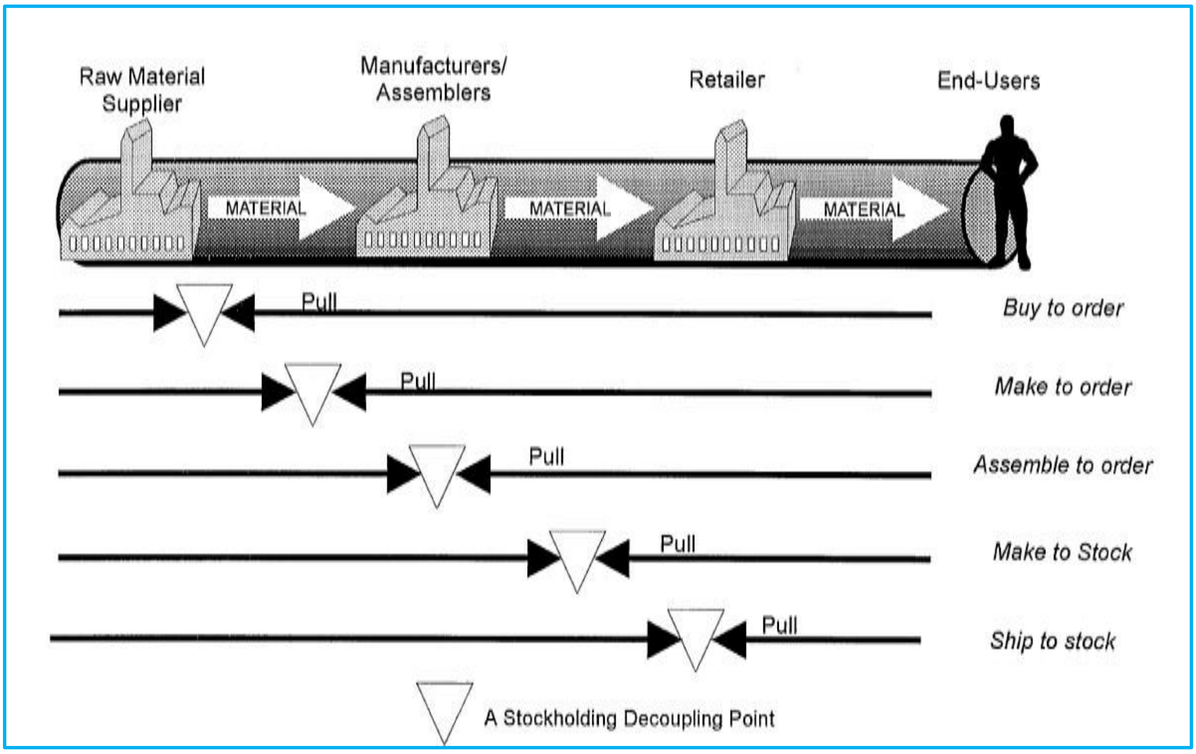


Figure 2.25. Supply Chain Options with respect to Customer Orders

Source: (Naylor et al., 1999, p. 113)

Christopher and Towill (2001, p. 240), further elaborated "de-coupling" point as shown in Figure 2.26. The authors called it strategic inventory point, as up-till this point organizations can keep buffer inventory and using "postponement" strategy from this point onwards can meet the customer requirements.

Prince and Kay also described this relation with respect to upstream and downstream demand dynamics as shown in Figure 2.27 (Prince & Kay, 2003, p. 310). Organizations can have leverage to use Lean operations until strategic inventory point and from onwards to Agile operations.

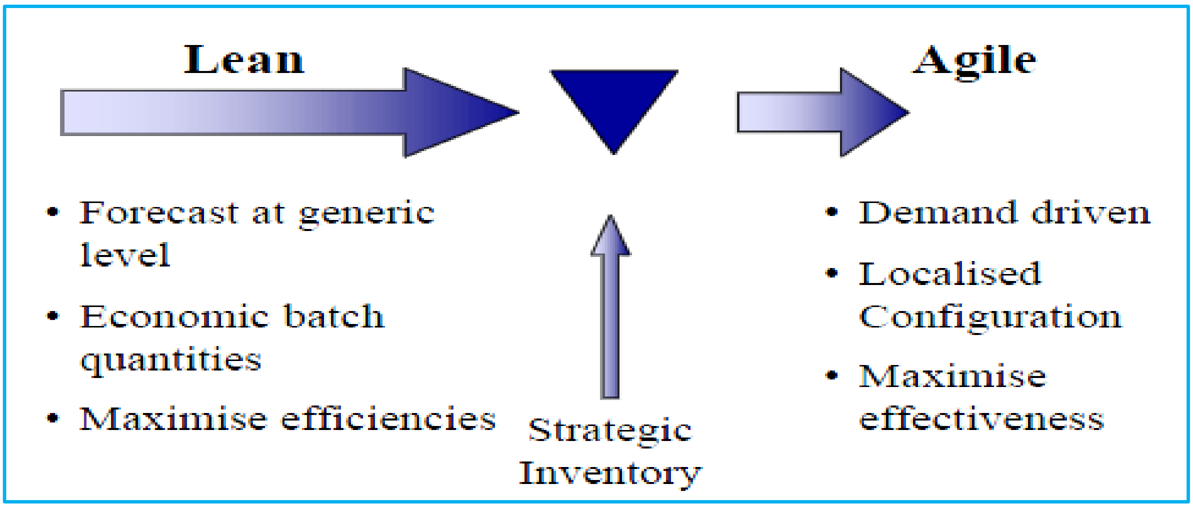


Figure 2.26. Strategic Inventory De-Coupling Point
Source: (Christopher & Towill, 2001, p. 240)

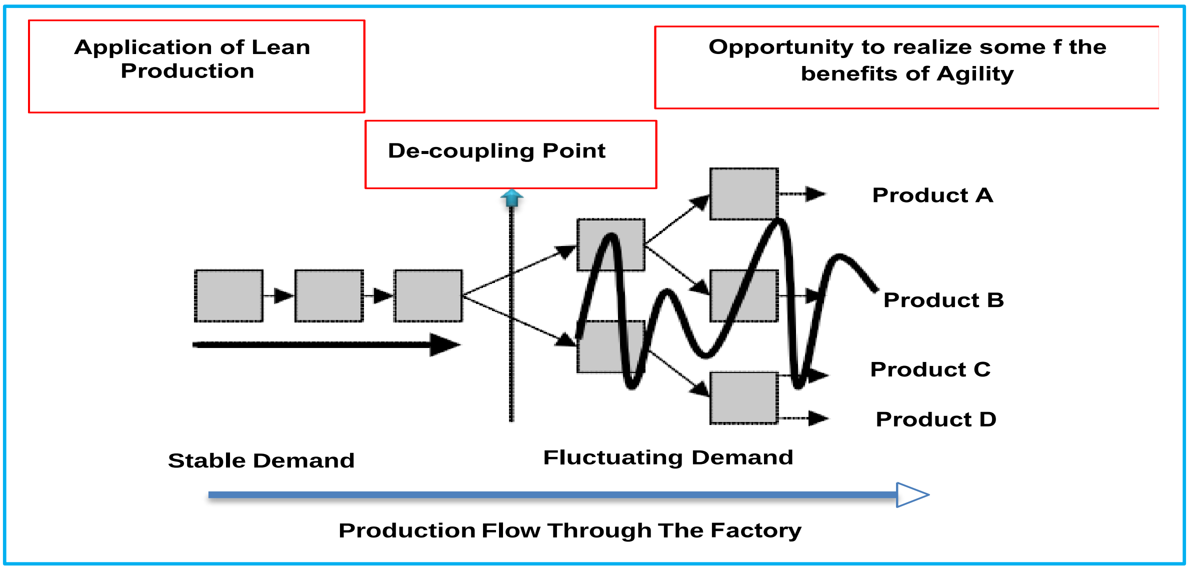


Figure 2.27. Demand Dynamics at De-Coupling Point
Source: (Prince & Kay, 2003, p. 310)

The role of de-coupling point plays a pivotal role between upstream stable production and downstream demand variability. More precisely Lean can be ascribed as forecast driven paradigm (upstream), whereas, AM is associated with customer demand volatility (downstream) (Hallgren & Olhager, 2009, p. 117). Brown and Bessant (2003, p. 710) also suggested that "operations management abilities, including TQM and JIT, provide vital foundations and manufacturing strategy can play a role in developing these capabilities". Narasimhan et al. (2006) also found Lean players focus on "make-to stock" operations, whereas, Agile significantly supports make-to" operations. Similarly, Krishnamurthy and Yauch (2007) also stated that Lean and Agile may exist in a supply chain, but their co-existence is not conceivable due to this decoupling point.

Goldsby, Griffin, and Roath (2006) conducted a study to check the suitability of supply chain (Lean / Agile / Leagile). Through simulation author found that Lean gives better results in customer satisfaction/low cost once ship-to-order option is used, but this was valid only for "involving low value finished goods (up to 10$) at lower inventory carrying cost percentages (30% and below). However the Agile strategy proved to be the low-cost in all other modelled scenarios" (Goldsby et al., 2006, p. 75). It also justifies the difference in the objectives being pursued by Lean and Agile. Lean pursues efficiency (through waste reduction) only, whereas, Agile pursue responsiveness and efficiency squarely (Yusuf et al., 1999). Literature summary on Lean and Agile mutually exclusive paradigms is given in Table 2.12.

2.8.2 MUTUALLY SUPPORTIVE OR LEAN (TQM & JIT) AS ANTECEDENT TO AM PARADIGMS

Goldman and Nagel defined agility as "agile manufacturing assimilates the full range of flexible production technologies, along with the lessons learned from Total Quality Management and Just-in-Time production and Lean production" Goldman and Nagel (1993, p. 19). Shah and Ward explored four Lean-facets, TQM and JIT are two out of those four Lean-facets (Shah & Ward, 2003, p. 138). Moreover, they took AM as sub-part of JIT-facet. Similarly, Papadopoulou and Özbayrak (2005) argued Lean as holistic manufacturing paradigm, which possess qualities of all production paradigms. Katayama and Bennett based on literature defined "Lean as overarching concept that is compatible with any production system and complements the other approaches like adaptability and agility" (Katayama & Bennett, 1999, p. 46).

Richards (1996) stated that literature is yet to be matured enough to distinguish AM from other already available systems. This is principally a matter of facts, that AM roots are deeply interconnected with other systems, such as Lean (Womack et al., 1990), FMS (Sarkis, 2001), time-based competition (Dröge, Jayaram, & Vickery, 2004). Sarkis (2001) defined AM as conjoint set of FMS and LP. Gunasekaran (1998) proposed the suitability of agility (using FMS and JIT systems) to accomplish make-to-order (Gunasekaran, 1998, p. 1233), whereas, TQM is an in-built part of AM and help to develop employees' skill (Gunasekaran, 1998, p. 1236). Overall, BPR, JIT and TQM in combination with technologies can be deployed to attain agility prestige (Gunasekaran, 1998, p. 1245).

Table 2.12. Mutually Exclusive Paradigms

Studies	Lean and AM Relationship - Mutually Exclusive Paradigms
Richards (1996)	Literature is yet not matured enough to distinguish AM from other already available systems.
Harrison (1997)	He has serious "doubts" over the compatibility of Lean with AM.
Yusuf et al. (1999)	Lean pursues efficiency, through waste reduction, only, whereas, Agile pursues responsiveness and efficiency squarely.
Naylor et al. (1999)	Although these paradigms are differentiate-able. Nonetheless, it is difficult to make which one is better and which one is worse than the other is.
Christopher and Towill (2001)	Organizations can have leverage to use Lean operations until strategic inventory point and from onwards to Agile operations.
Brown and Bessant (2003)	These paradigms are neither identical nor are interchangeable due to peculiarity in their scope.
Narasimhan et al. (2006)	Difference from performance perspective was identifiable. Moreover, Lean players focus on "make-to-stock" operations, whereas, Agile significantly supports “engineer, assemble and make-to-order" operations.
Goldsby et al. (2006)	Lean gives better results in customer satisfaction/low cost once ship-to-order option is used, but this was valid only for "involving low value finished goods (up to 10$) at lower inventory carrying cost percentages (30% and below)”. However, the Agile strategy proved to be the low cost in all other modelled scenarios.
Zhang and Sharifi (2007)	AM is a business wide manufacturing strategy
Vázquez-Bustelo et al. (2007)	Lean manufacturing is also identified with a production model that can operate effectively when market conditions are stable whereas agile manufacturing is more appropriate for turbulent situations because of its operational and strategic responsiveness.
Krishnamurthy and Yauch (2007)	Lean and agile may exist in a supply chain, but their co-existence is not conceivable due to decoupling point.
Hallgren and Olhager (2009)	Lean and AM could be clearly delineated respectively on strategy (low-cost and differentiation), core practices (schedule levelling and mass-customization) and competitive priorities (low-cost and flexibility. Moreover, Lean is less sensitive to market change as compare to AM.

Yusuf et al. (1999, p. 36), argued that AM is a set of synthesised practices and technologies, and is fully compatible with TQM, CIM and JIT etc. Sharp et al. (1999) also acknowledged that WCM are in a state of progression towards utmost class of AM, to address competitive priorities more efficiently than ever (Cheng, Harrison, & Pan, 1998). Prince and Kay (2003) developed "enhanced production flow analysis" model for Lean and AM joint implementation, and validated it successfully by implementing at one plant. Hormozi (2001, p. 132) called AM the "next logical step" towards production revolution stating that its roots are deeply linked with its predecessor like Lean (JIT) and MP. Whereas, Jin-Hai et al. (2003, p. 181) declared Agile evolutionary production paradigm and it has evolved from synthesis of previous set of management initiatives like TQM, JIT, work-study etc.

Krishnamurthy and Yauch (2007), also maintained that desired results are not realized, if, Lean and AM are implemented in seclusion. These are highly compatible and can work effectively in a corporate, separated by "de-coupling point". Gunasekaran et al. (2008, p. 559) found JIT as one of the critical success factor to accomplish responsive (agile) Supply chain. Narasimhan et al. (2006) found that manufacturing practices, patent to Lean paradigm, are also equally followed by agile groups, rather in some cases agile group implement Lean more rigorously as compare to Lean group. Lean practices like SPC (Flynn et al., 1995a) and benchmarking (Ahire et al., 1996a) implementation score was same in Lean and AM groups. Moreover, Agile dominated Lean group on Lean Core Practices, like TQM and JIT flow etc. (Shah & Ward, 2003). Inman et al. (2011) found that Lean (JIT supply) as antecedent to AM. Whereas, Lean (JIT flow) and AM path was mediated through JIT supply. Similarly, Zelbst et al. (2010) found that Lean (TQM & JIT) are antecedent to AM and are TQM directly and JIT indirectly positively associated with AM respectively. Literature summary on Lean and Agile mutual supportive or one antecedent to the other relationship is given in Table 2.13.

Sub-sections 2.8.1 and 2.8.2 provide a brief overview of Lean (TQM & JIT) and AM relation, (mutually exclusive, mutually supportive and Lean (TQM & JIT) as antecedent to AM). Mostly evidences reported to support this argument base on theoretical explanation or anecdotal. It can be summarised that AM is nothing new in manufacturing arena, rather has evolved over a period of time and have developed over strong foundations of Lean (TQM & JIT). Literature is of the opinion that Lean (TQM & JIT) is antecedent to AM implementation. This study is a step forward to resolve this long un-resolved issue. Moreover, this study will also cater for internal (organizational) and external (business environment) contextual influence.

Table 2.13. Mutually Supportive or Lean (TQM & JIT) as Antecedent to AM Paradigms

Studies	Lean And AM Relationship - Mutually Supportive / Antecedent Paradigms
Goldman and Nagel (1993)	Agile manufacturing assimilates the full range of flexible production technologies, along with the lessons learned from Total Quality Management and Just-in-Time production and Lean production.
Richards (1996)	AM roots are deeply interconnected with other systems
Gunasekaran (1998)	Proposed the suitability of agility (using FMS and JIT systems) to accomplish make-to-orders, whereas, TQM is an in-built part of AM and help to develop employees' skill. Overall, BPR, JIT and TQM in combination with technologies can be deployed to attain agility prestige.
Naylor et al. (1999)	Compatible to each other.
Katayama and Bennett (1999)	Lean as overarching concept that is compatible with any production system and complements the other approaches like adaptability and agility.
Yusuf et al.(1999)	AM is a set of synthesised practices and technologies, and is fully compatible with TQM, CIM and JIT etc.
Sharp et al.(1999)	WCM are in a state of progression towards utmost class of AM, to address competitive priorities more efficiently than ever.
Hormozi (2001)	AM the "next logical step" towards production revolution and its roots are deeply linked with its predecessor like Lean (JIT) and MP.
Brown and Bessant (2003)	Operations Management abilities, including TQM and JIT, provide vital foundations and manufacturing strategy can play a role in developing these capabilities.
Prince and Kay (2003)	Developed "enhanced production flow analysis" model for Lean and AM joint implementation, and validated it successfully by implementing at one plant.
Jin-Hai et al. (2003)	Agile evolutionary production paradigm and it has evolved from synthesis of previous set of management initiatives like TQM, JIT, work-study etc.
Shah and Ward (2003)	Used AM as sub-part of JIT-facet.
Papadopoulou and Özbayrak (2005)	Declared Lean as holistic manufacturing paradigms, which possess qualities of all production paradigms.
Narasimhan et al. (2006)	Manufacturing practices, patent to Lean paradigm, equally being followed by Agile groups.
Krishnamurthy and Yauch (2007)	Desired results, are not realized, if, Lean and AM are implemented in seclusion. These are highly compatible and can work effectively in a corporate, separated by "De-Coupling Point".
Zelbst et al. (2010)	Lean (TQM & JIT) found directly and indirectly positively associated with AM respectively.
Gunasekaran et al. (2008)	JIT as one of the critical success factor to accomplish responsive (agile) Supply chain.
Inman et al. (2011)	Lean (JIT supply) is antecedent to AM. Whereas, Lean (JIT flow) was also found positively associated with AM, though mediated through JIT supply.

2.9 LEAN (TQM & JIT) AND AM RELATIONSHIP WITH ORGANIZATIONAL PERFORMANCE

Literature is replete with theoretically arguments about Lean and AM relationship (Gunasekaran, 1998, 1999a, 1999b), but the validity of those theories is seriously missing in OM literature. However, very less large scale empirical evidence has been reported on this aspect so far (Narasimhan et al., 2006; Yusuf & Adeleye, 2002) and needs thorough investigation.

Yusuf and Adeleye (2002) endeavoured to check the relationship between Lean and AM. A sample of 109 firms from UK manufacturing industry (automobile, fashion, including textiles, food, drink, chemical, and pharmaceuticals, computer, office & communications, electrical and electronics, industrial, hospital and agricultural, aircraft and ship-building) participated in the industry. Mostly firms were having business dimensions expanded globally. Using correlation methodology relationship was tested in three steps. At first step, relation among Agility Drivers and performance measures was tested. All Agility Drivers were significantly related to performance measures except, % sales new products. At second step, capabilities' relationship was tested with Agility Drivers. Speed to market, dependability, new technology leadership significantly correlated with manufacturing technology, information technology and global competition. At third step, relationship was tested between capabilities and performance. A positive significant relationship was observed between all the capabilities and performance measures, except cost. Cost was found negatively associated with sales turnover in Agile environment. However, no significant difference was observed between performance and capabilities like quality and custom production.

Firms were divided into two groups (high and low performers) based on their means score on performance, capability and drivers. Authors using a novel approach found significance of capabilities among high and low performer groups. Each group capabilities means scores were calculated and then mean's range were calculated, Agile group with low range, was found more focused towards all capabilities, as compared to low performer who had high range of mean's score among capabilities, due to much focus on cost as compared to other capabilities. Moreover, no demographic differences were observed. Authors also argued universal application of AM drivers and declared it free from context limitations, which is seriously contrary to contingency theory (Hayes & Pisano, 1994; Skinner, 1969). It is worth noting that organizations differences were observed on same capabilities, performance and drivers. Just because of capability focus groups' difference were called either Lean or Agile. No specific set of practices was designed for each group.

Narasimhan et al. (2006), also made an endeavour to resolve this paradoxical relation between Lean (TQM & JIT) and AM. Using a sample of 281 US manufacturing plants, the authors found that performance gap between Lean and Agile groups was identifiable, whereas, practices were so tightly overlapped that both groups could not be differentiated. 19 (Nineteen) major practices were selected from literature related to either of the group. At first stage using cluster analysis, groups were divided into three groups based on performance. Salient results of the study are as following:

(a) Lean outperforms low performer group on all performance and practices measures, except MRP/ERP and supplier certification.
(b) AM (group) outperform others on all performance measures except low cost.
(c) Lean and Agile were at par on SPC & benchmarking.
(d) On all other practices Agile group outperformed all others. Moreover, a few Lean patent practices like TQM, JIT flow, skilled workforce etc., were being followed more consistently by Agile group.
(e) Plant workers effects were significant, in fact, Agile groups ware more focused towards less employees, which is again contrary to theory as Lean group is theorised to have less no. of workers as compare to others (Krafcik, 1988; Shah & Ward, 2003; Womack et al., 1990). Moreover, agile group was found more focused towards make-to operations and Lean, towards make-to-stock (Christopher & Towill, 2001; Naylor et al., 1999).

It can be safely maintained that agility seriously based on most of the same practices patent to Lean manufacturing like empowered work force (MacDuffie, 1995), JIT flow (Christopher & Towill, 2001), reduced cost and lead time (Gunasekaran et al., 2008) etc.

Hallgren and Olhager (2009) extended the boundaries of Lean and AM by relating competitive pressures, with organizational (low-cost, differentiation) and manufacturing (Lean and AM) strategies, and checking their impact on individual competitive performance measure. The study sample comprised 211 plants, from seven countries and three major industrial sectors (1) machinery, (2) auto suppliers, (3) electronics. Using SEM, it was found that competitive intensity influence competitive strategy (low-cost/differentiation). Competitive strategy influenced manufacturing strategy. Competitive intensity did not influence manufacturing strategy, however strategy (low cost / differentiation) did mediate the relation pressure and manufacturing approach. Lean was found positively associated with all performance measures, whereas, Agile negatively loaded on cost. Moreover, Agile performers were better on all performance measures, except cost, than Lean performers.

Similarly, Inman et al. (2011), made an effort to establish the relationship between Lean (JIT production & JIT supply) and AM. A sample of US manufacturing firms generally having employees > 250 was selected to check the hypothesised relation. The author used Lean (JIT production & supply) as antecedent to AM. The study failed to establish a positive relation between JIT production and AM contrary to prevailing theory (Narasimhan et al., 2006; Zelbst et al., 2010). The probable justification offered by the author can be summarized as following:

(a) JIT might already be in place and integral part of AM, so that their marginal difference could not be differentiated.

(b) Nevertheless, JIT supply mediated the AM→JIT production relation. This can be supported as Sakakibara et al. (1997) also supported that JIT alone failed to give results until not employed along with associated infrastructure practices like quality, workforce etc.

(c) Interestingly, the study also failed to find the moderating impact of environmental uncertainty, a prerequisite to enable AM (Vázquez-Bustelo et al., 2007). Study did not provide any justification to this unusual result.

(d) However, following grounds were offered to justify these unusual results. First, the sample size was too small to test the (SEM) model. Second, measurement scales were inconsistent, as JIT production was measured as categorical variable, contrary to other variables, which were measured as continuous variables. Thirdly, only large similar organizations were included in the study, where it might get difficult to differentiate the difference, if at all exist, between different practices followed by these organizations as such management practices take the form of organizational culture.

(e) However, author also suggested to expand the theory boundaries by testing such relation by including other essentials of Lean (TQM, TPM & HRM etc) (Inman et al., 2011, p. 352).

Recently, Zelbst et al. (2010) attempted to resolve this issue through integrated application of Lean (TQM & JIT), AM along with Market Orientation (MO). A sample of 104 senior managers (quality and supply chain) from US manufacturing sector participated in this study. They found that MO positively elicited JIT, TQM & AM. Using path analysis, as sample size was not sufficient to conduct SEM, the authors claimed customer orientation as major driving force to the organizational internal functions. JIT positively elicited TQM through small lot sizes. TQM in combination with JIT and through process control elicited AM. Surprisingly, JIT and TQM did not influence OP (Operational Performance as Efficiency), however it was achieved indirectly through AM. AM positively contributes in OP as well as LP (Logistics Performance as Flexibility) such as customer satisfaction, responsiveness, order fill capacity and delivery speed & dependability. The authors provided the probable justification for insignificant relation between Lean (TQM, JIT) and OP, as although inventory level controlling does provide efficiency but those levels should not be below than a certain level that customer choice gets restricted which is against customer oriented business theory. Moreover, TQM and JIT as per (ToS) actually provide elicited (through efficient inventory control and continuous process improvement) to AM and this, as organization wide strategy, bridges the relation between customer satisfaction and business wide results.

From above discussions, it is imperious to conclude that literature is indecisive among researchers on Lean and AM relation as a few are for it (Narasimhan et al., 2006; Zelbst et al., 2010) and few reject it (Inman et al., 2011; Yusuf & Adeleye, 2002), moreover, few claimed it as universally constant (Yusuf & Adeleye, 2002), on the other hand few seriously declared these context dependent (Goldman et al., 1995). Goldman et al. (1995) also noted that agility implementation is deeply interconnected with organizational context. Therefore, an in-depth study integrating Lean (TQM & JIT) with AM in the complete horizon of context (internal & external), structure (internal organization operations) and performance (capabilities) links is deem necessary to resolve this theoretical issue. Moreover, yet no study is reported, in the field of OM literature, which clearly spells out that what are common internal and common external set of practices require to enable core TQM, core JIT and core AM in a single framework in an agile working environment. Core TQM and Core JIT practices are reported in the literature but Core AM practices still needs to get more matured in OM literature. This study is designed to address these long outstanding issues in the field of OM. Summary of major empirical studies on Lean (TQM & JIT) and AM relationship with organizational performance is given in Table 2.14.

Table 2.14. Lean (TQM & JIT) and AM Relationship with Organizational Performance – Summary of Major Empirical Studies

Studies	Sample	Industry	Contextual Variables	Core Agile Practices	Core Lean (TQM & JIT) Practices	Common Infrastructure Practices	Performance Outcomes	Method	Findings
Yusuf and Adeleye (2002)[a]	109 Firms (chief executives)	1. Automobile 2. Fashion, including textiles 3. Food, drink, chemical, and pharmaceuticals 4. Computer, office & communications 5. Electrical and electronics 6. Industrial, hospital and agricultural 7. Aircraft and ship-building	1. Size by employees 2. Size by turnover 3. Broad product groups	**Capabilities** 1. Low cost 2. Speed to market 3. Dependability 4. New technology leadership 5. Quality 6. Custom production		1. Manufacturing technology 2. Information Technology 3. New products 4. Global competition 5. Product customisation	1. Sales turnover 2. Net profit 3. Market share 4. % Sales-new products 5. Customer loyalty 6. Performance relative to competitors	Correlation	All agility drivers were significantly related to performance measures less % sales new product. Speed to market, dependability, new technology leadership significantly correlated with manufacturing technology, information technology and global competition. Except low cost, which has a negative significant correlation of 0.3 with sales turnover, all other correlations were positive. Quality and custom production did not correlate significantly with any Agility Driver or business performance measures. Companies paying equal attention on all competitive objectives outperform all other companies. No demographic differences were observed, hence establishing agility a universal strategy.
Narasimhan et al. (2006)	281 Plants (plant managers)	US manufacturing plants	1. No. of factory workers 2. Total sales 3. No. of major products 4. Percent continuous flow 5. Percent assembly line 6. Percent batch 7. Percent job shop 8. ETO, MTO, ATO, MTS	1. Advanced MRP/ERP 2. Supplier certification 3. Statistical quality control 4. Benchmarking 5. In-house technology 6. Customer orientation 7. Integrated product design 8. Teams 9. Advanced manufacturing technologies 10. Supply base rationalization 11. Supplier development 12. Manufacturing strategy integration 13. TQM 14. Workforce development 15. JIT flow 16. Cellular manufacturing 17. Supplier information sharing 18. Supplier partnership 19. Strategic supplier selection 20. Equipment investment over last 3 years ($1000) 21. Information technology investment over		-	1. Cost 2. Conformance quality 3. Design quality 4. Delivery reliability 5. Delivery speed 6. New product flexibility 7. Process flexibility	1. Cluster analysis 2. Discriminant analysis 3. ANOVA (pairwise t-test)	Lean outperforms low performer group on all performance and practices measures, except MRP/ERP and supplier certification. Agile outperformed others on all performance measures except low cost. Lean and Agile were at par on SPC & benchmarking. On all other practices agile outperformed all others. Moreover, Agile group was more rigorously following a few Lean patent practices like TQM, JIT flow. Plant workers effects were significant; in fact, agile groups were more focused towards less employees. Moreover, Agile was focused towards make-to-operations and Lean towards make-to-stock.

Continued (Table 2.14)

Studies	Sample	Industry	Contextual Variables	Core Agile Practices	Core Lean (TQM & JIT) Practices	Common Infrastructure Practices	Performance Outcomes	Method	Findings
Hallgren and Olhager (2009)	**211 plants** Seven Countries • Finland • Austria • United States • Germany • Sweden • Japan • South Korea	1. Machinery 2. Auto Suppliers 3. Electronics	1. Competitive intensity 2. Competitive strategy • Low cost • Differentiation	1. High customization capability 2. Efficient variety handling 3. New product agility	1. Daily schedule adherence 2. Flow oriented layout 3. Repetitive production	-	1. Unit cost of manufacturing 2. Quality conformance to product specification 3. On time delivery performance 4. Fast delivery 5. Flexibility to change product mix 6. Flexibility to change volume	Structural equation modelling	Competitive intensity influence competitive strategy. Competitive strategy influence manufacturing strategy. Competitive intensity did not influence manufacturing strategy, however, the same was mediated through competitive strategy. Lean was positively associated with all performance measures, whereas, Agile negatively loaded on cost. Moreover, Agile performers were more focused towards performance measures, except cost, than Lean performers.
Zelbst et al.(2010)[a]	104 (manufacturing managers, supervisors, and quality professionals)	Manufacturing Sector	-	1. Capability to sense market change 2. Production processes flexibility 3. Reaction to change 4. Technological capability 5. Strategic vision towards flexibility and agility 6. Skilled workforce 7. Timely products delivery	**TQM** • Customer focus • SPC • Product design **JIT** • Kanban • Plant layout • JIT scheduling • Lot size reduction • Setup time reduction	**Marketing Orientation (MO)** 1. Customer satisfaction 2. Understanding customers' needs as competitive strategy 3. Customers satisfaction measurement 4. Customer service measurement 5. More customer focused than our competitors 6. Business exists primarily to serve customers.	**Operational Performance (OP)** 1. Lead time 2. Product cycle time (through-put time) 3. Due date performance 4. Inventory levels **Logistics Performance (LP)** 1. Customer satisfaction 2. Delivery speed 3. Delivery dependability 4. Responsiveness 5. Order fill capacity	Path analysis	MO positively associates with JIT, TQM and AM. JIT positively contributed in TQM through inventory reduction. TQM positively contribute in AM through process control. JIT and TQM did not explain OP (efficiency), however, through AM it was positively associated. Moreover, LP (flexibility) has significant relation with AM. JIT and TQM did not relate with OP, may be the reason that if TQM and JIT do not provide leverage to the organization to become Agile their effect on OP becomes insignificant. Moreover, relative Low cost, relative high quality, and rapid response to changes in customer demand combine as strategic imperatives to sustainable competitive advantage.

Continued (Table 2.14)

Studies	Sample	Industry	Contextual Variables	Core Agile Practices	Core Lean (TQM & JIT) Practices	Common Infrastructure Practices	Performance Outcomes	Method	Findings
Inman et al. (2011)	96 large US Manufacturers	General Manufacturing	1. Environmental uncertainty 2. Firms with more than 100 employees	1. Capability to sense market change 2. Production processes flexibility 3. Reaction to change 4. Technological capability 5. Strategic vision towards flexibility and agility 6. Skilled workforce 7. Timely products delivery	**JIT Production** 1. Kanban 2. Integrated product design 3. Integrated supplier network 4. Plan to reduce setup time 5. Quality circles 6. Focused factory 7. Preventive maintenance 8. Line balancing 9. Education about JIT 10. Level schedules 11. Stable cycle rates 12. Market-paced final assembly 13. Group technology 14. Program to improve Product 15. Program to improve Process 16. Fast inventory transportation 17. Flexibility of worker's skill **JIT supply** 1. Orders are placed to suppliers and delivered on a daily basis. 2. Our suppliers' warehouses /factories are located nearby. 3. Production plans are shared with suppliers. 4. Small lot size orders are placed with suppliers. 5. Inspection of incoming materials has been reduced. 6. Our staff visits suppliers' plants on an informal basis. 7. We involve suppliers in new product/materials design	-	**Operational Performance** 1. Customer's satisfaction 2. Product customization 3. Delivery speed 5. Delivery dependability 6. Responsiveness 7. Order flexibility 8. Delivery 9. Information systems support 10. Order fill capacity 11.Advance ship notification **Market Performance** 1. Market share 2. Sales volume **Financial Performance** 1. ROA 2. Profitability 3. Profit growth 4. ROS	Structural equation modelling	JIT production did not support AM. However, JIT supply mediated the path between JIT production and AM. Moreover, environmental uncertainty did not moderated the relationship between AM and OP

[a] Core and infrastructure practices classification is given by the author as study does not explicitly categorised these practices.

2.10 LITERATURE SYNTHESIS OF LEAN (TQM & JIT) AND AM PRACTICES

Through discussion made in from Sections 2.2 to 2.9, AM, TQM and JIT are grouped into four easily separable and identifiable groups to investigate the best possible relationship among management, infrastructure (internal and external), core TQM, core JIT and core AM practices. (Ahmad et al., 2003; Flynn et al., 1995a; Ho, Duffy, & Shih, 2001; Lakhal et al., 2006; Sakakibara et al., 1997). These practices are grouped as (a) management practices (b) common infrastructure (internal) practices (c) common infrastructure (external) practices (d) core (TQM, JIT & AM) manufacturing practices. These practices identified though literature review (Section 2.2 to Section 2.9) to be used in this study, are presented in in Table 2.15. A 3-Stage theoretical framework indicating mutual relationship of these set of practices is presented in Figure 2.30.

(a) **MANAGEMENT PRACTICES**

- (1) Top Management Commitment (TMC)

(b) **COMMON INTERNAL INFRASTRUCTURE PRACTICES**

- (1) Cross Training (CT)
- (2) Employees Empowerment (ET)
- (3) Strategic Vision and Planning (SV&P)
- (4) Information System (IS)
- (5) Plant Environment (PE)

(c) **COMMON EXTERNAL INFRASTRUCTURE PRACICES**

- (1) Relationship with Suppliers (RWS)
- (2) Relationship with Customers (RWC)

(d) **CORE MANUFACTURING PRACTICES**

- (1) **CORE TQM PRACTICES**
  - (i) Product Design (PD)
  - (ii) Process Management (SPC)
  - (iii) Continuous Improvement (CI)
- (2) **CORE JIT PRACTICES**
  - (i) Set-up Time Reduction (STR)
  - (ii) Pull System Production (PPS)
  - (iii) Lot Size Reduction (LSR)
  - (iv) JIT Scheduling (JS)

Table 2.15. Summary of Lean (TQM & JIT) & AM Practices

Framework Concept	Framework Practice or Technique	TQM Literature															JIT Literature									AM Literature									
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
TQM	Product design	✓	✓	✓	✓	✓	✓	✓			✓			✓	✓	✓			✓	✓		✓				✓	✓		✓	✓	✓	✓		✓	
TQM	Process management (SPC)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓		✓	
TQM	Continuous improvement		✓		✓	✓				✓	✓	✓	✓		✓						✓			✓	✓	✓			✓	✓		✓	✓	✓	
JIT	Set-up time reduction																✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓			
JIT	Pull system production																✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓		✓	
JIT	Lot size reduction																✓			✓	✓			✓	✓	✓			✓	✓	✓	✓			
JIT	JIT scheduling															✓	✓	✓	✓	✓	✓	✓		✓	✓	✓			✓	✓	✓	✓		✓	
AM	Knowledge management																										✓	✓	✓	✓			✓	✓	
AM	Change proficiency																											✓	✓	✓	✓	✓	✓	✓	✓
AM	Advance manufacturing technology																									✓	✓	✓		✓	✓	✓	✓	✓	
Common Mgmt	Top management commitment	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓		✓		✓	✓				✓	
Common_Int_inf	Cross training	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓
Common_Int_ inf	Empowered Teams	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓
Common_Int_ inf	Information system	✓	✓	✓	✓		✓	✓			✓			✓	✓	✓		✓	✓	✓		✓	✓		✓		✓		✓	✓			✓	✓	✓
Common_Int_ inf	Strategic vision and planning	✓	✓		✓	✓		✓	✓			✓		✓	✓		✓		✓						✓		✓		✓	✓			✓	✓	
Common_Int_ inf	Plant environment	✓	✓	✓												✓	✓	✓	✓		✓		✓	✓	✓							✓			
Common_Ext_ inf	Relationship with customers		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓			✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Common_Ext_ inf	Relationship with suppliers	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

1. Saraph et al . (1989, p. 818)
2. Flynn et al. (1994, p. 345)
3. Flynn et al. (1995a, pp-1358-1359 &1995b, pp-687-690)
4. Anderson et al. (1994, p. 480)
5. Powell (1995, p. 19)
6. Ahire et al. (1996, p. 34)
7. Black and Porter (1996, pp. 19-21)
8. Samson and Terziovski (1999, pp. 405-407)
9. Rungtusanatham et al. (1998, p. 79)
10. Forza and Filippini (1998, p. 6)
11. Douglas & Judge Jr (2001, pp. 168-169)
12. Curkovic et al. (2000, pp. 887-888)
13. Ravichandran & Rai (2000, pp. 411-412)
14. Sila and Ebrahimpour (2005, p. 1128)
15. Zu et al. (2008, pp. 645-647)
16. Mehra & Inman (1992, p. 162)
17. Mckone et al. (1999, pp. 139-143)
18. Cua et al. (2001, pp. 689-692)
19. McLachlin (1997, p. 273)
20. Shah and Ward (2003, p. 138)
21. Ahmad et al. (2003)
22. Shah and Ward (2007, p. 803)
23. Furlan et al. (2011b, p. 811)
24. Yang et al. (2011, pp. 258-259)
25. Narasimhan et al. (2006, pp. 453-456)
26. Vázquez-Bustelo et al. (2007, pp. 1329-1332)
27. Dove (1999, p. 22)
28. Gunasekaran (1998)
29. Zhang and Sharifi (2000, p. 509)
30. Zelbest et al. (2010, pp. 655-657)
31. Inman et al. (2011, pp. 352-353)
32. Sharp et al. (1999, p. 161)
33. Zhang and Sharifi (2007) and Zhang (2011)
34. Yusuf et al. (2012, p. 4)

TQM = Total Quality Management; JIT = Just-in-Time; AM = Agile Manufacturing; Mgmt = Management; Int = Internal; Ext = External; Inf = Infrastructure;

(3) **CORE AM PRACTICES**

(i) Knowledge Management (KM)

(ii) Change Proficiency (CP)

(iii) Advance Manufacturing Technology (AMT)

PHASE - IV

2.11 IMPLEMENTATION OF LEAN (TQM & JIT) AND AM IN CONTEXTUAL APPROACH

This section is further divided into two groups as following:

(a) Contingency Theory (CT)

(b) Institutional Theory (IT)

2.11.1 CONTINGENCY THEORY

The management gurus (e.g., Crosby, 1979; Deming, 1986; Juran, 1986) always backed these practices are universally germane and free from contexts (organizational and environmental) bias (Sitkin et al., 1994, p. 538). Nevertheless, some researchers have seriously questioned universal claim, based on their contradictory results on their universal application, and developed strong arguments regarding these practices robustness and cautioned about context interference (Dean Jr & Bowen, 1994; Sila, 2007; Sitkin et al., 1994). These sets of practices were developed as WCM practices and have wide acceptance in OM research due to their regulatory influence in organizational performance (Flynn et al., 1995a; Rahman & Bullock, 2005; Shah & Ward, 2003). But their performance relation have also been attributed to their validity testing, which was done only on WCM companies and mostly float on managers discernments and not real time secondary data (Flynn et al., 1995a; Konecny & Thun, 2011). Both schools of thought have their rational to support their prerogative. Pro-universal approach proponent it to organizational learning process and limits its success to its maturity. Nevertheless, pro-context school of thought offers their rational as, just applying practices without aligning with organizational structure is going to end up in partial success or may be a catastrophe as well (Hayes & Pisano, 1994; Skinner, 1969). WCM practices shift from universal to context, has a well track record (Sousa & Voss, 2008). OM field has been pragmatically interacting and benefiting other research areas like environmental management (Yang et al., 2011), market orientation (Zelbst et al., 2010) and arena of economics, etc (Amundson, 1998). Skinner work on organizational primacies vis-à-vis structural strength work introduced “contingency theory (CT)”, however, Skinner (1969) work can be further linked back to the work of Woodward (1958), Chandler Jr. (1962), Thompson (1967) and P. R. Lawrence, Lorsch, and Garrison (1967).

Skinner (1969, pp. 138-139) defined fit as "the notion is simple enough - namely, that a company's competitive strategy at a given time places a particular demand on its manufacturing functions, and, conversely, that company's manufacturing posture and operations should be specifically designed to fulfil the task demanded by strategic plans. What is more elusive is the set of cause and effect factors, which determine the link between strategy and production operations". Such fit (strategy-structure) steer to superior organizational performance, and sustenance of OM association with CT (Venkatraman, 1989). But at the same time organizations are always confronted with resource paucity, hence provide a little space for mangers (Hayes & Pisano, 1994), to make a balanced trade-off between requirements and resources called "quasi-fit" (Donaldson, 2001, p. 257). Context significance has been well documented, yet no specific framework, to deal with such concerns with specified boundaries, have been developed/reported so far. Sousa and Voss (2008, p. 703) classified organizational contextual variables into four general categories as following: "(1) national context and culture (2) firm size (3) strategic context (4) other organizational context variables". These contextual factors can also be classified with respect to company control (internal and external). Internal are those where company can play to modify their effects like firm size/process type/strategy etc., on the other hand, company has less control over external context like market/competition/technology turbulence, national/international culture etc. These contingency variables generally can be further explicated as following:

(a) National Context/Culture: Country location (Sila, 2007), degree of development (Yang et al., 2011), national culture (Flynn & Saladin, 2006)

(b) Firm size: employees number (Claycomb, Germain, & Dröge, 1999b; Shah & Ward, 2003)

(c) Strategic context: Degree of international competition (A. Das, Handfield, Calantone, & Ghosh, 2000), rate of new product introduction (Z. Zhang & Sharifi, 2007), environmental uncertainty (Inman et al., 2011), situational uncertainty (Sitkin et al., 1994), operations scope (Sila, 2007), technological advancements (Wang, Chen, & Chen, 2012), types of production process (Narasimhan et al., 2006)

(d) Other Organizational (contextual) Variables: Industry type (Jayaram et al., 2010), equipment age (Cua et al., 2001), plant age (McKone et al., 1999), unionization (Pagell & Handfield, 2000).

CT has yet not been apprehended within specific boundaries. "Lens" have been recognised as a tool for insight investigation of different theories. These "lens" are such a powerful management instrument to look into different philosophies/concepts from different perspective. Researchers use these lenses to investigate the prevailing theories as shown in Figure 2.28.

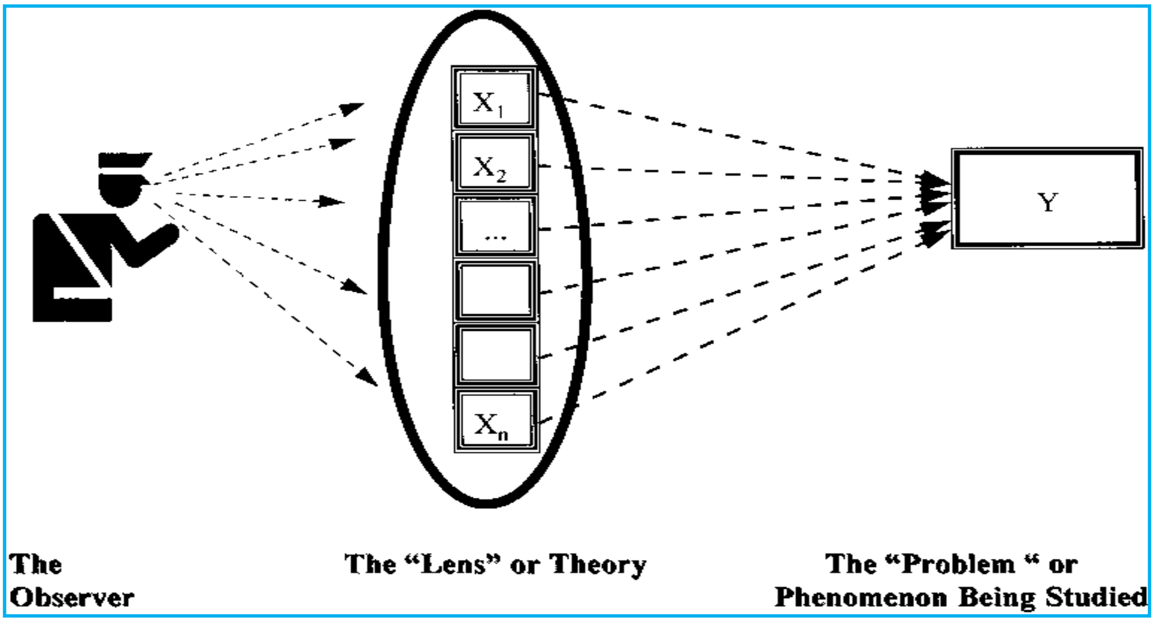


Figure 2.28. Contextual Lens to Investigate Underlying Theories

Source: (Amundson, 1998, p. 345)

A detailed literature review on different contexts and their effect significance/insignificance, is summarised in Table 2.16. Shah and Ward (2003) conclude that Lean (TQM & JIT) are seriously context dependent and organizations with Lean staff are more efficient to perform more effectively (Ahire & Dreyfus, 2000; Claycomb et al., 1999b), whereas, Narasimhan et al. (2006) found Agile organizations are more concerned towards Lean staff than Lean organizations. Moreover, Sila (2007) in his study could not find size (employees) effects (Ahire & Golhar, 1996d). Unionizations impact on management practices also reflected mixed results. Unionization can play an important role due to having strong links with workers work practices and can directly/indirectly influence practices (Jayaram et al., 2010; Pagell & Handfield, 2000; Shah & Ward, 2003). Process types (job shop, batch, continuous and assembly line) reported did not conform to consistency (Cua et al., 2001;

Narasimhan et al., 2006). Management practices across different industries have produced range of results from no-support → weak-support → strong support (Cua et al., 2001; Jayaram et al., 2010; J. J. Lawrence & Hottenstein, 1995; Narasimhan et al., 2006; Shah & Ward, 2003). TQM implementation results vary from strong support (Sriparavastu & Gupta, 1997) to no support (Sila, 2007). ISO certification positively influences business (export performance) (Clougherty, 2009), whereas, Sila (2007) in his study did not find any effect of organizational contexts between TQM and performance relation. Environmental context also known as external fit as market uncertainty, competitive intensity the different name of same contextual factors have strong influence on business strategy and business results. Inconclusive results have been reported in the literature. Mostly studies found positive impact of environmental context (Hallgren & Olhager, 2009; Vázquez-Bustelo et al., 2007; Yauch, 2010), except, a few failures (Inman et al., 2011; Jaworski & Kohli, 1993). Technology turbulence also influence organizations to improve their working environment and enhance process efficiency (Dröge et al., 2004; Terawatanavong, Whitwell, Widing, & O'Cass, 2011; Wang et al., 2012; Z. Zhang & Sharifi, 2007), whereas, Jaworski and Kohli (1993) in their study, did not find any effect of it. Informational Technology has been reported strong contributor in organizational performance (Cao & Dowlatshahi, 2005; Dowlatshahi & Cao, 2006; Ghobadian & Gallear, 1997; Mo, 2009; Narasimhan et al., 2006). Production technology advancements play an important role in meeting the diversified demands of the customers (Vázquez-Bustelo et al., 2007; Yusuf & Adeleye, 2002; Z. Zhang & Sharifi, 2007). A. Das et al. (2000) tested the contingency effects of "degree of international competition" and found its moderating impact between quality practices and customer satisfaction, as well as workers involvement and business performance. Literature on contextual factors impact on Lean (TQM & JIT) and AM is inconclusive, and still need more deep insight investigation. Moreover, researchers have argued that both these paradigms are context dependent and their implementation will not materialise full benefits, if context effects are ignored (Goldman et al., 1995; Shah & Ward, 2003).

2.11.2 INSTITUTIONAL THEORY (IT)

The organizational internal and external pressures (legal, market, customers, partners, social etc) forces organizations to adopt different management initiatives (TQM, JIT, AM etc) and acquire different certifications (ISO-9000, ISO-14000, SA-8000 etc), sometime may be even to qualify in local and international market. The external pressures are further sub-divided into two groups (a) Efficiency (b) Non-efficiency (Sousa & Voss, 2008).

Table 2.16. Literature Summary of Lean (TQM & JIT) and AM Implementation in Contextual Approach

STUDY vs. CONTEXT	Plant Size	Plant Age	Unionization	Capacity Utilization	Process Type*	Production Type@	Industry Type	TQM Implementation	TQM Duration	ISO 9001 Registration	Market Turbulence/ Environmental Uncertainty	Competitive Intensity	Technology Turbulence	Information Technology	Production Technology	Level of International Competition
Cua et al. (2001)	ns			ns	ss											
Ahire & Dreyfus (2000)	ws								ss							
Yusuf & Adeleye (2002)	ns														ss	
Narasimhan et al. (2006)	ns				ws	ss								ss		
Zhang & Sharifi (2007)											ss	ss	ss		ss	
Inman et al. (2011)											ns					
Shah & Ward (2003)	ss	ss	ns				ns									
Hallgren & Olhager (2009)											ss	ss				
Sila (2007)	ns							ns		ns						
Jayaram et al. (2010)	ss		ws				ss		ss							
Yang et al. (2011)	ss															
Vázquez-Bustelo et al. (2007)											ss	ss			ss	
Cao & Dowlatshahi (2005,2006)							ns							ss		
Yauch (2010)											ss					
Bottani (2010)																
Benson et al. (1991)							ss									
Sharp et al. (1999)																
Das et al.(2000)																ss
Ahire and Golhar (1996)	ns															
Pagell & Handfield (2000)			ss													
Lawrence & Hottenstein (1995)	ss				ss		ss									
Droge et al. (2003)	ns										ns		ss		ns	
Claycomb et al (1999)	ss															
Ghobadian and Gallear (1997)	ws															
Clougherty and Grajekm (2009)										ss						
Martincus et al. (2010)										ss						
Sriparavastu & Gupta (1997)								ss								
Terawatanavong et al. (2011)													ss			
Sun (2000)										ws						
Jaworski & Kohli (1993)											ns	ns	ns			
Wang et al. (2012)											ss	ss	ss			
Lima et al. (2000)										ns						
Mo (2009)														ss		
Prajog and Olhager (2012)														ss		

Key: ss = strong support; ws = weak support; ss = strong support ***JOB SHOP / BATCH / CONTINUOUS / ASSY LINE @ ETO/MTO/ATO/MTS**

Efficiency pressures are those, which directly have bearing on organizational efficiency and can be generally categorised as decrease in market share, productivity loss, enhanced international competitive intensity etc. (A. Das et al., 2000) and to respond these efficiency-based pressures organizations adopt different improvement programs like JIT, TQM, AM, BPR. Whereas, Non-efficiency based programs are those, which do not have direct bearing on organizational efficiency, and are acquired just to fulfil certain market, customer, legal or social, requirements (Sila, 2007). These are baptized as institutional and the theory is branded as Institutional Theory (IT). Hence, IT appears as an auspicious theory on landscape of organizational theory and partially deviates from CT. Institutional pressures are further classified into three groups as briefly explained in Table 2.17.

After going through Section 2.11.1 and 2.11.2 internal organizational contextual factors and external business environmental contextual factors identified for investigation are as following:

(a) **Organizational Contextual Factors**

- Firm Size
- ISO-9001 Registration
- Industry Type
- Information Technology

(b) **Business Environmental Contextual Factors**

- Competitive Pressures
- Market Dynamics
- Technological Dynamics

ISO-9001 registration is regarded as part of institutional theory as explained in section 2.11.2. Contextual Factors effects, mentioned in Table 2.15, except IT, are inconclusive in implementation of Lean (TQM & JIT) and AM practices and needs further investigation. This study will investigate the moderating effects of above mentioned organizational and environmental contextual factors effects.

Table 2.17. Institutional Drivers for Adoption / Use of OM Practices

Source: Adapted from (Sousa & Voss, 2008, p. 710)

Category	Definition	Pressure Type and Response
Coercive Pressures	Organizations adopt certain practices because of pressure from the state, other organizations or the wider society	Customer pressure e.g for JIT, ISO-9000 certification, for quality management
Normative Pressures	In certain sectors with professionalized personnel status competition playing to professional criteria can significantly influence the form of the adopted organizational structure	• Legitimization pressures (e.g., image building and gaining credibility with potential customers by achieving ISO9000 Certification. • Pressures from the parent company already using the practices. • Legal requirements (e.g., regulatory pressure for ISO9000 certification
Mimetic Pressures	As a result of bounded rationality and limits on time, energy, as well as substantial uncertainty regarding the efficiency of new practices, organizations copy others by adopting what are perceived to be legitimate practices.	• Fad/fashion effects • Imitation of Japanese manufacturing practices • Benchmarking exercises • Global network effects (e.g., the international spread of ISO9000 practices through business ties

2.12 IMPLEMENTATION OF LEAN (TQM & JIT) AND AM IN CONFIGURATIONAL APPROACH

Configurational perspective is somewhat different from contingency perspective. Contingency perspective scope, being reductionist approach, is limited as compare to configurational perspective (Flynn, Huo, & Zhao, 2010, p. 61). Configurational approach is holistic in nature and can handle multiple contingencies at one time (Ahmad et al., 2003; Flynn et al., 2010; Meyer, Tsui, & Hinings, 1993).

Configurational perspective takes lead from contingency perspective and, in broader prospects, can handle all contingencies at once (Ahmad et al., 2003, p. 172). Meyer et al. (1993, p. 1177) explain this link as, “By synthesizing broad patterns from contingency theory's fragmented concepts and grounding them in rich, multivariate descriptions, the configurational approach may help consolidate the past gains of contingency theory”. In configurational perspective, sub-parts, instead of one-by-one, are collectively tuned to accomplish organizational objectives (Drazin & Van de Ven, 1985). Cua et al. (2001) and

Ahmad et al. (2003) tested the configurational aspects of manufacturing practices and infrastructure practices. Cua et al. (2001) tested the configurational relationship of TQM, JIT, and TPM with infrastructure and organizational contextual factors. Similarly, Ahmad et al. (2003) explored the configuration of JIT and its infrastructure practices. However, yet no study is evident reporting the configurational relationship of AM and Lean (TQM & JIT) along with management and infrastructural (internal and external) practices. This study design also facilitates to explore this relationship.

PHASE - V

2.13 PERFORMANCE MEASUREMENT IN OPERATIONS MANAGEMENT

OM research is inconclusive as far as performance measurement is concerned (Sousa & Voss, 2008). There is no set pattern among researchers, that, which performance variable when and why is best suited to measure performance. Yet, standardised measures have not been demarcated, and question is still unanswered, to measure what, with which measuring instrument. A few researchers consider operational performance sufficient (Hallgren & Olhager, 2009; Shah & Ward, 2003), whereas a few tried customer satisfaction, human resource performance along with operational performance (Sila, 2007; Zelbst et al., 2010) and few extended their performance measurement boundaries till business performance (market/financial) (Inman et al., 2011; Yang et al., 2011) advocating application of these management practices in complete business horizon. Export performance also has been operationalized in the literature using measures like ROA, ROI, profitability, sales volume/growth, market share/growth, etc.) (Akyol & Akehurst, 2003; Ellis, Davies, & Wong, 2011; Robertson & Chetty, 2000; Stoian, Rialp, & Rialp, 2011). The variation in performance measures are closely linked with context, due to strong reliance of OM practices on context. Skinner (Skinner, 1969, p. 140) identified the underlying trade-off, that, managers may have to make among competitive priorities like quality, technology, customer satisfaction and most importantly cost. Moreover, extending his point of view, on trade-off, he provided some examples where firms may adopt trade-off stance.

(a) Minimum inventory level vis-à-vis Short lead times

(b) Direct vis-à-vis Indirect labour cost

(c) High quality vis-à-vis Low cost

The author further argued that factories can't realize competence on all competitive priorities as "A factory cannot perform well on every yardstick" (Skinner, 1974, p. 115). But now these questions have been well addressed by TQM, JIT, concurrent engineering and other improvement initiatives, etc. (Vokurka & Fliedner, 1998).

Ferdows and De Meyer (1990) found that high quality can't acquired with low-cost strategy directly, however, a superior quality base ultimately lead to cost efficiency, if organizations manage to acquire dependability and flexibility (Vokurka & Fliedner, 1998). These authors proposed a sand cone model to achieve cost efficiency based on quality improvement as shown in Figure 2.29. The same model was upgraded by Vokurka and Fliedner (1998) including flexibility and agility in the model. They hypothesised the complete chain as sequential outcomes of predecessors. For example, if an organization wants to make an improvement in cost for 10%, then an additional effort of 15% in speed, followed by 25% increase in dependability and 35-40% increase in quality will be required. The limitation of these models is, that no stage in any case can be by-passed to achieve higher stage competitive standards.

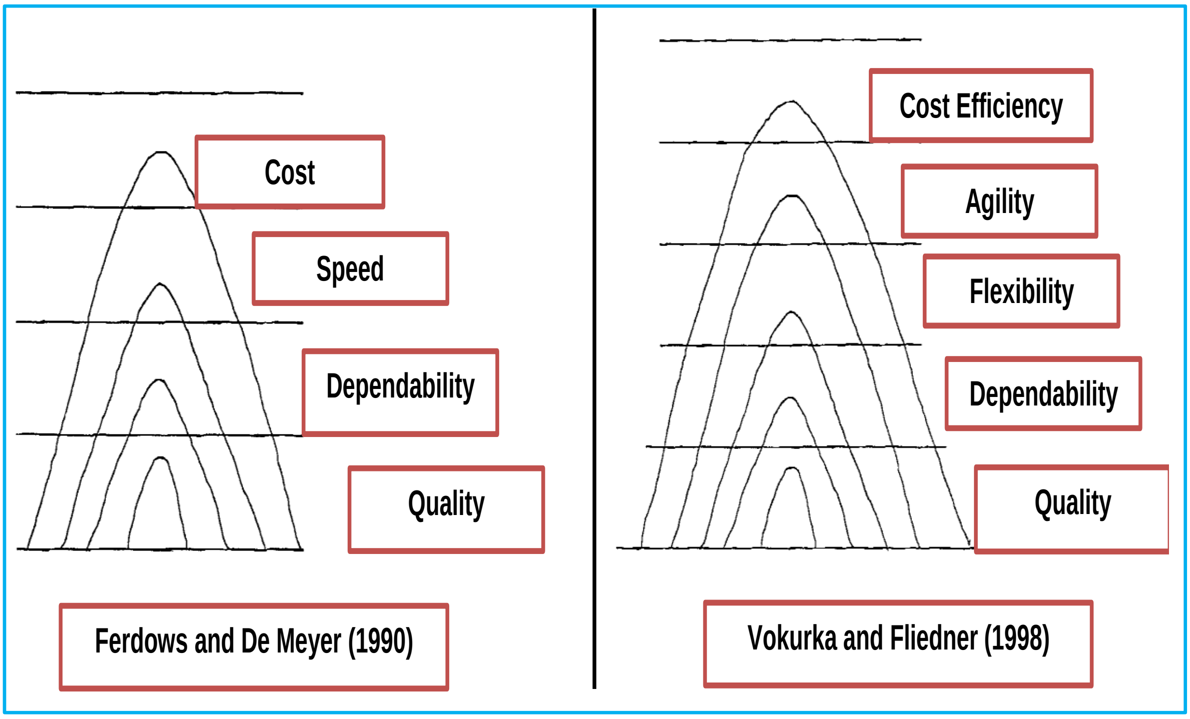


Figure 2.29. Sand Cone Model for Performance Measurement

Source: (Ferdows & De Meyer, 1990, p. 175; Vokurka & Fliedner, 1998, p. 169)

Agility and flexibility are detached with respect to their response to change. Flexibility means respond to change, when change is already predicted. It generally includes machine change-over, product mix, etc. and standard practices are available to perform these tasks. However, agility is referred to response in a situation not forecasted earlier. Therefore, it is possible that organization will be flexible, but not Agile. But an Agile organization will first be flexible and then Agile (Vokurka & Fliedner, 1998).

Quality is generally measured with conformance to specifications (Hallgren & Olhager, 2009), whereas, Garvin (1987) identified and validated eight different dimensions of product quality as:

(a) Conformance
(b) Performance
(c) Reliability
(d) Durability
(e) Serviceability
(f) Aesthetics
(g) Perceived Quality
(h) Features

Various performance measures, regularly cited in the OM literature, are summarised in Table 2.18. Export business performance measures identified are as following:

(a) **OPERATIONAL PERFORMANCE**

- Cost (Unit Cost of Manufacturing)
- Quality (Conformance to Specifications)
- Flexibility (Product Variety and Volume Change)
- Reliability (On-Time Delivery and Delivery Speed)

(b) **MARKET PERFORMANCE**

- Market Share Growth
- Sales Volume Growth

(c) **FINANCIAL PERFORMANCE**

- Return on Investment (ROI)
- Return on Asset (ROA)
- Profitability

Table 2.18. Performance Variables Measurement in OM Literature

	Performance Indicator	Operational Performance (OP)														Market Performance (MP) / Financial Performance (FP)													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
OP	Cost (Manufacturing)			✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓		✓			✓	✓	✓				✓	✓	✓
	Cost (Rework, Scrap)		✓			✓		✓																					
	Quality (Design)	✓						✓						✓								✓							
	Quality (Conformance)	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				✓	✓		✓	✓		✓			✓	✓	✓
	Delivery (Reliability)		✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓		✓			✓						✓	✓	✓
	Delivery (Speed)			✓				✓			✓		✓	✓	✓	✓		✓			✓								✓
	Flexibility (Volume)			✓	✓		✓	✓	✓		✓	✓	✓	✓				✓			✓								✓
	Flexibility (Product)			✓			✓	✓			✓		✓	✓		✓		✓			✓								✓
	Lead time					✓									✓			✓	✓										
	Service													✓										✓			✓	✓	
	Productivity		✓			✓								✓													✓	✓	
	Defects %		✓																✓				✓				✓	✓	
	Warranty Claims %		✓																				✓						
	Inventory Turnover			✓														✓	✓							✓			
	Cycle Time					✓									✓			✓	✓	✓							✓	✓	
	Order Fill Capacity														✓	✓													
	Customer Satisfaction		✓											✓	✓	✓				✓		✓					✓	✓	
	Employees Moral		✓																								✓	✓	
M P / FP	ROI									✓						✓	✓								✓	✓			
	ROA	✓								✓				✓										✓			✓	✓	
	ROS															✓	✓								✓	✓			
	Profitability	✓								✓						✓						✓			✓	✓	✓	✓	✓
	Sales Volume	✓												✓		✓	✓												
	Sales Volume Growth															✓						✓			✓				
	Market Share Growth	✓														✓	✓							✓	✓		✓	✓	✓

Continued (Table 2.17)

1. Powell (1995)	**7.** Narasimhan *et al.* (2006)	**14.** Zelbst *et al.* (2010)	**21.** Lau (2000)
2. Samson and Terziovski (1999)	**8.** Cua *et al. (*2006)	**15.** Inman *et al.* (2011)	**22.** Dow *Et Al.* (1999)
3. Mckone *et al.* (1999)	**9.** Jayaram et al. (2008)	**16.** Yang et al. (2011)	**23.** Kannan and Tan (2005)
4. Cua *et al.* (2001)	**10.** Dal Pont *et al.* (2008)	**17.** Sakakibara *et al.* (1997)	**24.** Cao and Dowlatshahi (2005)
5. Shah and Ward (2003)	**11.** Furlan *et al.* (2011a)	**18.** Nakamura *et al.* (1998)	**25.** Claycomb *Et Al.*(1999b)
6. Yusuf and Adeleye (2002)	**12.** Furlan et al. (2011b)	**19.** Flynn *et al.* (1995)	**26.** Sila (2007)
	13. Vázquez-Bustelo *et al.* (2007)	**20.** Hallgren and Olhager (2009)	**27.** Sila and Ebrahimpour (2005)
			28. Yusuf *et al.* (2012)

PHASE VI

2.14 DEVELOPMENT OF A 3-STAGE LEAN (TQM & JIT) AND AM INTEGRATED MANUFACTURING THEORETICAL FRAMEWORK

Through detailed literature review, from Section 2.2 to Section 2.13, of Lean (TQM & JIT) and AM paradigms, and different management theories like Theory of Systems (ToS), contingency theory, institutional theory and configurational theory, a 3-stage theoretical framework is proposed as shown in Figure 2.30. Theoretical framework proposes a theoretical relationship among management, infrastructure (internal and external), Lean (TQM & JIT), AM and business performance. The proposed three stages are; (1) organization culture, (2) core manufacturing practices, (3) outcomes. Each stage acts as input to the next stage to form a complete system comprises socio-technical practices. ToS explains that these macro and micro systems integrate with each other to generate synergy effects. Macro systems, comprising of micro systems, integrate with each other to form a complete business-wide integrated manufacturing system.

Stage-1, organization culture is represented with three macro systems’ management practices, common internal infrastructure practices and common external infrastructure practices. Management practices are represented with top management commitment practices. Common internal infrastructure system is formed up with a combination of five micro systems as, (1) strategic vision and planning, (2) cross training, (3) empowered teams, (4) information system, (5) plant environment. Similarly, common external infrastructure system is a combination of two micro systems as (1) relationship with suppliers, (2) relationship with customers. Stage-2, core manufacturing practices is represented with three macro systems Core TQM practices, Core JIT practices and Core AM practices. Core TQM system is formed up with a combination of three micro systems as, (1) continuous improvement, (2) product design, (3) process management. Core JIT system comprises four micro systems as, (1) lot size reduction, (2) set-up time reduction, (3) JIT scheduling, (4) pull production system. Similarly, Core AM system comprise three micro systems as,

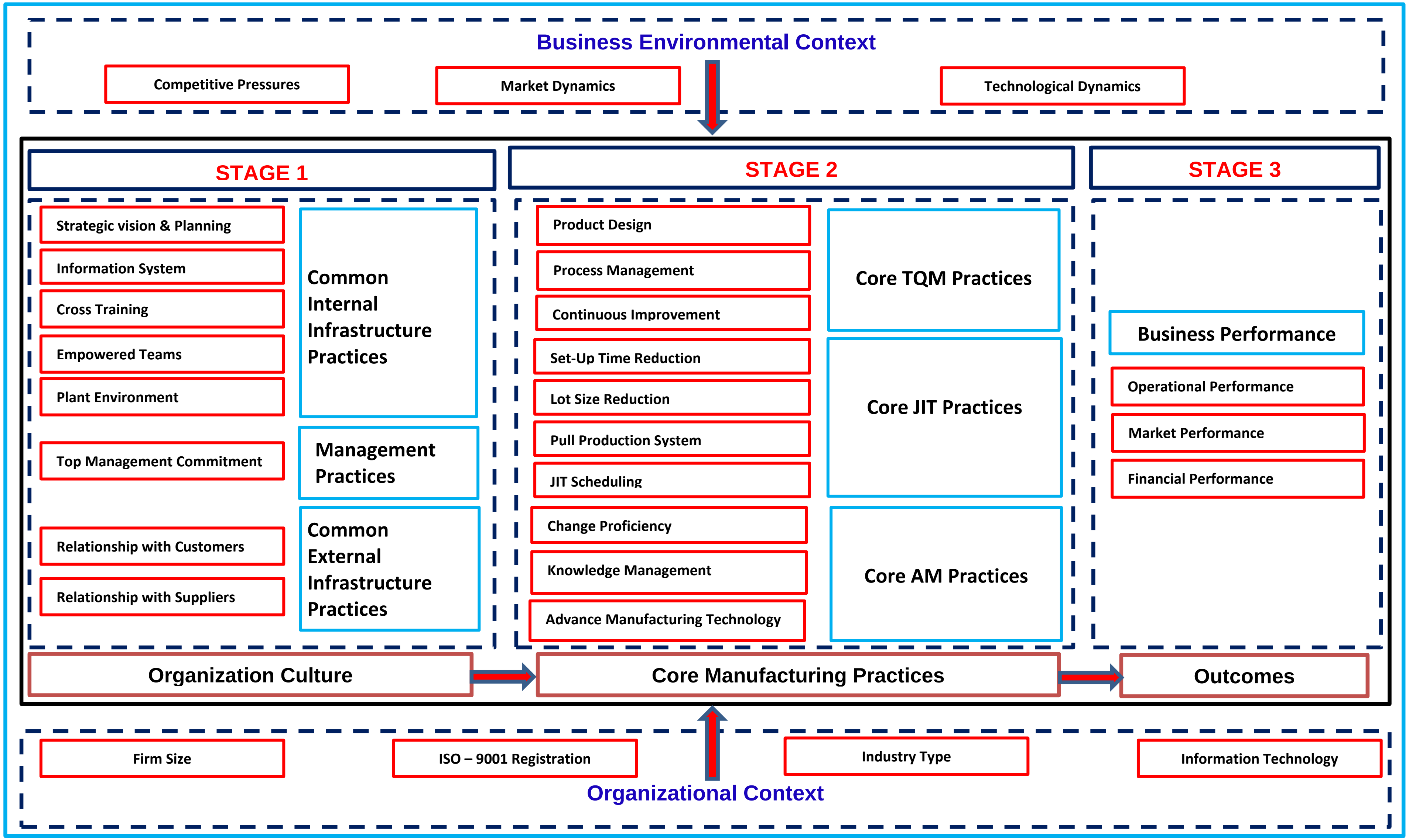


Figure 2.30. 3-Stage Theoretical Framework of Lean (TQM & JIT) and AM Integrated Manufacturing

(1) change proficiency, (2) knowledge management, (3) advance manufacturing technology. Finally, Stage-3 outcomes, export business performance is represented with three inter-dependent performance measures as (1) operational performance, (2) market performance, (3) financial performance.

Further, this theoretical framework facilitates to test the Lean (TQM & JIT) and AM relationship under different OM perspectives (i.e., universal perspective, contingency perspective and configurational perspective). Universal perspective proposes implementation of these sets of manufacturing practices is free form organizational or business environmental changes. In contingency perspective, these sets of practices are likely to behave differently under different organizational and business environmental contexts. This framework design facilitates to test the contextual effects of organizational factors as (1) firm size, (2) ISO-9001 registration, (3) industry type, (4) information technology and business environmental factors as, (1) competitive pressures, (2) market dynamics, (3) technological dynamics. In configurational perspective, Lean (TQM & JIT) and AM practices' holistic (alignment) effects are tested. This framework facilitates the in-depth investigation of the contribution of each sub-system while integrating to form a holistic system.

PHASE - VII

2.15 AWARENESS OF LEAN (TQM & JIT) AND AM PRACTICES IN PAKISTAN

Globalisation, technology boom, and WTO free trade has put lot many challenges to the ailing players of the market. Developed countries are extra-cautiously planning to meet these challenges harmoniously. Nevertheless, management practices are not being given due consideration in developing countries (Mersha, 1997). Similarly, Pakistan being a developing country is yet not mature enough in the applied field of OM. It is well established fact that nations, due to their unique culture, are different in application of these practices (Rungtusanatham et al., 1998) and culture may be one of the strong factors in the success, or failure, of management practices. Flynn and Saladin (2006) also endorsed that management practices are seriously linked with country cultural context.

Moosa, Sajid, Khan, and Mughal (2010) through a survey, from manufacturing as well as services firms (134 respondent from 22 firms), found that organizational culture is a decisive constituent in the successful implementation of TQM in Pakistani firms. Similarly, Raja, Bodla, and Malik (2011), using a sample of 65 managers through a survey of manufacturing firms found that top management commitment is vital in the achievement of business performance. Moreover, ISO-9001 certification pays back in term of organizational performance. Malik, Iqbal, Shaukat, and Yong (2010), using a sample of 60 firms, tested the significant implementation of TQM in SMEs, and argued that employees, involvement and work environment does not contribute in performance, whereas, top management backing, supplier relationship, benchmarking and customer focus were significant contributors. Similarly, Khan (2011), using a sample of 120 managers, also identified barriers in implementation of TQM in services industry of Pakistan like inadequate TQM infrastructure, insufficient planning, non-efficient HRM practices, weak leadership and customer focus. Amir (2011) revisited the established Leagile (Lean and Agility) concepts in the literature and acknowledged the significance of de-coupling point linking Lean and Agile in a highly volatile market environment. SMEs are regarded as most significant contributor in the economy of a country, especially of developing economies. S. B. Memon, Rohra, and Lal (2010) evaluated performance management system in SMEs of Pakistan (Karachi). 142, respondents from 12 SMEs participated in the study. The study findings revealed that SMEs are not well cognizant of, planned performance measurement system, HRM practices, specific organizations and individuals' goal settings and strategies to acquire those goals, and most significantly managers are not trained and well conversant with performance appraisal mechanisms.

Textile and Clothing sector is the major contributor (50-60% export share, 46% total production share, 38% employment share of manufacturing industry) in the national economy of the Pakistan. Nevertheless, its performance is significantly deteriorating over a period due to a number of reasons (lack of government interest, non-adherence of modern management practices, out-dated technology, lack of foreign investment, etc). A benchmarking study in Cotton Yarn Industry by NPO (2003) found that dynamic top management initiatives are required to take this industry to transform into a mature industrial sector. Similarly, NPO in another study "Bench Marking Study in the Garment Sector" (NPO, 2007) found that Garment Industry have lot of potential to improve in terms of productivity. The study also highlighted the weak areas like non-adherence to latest management practices. Moreover, mangers'/employees' training and development was the weakest area as compared to international standards and needs special top management attention. Mahmood (2008) in his study thoroughly analysed global business culture diffusion process in local Textile organizations involved in export business. Impact and duration of change of numerous variables like education, income, age, family living design, marital status and background of respondents were studied in the global business culture context. Intervening variables, like motivation and rewards, stress, encouragement and achievements, decision-making, politics, performance appraisal structure, change acceptance, employees training and development, degree of other cultures understanding, loyalty, commitment and perception were also incorporated in quest of the study goals. A sample of 500 respondents, (5 respondents, managers and workers, from each firm) from 100 textile firms (from district Faisalabad) involved in export business participated in the study. The study results revealed a significant shift in employees working style under global culture context. Moreover, it was illustrious, that only continuously learning and change proficient employees were able to retain themselves in export firms. Similarly, Awan (2008) in his PhD study, using a sample of 105 Chief Executive Officers (CEOs) from Apparel sector of Pakistan, evaluated "impact of capacity building interventions on employee's development". Six measures like "(1) training in general, (2) skills, (3) knowledge, (4) technical and vocational training, (5) information and communication technologies, (6) transfer of information", are employed as capacity building measures (independent variables). Using multiple regression analysis it was found that out of six, only two measures training in general and skills significantly contribute in employees' development, whereas, knowledge, technical and vocational training, information and communication technologies and transfer of information, did not contribute towards employees' development. Moreover, medium and large firms were better off, primarily being more focused and resourceful, in employing capacity-building measures as compared to small firms.

Hussain (2009), also reported that Cotton Yarn Industry, sample of 110 firms, is not adhering the supplier quality management aspects ("supplier failing to improve their quality") and this was found to be a major contributor in performance decline. Nevertheless, all other management practices ("customer focus, top management commitment, quality-oriented system, customer oriented environment, developing employees etc.") were significantly associated with performance. Moreover, Nawaz (2010) tested the relationship between labour productivity and female empowerment in the Apparel Sector of Pakistan. Using a sample of 114 respondents from 11 firms, significant differences were found across female empowerment ("social network economic stability, organizational environment, welfare, mobility and access political and decision and policy-making power, legal awareness") and labour productivity.

After going through discussion made above, it is evident that a comprehensive study on joint implementation of Lean (TQM & JIT) and AM incorporating management and common infrastructure (internal and external) practices is yet missing in the field of OM literature, in all, industrial and service sectors in general and particularly in export sector of Apparel industry of Pakistan.

2.16 FINDINGS OF LITERATURE REVIEW

After going through literature from Section 2.2 to Section 2.15, literature review major findings are enlisted as following;

(a) Literature explicitly explains that Lean (TQM & JIT) bundles are complementary to each other. Moreover, Lean (TQM & JIT) success is context-dependent and different results are expected under different business working environments.

(b) Literature does not explicitly explain whether Lean (TQM & JIT) and AM are mutually supportive, mutually competing or one is antecedent to the other. Moreover, if antecedent to each other, then which paradigm is precursor to the other within the constraints of internal (organizational) and external (business environmental) contextual factors?

(c) Literature does not explicitly delineate common internal and external infrastructure practices to enable Core TQM, Core JIT and Core AM practices. A set of management, common internal and external infrastructure, Core TQM, Core JIT and Core AM practices is identify through extant literature review.

(d) To the best knowledge of the researcher, research on joint implementation of Lean (TQM & JIT) and AM incorporating management, common (internal and external) infrastructure practices in the field of OM, in general and particularly in the Apparel Export Industry of Pakistan is yet not matured enough. A 3-stage Lean (TQM & JIT) and AM integrated manufacturing theoretical framework for joint implementation of management, common infrastructure (internal and external), Core Lean (TQM & JIT) and Core AM and impact on business performance is proposed.

(e) Literature review reveals that Lean (TQM & JIT) and AM are seriously context dependent. Research is yet maturing in unfolding the organizational and environmental contextual factors impact.

(f) Organizational (firm size, industry type, ISO-9001 registration, information technology) and environmental (competitive pressures, market dynamics and technological dynamics) contextual factors are identified that plausibly can moderate the relationship among management, infrastructure and core practices and impact on business performance.

(g) Literature is inconclusive on Core AM assessment; hence, an agility measurement instrument is required to assess organizational AM capability.

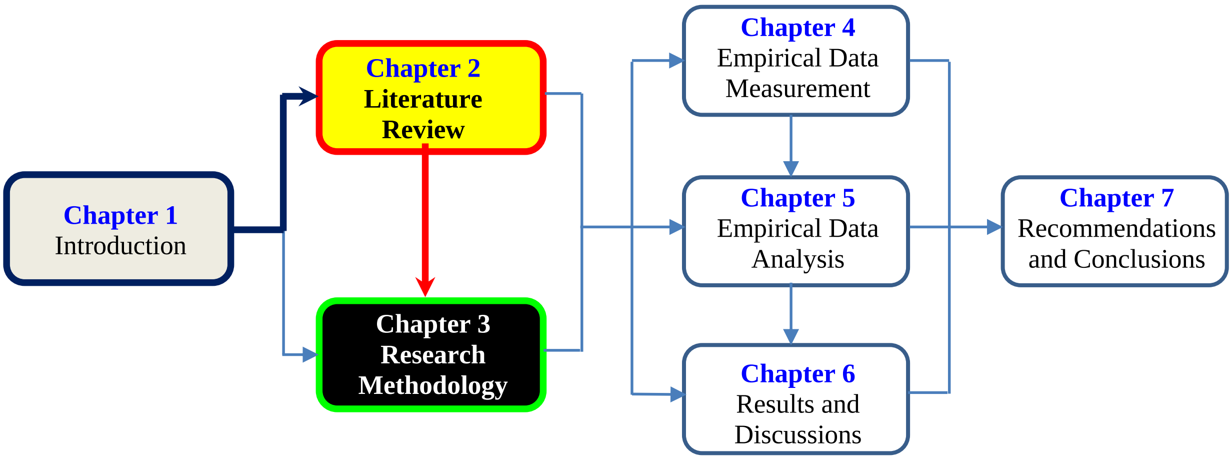
This research study will address all the research gaps, through in-depth empirical investigation, as mentioned above.

2.17 SUMMARY

It is evident from literature review, that OM literature is still in a fluid form and yet its concrete boundaries have not been established (Hayes & Pisano, 1996). Moreover, agility, a new concept, emerged in early 1991 (Goldman et al., 1991), yet has not matured. A number of theoretical frameworks to achieve agility have been proposed in the literature (Dove, 1999; Gunasekaran, 1999b; Sharp et al., 1999; Vázquez-Bustelo & Avella, 2006). However, empirical evidences are rare (Vázquez-Bustelo et al., 2007). Sufficient theoretical evidences are available that Lean (TQM & JIT) and AM are mutually supportive, but empirical evidences are not sufficient to support this relationship (Inman et al., 2011; Zelbst et al., 2010). It is also obvious from literature that Lean (TQM & JIT) and AM universalistic applicability has not been established, rather their success and failure have been attributed to different context (Narasimhan et al., 2006; Rungtusanatham et al., 1998; Yusuf & Adeleye, 2002; Z. Zhang & Sharifi, 2007).

Developing countries are finding it difficult to adopt state-of-the-art management programs (Z. X. Chen & Tan, 2011; Mersha, 1997). Pakistan being a developing country is far behind in the race of adoption of these well-known management initiatives. Especially, evidence are very sketchy for implementation of these state-of-the-art improvement programs in Apparel Export Sector of Pakistani Industry (NPO, 2007), however, the studies reported are conducted under different perspectives (Nawaz, 2010). Moreover, declining export share also confirms the non-compliance of modern management performance improvement initiatives (NPO, 2007). Such missing research link provides a perfect landscape to conduct this study in Apparel Export Sector of Pakistan. Apparel Export Sector being a high value-added segment and volatile market characteristics provides an excellent platform to test the joint implementation of Lean (TQM & JIT) and AM along with management and common infrastructure (internal and external) practices in International competitive environment. The Chapter 3 shall provide complete research methodology for accomplishment of this research study.

Chapter-2 Direction to the Chapter-3



CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This Chapter explains the research scheme of this research study. It comprises nine sequentially linked sections. In the second section, conceptual framework, based on the literature review, and proposed theoretical framework (see Chapter-2), is explained. In the third section, research constructs, based on existing literature are described in detail. In the fourth section, research hypotheses are developed to test the underlying theoretical link proposed in the conceptual framework. In the fifth section, research design is explained. The research design section includes research purpose, research approach, research strategy and research timelines. The sixth section discusses research study questionnaire development in length. The seventh section describes survey design. This section describes sampling frame, data collection method and variables coding for data analysis. The eighth section describes the data analysis systematic progression methods. Finally, last section summarises the Chapter. Section wise brief description of the Chapter is given in Table 3.1.

Table 3.1. Chapter Overview

Section	Description
Section 3.2	Describes the Research Study Questions and Conceptual Integrated Manufacturing Research Framework.
Section 3.3	Describes the Research Constructs in detail through literature review.
Section 3.4	Outline Research Hypothesis, based on Universal, Contingency, and Configurational Perspectives.
Section 3.5	Explicitly describes complete Research Design including Research Approach, Purpose, Strategy, Choice, Time Framework and Scope.
Section 3.6	Describes the Survey Questionnaire Development Process in length, including Variables Operationalization and Measurement.
Section 3.7	Explicitly describes Survey Design, including Sampling Frame, Data Collection Method and Variables Coding Scheme.
Section 3.8	Describes the Data Analytic Schematic Progression.
Section 3.9	Concludes the Research Methodology Chapter.

3.2 CONCEPTUAL FRAMEWORK DEVELOPMENT OF LEAN (TQM & JIT) AND AM INTEGRATED MANUFACTURING

Literature review carried out in chapter-2 resulted into a theoretical framework (see section 2.14). Proposed theoretical framework provides a concreted platform to develop a conceptual framework and mature research questions and to answer these questions scientifically. The research problem is transformed into following research questions, in order to find out the scientific and objective solutions:

(a) **RESEARCH QUESTION 1**

What are the Management, Common Infrastructure (internal and external), Core Lean (TQM & JIT) and Core Agile Manufacturing practices reported in the literature and how these can be integrated in a single conceptual framework in the export environment of Apparel (Readymade garments, Knitwear and Hosiery) Export Industry of Pakistan?

(b) **RESEARCH QUESTION 2**

What level of Management, Common Infrastructure (internal and external), Core Lean (TQM & JIT) and Core Agile Manufacturing Practices are being implemented in the export environment of Apparel (Readymade garments, Knitwear and Hosiery) Export Industry of Pakistan?

(c) **RESEARCH QUESTION 3**

How do Management, Common Infrastructure (internal and external), Core Lean (TQM & JIT) and Core Agile Manufacturing Practices interrelate in the export environment of the Apparel (Readymade garments, Knitwear and Hosiery) Export Industry of Pakistan?

(d) **RESEARCH QUESTION 4**

Are Core Lean (TQM & JIT) and Agile Manufacturing Practices, Mutually Supportive or Complementary to each other in the export environment of Apparel (Readymade garments, Knitwear and Hosiery) Export Industry of Pakistan?

(e) **RESEARCH QUESTION 5**

Are Core Lean (TQM & JIT) Manufacturing and Core Agile Manufacturing competeing, thus, the two are 'Mutually Exclusive or Competeing' in the export environment of Apparel (Readymade garments, Knitwear and Hosiery) Export Industry of Pakistan?

(f) **RESEARCH QUESTION 6**

Are Core Lean (TQM & JIT) antecedent to Core Agile Manufacturing, in the export environment of Apparel (Readymade garments, Knitwear and Hosiery) Export Industry of Pakistan?

(g) **RESEARCH QUESTION 7**

Do Organizational Contextual Factors (Firm Size, ISO-9001 Registration, Industry Type, and Information Technology) moderate the Management, Common

Infrastructure (internal and external), Core Lean (TQM & JIT) and Core Agile manufacturing practices implementation and impact on export performance in the export environment of Apparel (Readymade garments, Knitwear and Hosiery) Export Industry of Pakistan?

(h) **RESEARCH QUESTION 8**

Do Business Environmental Contextual Factors (market dynamics, competitive pressures and technological dynamics) moderate the Management, Common Infrastructure (internal and external), Core Lean (TQM & JIT) and Core Agile manufacturing practices implementation and impact on export performance in the export environment of Apparel (Readymade garments, Knitwear and Hosiery) Export Industry of Pakistan?

(j) **RESEARCH QUESTION 9**

What are the Macro and Micro Management, Common Infrastructure (internal and external), Core Lean (TQM & JIT) and Core Agile Manufacturing practices which significantly differentiate between high and low performance measures i.e., OP, MP and FP.

After thorough study of Lean (TQM & JIT) and AM relationship models and literature review carried out in Chapter-2 theoretical framework proposed (see Figure 2.30) is transformed into a comprehensive scientific conceptual framework as shown in Figure 3.1. Key Macro constructs, are theoretically linked with other Macro constructs. For the parsimony purpose hypotheses are shown in this framework, whereas, hypotheses detail justification is provided in Section 3.4. Key Macro and Micro organizational elements of conceptual framework are presented in Figure 3.2.

This framework comprises three main building blocs (1) Culture, (2) Core Manufacturing Practices, (3) Outcomes and two auxiliary building blocs (1) Organizational Context as Internal (2) Business Environment Context as External (Ahire & Ravichandran, 2001; Cua et al., 2001, 2006; Flynn et al., 1995a; Goldman & Nagel, 1993; Gunasekaran, 1999a, 1999b; Jayaram et al., 2010; Lakhal et al., 2006; Ravichandran & Rai, 2000; Sousa & Voss, 2008; Vázquez-Bustelo & Avella, 2006; Vázquez-Bustelo et al., 2007).

This study premises implementation of Lean (TQM & JIT) and AM as a holistic approach, where competitive advantage of cost, quality, delivery and flexibility is acquired through integrated manufacturing (Cua et al., 2001; Hayes & Pisano, 1994; Zelbst et al., 2010).

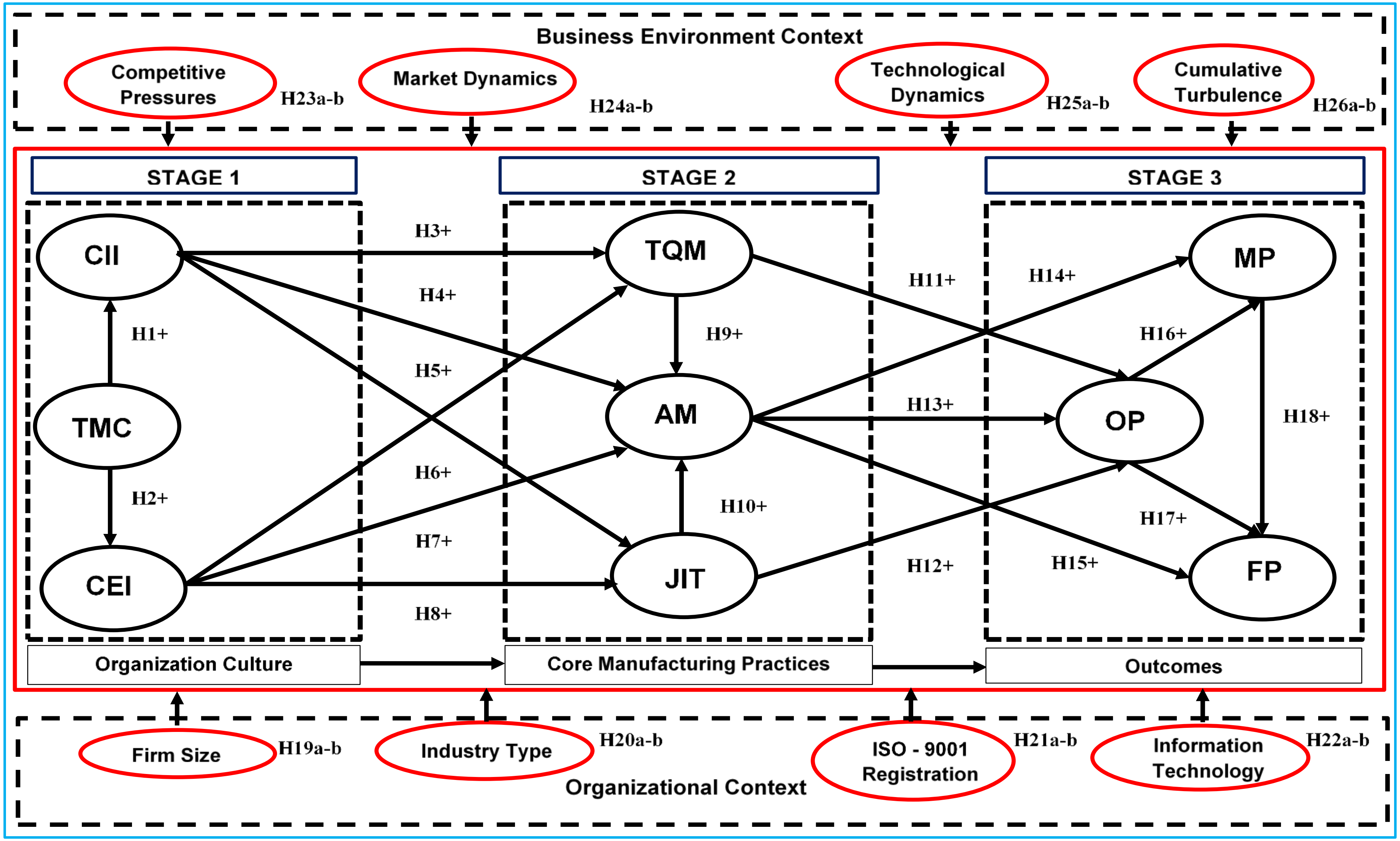


Figure 3.1. 3-Stage Lean (TQM & JIT) and AM Integrated Manufacturing Conceptual Framework

Left bloc (Culture) of Research Framework comprises three round boxes, top management commitment, common internal infrastructure, and common external infrastructure. Top management is responsible to ensure effective establishment of internal and external infrastructure. Sound common internal and external infrastructure provides solid foundation for effective implementation of Core TQM, Core JIT and Core AM practices. Core TQM Practices and Core JIT Practices also provide solid foundation for effective implementation of core AM through process management and waste reduction (Zelbst et al., 2010). Core AM being the focal improvement program contributes towards better operational performance like Cost, Quality, Delivery and Flexibility. Improved operational performance leads to enhanced marketing performance, which make significant enhancement in business financial performance (Hallgren & Olhager, 2009; Inman et al., 2011; Narasimhan et al., 2006; Zelbst et al., 2010).

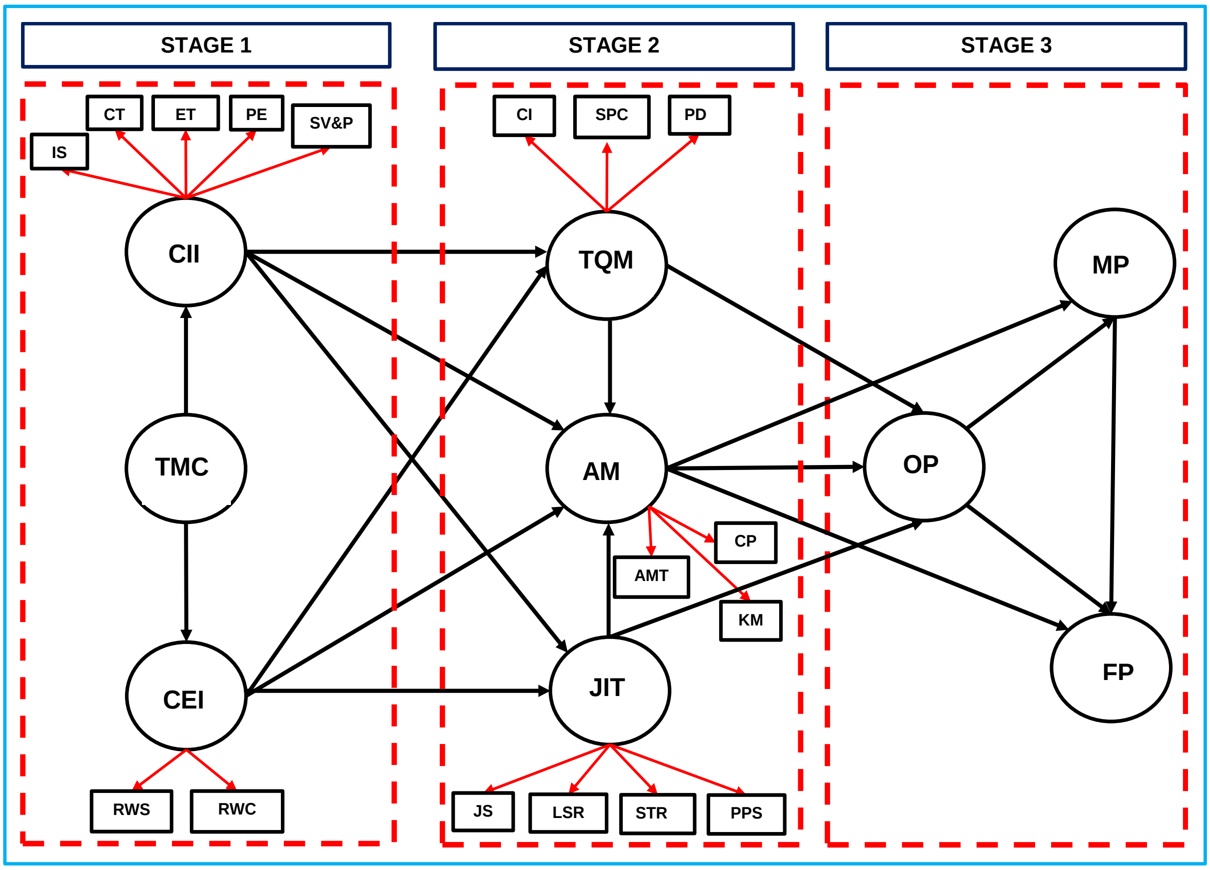


Figure 3.2. Key Macro and Micro Organizational Elements of Conceptual Framework

3.3 RESEARCH CONSTRUCTS

Key Macro and Micro organization design elements summary is given in Table 3.2. Detailed description of each construct, along with literature support, is given at Appendix **'A'**.

Table 3.2. Key Macro and Micro Organization Design Elements

Key Macro Organization Design Elements	Key Micro Integrated Manufacturing Oriented Organization Elements
1. **Organization Culture**	• Top Management Commitment • Common Internal Infrastructure • Common External Infrastructure
2. **Core Manufacturing Practices**	• Core TQM • Core JIT • Core AM
3. **Outcomes**	• Operational Performance • Market Performance • Financial Performance
4. **Organizational Context**	• Firm Size • ISO-9001 Registration • Industry Type • Information Technology
5. **Business Environment Context**	• Competitive Pressures • Market Dynamics • Technological Dynamics

3.3.1 ORGANIZATION CULTURE

Organization culture comprises three pillars, top management commitment, common internal infrastructure and common external infrastructure (Cua et al., 2001, 2006; Dean Jr & Snell, 1996; Flynn et al., 1995a; Jayaram et al., 2010; Lakhal et al., 2006; Snell & Dean Jr, 1992; Sousa & Voss, 2008). Organizational culture hypothetically can be regarded as combination of a set of practices to establish a solid foundation for execution of core-integrated manufacturing. It is the degree of management commitment towards market orientation, establishment of internal and external infrastructure systems mandatory for smooth execution of core manufacturing (Ahire et al., 1996a; Flynn et al., 1994; Saraph et al., 1989). Generally, a harmony between leadership, strategic planning, employees, customer, supplier, plant readiness and organization-wide information system reflects sound organizational culture (Cua et al., 2001; Flynn et al., 1995a).

3.3.1.1 TOP MANAGEMENT COMMITMENT

Top management is regarded as the leading pillar responsible for design and development of organizational culture (Flynn et al., 1994, 1995a, 1995b; Jayaram et al., 2010; Saraph et al., 1989). Top management takes the responsibility to promote quality and innovation culture in the organization and endorse its commitment by providing sufficient resources for process and product improvement and at the same time devise accountability mechanism to achieve quality and innovation targets (Ahire et al., 1996a; D. Y. Kim et al., 2012). Top management anticipate change in market and accordingly make necessary change in the organizational strategy to meet those challenges (Grandzol & Gershon, 1998). Top management responsibility is two pronged. Internally develop a clear organization mission and strategy (Cua et al., 2001), enhance workforce capability through training and empowerment (Ahire, Waller, & Golhar, 1996b; Cua et al., 2001; Flynn et al., 1995b; Jayaram et al., 2010; Sila & Ebrahimpour, 2005), establish organization-wide information system (Cua et al., 2001; Sila & Ebrahimpour, 2005) and ensure plant readiness (Cua et al., 2001; Flynn et al., 1995a; McKone et al., 2001). Externally, maintain a long-term relationship with customers and suppliers, rather establish a system where suppliers are directly involved to understand and meet the changes in customer requirements right from the product designing/re-designing stage (Ahire & Ravichandran, 2001; Flynn et al., 1995a, 1995b; Jayaram, Kannan, & Tan, 2004; Jayaram et al., 2008; D. Y. Kim et al., 2012; Sila & Ebrahimpour, 2005). Ahire and O'shaughnessy (1998) through a survey of 449 auto firms found that variation in the degree of implementation of top management commitment seriously affects the implementation of whole TQM tools and techniques.

3.3.1.2 COMMON INTERNAL INFRASTRUCUTRE PRACTICES

Common internal infrastructure comprises five elements i.e. (1) Strategic Vision and Planning (2) Information System (3) Cross Training (4) Empowered Teams (5) Plant Environment. There are a few practices which are common to TQM, JIT and AM and are difficult to differentiate among these improvement programs (Ahire et al., 1996a; Ahire & Ravichandran, 2001; Cua et al., 2001; Flynn et al., 1995a; Lakhal et al., 2006; Ravichandran & Rai, 2000; Vázquez-Bustelo et al., 2007; Zu et al., 2008). The scope of these practices is internal to an organization. Moreover, these factors are also known as "internal structural factors", which lay solid foundation for effective implementation of ensuing core integrated (TQM, JIT, AM) manufacturing practices.

(a) **CROSS TRAINING**

Trends have changed from specialised workers to multi-skilled workers due to the turbulent changes in the technology and customer requirements. Employees' training has been recognised as one of the most important aspect of any organization pursuing quality management (Ahire et al., 1996a; Saraph et al., 1989). Monden (1983) emphasised employees' training at all levels including management. Ahire et al. (1996a) argued that employees' empowerment and involvement will not be effective until they are continuously trained on new skills. Employees should be cross-trained on multiple tasks by rotating them among different jobs (D. Y. Kim et al., 2012; Sila & Ebrahimpour, 2005). This will not only enhance their skills rather it will also provide organization to get leverage from their suitability to multiple tasks (Zu et al., 2008). Employees should be encouraged through incentives and rewards on acquiring new professional skills. Cross training also help employees' to improve their problem solving skills (Narasimhan et al., 2006; Sila & Ebrahimpour, 2005).

(b) **EMPOWERED TEAMS**

Empowered teams formulation raises the workers' confidence level. Empowered teams can take independent decisions like inspecting their own work and stop production line if process is deviating from pre-set standards. Empowerment scope is not limited to extra work rather resources are also provided to empowered teams to fix the problem once identified (Ahire et al., 1996a; Narasimhan et al., 2006). Employees are given leverage to adjust their production schedule and share quality problems with management and suppliers (Curkovic et al., 2000; Ravichandran & Rai, 2000). Empowerment also help to raise the employees' satisfaction level and they feel sense of ownership (Anderson, Rungtusanatham, & Schroeder, 1994).

(c) **INFORMATION SYSTEM**

An effective organization-wide information system is responsible to receive and convey customer feedback to the respective department to address the on-going problems (Ahire et al., 1996a; Fynes & Voss, 2002; Sila & Ebrahimpour, 2005). Moreover, this system keeps on monitoring and sharing quality and productivity (scrap and rework) data with employees for problem solving (Cua et al., 2001). This system also highlights issues, if any, related to suppliers' incoming shipments (Vázquez-Bustelo et al., 2007). The most important task of this system is to provide requisite information while taking strategic decisions and evaluating customer requirements (Samson & Terziovski, 1999).

(d) **STRATEGIC VISION AND PLANNING**

Strategic vision and planning refers to the formal strategic planning to meet the market challenges (Samson & Terziovski, 1999; Sila & Ebrahimpour, 2005). It results in unambiguous written mission, short-term and long-term business goals and implementation strategies to acquire these goals. Moreover, regular revision is carried out and necessary changes are made if required (Cua et al., 2001). The most important task of an effective information system is the dissemination of the organizational goals down to section level so that employees are well aware about organizational mission and goals and strategies to achieve these goals (Anderson et al., 1994; Douglas & Judge Jr, 2001; Saraph et al., 1989).

(e) **PLANT ENVIRONMENT**

Plant environment refers to the degree of plant readiness to avoid any unnecessary production process stoppages (Flynn et al., 1995a). Maintaining plant, in worthiness condition, helps to meet daily production schedules. Training is imparted to workers to keep fixtures and tools at their place after use. Moreover, preventive maintenance training is provided to machine operators to fix minor issues (McKone & Weiss, 1999). Efforts are made to keep the shop floor neat and cLean (Zu et al., 2008). Hayes suggested that plant cLeanliness does not only affects plant equipment only rather it also has strong bearing on employees' working attitude as "if you cLean up the factory floor, you tend to cLean up the thought process of the people on it" (Hayes, 1981, p. 59).

3.3.1.3 COMMON EXTERNAL INFRASTRUCTURE PRACTICES

These are set of practices which are common to TQM, JIT and AM and are difficult to differentiate among these improvement programs (Ahire & Ravichandran, 2001; Flynn et al., 1995a; Inman et al., 2011; Narasimhan et al., 2006; Ravichandran & Rai, 2000; Sila & Ebrahimpour, 2005; Yusuf et al., 2014; Zu et al., 2008). The scope of these practices is external to an organization. Moreover, these factors are also known as "external structural factors", which lay solid foundation for effective implementation of ensuing core integrated (TQM, JIT, AM) manufacturing practices.

(a) **RELATIONSHIP WITH SUPPLIERS**

Suppliers are regarded as integral stake holder of any organization and now-a-days competition has shifted from within firms to their supply chains (Jayaram et al., 2004; Yusuf et al., 2014). Organizations are required to maintain long-term strategic relationship with their suppliers and supplier selection criteria should be based on quality and reliability along with cost (Flynn et al., 1995b; Jayaram et al., 2008; Prajogo, Chowdhury, Yeung, & Cheng, 2012; Prajogo & Olhager, 2012). Suppliers should be involved right from the beginning of product design to offer their valuable input for availability of required/alternative materials. A few high quality suppliers also help to reduce process variation (Flynn et al., 1995b; D. Y. Kim et al., 2012; Sila & Ebrahimpour, 2005; Zu et al., 2008).

(b) **RELATIONSHIP WITH CUSTOMERS**

Customers' satisfaction is regarded as survival cause of any business (Anderson et al., 1994) and failure to this may lead to disaster (Ahire et al., 1996a). Maintaining a close liaison with customer, through feedback, provides an opportunity to the organization to incorporate customer demand right from the product design process (Flynn et al., 1995b; Flynn, Schroeder, Flynn, Sakakibara, & Bates, 1997; D. Y. Kim et al., 2012; Sila & Ebrahimpour, 2005). This close liaison can be maintained through open communication with customers allowing them to visit our plants and visiting their places as well (Black & Porter, 1996; Forza & Filippini, 1998; Jayaram et al., 2008; Rungtusanatham et al., 1998). Customer service employees should be empowered to resolve the customer concern promptly (Flynn et al., 1995b). Ahire et al. (1996a) also argued that organization's long-term strategic planning changes should be strictly tied with customer demands (Narasimhan et al., 2006; Yusuf et al., 2014).

3.3.2 CORE INTEGRATED MANUFACTURING PRACTICES

Core integrated manufacturing practices comprises Core TQM, Core JIT and Core AM practices. These practices are also known as "ensuing practices" and based on active existence of internal and external structural factors.

3.3.2.1 CORE TQM PRACTICES

Core TQM practices comprise Product Design, Process Management (SPC) and Continuous Improvement (Anderson et al., 1994; Cua et al., 2001; Flynn et al., 1995a; D. Y. Kim et al., 2012; Sila & Ebrahimpour, 2005; Zu et al., 2008). TQM core practices focus on quality improvement by improving product design, keeping process within control limits through process management using statistical process control techniques and continuous improvement. These all contribute to reduce process variation.

(a) **PRODUCT DESIGN**

An integrated approach to design error free products reflects strategic quality planning of an organization (Ahire et al., 1996b, p. 29). Product features, serviceability and its reliability to use for longer time period measure the effectiveness of product design (Flynn et al., 1995b, p. 662). Product features and its serviceability is improved through joint product development process by involving members from designing, production, quality assurance people, customer representative, and suppliers to give their input regarding availability of requisite material (Forza & Filippini, 1998; D. Y. Kim et al., 2012; Sila & Ebrahimpour, 2005). Moreover, product reliability is enhanced by giving due consideration to failure probabilities of each system and its sub-system right at the product designing stage (Cua et al., 2001). Product manufacturability barriers are also eliminated at designing stage through design simplification (Zu et al., 2008, p. 632).

(b) **PROCESS MANAGEMENT USING STATISTICAL PROCESS CONTROL (SPC)**

Using statistical process control techniques process limits are defined and continuously monitored to keep the process within these limits and, if any assignable variation is detected at any stage feedback is given to production operators/engineers (Ahire et al., 1996a; Black & Porter, 1996; Flynn et al., 1995b; Sila & Ebrahimpour, 2005). Employees are empowered to monitor these limits closely and stop the production process if any variation is identified. SPC helps to differentiate between natural and assignable cause (Anderson et al., 1994; Curkovic et al., 2000; Douglas & Judge Jr, 2001). SPC charts are used to monitor the process capabilities (Cua et al., 2001). Flynn et al. (1995a) argued that timings are most critical in feedback mechanism if delayed mean becoming more difficult to identify the actual cause. Schonberger (1990) also stressed that "when discovery of a mishap is delayed, the trail of evidence of causes grows cold and the number of combinations of causes quickly becomes astronomical".

(c) **CONTINUOUS IMPROVEMENT**

Organizations continuously strive for incremental/radical improvement in their processes, and product quality, and innovation capabilities. Continuous improvement philosophy is promoted throughout the organization (Curkovic et al., 2000; Douglas & Judge Jr, 2001). Every employee, on the basis of their experience, is responsible to contribute towards continuous improvement of the products and processes (Anderson et al., 1994; Sila & Ebrahimpour, 2005). Continuous quality improvement efforts help organizations to win customers' confidence (Anderson et al., 1994; Anderson et al., 1995; Rungtusanatham et al., 1998; Sila & Ebrahimpour, 2005).

3.3.2.2 CORE JIT PRACTICES

Ohno (1982), defined JIT Core Practices as a function of time. He emphasised the availability of the right parts in right numbers, exactly whenever are needed on the shop floor. JIT Core Practices focus on waste elimination through waste reduction. Waste reduction is ensured through elimination of large inventory buffers and this is accomplished in close interaction with TQM process by keeping process in highly under control conditions. Core JIT Practices comprise four sub-sets (1) Lot size reduction, (2) JIT scheduling, (3) set-up time reduction, (4) pull production system (Cua et al., 2001; Flynn et al., 1995a; Furlan et al., 2011a; McKone et al., 1999; Shah & Ward, 2007; Yang et al., 2011; Zelbst et al., 2010).

(a) **LOT SIZE REDUTION**

Lot Size Reduction means production in small lots. It minimizes work-in-process inventory and directly reduces cycle time (Yang et al., 2011). As Lot Size reduces, quality improves and, feedback mechanism becomes more effective, as gap between feedbacks decreases as well, and process continuously remain under observation (Flynn et al., 1995a; Mehra & Inman, 1992; Shah & Ward, 2003). If Lot Size increases and quality problems, due to process malfunctioning, are detected after processing of complete lot, then two problems are faced. First, waste increases in terms of rework and scrap increases production cost thus making organization products less competitive (Schonberger, 1990). Second, it is possible that by then process has been set-up to another production process and limits the system to actually detect the process malfunction cause (Mefford, 1989).

(b) **SET-UP TIME REDUCTION**

Set-up time reduction refers to reducing equipment changeover time between two consecutive processes (Cua et al., 2001; McKone et al., 1999; Shah & Ward, 2007). Set-up time reduction actually does not add anything to the product but it does provide leverage to the organization to keep Lot Size small through, frequently, switching between different processes (Ahmad et al., 2003; Flynn et al., 1995a; Mehra & Inman, 1992; Zelbst et al., 2010). Virtually set-up time reduction is termed as single minute exchange of die (SMED) and helps to reduce lead time (Shingō, 1986).

(c) **PULL PRODUCTION SYSTEM (KANBAN)**

Pull Production System is a technique for production control to produce exactly what, and when, it is required (Ahmad et al., 2003; McKone et al., 1999). Ohno, was the first one to introduce Kanban technique at Toyota Motors (Sugimori et al., 1977). Upstream production is only undertaken once there is demand from downstream

(Flynn et al., 1995a; Shah & Ward, 2007). It eliminates unnecessary production at workstations within the plant and products being outmoded in the market (Cua et al., 2001; McLachlin, 1997). Kanban helps to use plant capacity more effectively and once not in use, that time can be utilized for maintenance purposes or sharing ideas with management (Ahmad et al., 2003; Shah & Ward, 2003). Kanban squares/containers or signals are used to control the production flow at plant level (Shah & Ward, 2007).

(d) **JIT SCHEDULING**

JIT scheduling is also an element of JIT Core Practices and it refers to continuously looking for changes in master production schedule (Ahmad et al., 2003; Cua et al., 2001; McKone et al., 1999). It emphasises that master production schedule is accomplish as designed, and accommodate accounted and unaccounted, for changes due to plant breakage, quality problems or late deliveries by the suppliers (Flynn et al., 1995a; Zelbst et al., 2010). Daily production schedule is aligned with master schedule and, if any misalignment is observed, then necessary changes are incorporated in the master schedule and efforts are made to accomplish the master schedule within prescribed timelines. Moreover, while, designing master schedule additional time is added to cater for such problems (Cua et al., 2001; Flynn et al., 1995a; Hallgren & Olhager, 2009; Zelbst et al., 2010).

3.3.2.3 CORE AM PRACTICES

AM Core Practices are comprised change proficiency (Dove, 1999; Goldman et al., 1995), knowledge management (Dove, 1999; Kidd, 1995b) and advance manufacturing technology (Bottani, 2010; Vázquez-Bustelo et al., 2007).

(a) **CHANGE PROFICIENCY**

Change Proficiency is the ability of an organization how quickly it can adapt to the market changes (Goldman et al., 1995; Yusuf et al., 1999). Organizations tend to be Agile have to develop capabilities to sense, perceive and respond quickly to the market requirement as compare to the competitors (Gunasekaran, 1999b; Sharifi & Zhang, 1999). Flexibility to change product models, and launch new products, in the market with in no times is the essence of agility (Gunasekaran, 1998; Z. Zhang, 2011). Strategic goals tend to be fluid and keep on shaping to new standards with respect to the customer changes (Vázquez-Bustelo et al., 2007; Yusuf et al., 2014; Z. Zhang & Sharifi, 2007).

(b) **KNOWLEDGE MANAGEMNT**

Knowledge Management refers to the ability of an organization to acquire, disseminate and update the body of knowledge (Dove, 1999). Knowledge oriented organizations make teams which continuously monitor What, When, and Why they need to upgrade their knowledge base (Gunasekaran, 1998, 1999b). These organizations also encourage and provide opportunities to their employees to acquire new skills. Employees are given full access to the organization knowledge-database, to get benefit out of it, and they are also given incentives if they add value to it (Hakala & Kohtamäki, 2011; Sharp et al., 1999; Vázquez-Bustelo et al., 2007). Employees are encouraged to share their work experiences, innovative ideas with other workers and managers (Gunasekaran et al., 2008; Vázquez-Bustelo & Avella, 2006; Vázquez-Bustelo et al., 2007).

(c) **ADVANCE MANUFACTURING TECHNOLOGY**

Advance Manufacturing Technology comprises Computer-aided Designing/Manufacturing, Flexible Manufacturing Systems, Robotics and Rapid Prototyping etc. (Bottani, 2010; Jin-Hai et al., 2003; Narasimhan et al., 2006). Advance manufacturing technology provides leverage organizations to quickly response to the abrupt changes in the market (Bottani, 2010; Gunasekaran & Yusuf, 2002). Organizations, continuously updating their technological capabilities always have an edge over competitors in terms of development and quickly launching new products to the market (Inman et al., 2011; Narasimhan et al., 2006; Vázquez-Bustelo et al., 2007). Those organizations, who do not upgrade their technological capabilities, are likely to be phased out of the business, therefore organizations, who intend to remain in the market, have to upgrade their technological capabilities (Bottani, 2010; Gunasekaran, 1998; Narasimhan et al., 2006).

3.3.3 PERFORMANCE OUTCOMES

Performance Outcomes comprise operational performance, also known as plant level performance, along with two other performance measures; market performance and financial performance. Organizations pursuing integrated manufacturing practices tend to acquire high performance standards on these measures (Inman et al., 2011; Sila & Ebrahimpour, 2005; Vázquez-Bustelo et al., 2007; Yang et al., 2011; Zelbst et al., 2010).

3.3.3.1 OPERATIONAL PERFORMANCE

Operational performance is mostly regarded as plant level performance, but actually this performance establishes the organization competitiveness (Narasimhan et al., 2006). It is generally measured in terms of cost, quality, delivery and flexibility (Ahmad et al., 2003; Sila & Ebrahimpour, 2005; Yang et al., 2011; Zelbst et al., 2010). Cost means unit cost of manufacturing and includes all overhead cost like scrap and rework cost (Narasimhan et al., 2006). Quality has eight dimensions but generally if a product conforms to the customer specification it is considered good enough to meet the quality dimensions (Hallgren & Olhager, 2009; Sila & Ebrahimpour, 2005). Delivery includes timely delivery and the speed of an organization to deliver with respect to the competitors (Ahmad et al., 2003; Inman et al., 2011). Flexibility is the degree of an organization quickly to change product volume or product variety (Ahmad et al., 2003; Narasimhan et al., 2006; Vázquez-Bustelo et al., 2007).

3.3.3.2 MARKET PERFORMANCE

Organizations, having better operational performance, are more likely to have more market demand means growth in market share more, high sales volume eventually leading to sales volume growth as a natural outcome (Inman et al., 2011; Sila & Ebrahimpour, 2005; Vázquez-Bustelo et al., 2007; Yang et al., 2011).

3.3.3.3 FINANCIAL PERFORMANCE

Inman et al. (2011) states that organizations, having high AM performance will lead to improved operational performance, market performance and financial performance. He also found improved market performance result in better financial results like return on asset (ROA), return on investment (ROI) and profitability (Sila & Ebrahimpour, 2005; Vázquez-Bustelo et al., 2007; Yang et al., 2011).

3.3.4 BUSINESS ENVIRONMENTAL FACTORS

Business Environmental Factors comprise Competitive Pressures, Market Dynamics and Technological Dynamics.

3.3.4.1 COMPETITIVE PRESSURES

Competitive Pressures refer to the degree of competition in any industry. It reflects the competitor’s moves to capture more market share based on different competitive capabilities (Jaworski & Kohli, 1993; Kohli & Jaworski, 1990).

3.3.4.2 MARKET DYNAMICS

Market Dynamics is the degree of uncertainty in customer preferences. Customers' requirements are continuously changing and they always look for new products. Organizations feel it difficult to maintain old customers for longer period as production process and products are continuously changing due to innovations (Inman et al., 2011; Kohli & Jaworski, 1990; Vázquez-Bustelo et al., 2007).

3.3.4.3 TECHNOLOGICAL DYNAMICS

Technological dynamics refers to the degree of invention of new technology. New technological breakthroughs provide competitive edge over competitors through low cost, high quality products with shorter lead-time, and flexibility of switching between product volume/variety (Jaworski & Kohli, 1993; Kohli & Jaworski, 1990).

3.4 RESEARCH HYPOTHESES

Research Hypotheses are described in three perspectives i.e., (1) Universal perspective, (2) Contingency perspective, (3) Configurational perspective.

3.4.1 CONCEPT OF FIT

"Fit" means the degree of consistency of two or more variables/factors, and a good Fit means that when these variables/factors are deployed together always produce better results (Venkatraman, 1989). Management practices Gurus (e.g., Crosby, 1979; Deming, 1986; Juran, 1986)) always supported these practices as universally germane and free from context bias (Sitkin et al., 1994, p. 538). Nevertheless, some researchers have seriously questioned their universal claim, based on their contradictory results on universal application of these practices, and raised serious questions, regarding their robustness, and cautioned their strong context biasness (Dean Jr & Bowen, 1994; Sitkin et al., 1994; Sousa & Voss, 2008). "Fit" has got wide acceptance in the field of OM (Flynn et al., 2010; Furlan et al., 2011a; Furlan et al., 2011b; MacDuffie, 1995; Sousa & Voss, 2008; Wagner, Grosse-Ruyken, & Erhun, 2012). Researchers in the course of Fit investigation pursue Fit among macro/micro-systems known as internal Fit and with respect to external factors like culture, structure or environment known as external Fit. There are three different perspectives to conceptualize Fit as: (1) Universal Perspective Fit, (2) Contingency Perspective Fit, (3) Configurational Perspective Fit (Ahmad et al., 2003; Flynn et al., 2010).

(a) **UNIVERSAL PERSPECTIVE FIT**

In Universal Perspective, a Fit is free from external biases and support macro/micro systems universal applicability and its results are not liable to change with respect to change in organizational/environmental context (Ahmad et al., 2003). Universal Perspective Fit is depicted in Figure 3.3.

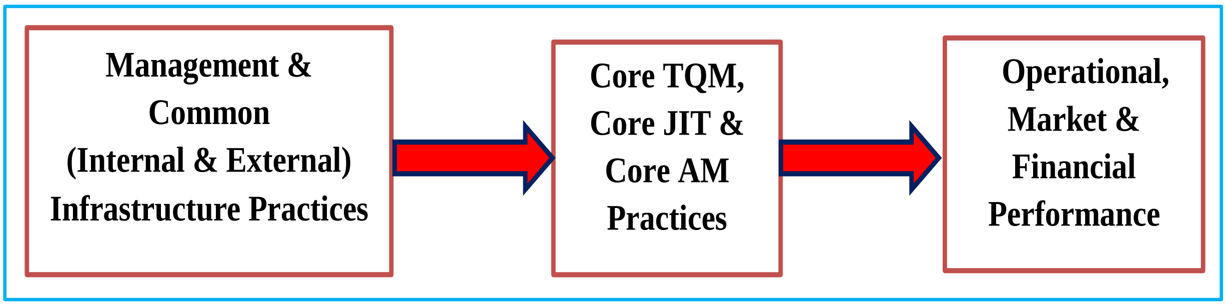


Figure 3.3. Universal Perspective Fit

Source: Adapted from (Lakhal et al., 2006, p. 629)

(b) **CONTINGENCY PERSPECTIVE FIT**

In Contingency Perspective, a Fit is not free from context biases among macro/micro systems and its results are seriously sensitive to change in organizational, internal and external, context (Shah & Ward, 2003). If the relationship between two factors, one independent and one dependent, is reliant on the degree of change in the third factor, then that third factor is known as moderator and the process is known as moderation (Venkatraman, 1989). Researchers undertake the study with respect to each contextual factor (moderator) and test the application of macro/micro factors/variables and this approach in literature is known as reductionism (Ahmad et al., 2003). Meyer et al. (1993) explained reductionism as “an approach whereby researchers seek to understand the behavior of a social entity by separately analyzing its constituent parts”. It can be concluded that in contingency perspective, sub-systems are loosely coupled and their individual application can be fine-tuned to attain better performance. Contingency perspective is represented in Figure 3.4.

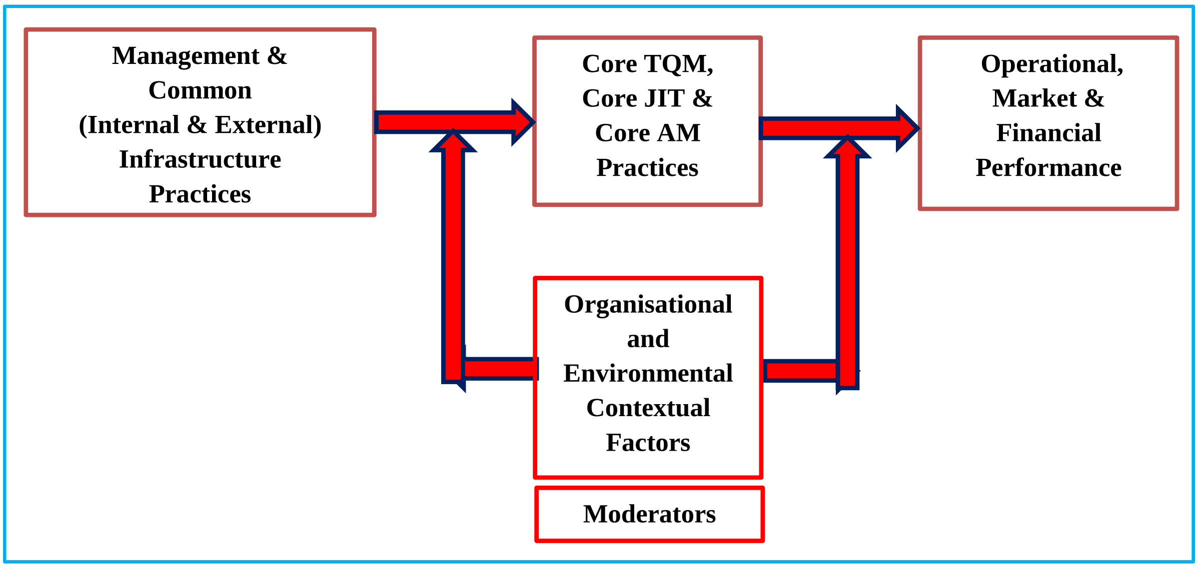


Figure 3.4. Contingency Perspective Fit

Source: Adapted from (Ahmad et al., 2003, p. 171)

(c) **CONFIGURATIONAL PERSPECTIVE FIT**

Configurational Perspective is opposite to contingency perspective and here researcher undertake study as holistic approach, contrary to reductionism, and check the combined effects of micro/macro systems with respect to internal structure or external context (Flynn et al., 2010; Fuentes-Fuentes, Lloréns-Montes, Molina-Fernández, & Albacete-Sáez, 2011). Meyer et al. (1993, p. 1178) explained configurational approach as “the parts of a social entity take their meaning from the whole and cannot be understood in isolation. Rather than trying to explain how order is designed into the parts of an organization, configurational theorists try to explain how order emerges from the interaction of those parts as a whole”. It can be concluded that in configurational perspective sub-systems cannot be separated from each other and their individual application cannot be fine-tuned to attain better performance rather these are applied collectively for higher performance. For configurational testing an ideal profile is required to check the understudy system deviation from the ideal profile. If ideal profile is not readily available to test the relationship, then ideal profile is generated from the sample subject to investigation (Drazin & Van de Ven, 1985; Venkatraman, 1989). Configurational Perspective is depicted in Figure 3.5.

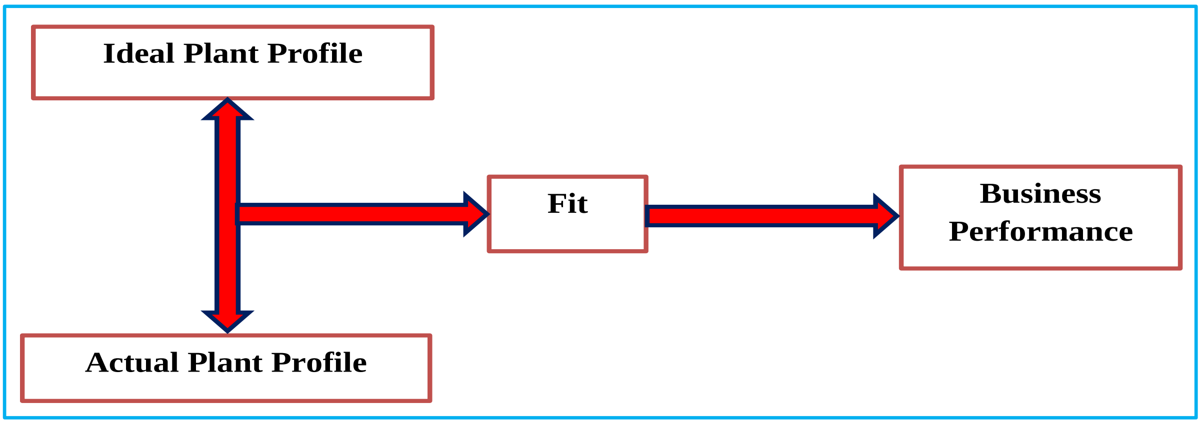


Figure 3.5. Configurational Perspective Fit

Source: (Ahmad et al., 2003, p. 173)

Research model hypotheses are proposed under three scenarios as following. (1) Universal Perspective Fit, (2) Contingency Perspective Fit, (3) Configurational Perspective Fit.

3.4.2 UNIVERSAL PERSPECTIVE FIT HYPOTHESES

Top management commitment previously was used to be expected part of OM research (Flynn et al., 1995b; Saraph et al., 1989), but with the passage of time and maturity of OM research (Sousa & Voss, 2008). It has been well established that top management commitment is the foremost critical element for implementation of any improvement program (TQM, JIT, AM, TPM, etc.) irrespective of manufacturing or service industry (Ahire & Ravichandran, 2001; Cua et al., 2001; Gunasekaran, 1998; Kaynak, 2003; D. Y. Kim et al., 2012; Ravichandran & Rai, 2000). For effective implementation of any improvement program, top management has to establish a sound internal infrastructure. For example, top management is the one who plan, develop and communicate organizational vision, mission and goals (Cua et al., 2001; Flynn et al., 1995b; Saraph et al., 1989). Top management also takes the responsibility to develop and implement strategies to accomplish those organizational long-term and short-term goals (Gunasekaran, 1998, 1999b; Samson & Terziovski, 1999; Sila & Ebrahimpour, 2005; Z. Zhang & Sharifi, 2000). Top management creates learning environment (Narasimhan et al., 2006) arrange resources for workforce to improve their technical and problem solving skills (Flynn et al., 1995a; Jayaram et al., 2010) through cross training by rotating employees among different jobs (Ahire & Ravichandran, 2001; Ahmad et al., 2003; Anderson et al., 1995; Cua et al., 2001; D. Y. Kim et al., 2012; Ravichandran & Rai, 2000; Sila & Ebrahimpour, 2005) and encouraging them to share new knowledge (Gunasekaran et al., 2008; Vázquez-Bustelo et al., 2007).

Top management develops empowered teams who are capable to take independent decision within their area of responsibility (Narasimhan et al., 2006), e.g., planning and readjusting their production schedule, interact directly with suppliers and customer to improve the product quality (Ahire & Ravichandran, 2001; Kaynak, 2003; Ravichandran & Rai, 2000). These teams also participate in organizational strategy development process (Cua et al., 2001; D. Y. Kim et al., 2012; Sila & Ebrahimpour, 2005; Zu et al., 2008). The concept is not just to give extra workload, rather to give extra responsibility and resources to encourage them to be more productive, through constructive participation (Ahire & Ravichandran, 2001; Flynn et al., 1994; Kaynak, 2003). Top management develops an organization-wide feedback based information system (Flynn et al., 1994; Powell, 1995; Saraph et al., 1989), with a purpose share quality productivity and other important strategic data to employees (Cua et al., 2001; Fynes & Voss, 2002). Respective departments have full access to the data, related to their department and also of relevant departments (Sila & Ebrahimpour, 2005). Suppliers are also given access to operational data to improve their supply performance. This information system provides opportunity to employees to communicate freely with customers and suppliers (Prajogo & Olhager, 2012). Top management ensures employees trained on plant maintenance (Flynn et al., 1994, 1995a), where employees are encouraged to keep their plant neat and cLean and readily in operational condition (Cua et al., 2001; McKone et al., 1999; Shah & Ward, 2007). Sufficient empirical evidences are available for significant positive direct/indirect relationship between top management commitment and internal infrastructure practices e.g., strategic vision and planning (Cua et al., 2001, 2006; Ravichandran & Rai, 2000; Sila & Ebrahimpour, 2005), cross training (Ahire & Ravichandran, 2001; Anderson et al., 1995; Flynn et al., 1995b; Kaynak, 2003; D. Y. Kim et al., 2012; Lakhal et al., 2006; Sila & Ebrahimpour, 2005), empowered teams (Flynn et al., 1995b; Forza & Filippini, 1998; Jayaram et al., 2010; Sila & Ebrahimpour, 2005), information system (Cua et al., 2001; Flynn et al., 1995b; Sila & Ebrahimpour, 2005), and plant maintenance (Cua et al., 2006; McKone et al., 1999). Above discussion leads to following hypothesis:

Hypothesis # 1: Top Management commitment is significantly (positively) associated with Common Internal Infrastructure Practices.

Top management along with establishment of Common Internal Infrastructure (CII) is also responsible to establish a strong Common External Infrastructure (CEI) (Flynn et al., 1995b). Top management takes measures to establish an open relationship with customer. Its commitment is reflected through appreciating the customers' requirements and transforming those requirements into products acceptable to the customer (Ahire, 1996c; Black & Porter, 1996; Flynn et al., 1995b; D. Y. Kim et al., 2012; Zu et al., 2008). Moreover, a culture is developed where, customers and employees visit each other's plants to familiarize with the working environment (Flynn et al., 1995b). Regular customer satisfaction feedback is checked to improve the products quality. Moreover, customer service employees are empowered to resolve the customer problems immediately (Jayaram et al., 2010; Sila & Ebrahimpour, 2005).

Suppliers are the key to business success and long-term relationship with suppliers give organization and competitive edge. Suppliers' contribution can be enhanced by keeping a few reliable suppliers and like customers they are also involved right from the product design stage to give their valuable inputs regarding availability of the required material at right time and acceptable quality (Flynn et al., 1995b; Kaynak, 2003; D. Y. Kim et al., 2012; Saraph et al., 1989; Sila & Ebrahimpour, 2005; Zu et al., 2008). Surprisingly, Ravichandran and Rai (2000) failed to find a direct significant link between top management commitment and supplier/customer relationship. However, indirect significant effects incurred through infrastructure practices. Apart from Ravichandran and Rai (2000) study, a number of studies have empirically validated the strong positive relationship between top management commitment with suppliers' relationship (Ahire & Ravichandran, 2001; Anderson et al., 1995; Flynn et al., 1995b; Sila & Ebrahimpour, 2005), and customers' relationship (Flynn et al., 1995b; Jayaram et al., 2010; D. Y. Kim et al., 2012). Above discussion leads to following hypothesis:

Hypothesis # 2: Top management commitment is significantly (positively) associated with Common External Infrastructure Practices.

Common Internal Infrastructure (CII) practices are the precursor for effective execution of Core TQM, Core JIT and Core AM practices. CII effective establishment lays a solid foundation for effective implementation of ensuing Core TQM, Core JIT and Core AM practices (Flynn et al., 1995b; Sharp et al., 1999). Quality policy establish quality goals, trained and empowered employees participate in product design process to improve product design, organization-wide information system provides quality and productivity data for improvement. A cLean and operationally ready plant helps to produce non-defective products. A number of studies have empirically established a significant positive relationship between CII Practices and ensuing core TQM Practices like; Product Design, Process

Management through SPC and Continuous Improvement (Anderson et al., 1995; Flynn et al., 1995a, 1995b; Jayaram et al., 2010; D. Y. Kim et al., 2012; Lakhal et al., 2006; Ravichandran & Rai, 2000; Sila & Ebrahimpour, 2005; Zu et al., 2008). Similarly, a number of studies have also found statistically significant relationship between common internal infrastructure practices and ensuing JIT practices like; set-up time reduction, JIT scheduling, lot size reduction and pull production system (Ahmad et al., 2003; Cua et al., 2001; Flynn et al., 1995a; Furlan et al., 2011b; Hofer, Eroglu, & Hofer, 2012; Matsui, 2007; Nakamura et al., 1998; Sakakibara et al., 1997). Literature is replete with theoretical support for relationship between CII and ensuing Core AM like; Change Proficiency, Knowledge Management and Advanced Manufacturing Practices (Goldman & Nagel, 1993; Goldman et al., 1995; Gunasekaran, 1998; Sharifi & Zhang, 1999; Yusuf et al., 1999), but empirical evidence are rare (Cao & Dowlatshahi, 2005; Inman et al., 2011; Narasimhan et al., 2006; Sharp et al., 1999). Above discussion, lead us to following hypotheses:

Hypothesis # 3: Effective establishment of Common Internal Infrastructure Practices is significantly (positively) associated with ensuing core TQM practices.

Hypothesis # 4: Effective establishment of Common Internal Infrastructure Practices significantly (positively) associated with ensuing core AM practices.

Hypothesis # 5: Effective establishment of Common Internal Infrastructure Practices significantly (positively) associated with ensuing core JIT practices.

Common External Infrastructure (CEI) like suppliers' and customers' relationship building processes provides concrete base for smooth execution of ensuing Core TQM, JIT and AM Practices. This link is deep-rooted in highly synchronised inter-firms relations, i.e., the firm functional areas relationship with suppliers and customers of a firm (Jayaram & Xu, 2013, p. 3). Supplier, and customer, participate in product development process, customer through expounding product requirements and; suppliers through availability of timely and defect free supplies at plant floor to eliminate additional inspection process. A number of studies have empirically established link between supplier and customer relationship with ensuing Core TQM Practices (Anderson et al., 1995; Bottani, 2010; Flynn et al., 1995b; D. Y. Kim et al., 2012; Zu et al., 2008). Supplier support core JIT Practices implementation through timely delivery and customer by furnishing timely and accurate demands. Sufficient empirical evidences are available to support the relationship between external infrastructure and ensuing Core JIT Practices (Cua et al., 2006; Jayaram et al., 2008; Narasimhan et al., 2006; Sakakibara et al., 1997). Similarly, suppliers and customer relationship are precursor to acquire agility milestone. A rare empirical evidence is available for relationship between CEI and ensuing Core AM (Inman et al., 2011; Narasimhan et al., 2006). Above discussion leads to following hypotheses:

Hypothesis # 6: Effective establishment of Common External Infrastructure Practices is significantly (positively) associated with ensuing core TQM practices.

Hypothesis # 7: Effective establishment of Common External Infrastructure Practices is significantly (positively) associated with ensuing core AM practices.

Hypothesis # 8: Effective establishment of Common External Infrastructure Practices is significantly (positively) associated with ensuing core JIT practices.

AM has been characterized as highly change proficient, knowledge-based manufacturing and high technology-oriented paradigm. To be competitive, in the market, organizations have to be proficient enough to change (Dove, 1999; Goldman & Nagel, 1993; Goldman et al., 1995; Yusuf et al., 2014) with respect to market and customer preferences (Yusuf et al., 1999; Z. Zhang, 2011; Z. Zhang & Sharifi, 2007). TQM is also an customer focused approach and continuously improve process and product quality to meet the customer shifting requirements (Anderson et al., 1994). Advance manufacturing provides leverage to the organizations to beat competitors and launch quickly and high quality products in the market (Inman et al., 2011; Narasimhan et al., 2006). Sharp et al. (1999), empirically established that agility builds on strong Lean foundation. Similarly (Goldman & Nagel, 1993, p. 19) also states that “Agile manufacturing assimilates the full range of flexible production technologies, along with the lessons learned from TQM, JIT, and Lean production”. Narasimhan et al. (2006, p. 452), found that Agile players were better on TQM culture implementation primarily due to continuous improvement philosophy as compare to Lean players, and provided justification that AM execution requires effective establishment of TQM. Similarly, Bottani (2010, p. 254) classified TQM as one of the agility enabler. Zelbst et al. (2010) found a significant positive relationship between TQM and AM. Above discussion leads to following hypothesis:

Hypothesis # 9: Effective establishment of Core TQM practices are positively associated with ensuing Core AM Practices.

AM has been theoretically well acceptance as an advance stage of Lean production (Hormozi, 2001; Jin-Hai et al., 2003). AM can be accomplished on sound establishment of already developed manufacturing programs like; Lean production, flexible manufacturing system, etc. (Goldman & Nagel, 1993; Gunasekaran, 1998; Sharifi & Zhang, 1999), whereas, Sarkis (2001) describes AM as combination of flexible manufacturing and Lean production system. Shah and ward identified JIT as one out of four important Lean bundles for accomplishing Lean production. .Narasimhan et al. (2006) found that agile group was at par than Lean players on JIT flow and JIT supply which are prime elements for JIT implementation and provides a strong justification for JIT as precursor to AM (Sharp et al., 1999; Vázquez-Bustelo et al., 2007). Inman et al. (2011) empirically found an indirect relationship between JIT production and AM. Similarly, Zelbst et al. (2010) also found an indirect positive relationship between JIT and AM. Above discussion lead to following hypothesis:

Hypothesis # 10: Effective establishment of Core **JIT** Practices are positively associated with ensuing Core AM Practices.

There is wide acceptance in OM literature that TQM positively contributes to organizational competitiveness capabilities (Ahire & Ravichandran, 2001; Cua et al., 2006; Flynn et al., 1995b; Hendricks & Singhal, 1997) through the manufacturing excellence (Grandzol & Gershon, 1998; Zu et al., 2008). Forza and Filippini (1998) found TQM as a positive contributor to customer satisfaction and quality conformance. Curkovic et al. (2000) found that TQM positively affects quality performance of the organization through quality improvement. Similarly, Lakhal et al. (2006) stated TQM positive link with quality performance as well as with operational performance. Consistent with literature above discussion leads to following hypothesis:

Hypothesis # 11: Core TQM practices are positively associated with operational performance.

JIT is known for waste elimination, improved delivery reliability and enhanced efficiency (Danese, Romano, & Bortolotti, 2012) by reducing buffer inventory through Lot Size Reduction (Flynn et al., 1995a) and pull production system (Shah & Ward, 2007), short cycle time through set-up time reduction (Cua et al., 2001; Shah & Ward, 2003), eliminating non-value added activities (Claycomb, Dröge, & Germain, 1999a; Claycomb et al., 1999b), and capability to meet master schedule timelines (Matsui, 2007; Zelbst et al., 2010). A number of studies have reported positive JIT association with organizational and business performance (Claycomb et al., 1999a; Claycomb et al., 1999b; J. J. Lawrence & Hottenstein, 1995; Nahm, Vonderembse, & Koufteros, 2004). Nahm et al. (2004) and Narasimhan, Kull, and Nahm (2012) reported a positive relationship between time based manufacturing (JIT) and organizational performance. Matsui (2007), also stated that JIT is a significant contributor to organizational performance. Similarly, McKone and Weiss (1999), Dal Pont et al. (2008) and Furlan et al. (2011b) found a positive association between aggregate JIT and firm competitiveness. Moreover, Furlan et al. (2011a) also found strong complementarity effects between internal and external JIT and their positive impact on performance. Contrary to above, Zelbst et al. (2010) and Green Jr, Inman, Birou, and Whitten (2014) reported an insignificant relationship between JIT and operational performance. However, Consistent with literature above discussion leads to following hypothesis:

Hypothesis # 12: Core JIT Practices are positively associated with Operational Performance.

AM is an emerging manufacturing paradigm in the field of OM having special emphasis on organizational flexibility and responsiveness enhancement (Goldman et al., 1995; Gunasekaran, 1998; Z. Zhang, 2011). Garvin (1984) argued that organization strive to acquire business excellence through manufacturing and marketing excellence. Further, he explained that manufacturing excellence depends upon quality improvement, and marketing depends upon customers' satisfaction. TQM and JIT provide ground to AM to improve competitiveness (Goldman & Nagel, 1993; Hormozi, 2001; Jin-Hai et al., 2003; Sharp et al., 1999). TQM primarily focuses to improve quality through continuous improvement of processes/products (Flynn et al., 1995b; Zu et al., 2008), JIT eliminates waste by eliminating excessive buffer inventory (Ahmad et al., 2003) and AM focuses on flexibility and responsiveness along with quality and delivery reliability (Hallgren & Olhager, 2009; Vázquez-Bustelo et al., 2007). Sufficient evidences are available that these improvement programs alone like TQM (Kaynak, 2003; Lakhal et al., 2006; Sila, 2007; Sila & Ebrahimpour, 2005), JIT (Ahmad et al., 2003; J. J. Lawrence & Hottenstein, 1995) and AM (Vázquez-Bustelo et al., 2007), as well as, integrated set of practices can improve operational and business performance (Cua et al., 2006; Dean Jr & Snell, 1996; Flynn et al., 1995a; Inman et al., 2011; Shah & Ward, 2003; Yang et al., 2011; Yusuf & Adeleye, 2002). Literature is replete with theoretical support for integrated relationship among AM, TQM and JIT with operational performance, and business performance (Gunasekaran, 1998; Yusuf et al., 1999), but sufficient large scale empirical evidence, to support AM, TQM and JIT integration is very rare (Vázquez-Bustelo et al., 2007; Yusuf & Adeleye, 2002). Yusuf and Adeleye (2002), reported a positive correlation of aggregate AD with operational and business performance and aggregate agility with market performance. Vázquez-Bustelo et al. (2007), developed and validated a strong link between aggregate agility with overall business performance through significant manufacturing strength. Zelbst et al. (2010), testified that AM, supported by TQM and JIT, leads to better operational and logistics performance. Similarly, Inman et al. (2011) found that AM, in association with JIT manufacturing, leads to operational performance, marketing performance and financial performance. Above discussion lead to following hypotheses:

Hypothesis # 13: Core AM Practices, supported by Core TQM Practices and Core JIT Practices are positively associated with Operational Performance.

Hypothesis # 14: Core AM practices, supported by Core TQM Practices and Core JIT Practices are positively associated with Market Performance.

Hypothesis # 15: Core AM practices, supported by Core TQM Practices and Core JIT Practices are positively associated with Financial Performance.

Marketing and financial performance results are direct impact of improved operational performance (Green Jr, McGaughey, & Casey, 2006; Inman et al., 2011; Sila, 2007; Vázquez-Bustelo et al., 2007). Green Jr et al. (2006) testified market performance direct positive association with financial performance. Sila (2007) found that organizational effectiveness positively contribute towards organizational market and financial results. Vázquez-Bustelo and Avella (2006) proposed market and financial performance to the manufacturing strength of the organization and also empirically validated this link (Vázquez-Bustelo et al., 2007). Similarly, Inman et al. (2011) and Green Jr, Whitten, and Inman (2012) found that operational performance directly improve the market performance, which significantly improve the business financial performance. Moreover, Inman et al. (2011) and Green Jr et al. (2012) also found that financial performance is a function of operational performance, only and when, market performance mediates this relationship. Hypotheses numbers H16 to H18 are tested in subsequent stage after testing hypothesis from hypotheses numbers H1 to H15.

Hypothesis # 16: In an Agile working environment, improved Operational Performance is positively associated with Market Performance.

Hypothesis # 17: In an Agile working environment, Operational Performance is positively associated with Financial Performance.

Hypothesis # 18: In an Agile working environment, improved Market Performance mediates the relationship between Operational Performance and Financial Performance.

3.4.3 CONTINGENCY PERSPECTIVE FIT HYPOTHESES

Under Contingency Perspective Fit, research framework also proposes that different organizational internal contextual factors (Firm Size, ISO-9001 Registration, Industry Type and Information Technology), and environmental external contextual factors (competitive pressures, market dynamics and technological dynamics), moderate the relationship among culture, integrated manufacturing and business performance outcomes.

(a) FIRM SIZE

Ghobadian and Gallear (1997) argued that quality gurus Juran, Deming, Crossby, Feigenbaum, limited improvement initiative programs implementation to large firms only. Large firms, in nature, are more formal, with more hierarchical management layers, rich in resources and formal decentralized communication setups, whereas, SMEs are nimbler and flexible in nature due to flatter communication and less cultural inertia (Ghobadian & Gallear, 1997; Jayaram et al., 2010). Due to hefty infrastructure, large firms are more reluctant to change and even give up if improvement results are not realized at earlier stage, due to huge implementation cost and time required (Sila, 2007). Firm size does moderate the relationship between integrated manufacturing practices and performance outcomes. Nevertheless, this moderation directionality is not consistent across firm size, and variation does exist between SMEs and large firms (Jayaram et al., 2010). Hendricks and Singhal (2001) also concluded that small firms are much efficient than larger firms. Mean percent of ones change in operating income and sales for small firms was much higher than large firms. J. J. Lawrence and Hottenstein (1995), also reported that firm size moderate the relationship between JIT and business performance, but effects of directionality were explicitly industry dependent. SMEs were more JIT-oriented in computer and electrical industry whereas, large firms were more JIT-oriented in metal fabrication industry. Shah and Ward found that large firms are more inclined to implement Lean (TQM and JIT) practices than small firms do. Similarly, Narasimhan et al. (2006) found that small firms are agility oriented, due to multi-skilled workers, as compared to large firms who are Lean-oriented because of specialised workforce. Contrary to this, Yang et al. (2011) found a moderating effect of firm size among Lean (TQM and JIT), environmental practices and business performance and SMEs were more effective on Lean (TQM & JIT) than large firms. Jayaram et al. (2010) found that SMEs enjoy hegemony on customer focuses through design management and performance due to less hierarchical structure, whereas, large firms having proper training mechanism realize better performance results through process management. Ahire and Dreyfus (2000) found that firm size did not moderate internal design and process management results, however, external quality results were moderated by firm size. Cua et al. (2001) did not find any significant impact of firm size on integrated manufacturing (TQM & JIT) and firm performance. Similarly Ahire and Golhar (1996d), Dröge, Claycomb, and Germain (2003) and Sila (2007) also did not find any significant difference between large and SMEs. Ghobadian and Gallear (1996) cautioned adverse effects of modified TQM in small firms, but TQM proper deployment increases the probability of an SME's growth and long-term survivability (Ghobadian & Gallear, 1997). Goldman et al. (1995) argued that AM is extremely context dependent but yet no large scale empirical evidence is available to support the firm size impact on firm size implementation. Due to mix results reported in these studies, it is propose that:

Hypothesis # 19a: The full structural model Fit varies across small, medium (SMEs) and large size firms.

Hypothesis # 19b: The relationship among culture, core manufacturing practices and outcomes vary across small, medium (SMEs) and large firms.

(b) **ISO-9001 REGISTRATION (INSTITUTIONAL CONTINGENCY FACTOR)**

ISO 9000 registration can be regarded as subset of TQM (Sila, 2007). The focus of ISO is on management practices to improve product design and process management through development, production and purchasing. ISO registration process has become a fad, more than requirement, to compete in international market (Rao, Ragu-Nathan, & Solis, 1997a; Sun, 2000) and also can be termed as international trade language (Clougherty, 2009). More than 9 million firms from 170 countries have registered to ISO 9000 (Singh, Power, & Chuong, 2011). ISO adoption also helps firms to overcome information obstructions and perform much better in international trade markets (Martincus, Castresana, & Castagnino, 2010). However, the literature is not in explicit agreement upon ISO 9000 impact on organizational performance. Few previous studies find mix results for ISO effects on performance from no support (A.M. Lima, Resende, & Hasenclever, 2000; Sila, 2007), to partial support (Sun, 2000) and full support (Clougherty, 2009; Martincus et al., 2010; Rao et al., 1997a). Sila (2007) using a sample from manufacturing and services firms, find no difference between 165 ISO registered and 121 non-registered firms. A.M. Lima et al. (2000), using a sample of 129 Brazilian firms, found no difference among ISO certified and non-ISO certified firms. Moreover, ISO implementation duration effects were also insignificant. Sun (2000), using a sample of 316 firms, found a significant difference between ISO and non-ISO firms. However, no significant difference between ISO and non-ISO firms was found on certain TQM critical quality enablers like; strategic planning, training on statistical methods, customer focus, workforce development and supplier involvement. Martincus et al. (2010), using export data (secondary data) from 1998-2006 of Argentinian firms and found that ISO adoption significantly improve export performance. Clougherty (2009), using a sample of 91 countries and trade data for the period from 1995-2005, found a strong evidence for ISO adoption between a pair of countries if host country is also adopting ISO registration and in the same language to eliminate information barriers. Singh et al. (2011) using a sample of 416 ISO-9000 registered manufacturing firms, found that those firms who design supplier relationship, customer relationship and internal process based in ISO standards coherently improve competitive performance than if applied individually. Due to mix results reported in these studies, it is propose that:

Hypothesis # 20a: The full structural model Fit varies across ISO-9001 certified and non-ISO-9001 certified firms.

Hypothesis # 20b: The relationship among culture, core manufacturing practices and outcomes vary across ISO-9001 certified and non-ISO 9001 certified firms.

(c) INDUSTRY TYPE

Manufacturing Industry is classified into two types based on production process, discrete and continuous. Industry dominantly employing continuous manufacturing processes include food products, textile, paper, etc., whereas, industry employing discrete manufacturing includes e.g., machinery, electronics, instruments, etc.

(Jayaram et al., 2010; Shah & Ward, 2003; Wagner et al., 2012). Researchers are of the view that improvement initiative programs implementation and results vary with respect to production processes (Jayaram et al., 2010). Inconclusive results are reported in the literature for industry moderating effects. Few previous studies find mix results for industry type effects on performance from no support for JIT and TQM (Shah & Ward, 2003) for agility (Dowlatshahi & Cao, 2006) to strong support for JIT and TQM (Benson et al., 1991; Jayaram et al., 2010; J. J. Lawrence & Hottenstein, 1995). Shah and Ward (2003) did not find industry moderating effects on implementation of TQM and JIT. Similarly, Dowlatshahi and Cao (2006) did not find industry moderating effects between AM (virtual integration and information technology) and business financial performance. J. J. Lawrence and Hottenstein (1995), using a sample of 124 plants, found a significant moderating impact of industry type on JIT practices and performance. Similarly, Jayaram et al. (2010) using a sample of 394 plants exploring total effects, found moderating effects of industry type. Total effects moderation, nine out of twelve of culture to outcomes, and five, out of eighteen of quality system design to outcomes were observed. Apparel industry has been regarded as highly innovative due to rapid new product introduction and changes in existing products (Wagner et al., 2012). For the purpose of this study, industry type is defined as readymade garment industry and Knitwear and hosiery industry. Although both industries belong to discrete industry category but to drill down industry type moderating effects on implementation of integrated manufacturing practices, it is proposed that:

Hypothesis # 21a: The full structural model Fit varies across Readymade-Garments and Knitwear & Hosiery Manufacturing Firms.

Hypothesis # 21b: The relationship among Culture, Core Manufacturing Practices and Outcomes varies across Readymade Garments and Knitwear & Hosiery Manufacturing Firms.

(d) **INFORMATION TECHNOLOGY**

Information Technology is the most critical instrument to manage complex intra, and inter, organizational information in following ways. First, it facilitates the communication within the organization, production planning, scheduling, and monitoring. Second, it facilitates strong coordination between firm and suppliers enabling better supplies while saving valuable time. Third, especially in export environment, close coordination with customer starting from product design development till delivery eliminate time and distance barriers (Prajogo & Olhager, 2012, p. 516). Researchers like; Gunasekaran (1998), Sharifi and Zhang (2001), Gunasekaran et al. (2008) and Bottani (2010) argued that Information Technology is a critical enabler to acquire agility. Narasimhan et al. (2006, p. 450), reported that Agile firms are more Information Technology oriented and invest more on Information Technology infrastructure than Lean players. However, Mo (2009) also argued a better association between Information Technology and Lean production. According to Dowlatshahi and Cao (2006), a better alignment between information technology and virtual enterprises leads to better business financial performance. Past few studies have shown that Information Technology significantly helps to improve information and material flow avoiding complexities like bullwhip effects. Prajogo and Olhager (2012), found that information technology along with effective information system positively mediate the supplier relationship and logistics performance. From above discussion, it is proposed that:

Hypothesis # 22a: The full structural model fit varies across High and Low Information Technology Oriented Firms.

Hypothesis # 22b: The relationship among culture, Core Manufacturing Practices and outcomes varies across High and Low Information Technology Oriented Firms.

(e) ENVIRONMENTAL CONTEXTUAL FACTORS

Environmental uncertainty, in the field of organizational literature, is defined as a set of External Environmental Factors, with respect to an organization, which are primarily not under management’s direct control though it may be for a shorter time. But such threat scenarios also provide opportunities (Bourgeois, 1980, 1985) and organizations capable to align themselves with these environmental changes survive in the business (Duncan, 1972). Goldman et al. (1995), Dove (1999), Gunasekaran (1998), and Sharifi and Zhang (1999), claimed agility as critical capability to operate when business environmental turbulence is high (Goranson, 1999; Sharp et al., 1999; Yusuf et al., 1999). Sharifi and Zhang (2001, p. 779) identified seven turbulence factors for example marketplace, competitive pressures, technology (Jaworski &

Kohli, 1993; Kohli & Jaworski, 1990), along with customers, suppliers, social factor and product/process diversity and complexity. Competitive pressure is the degree of competition, also known as competitive hostility, where competitors are in close competition and continuously strive to improve with respect to their competitors (Hallgren & Olhager, 2009) when resources are scare (Katayama & Bennett, 1996; Vázquez-Bustelo et al., 2007). Market dynamism reflects the degree of unanticipated change in the market/customer preferences (Inman et al., 2011). Technology turbulence refers to the degree of technological breakthroughs in the specific industry (Jaworski & Kohli, 1993; Yusuf & Adeleye, 2002) and provide leverage to the organizations to lead the market through introduction of new products and services (Wang et al., 2012). Although it has been theoretically well established, in the literature, that agility is the ability to respond more quickly to environmental changes but empirical evidences to support this argument are rare and partial attempts have been made to test this relationship like competitive pressures/intensity (Hallgren & Olhager, 2009), market dynamism (Inman et al., 2011; Vázquez-Bustelo et al., 2007), market dynamism and competitive intensity (Vázquez-Bustelo et al., 2007) technological turbulence (Yusuf & Adeleye, 2002) with Core AM. Similarly, Lean players also utilise cost reduction leverage to expand market share in competitive environment (Hallgren & Olhager, 2009; Katayama & Bennett, 1996). According to Dean Jr and Snell (1996), once market is highly competitive and complex, technology impact is not significant. Moreover, when market complexity are high and growth is low, TQM and JIT significantly contribute, whereas, when competitive pressures are low and market growth is high JIT become insignificant. Hallgren and Olhager (2009) reported a positive causal relationship between competitive intensity and agility. Vázquez-Bustelo et al. (2007), conclude a positive causal relationship between competitive pressure and market dynamism with Core AM Practices. Yauch (2010), also found that agile organizations perform better once competitive, market and technology turbulence is high. However, Inman et al. (2011) reported an insignificant environmental uncertainty moderating impact between Core AM and performance. Similarly, Jaworski and Kohli (1993) also reported an insignificant moderating impact of technology, market and competitive intensity between market orientation and business performance. Yusuf and Adeleye (2002) found a significant correlation between technology and sales turnover. Similarly, Dröge et al. (2003) found a significant moderating impact of technology turbulence among knowledge creation, knowledge application and business performance. Rose and Shoham (2002), using a sample of 124 export firms of general manufacturing, conclude that market orientation affects firm's export performance (net profit and profit growth) experiencing high technological turbulence as compare to market turbulent or competitive intense firms. Environmental uncertainty effects are similar across manufacturing industry (Hallgren & Olhager, 2009; Vázquez-Bustelo et al., 2007) as and service industry (Wang et al., 2012). Terawatanavong et al. (2011), using a sample of 162 Thai exporters (suppliers) and Australian importers (buyers), reported that technological turbulence moderate the supplier market orientation and buyers satisfaction association with financial performance. Wang et al. (2012), using a sample of 588 hotels from china, reported a significant moderating impact of competitive pressures, market turbulence and technology turbulence between TQM and hotel performance as well as between market orientation and hotel performance. Due to mix results reported in these studies, it is proposed that:

Hypothesis # 23a: The full structural model Fit varies across high and low competitive pressures.

Hypothesis # 23b: The association among culture, core manufacturing practices and performance outcomes, varies across high and low competitive pressures.

Hypothesis # 24a: The full structural model Fit varies across high and low market dynamics.

Hypothesis # 24b: The association among culture, core manufacturing practices and performance outcomes, varies across high and low market dynamics.

Hypothesis # 25a: The full structural model Fit varies across high and low technological dynamics.

Hypothesis # 25b: The association among culture, core manufacturing practices and performance outcomes varies, across high and low technological dynamics.

Hypothesis # 26a: The full structural model Fit varies across high and low cumulative environmental turbulence.

Hypothesis # 26b: The association among culture, core manufacturing practices and performance outcomes, varies across cumulative Environmental Turbulence.

3.4.4 CONFIGURATIONAL PERSPECTIVE FIT HYPOTHESES

Configurational approach is assumed to be an extension of contingency theory (Ahmad et al., 2003, p. 172). Meyer et al. (1993, p. 1177), also supported this notion as "by synthesizing broad patterns from contingency theory's fragmented concepts and grounding them in rich, multivariate descriptions, the configurational approach may help consolidate the past gains of contingency theory". Researchers believe that organizations, capable to align business structure with business strategy, lead to better performance (Skinner, 1969). Few studies have reported positive results for configurational approach. For example, configuration between common infrastructure and JIT (Ahmad et al., 2003) environment and TQM (Fuentes-Fuentes et al., 2011) and supply chain integration (Flynn et al., 2010). Ahmad et al. (2003) using a sample of 110 manufacturing plants, concludes a positive fit between JIT infrastructure and competitiveness. Similarly, Fuentes-Fuentes et al. (2011), in a sample of 273 firms, found a better alignment between five diversified organizational environment and TQM resulted in improved operational, market and financial performance.

A configurational perspective fit hypotheses are depicted in Figure 3.6. Configurational Perspective Fit Theory employment will confirm that a Fit among management, infrastructure and core integrated manufacturing practices leads to improved organizational and business performance and a misfit among management, infrastructure and core integrated manufacturing practices leads to negative performance. Above discussion leads to following hypotheses:

Hypothesis # 27: A misfit among quality management practices, internal and external infrastructure and core integrated manufacturing practices leads to negative operational performance.

Hypothesis # 28: A misfit among quality management practices, internal and external infrastructure and core integrated manufacturing practices leads to negative market performance.

Hypothesis # 29: A misfit among quality management practices, internal and external infrastructure and core integrated manufacturing practices leads to negative financial performance.

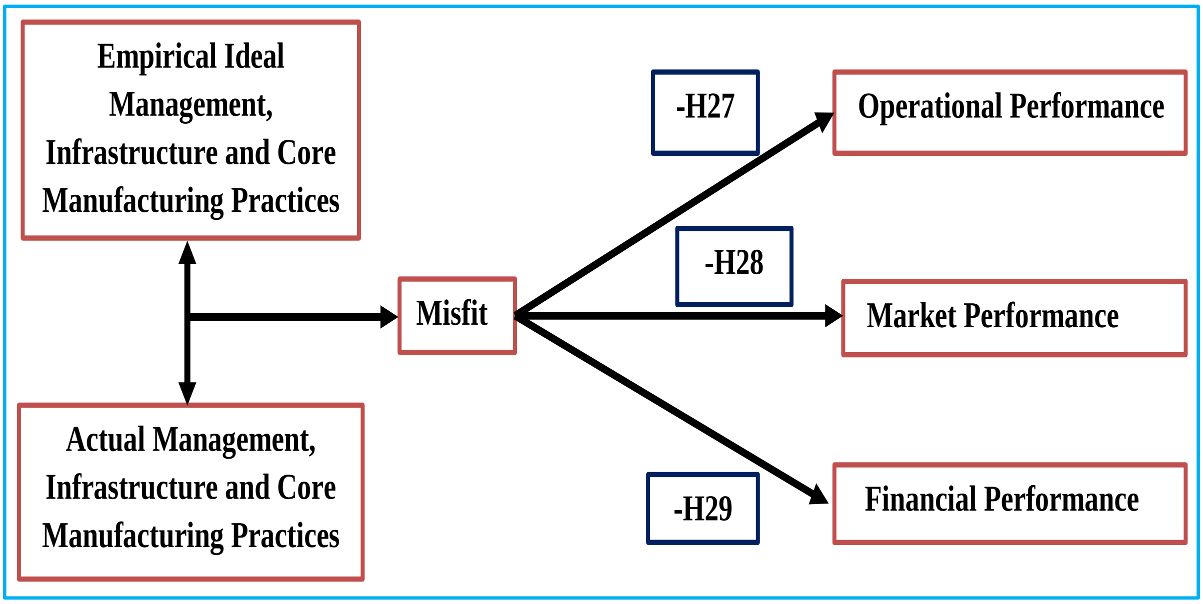


Figure 3.6. Proposed Configurational Perspective Fit

Source: Adapted from (Fuentes-Fuentes et al., 2011, p. 732)

3.5 RESEARCH DESIGN

According to Sekaran (2003, p. 117), research design is comprised "a series of rational decision making choices". Similarly, Zikmund, Carr, and Griffin (2012, p. 66) defined research design as, "a research design is a master plan that specifies the methods and procedures for collecting and analyzing the needed information. A research design provides a framework or plan of action for the research". Saunders, Lewis, and Thornhill (2011) developed a logical research onion to explain research design as shown in Figure 3.7. Generically, research onion is decomposed into three major parts as (1) Philosophies, (2) Approaches, (3) Research Design. Research philosophies and approaches are precursor to research design. Research design includes research strategy i.e. the method how research will be undertaken i.e., survey, experiment, action research etc., choices between qualitative or quantitative, time horizon and finally data collection methods and data analysis. Brief description of research philosophy, approach and design elements is given in section 3.5.1 to section 3.5.6 respectively.

3.5.1 PHILOSOPHY

Research philosophies are categorized in four types as (1) Realism, (2) Positivism, (3) Interpretivism and (4) Pragmatism. Realism philosophy relates to scientific investigation, it seriously depends upon researcher sensation power, and what researcher sense and the sensation effects perceived by his mind are believed to be right.

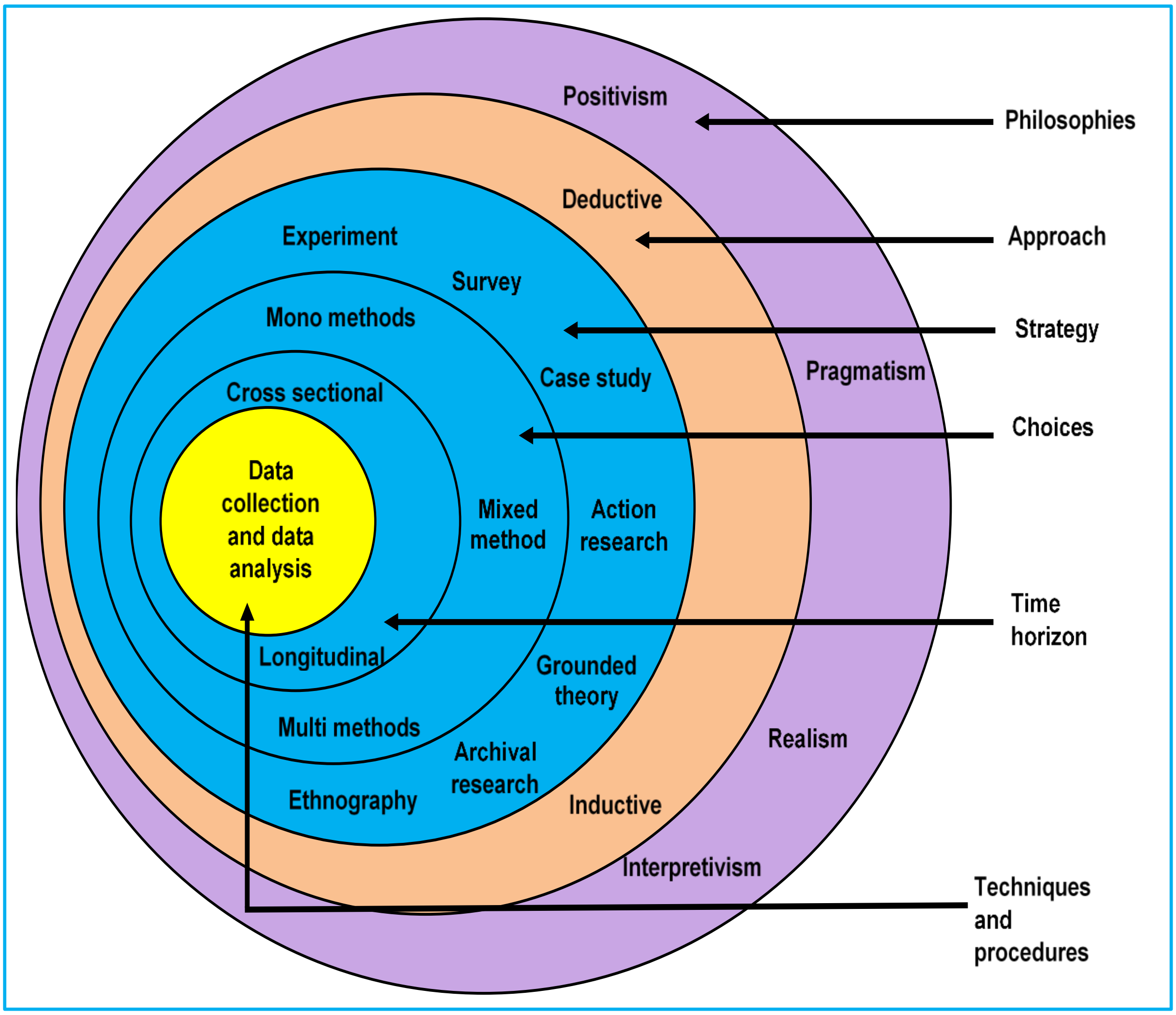


Figure 3.7. Research Onion

Source: (Saunders et al., 2011, p. 138)

Illusions may seriously moderate this kind of philosophy. Positivism philosophy is, where, research is generally pursued, like natural scientists and leads to development of laws, like generalization and natural sciences. Interpretivism philosophy advocates the relative position of the researcher to the research and deductions are drawn upon interpretation of different social actors (non-objective) responses in certain environment. Pragmatism philosophy advocates the situations where researcher's research scope is wide spread and, most probably, where research question explicitly does not define research philosophy that it is either Positivist, Realism or Interpretivism to find the scientific and objective solution to the research question. Furthermore, pragmatism approach roots are rooted in empirical investigation based on theory. No philosophy approach is superior or inferior to other, it is the research question, which explicitly defines the approach to be applied. For the purpose of this study, pragmatic philosophy is suitable, as it will unfold the theory, through investigation of multiple research questions, through empirical investigation.

3.5.2 APPROACH

Research approach is divided into two main branches, i.e., Inductive approach or Bottom Up Approach and Deductive approach or Top Down Approach as shown in Figure 3.8 (Saunders et al., 2011; Sekaran, 2003). Theoretical differentiation between these two approaches are briefly described as following and suitable approach for this study is described.

(a) INDUCTIVE RESEARCH APPROACH

In inductive research, researcher witnesses few observations and then develops patterns on the bases of observation. Based on these patterns further hypotheses are developed to develop new theory. Testing results define new knowledge boundaries in the form of new theory. This approach is also known as Bottom-Up-Approach (Saunders et al., 2011; Sekaran, 2003). Inductive research is flexible, in terms of collecting data, and easily can accommodate small sample size (Easterby-Smith, Thorpe, Jackson, & Lowe, 2008). Inductive research approach is not suitable for this research study, as sufficient relevant literature is already available to test the under question theory.

(b) DEDUCTIVE RESEARCH APPROACH

Deductive research approach is based on previous knowledge where relevant theory preludes and research boundaries are extended through empirical testing of proposed theory developed based on literature review (Robson, 2002). Hypotheses, based on existing literature, are developed to test the proposed theory. Data is collected and hypotheses are tested to confirm or reject the proposed theory. Based on test results specific theory boundaries are reshaped. This approach is known as top-down approach (Saunders et al., 2011; Sekaran, 2003). For the purpose of this study and consistent with deductive approach, a theoretical framework is developed through literature review (see section 2.14) and hypotheses are proposed in section 3.4.

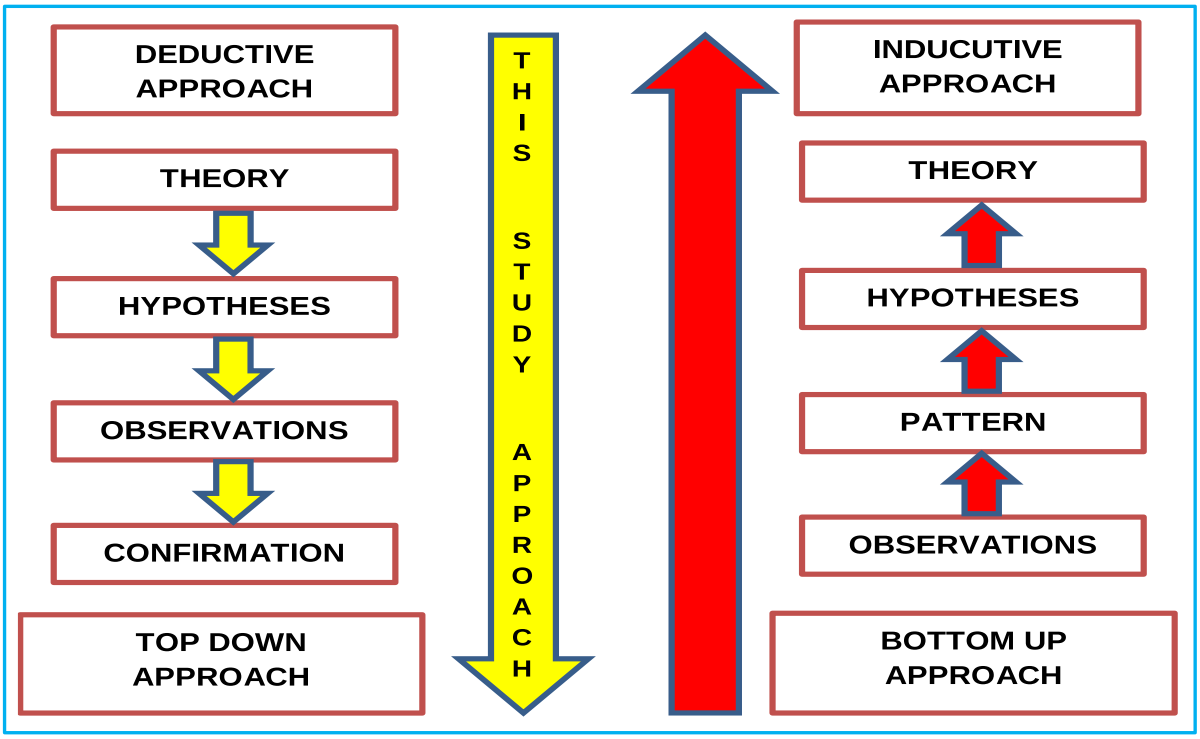


Figure 3.8. Deductive and Inductive Research Approach
Source: (Saunders et al., 2011; Sekaran, 2003)

3.5.3 PURPOSE

Before making a decision, to select research strategy, researcher shall clearly define the purpose of study and, based on the purpose of study, the best suitable research strategy shall be selected to address the research problem. Research purpose has been classified into three-fold in the literature i.e. Descriptive Study, Exploratory Study and Explanatory Study (Saunders et al., 2011; Sekaran, 2003). Research purpose may be of one type or a combination of two types. Moreover, the research purpose keeps on changing with respect to time (Robson, 2002). According to Uma (Sekaran, 2003), descriptive studies are best when researchers just want to describe the tangible characteristics of under study variables at a specific time (Bottani, 2010). For example, number of students in a class, with respect to gender, age or number of subjects, different students have taken etc. According to Robson (2002, p. 59), "descriptive study purpose is to portray an accurate profile of persons, events or situations".

Exploratory Studies are undertaken once much information is not available, or literature support link is missing at present, that how such problems have been addressed in past (Sekaran, 2003, p. 119). Similarly, Robson (2002, p. 59) stated that an exploratory study is best suited to inquire "what is happening; to seek new insights; to ask questions and to assess phenomena in a new light", and mostly inductive approach due to flexible in nature

(Easterby-Smith et al., 2008) is used to address such kind of situations (Saunders et al., 2011). Exploratory studies are the most flexible and keep on changing with respect to time and observation patterns. Qualitative approach is preferred over quantitative to accomplish Exploratory Study objectives through unstructured interviews or observations etc.

Explanatory Studies are undertaken once researchers wish to know the causal relationship between variables under study. Such studies are undertaken to "establish a definitive cause and effect relationship" (Sekaran, 2003, p. 126). Causal approaches are best suited to conduct explanatory studies. In causal study, researcher is interested to outline the cause of at least one or more as well as supplementary problems. Whereas, in correlational studies researchers outline the variables, which, are utmost associated with the core problem. In most Studies, Descriptive and Explanatory parts go side by side and such studies are named as "Descripto-Explanatory Studies" (Saunders et al., 2011, p. 139). This research study is deductive in nature and the purpose of this study is to find a causal relationship among culture, core-integrated manufacturing and performance outcomes. According to our research problem, this study is Descriptive, Exploratory, as well as, Explanatory in nature.

3.5.4 STRATEGY AND CHOICES

According to Saunders et al. (2011), there are seven different research strategies, for example (1) survey, (2) action research, (3) experiment, (4) case study, (5) ethnography, (6) grounded theory, and (7) archival research, to accomplish the research objectives. According to Saunders et al. (2011, p. 144), survey strategy, due to its inbuilt capability of being objective and analytical, is best suited to test the proposed research theory (Atanasova, 2007, p. 101). Unstructured surveys are suitable for descriptive and exploratory studies, whereas, structured survey supports Descriptive and Explanatory Studies. Survey strategy is instrumental to collect data from large sample in an economical way and results drawn, through descriptive and inferential statistics, from large sample, are much robust in nature and have wide acceptance as far as their large scale generalizability is concerned (Atanasova, 2007). Moreover, large scale quantitative data facilitates to identify multiple patterns which reflect a better insight of structures' persistency in certain working environments (Bentz & Shapiro, 1998). Surveys research strategy has been significantly used in OM research employing quantitative research methods (Ahire & Ravichandran, 2001; Flynn et al., 2010; Flynn et al., 1995a, 1995b; Inman et al., 2011; Nair, 2006; Narasimhan et al., 2006; Zelbst et al., 2010). Surveys, using quantitative method approach, are equally applicable in manufacturing (Jayaram et al., 2010; Kaynak, 2003; Lakhal et al., 2006), as well as, in services industry (Bottani, 2010; Ravichandran & Rai, 2000; Wang et al., 2012) and provide a solid rational to employ survey (quantitative) research strategy to undertake this research.

3.5.5 TIME FRAME

There are two types of time horizons, to undertake a research study, in the field of OM. One is known as Cross Sectional or Snap-shot, and the second is Longitudinal or Diary. Snap-shot means, the researchers take some observations at one time and extract results, based on those readings, whereas, in Diary researchers keep on recording observations over a certain period of time, defined / undefined in research timelines, and then extract results using those observations (Saunders et al., 2011; Sekaran, 2003). Time horizon choice is critically dependent to economic, time and availability of study sample constraints. Most of the studies in OM are cross-sectional specifically due to economic and time constraints. Study sample willingness to participate for a longer period is major constraint for Longitudinal Studies. Longitudinal Studies' results are more robust in nature as compare to Cross Sectional Studies. OM literature is replete with cross-sectional studies (Inman et al., 2011; Jayaram et al., 2010; Narasimhan et al., 2006; Yang et al., 2011). Nonetheless, few longitudinal studies are also reported (Dean Jr & Snell, 1996; Fullerton et al., 2003; Terziovski, Power, & Sohal, 2003). This study follows Cross Sectional Survey Approach due to time and economic constraints.

3.5.6 DELIMITATIONS

Along with timelines, researcher also decides how to undertake study, like using a single respondent or many respondents from one company. Reliability measures in case of many respondents per company are higher than single respondent per company (Flynn et al., 1997; Konecny & Thun, 2011). General trend, in OM research, is single firm-single respondent (it helps to have large sample) primarily due to time and economic constraints (Inman et al., 2011; Yang et al., 2011; Zelbst et al., 2010). However, evidences for single firm multiple respondents, although not very common, also do exist in OM literature (Cua et al., 2001, 2006; Flynn et al., 1995b; Konecny & Thun, 2011; McKone et al., 2001; McKone & Weiss, 1999). Consistent with literature and due to economic/time constraints Cross Sectional approach is best suitable for this research study with single firm - single respondent (however that respondent may consult other departments while answering) approach. The scope of this research study is limited to Readymade Garments, Knitwear and Hosiery Export firms of Pakistan spread in two (based on their geographical location) major industrial zones i.e., North Zone and South Zone. These two industrial zones are comprised four major industrial cities. North zone is comprise three cities (1) Lahore (2) Faisalabad (3) Sialkot and south zone is comprise one city (1) Karachi. The entire survey, apart from demographic information, purely is based on respondent's perception.

3.6 SURVEY QUESTIONNAIRE

The questionnaire is designed to test the relationship proposed in the research framework. The questionnaire scale comprises multi-items. To confirm the reliability and validity of measurement scale necessary measures are taken in the light of best available literature guidelines (Churchill, 1979; Crowston, 1997; Dillman, 1991, 2000, 2007; Phipps, Butani, & Chun, 1995; Raghunathan & Grizzle, 1995). The questionnaire development process comprises three stages. At first stage, all relevant literature is explored in length to find the already developed measures with high degree of reliability and validity (Crowston, 1997). Questionnaire items are partially modify with respect to Apparel Export Industry working environment, nonetheless, items essence is not disturbed. At second stage, five industry specialists are asked to provide feedback, regarding survey instrument suitability with respect to Apparel Export Industry working environment. Their feedback, regarding importance of few items, elimination of certain biases and questionnaire flow etc., is incorporated in the questionnaire. Questionnaire items' language 'English' has not changed, as the entire industry interacts with international customers using 'English' as international communication language. At third stage, three senior academic experts (Phd), and five Phd scholars are asked to review the questionnaire items to remove any content bugs. Finally, questionnaire is again tested among industry and academic experts. They are asked to complete the survey and suggest any additional improvement required to improve the clarity of the questionnaire. Average time, required to complete the survey, is calculated during this exercise. The only concern at this stage is the length of the questionnaire. Few, unnecessary items are eliminated, or modified, in the light of feedback provided. In this way, the questionnaire content and face validity is established (Crowston, 1997; Dillman, 2007; Saunders et al., 2011). Although pre-test is not run using a large industry sample size, however, it is done with the help of industry specialists, academic experts and academic scholars. Saunders et al. (2011, p. 394) suggested that questionnaire face validity can be acquired, even with the help of some academic friends, if industry sample is readily not available.

The questionnaire, in final version, appears at Appendix '**B**'. Dillman (2007) guidelines are followed and a cover letter is designed and sent along with the questionnaire.

The covering letter simply explains about the purpose and importance of the study and encourages participants for maximum participation. Respondents' confidence is ensured by assuring that, "information provided by you will be used for academic research only, and its confidentiality is assured and no individual data will be reported / quoted at any level". This exercise helps to gain the respondents' confidence and to improve the response rate. Moreover, as per Saunders et al. (2011, p. 391) guidelines, questionnaire is "closed" with paying high regards to the respondents for their valuable contribution through participation in this research study.

3.6.1 VARIABLES OPERATIONALIZATION

The questionnaire comprises four major parts as shown in Table 3.3. Already developed and fully validated scales are adapted in this study. Already developed and tested, due to consistently use in OM research, scales are much reliable as compared to newly developed measurement scales. The first part (demographics) relates to the respondent and firm general information. The second part relates to independent variables. Third part is about business environment. The fourth part is about different performance outcomes. Likert scale is best to use for rating purposes (Crowston, 1997; Flynn, Sakakibara, Schroeder, Bates, & Flynn, 1990). Different types of Likert scales are common like three, five, seven or nine point. Seven point Likert scale is use in this study. As the rating scale points increase it provides more freedom to respondent to rate itself, and researcher gets detailed insight information. Second and third part are measured on seven point Likert scale form "strongly disagree = 1, neutral = 4, strongly agree = 7". The fourth part is also measured on seven point Likert scale but these measurements change with respect to operational, market and financial performance. For operational performance, respondents were asked to rate their firm with respect to their main competitors on seven point Likert scale as following, "well below average = 1, neutral = 4, well above average = 7". For market and financial performance, respondents' were asked to rate their firm market and financial performance as following, "deteriorated more than 20% = 1, stay about the same = 4, improved more than 20% = 7".

Hair, Black, Babin, and Anderson (2010, p. 704), suggested that for better consistency each latent variable should be measured at least with three questions. Therefore, for improved consistency, due consideration was given while measuring latent variables and efforts were made to ensure that each latent variable is measured with at least three questions. The respondents are asked to provide their perception, not their personal experiences, about firms on different aspects, to minimize interest bias.

Table 3.3. Summary of Items Used in the Research Survey

Part	Strategic Area	Key Constructs	No of Items	Literature Support
I	Demographic	Respondents' and Organization General Profile	11	
II	Lean (TQM &JIT) and AM Practices	Top Management Commitment	5	Saraph et al. 1989, F1ynn et al. 1994, Ahire et al. 1996, Grandzol and Gershon 1998
		Cross Training	4	Saraph et al. 1989, F1ynn et al. 1994, Ahire et al. 1996, Cua et al. 2001
		Empowered Teams	6	F1ynn et al. 1994, Ahire et al. 1996, Cua et al. 2001, Narasimhan et al. 2006, Jayaram et al. 2010
		Information System	4	Cua et al. 2001 & 2006, Fynes and Voss 2002, Prajogo and Olhager 2012
		Strategic Vision and Planning	4	Cua et al. 2001 & 2006
		Plant Environment	4	Flynn et al. 1995a, Cua et al. 2001, Shah and Ward 2007
		Relationship with Customers	5	Flynn et al. 1994, Narasimhan et al. 2006, Sila 2007, Jayaram et al. 2010
		Relationship with Suppliers	5	Flynn et al. 1994, Narasimhan et al. 2006, Prajogo et al. 2012
		Product Design	5	Flynn et al. 1995a, Cua et al. 2001, Zelbst et al. 2010
		Process Management (SPC)	3	Flynn et al. 1995a, Cua et al. 2001, Zelbst et al. 2010
		Continuous Improvement	3	Anderson et al. 1995, Rungtusanatham et al. 1998, Curkovic et al. 2000
		Lot Size Reduction	3	Flynn et al. 1995a, Zelbst et al. 2010
		Set-Up Time Reduction	3	Flynn et al. 1995a, Cua et al. 2001, Zelbst et al. 2010
		Pull Production System	4	Flynn et al. 1995a, Cua et al. 2001, Shah and Ward 2007, Zelbst et al. 2010
		JIT Scheduling	3	Flynn et al. 1995a, Cua et al. 2001, Zelbst et al. 2010
		Change Proficiency	7	Sharifi and Zhang 2001, Zhang and Sharifi 2007, Zelbst et al. 2010, Inman et al. 2011
		Knowledge Management	5	Vázquez-Bustelo et al. 2007, Hakala & Kohtamäki 2011
		Advance Manufacturing Technology	5	Narasimhan et al. 2006
III	Organizational Context *Demographic items	Information Technology	7	Chen and Paulraj 2004, Prajogo and Olhager 2012
		Firm size*	1	Shah and Ward (2003), Jayaram et al. (2101)
		ISO-9001 Registration*	1	Sila (2007), Clougherty and Grajekm (2009)
		Industry Type*	1	Jayaram et al. (2101)
IV	Business Environment Context	Competitive Pressures	3	Jaworski and Kohli 1993, Wang et al. 2012
		Market Dynamics	3	Jaworski and Kohli 1993, Wang et al. 2012
		Technological Dynamics	3	Jaworski and Kohli 1993, Wang et al. 2012
V	Performance Measurement	Operational Performance	6	Cua et al. 2001 & 2006, Ahmed et al.2003, Narasimhan et al. 2006, Hallgren and Olhager 2009, Furlan et al. 2011
		Market Performance	3	Inman et al. 2011, Yang et al. 2011
		Financial Performance	3	Inman et al. 2011, Yang et al. 2011

The measurements are subjective instead of objective, in nature and depend upon the general perception of the respondents. Nonetheless, Ketokivi and Schroeder (2004) cautioned that there is a strong correlation between performance subjective and objective measures. Therefore, subjective measures are well thought-out close to the objective measures in the field of OM (Cua et al., 2001; Flynn et al., 1995b; Lakhal et al., 2006; Zelbst et al., 2010).

3.6.2 INDEPENDENT VARIABLES

Top management commitment is measured using five-question scale adopted from Saraph et al. (1989) "role of divisional top management and quality policy", Flynn et al. (1994) "top management support" and Grandzol and Gershon (1998) "Leadership in your organization". The scale items are as, (1) "top managers anticipate change in business/market and make plans to respond", (2) "top managers promote the use of quality tools & techniques in manufacturing processes", (3) "top managers have received adequate training on quality tools & techniques", (4) "top Managers provides adequate resources for product and process quality improvement", (5) "top managers are held accountable for achieving quality, innovation and improvement targets".

A number of studies have classified infrastructure and core practices separately (Flynn et al., 1995a; Sousa & Voss, 2002). Moreover, the significant contribution of these internal and external infrastructure practices, in close association with core practices, in integrated manufacturing, have been theoretically and empirically well-established (Ahmad et al., 2003; Flynn et al., 1995a; Jayaram & Xu, 2013; Lakhal et al., 2006; Sakakibara et al., 1997; Sousa & Voss, 2002). For instance, internal infrastructure like "management support, plant environment and information feedback" with Core TQM and JIT Practices (Flynn et al., 1995a), "strategic planning, cross functional training, employees' involvement information and feedback" with Core TQM, JIT and TPM practices (Cua et al., 2001). Whereas, external infrastructure like "supplier development" with Core JIT and TQM practices (Flynn et al., 1995a), customer orientation" with Core TQM, JIT, and AM Practices (Zelbst et al., 2010), "JIT purchasing" with JIT production and AM (Inman et al., 2011), "relationship with supplier" and "relationship with customers" with Core Internal Process (Singh et al., 2011), and customer focus and supplier relationship (as external focus) with internal core practices e.g., information management and process management (Jayaram & Xu, 2013) etc. Common internal infrastructure practices were grouped into a set of following practices (1) cross training, (2) empowered teams, (3) information system, (4) strategic vision and planning, (5) plant environment.

Internal infrastructure super-scale is measured using five sub-constructs as, (1) cross training, (2) empowered teams, (3) information system, (4) strategic vision and planning, (5) plant environment. These sub-constructs are measured as independent multi-item scale and then a summated scale, by taking average of each sub-construct, is used to measure internal infrastructure construct.

The extent of training in an organization is measured using four-question scale. These measures are taken from Saraph et al. (1989) “training”, Flynn et al. (1995a) “workforce management”, Ahire et al. (1996a) “employee training” and Cua et al. (2001) “cross-functional training”. The scale items are, (1) “ employees receive different training to be capable to perform multiple tasks” (2) “shop floor employees are rotated regularly among different jobs” (3) “employees are rewarded for learning new skills & techniques” (4) “employees are evaluated on continual professional development criteria”.

Similarly, empowered teams is measured as five-question scale adapted from Flynn et al. (1994) “teamwork”, Ahire et al. (1996a) “employee empowerment”, Cua et al. (2001) “employee involvement”, Narasimhan et al. (2006) “teams”, and Jayaram et al. (2010)“empowerment”. The scale items are as, (1) “production scheduling is handled by empowered teams”, (2) “suppliers certification and training are handled by empowered teams”, (3) “labour scheduling/job assignment is handled by empowered teams” (4) “independent decision-making done by empowered teams is encouraged in the firm” (5) “performance reviews are handled by empowered teams”, (6) “empowered working teams operate together with suppliers and customers”.

Information feedback is measured using four-question scale taken from Cua et al. (2001), “information and feedback” Fynes and Voss (2002), “feedback” and Prajogo and Olhager (2012) “information sharing”. The scale items are as, (1) “information on productivity is readily available to employees” (2) “feedback on strategic and economic information is provided to employees” (3) “generic operational data is shared with suppliers to improve supplies” (4) “frequent contact and communication is maintained with suppliers and customers”.

For Strategic vision and planning four items are taken from studies (Cua et al., 2001, 2006). The scale items are as, (1) “the management follows a formal strategic planning process resulting in written mission, long-term goals and implementation strategies”, (2) “plant management is included in the strategic planning process”, (3) “top management regularly reviews and updates long-range strategic plans”, (4) “formal and well-defined strategy is implemented in the plant”.

Finally, plant environment is measured with four-question scale adapted from Flynn et al. (1995a) “plant environment”, Cua et al. (2001) “TPM”, Shah and Ward (2007) “TPM”. The scale items are as, (1) “plant and equipment is in a high state of readiness for production at all times” (2) “emphasis is placed on putting all tools and fixtures at their place after use” (3) “pride is felt in keeping plant neat and cLean” (4) “maintenance department train machine operators to perform routine preventive maintenance”.

Similarly, external infrastructure super-scale is measured using two sub-scales as, (1) relationship with customers (2) relationship with suppliers. These sub-constructs are measured as independent multi-item scale and then a summated scale, by taking average of each sub-construct, is used to measure external infrastructure construct. Relationship with customers is measured with five-question scale adapted from Flynn et al. (1994)“customer interaction”, Narasimhan et al. (2006) “customer orientation”, Sila (2007) “customer focus”, Jayaram et al. (2010) “customer focus”. The scale items are as, (1) “close contact with customers is maintained”, (2) “results of customer satisfaction surveys are shared with all employees”, (3) “opportunities for employee-customer interactive sessions are created”, (4) “a systematic process exists to translate customer requirements into new/improved products/services”, (5) “customer service employees are empowered to resolve customers’ complaints quickly”. Relationship with suppliers is measured using five-question scale adapted from Flynn et al. (1994) “supplier relationship”, Narasimhan et al. (2006) “supplier partnership” and Prajogo et al. (2012) “long term relationship”. The scale items are as; (1) “strives to establish long-term relationships with suppliers based on quality, price and reliability”, (2) “suppliers are actively involved in new product development process”, (3) “collaborates with key suppliers to improve their quality of supplies in the long-term”, (4) “quality and reliability is priority one in selecting suppliers”, (5) “firm relies on a few high quality and reliable suppliers”.

Core integrated manufacturing practices comprises Core TQM, Core JIT and Core AM practices. Respondents are asked to give heir their perception about general level of implementation of these practices. Moreover, the focus is limited to extent of implementation, and adoption duration is not considered. Nair (2006, p. 963) through meta-analysis (23 research studies) identified core quality management practices as “process management” and “product design”, along with “management leadership and people management” as internal infrastructure and “customer focus and supplier quality development” as external infrastructure practices. Similarly, Anderson et al. (1995), Rungtusanatham et al. (1998) and Curkovic et al. (2000) empirically measured "continuous improvement" as Core TQM practice in their research framework. For this study, Core TQM super-scale is measured with three sub-scales, (1) product design (2) process management (3) continuous improvement. These sub-constructs were measured as independent multi-item scale and then a summated scale, by taking average of each sub-construct, was used to measure Core TQM construct. Product design is measured with five-question scale taken from Flynn et al. (1995a) and Zelbst et al. (2010) "product design", Cua et al. (2001) "cross-functional product design". The scale items are as, (1) "there is a considerable involvement of production and quality assurance people in the early design of products", (2) "manufacturing engineers are involved to a great extent in new product design and development", (3) "employees are involved to a great extent (teams or consultants) for introducing new products or making product changes", (4) "composite teams are made from major functions (marketing, manufacturing, etc.) to introduce new products", (5) "customer requirements are thoroughly analyzed / reviewed in the new product design process".

Process management using statistical process control, is measured with three questions scale taken from Flynn et al. (1995a) and Zelbst et al. (2010) "statistical process control" and Cua et al. (2001) "process management". The scale items are as, (1) "a large number of the processes on the shop floor are controlled through statistical process control techniques", (2) "statistical techniques are extensively used to reduce variance in processes/supplies" (3) "SPC charts are used to determine manufacturing processes' capabilities". Similarly, continuous improvement is measured using three-question scale taken from following studies (Anderson et al., 1995; Curkovic et al., 2000; Rungtusanatham et al., 1998) "continuous improvement". The scale items are as, (1) "quality improvement is the responsibility of every employee in the firm", (2) "continuous improvement of quality is stressed in all work processes throughout the firm', (3) "all employees analyze their work to look for ways and means of improvement".

Mackelprang and Nair (2010, p. 285) through meta-analysis (25 research studies) identified Core JIT practices as "setup time reduction, small lot sizes, daily schedule adherence, Kanban, and repetitive nature of master schedule", internal infrastructure practices as "preventive maintenance, equipment layout" and external infrastructure practices as "JIT delivery from suppliers, JIT link with customers". For the purpose of this study core JIT practices super-scale was measured using four sub-scales as, (1) lot size reduction, (2) set-up time reduction, (3) Kanban, (4) JIT scheduling (Flynn et al., 1995a; Zelbst et al., 2010).

These sub-constructs are measured as independent multi-item scale and then a summated scale, by taking average of each sub-construct, is used to measure Core JIT construct.

Lot size reduction is measured with three-question scale adapted from Flynn et al. (1995a), and Zelbst et al. (2010) “lot size reduction practices”. The scale items are as, (1) “small lot sizes are used in the firm”, (2) “small lot sizes are used in master schedule”, (3) “aggressively working to lower lot sizes in plant”. Similarly, set-up time reduction is also measured with three-item scale adapted from studies (Cua et al., 2001; Flynn et al., 1995a; Zelbst et al., 2010). The scale items are as, (1) “aggressively working to reduce set-up time in the firm”, (2) “workers carryout practices to reduce set-up time”, (3) “low equipment set-up time is assured in the firm”.

Pull production system (Kanban) is measured with four-question scale adapted from Flynn et al. (1995a) and Zelbst et al. (2010) “Kanban”, (Cua et al., 2001) “Pull System Production” and Shah and Ward “Pull”. The four item scale is as, (1) “pull system for production control is used”, (2) “production is pulled by the delivery of finished goods”, (3) “production at current work station is pulled by the current demand of the next work station”, (4) “Kanban squares, containers of signals for production control are used”. Similarly, JIT scheduling is measured with three-items scale adapted from Flynn et al. (1995a) and Zelbst et al. (2010) “JIT scheduling” and Cua et al. (2001) “schedule adherence”. The three item scale is as, (1) “production schedule is met each day”, (2) “there is time in the schedule for machine breakdowns or production stoppages”, (3) “production schedule is designed to allow time for catching up due to production stoppages for quality problems”.

Core AM super-scale is measured using three sub-scales as, (1) change proficiency (2) knowledge management, (3) advance manufacturing technology. These sub-constructs are measured as independent multi-item scale and then a summated scale, by taking average of each sub-construct, is used to measure Core AM construct. As far as, Core AM practices are concerned, very less empirical evidence is available. Dove (1999) proposed a theoretical framework comprising of two main pillars (1) change management (2) knowledge management, but empirical evidence, to support this relationship, still lack in the literature. However, these measures, independently, have been used to measure AM, e.g., change proficiency by Inman et al. (2011) and Zelbst et al. (2010). They empirically measured AM (change proficiency) using first ten (out of twenty) capabilities of an Agile enterprise identified by Sharifi and Zhang (2001, p. 786). Whereas, Vázquez-Bustelo et al. (2007) empirically validated knowledge management as important agility enabler. Similarly, Narasimhan et al. (2006) “advance manufacturing technologies” and Vázquez-Bustelo et al. (2007) “agile technologies’ empirically tested as important agility enablers. For this study, a Core AM super scale comprises three sub-scales as: (1) change proficiency (2) knowledge management (3) advance manufacturing technology.

Change Proficiency scale is based on seminal work of Sharifi and Zhang (2001, p. 786) AM capabilities. Further, Inman et al. (2011, p. 352) refined the scale by using 10 items from these AM capabilities to represent Agile Manufacturing (AM) construct. Similarly, Zelbst et al. (2010, p. 656) used the same scale to represent Agile Manufacturing (AM). To develop change proficiency scale ***Q*-sorting** technique is employed. ***Q*-sorting** technique is used to confirm content and face validity of change proficiency scale. These ten items, in a random order, were presented to two groups, five each, of Masters’ students from engineering management department of a public university. In first step, one group was asked to sort these ten items, based on contents, into two constructs i.e., change proficiency and other AM capabilities. They were asked to rate items, related to change proficiency as, “**1 = Yes** and **0 = No**” These ten items were sorted into two constructs as seven items in change proficiency and three in other AM capabilities’ constructs. In the second step, next group was asked to sort these constructs in a similar way. The second group sorted these items into two constructs, change proficiency and other AM capabilities, with an accuracy of **80%** with respect to first group.

Finally, to confirm sorting accuracy, a panel of two PhD (engineering management) scholars was instituted. Both the scholars were asked, to act as judge, to sort these ten items into two scales i.e., change proficiency and other AM capabilities. Items, presented to them, were in a random order. To evaluate the sorting precision of these judges’ two step approach was adopted (1) “inter-judge raw agreement scores” (Li, Ragu-Nathan, Ragu-Nathan, & Subba Rao, 2006), and Cohen Kappa Coefficient (Cohen, 1960). In first step, Inter-judge raw agreement score, using accurate placement of items into respective scale, was calculated. The raw-agreement score was **0.90**. In the second step, to eliminate presence of any chance agreement Cohen’s Kappa technique was employed to assess the degree of agreement between both the Judges. The Cohen’s Kappa inter-rater agreement coefficient was **0.783** ($p < 0.05$). Cohen’s Kappa score of **0.783** reflects a substantial agreement between two judges as proposed by Landis and Koch (1977). The first two groups’ items placement accuracy of **80%**, two independent judges raw agreement score of **0.90 (90%)** and Cohen kappa Coefficient of **0.783** confirmed high construct reliability and pre-convergent validity.

Change proficiency scale items are as, (1) "capabilities necessary to sense, perceive and anticipate market changes exist", (2) "production processes are flexible in terms of product models and configurations", (3) "immediately reacts to incorporate changes into manufacturing processes and systems", (4) "appropriate technology capabilities exist to quickly respond to changes in customer demand", (5) "strategic vision is used to emphasize the need for flexibility and agility to respond to market changes", (6) "the firm has the capabilities to deliver products to customers in time and quickly respond to changes in delivery requirements", (7) "firm can quickly get new products to market".

Knowledge management is measured as five-item scale adapted from Vázquez-Bustelo et al. (2007) "knowledge management" and Hakala and Kohtamäki (2011) "learning". The scale items are as, (1) "employees are encouraged to learn from work experiences and share innovative ideas with each other and management", (2) "teams are prepared to constantly assess, apply and update knowledge of work", (3) "databases containing organizational information are easily accessible to respective employees", (4) "firm information system allow extensive dissemination of work knowledge throughout the organization", (5) "employees are encouraged to share technical and work information". Similarly, advance manufacturing technology is measured using a five-question scale taken from Narasimhan et al. (2006). The scale items are as, (1) "firm uses computer aided design (CAD)", (2) "firm uses computer aided manufacturing (CAM)", (3) "firm uses flexible manufacturing systems (FMS)", (4) "firm uses robotics in production system", (5) "firm uses rapid prototyping for product development and design validation".

3.6.3 DEPENDENT VARIABLES

Dependent Variables comprise two parts; first part plant level (operational performance), and second part business level (market and financial performance). These measures are based on respondent's perception as, generally, firms do not share their objective data (Atanasova & Senn, 2011) and even in emerging economies they are much conscious in sharing objective performance data (Iqbal, Khan, Talib, & Khan, 2012; Sarwar et al., 2012). Nevertheless, Ketokivi and Schroeder (2004) argued that there is not much difference between objective and subjective data, especially, in case of large sample size.

Operational performance is measured primarily using four major competitive priorities (1) manufacturing cost (including scrap and rework overhead cost), (2) quality (conformance to specifications), (3) delivery (combination of on-time delivery or delivery reliability and delivery speed) and, (4) flexibility (combination of capability to switch between product volume and variety mix) (Cua et al., 2001; Hallgren & Olhager, 2009). These all measures are measured as single item measurement scale and then a linear combination of these four major performance dimensions (six items) result into overall operational performance. Garvin (1987) identified eight dimensions (1) conformance, (2) aesthetics, (3) features, (4) serviceability, (5) performance, (6) reliability, (7) durability, and (8) perceived quality, for a product to fully qualify the quality standards. For instance, aspects like product durability, serviceability and performance cannot be checked at plant level and can only be measured through usage during product life cycle. There is a general agreement between researchers that conformance to specifications alone is sufficient to declare that a product meets quality standard (Hallgren & Olhager, 2009, p. 988). Delivery, in general, has been operationalized in OM literature through measurement of single item on-time delivery (Ahmad et al., 2003; Cua et al., 2001, 2006; Furlan et al., 2011a). To capture better insight of delivery performance it has been operationalized as combination of two items on-time delivery and delivery speed (Dal Pont et al., 2008; Furlan et al., 2011b; Hallgren & Olhager, 2009; Konecny & Thun, 2011; McKone et al., 2001; Narasimhan et al., 2006). Similarly, flexibility has also been operationalized as single item e.g. flexibility to change volume (Cua et al., 2001; Furlan et al., 2011a).

However, in current literature, it has been operationalized as combination of two items scale as, (1) product volume mix flexibility, (2) product variety mix flexibility (Dal Pont et al., 2008; Furlan et al., 2011b; Hallgren & Olhager, 2009; Konecny & Thun, 2011). These six measures are adapted from Hallgren and Olhager (2009) “operational performance items” Furlan et al. (2011b) and Dal Pont et al. (2008). “performance” The scale items are as, (1) “firm unit cost of manufacturing is lower than major competitors”, (2) “firm product quality (conformance to specification) is better than major competitors”, (3) “firm on-time delivery performance is better than major competitors”, (4) “firm delivery speed to the customer is better than major competitors”, (5) “firm has more flexibility to change product (variety) mix as compare to major competitors”, (6) “firm has more flexibility to change product (volume) mix as compare to major competitors”.

In the second stage, sequential, performance is measured through market share and financial performance. Market share is measured using three-question scale. These measures have been adapted from Sila and Ebrahimpour (2005) and Sila (2007) “financial and market results”, Inman et al. (2011)“marketing performance” and Yang et al. (2011). “market performance”. The scale items are (1) “sales growth performance of the firm for the last three years", (2) "market share growth performance of the firm for the last three years", (3) "sales (volume) performance of the firm for the last three years". Similarly, financial performance is measured using three-item scale and adopted from Sila and Ebrahimpour (2005) and Sila (2007) "financial and market results", Inman et al. (2011)"marketing performance" and Yang et al. (2011). "market performance". The scale items are (1) "Return on Asset (ROA) performance of the firm for the last three years", (2) "Return on Investment (ROI) performance of the firm for the last three years", (3) "Profitability performance of the firm for the last three years".

3.6.4 ORGANIZATIONAL CONTEXT VARIABLES

The measures used for measurement of Organizational Context are simple (less information technology) and described in demographic part in Appendix **'B'**. These measures are (1) firm size, (2) ISO-9001 registration, (3) industry type, (4) information technology. Firm size classification based on number of plant employees. ISO-9001 registration described the firm status that either the firm is ISO-9001 registered or not. Industry type is either firm from export Chapter HS Code 61(knitwear and Hosiery) or export Chapter HS Code 62 (Readymade Garments). The scope is limited to registration only and not to the duration of the registration. Finally, information technology measures the extent of use of Information Technology in routine business activities. The scale is measured using seven-question items adapted from I. J. Chen and Paulraj (2004) and Prajogo and Olhager (2012) "information technology". The scale items are as; (1) "firm has direct computer-to-computer links with key suppliers", (2) "firm has direct computer-to-computer links with key customers", (3) "inter-organizational coordination is achieved using electronic links", (4) "firm uses information technology-enabled orders processing", (5) "firm has electronic mailing capabilities with key suppliers and customers", (6) "firm uses electronic transfer of purchase orders, invoices, and funds etc.", (7) "firm uses advanced information systems to track and expedite shipments".

3.6.5 BUSINESS ENVIRONMENTAL CONTEXT VARIABLES

Business Environment is measured using three sub-scales (1) competitive pressures, (2) market dynamics, (3) technological dynamics. These scales are adapted from Jaworski and Kohli (1993) and Wang et al. (2012) "competitive intensity, market turbulence and technological turbulence". Competitive pressures scale is measured using three item, as (1) "competitive pressures in Apparel (Readymade Garments, Knitwear And Hosiery) Export industry are extremely high", (2) "competitive moves in market are rapid and deliberate, with short-time for companies to react", (3) "much attention is paid to main competitors". Market dynamics is measured using three-questions scale as (1) "customers' product preferences change very quickly", (2) "customers tend to look for new products all the time", (3) "demand for products and services is sought from new customers". Similarly, technological dynamics is measured using three-question scale as: (1) "technological changes provide big opportunities in Apparel (Readymade Garments, Knitwear and Hosiery) export industry", (2) "a large number of new product ideas have been made possible through technological breakthroughs in Apparel (Readymade Garments, knitwear and hosiery) export industry", (3) "major technological developments are taking place in Apparel (Readymade Garments, knitwear and hosiery) export industry".

3.7 SURVEY DESIGN

Survey design comprises two steps (1) sample selection and (2) data collection method.

3.7.1 SAMPLING FRAME

The research study participating firms (sample) selection criteria based on two aspects. First, the firm should be an exporter for export-articles belonging to export Chapter HS Code 61 (Knitwear and Hosiery) and export Chapter HS Code 62 (Ready-made Garments). Second, the firm should be registered member of PHMA or PRGMEA of Pakistan. The focus of this study is restricted to one industry only i.e., Apparel (Readymade Garments, knitwear and hosiery) Export Industry of Pakistan.

Garvin (1988) argued that single industry focused studies provide better performance insight of an industry, at the same time results implications are much practical for that particular industry (Iqbal et al., 2012; Jayaram et al., 2008; Lakhal et al., 2006; Wong, Boon-itt, & Wong, 2011). The study participants' particulars were drawn from membership list available on PHMA and PRGMEA websites (PHMA, 2013; PRGMEA, 2013). Key respondent survey methodology is employed to collect the desired data (Fuentes-Fuentes et al., 2011, p. 733). The study sampling frame selection is done using stratified random sampling method. Specific industry sub-sector and region-wise sampling scheme details are given in Table 3.4.

Table 3.4. Sampling Frame from PHMA and PRGMEA Members

Source: (PHMA, 2013; PRGMEA, 2013)

Pakistan Hosiery Manufacturers Association (PHMA)- Chapter 61					
Region	**Members**	**Questionnaire Sent**	**Questionnaire Received Valid**	**Received %**	**Remarks**
Karachi	419	250	65	26.00	419 South Zone of Pakistan
Lahore	150	100	22	22.00	578 North Zone of Pakistan
Sialkot	170	100	27	27.00	
Faisalabad	258	150	37	24.67	
Total	**997**	**600**	**151**	**24.91**	
Pakistan Readymade Garments Manufacturers and Exporters Association (PRGMEA)- Chapter 62					
Region	**Members**	**Questionnaire Sent**	**Questionnaire Received**	**Received %**	**Remarks**
Karachi	265	150	40	26.67	265 South Zone of Pakistan
Lahore	116	100	24	24.00	284 North Zone of Pakistan
Sialkot	168	100	33	33.00	
Total	**549**	**350**	**97**	**27.88**	
Grand Total	**1546**	**950**	**248**	**26.1**	
*950 Target sample is 61.5% of the Population. Valid response rate is 26.1%					

3.7.2 DATA COLLECTION METHOD

An internet-based e-mail questionnaire is developed to collect data from the participating firms. The entire survey was designed using ***Qualtrics*** (www.qualtrics.com) internet-based survey interface. A significant problem in data collection is the lead-time associated with data collection through mail or telephone survey (Crowston, 1997, p. 252). Internet-based survey has many advantages over other self-administered survey methods e.g., postal method or self-distributed and collection survey method. The only limitation, which internet survey poses, is the literacy level of the respondent (Dillman, 2007). For this study, this is not considered as a barrier as all the firms interact with their international customers using e-mails (Dillman, 2007, p. 356). Apart from this, internet-based survey, also has other advantages. For instance, few significant advantages are as, (1) geographical boundaries does not pose any problem to internet-based surveys and can cover massively spread sample, (2) significantly decreases survey time and cost, (3) high probability that the respondent is a responsible person, (4) the most significant contribution of internet-based survey is the complete elimination of data entering errors, as the data automatically gets into its precise place once respondent makes an entry, and (5) it can be designed in more interactive way by making it colourful or using some graphics (Atanasova, 2007; Dillman, 2007; Saunders et al., 2011; Zikmund et al., 2012).

Data is required to be collected from exporting firms belonging to Export Chapter HS code 61 (Knitwear and Hosiery) and export Chapter HS code 62 (Readymade Garments). The data collection completed in two phases. Associations (PHMA and PRGMEA), being the hub of these firms for coordinating their export related issues with other government agencies, are contacted. **Phase-I** can be described as Researcher and Industry Interactive phase. In **Phase-I**, the Department of Engineering Management College of Electrical and Mechanical Engineering (EME) National University of Sciences and Technology (NUST), to develop an academia and industrial bridge, sent a written request to PHMA and PRGMEA north zone offices. Subsequently, the researcher personally visited these offices and met with the respective officials. The researcher personally briefed the objectives of this study to the respective officials. The respective authorities, after detailed meetings, agreed to assist in this study by extending maximum support.

The researcher personally visited five operational plants as well to know the production dynamics of export apparel industry. These five plants are small, medium and large with respect to plant employees respectively. Apart from this researcher also met three industrial consultants for better understanding of operational and marketing dynamics of Apparel Export Industry. The details of these plants and industrial consultants are given in Table 3.5.

Phase-II can be described as Execution Phase. In **phase-II**, once the questionnaire was ready for execution, again written requests were sent to the respective association offices. The significant problem in directly approaching industry is the non-availability of senior management and operational managers due to heavy working schedules (Li et al., 2006). To overcome this barrier, associations provide best academia-industry linkage platform to approach respective industry (Jayaram & Xu, 2013). Subsequently, the researcher personally visited associations' offices located all over the Pakistan and met with the officials for necessary coordination for execution of this questionnaire. Associations' officials also provided support-letter to the researcher, if at all researcher personally has to interact with any one of the association-members firm. Meeting details, with PRGMEA & PHMA different representatives, are given in Table 3.6.

Table 3.5. Researcher - Industry Interactive Sessions

Ser	Firm Name	Representative	Job Position	ISO-9001	Membership	Firm Size
1.	Paramount Spinning Mills Ltd	Mr Arif Raza Khan	Marketing Manager	Yes	PRGMEA	Large > 250 employees
2.	Fine Garments	Mr Mian Muhammad Ikram Mr Majid	CEO GM	Yes	PRGMEA	Medium > 50 and < than 250 employees
3.	ABC[3]	Mr Wahab	CEO	No	PRGMEA	Small < 50 employees
4.	Comfort knitwear	Asher Khurrram Iftikhar	CEO GM	Yes	PHMA	Large > 250 employees
5.	Knittex Apparel	Naeem Butt Rizwan Ghani	CEO GM	No	PHMA	Medium > 50 and < than 250 employees

Industrial Consultants			
	Name	**Appointment**	**Remarks**
1.	Mr Shafqat Hayat Bhatti	Associate National Expert - UNIDO[4]	Conducted study sponsored by UNIDO Diagnostic study-Garments Cluster Lahore – Pakistan
2.	Mr Haider	Consultant at SMEDA	Small and Medium Enterprise Development Authorities
3.	Mr Kanwar Usman	R&D Head	Ministry of Textile Industries of Pakistan

During meetings with the respective associations' officials, it was decided, that the questionnaire would be sent to the member firms using association's platform through e-mails. It was beneficiary in two ways, (1) the firm's e-mail addresses with the associations were up-to-date, thus eliminating address errors, (2) an obligation for firms to respond to the association request.

It was also decided that after every two weeks a reminder would be served to the member firms. The core benefit for initiating questionnaire through association was to gain the firms confidence and to motivate the respondents for maximum participation.

Data collection took place in between 15^{th} April to 15 June 2013. Two reminders were also issued to the potential respondents for questionnaire filling. First reminder was issued after fourth week and second after sixth week. 261, respondents (firms) responded to this questionnaire, with a response rate of 27.5%. However, 13 questionnaires were not completely filled and missing entries were more than 20% and were eliminated from the final sample (Samson & Terziovski, 1999). The final sample for this study comprises 248 (26.1%) firms (see Table 3.4).

[3] Mr Wahab the CEO of ABC company requested not to disclose particulars of his firm.
[4] UNIDO- Unites Nations Industrial Development Organizations.

Table 3.6. Details of Meetings with Association Representative

Ser. No	Date	Representative	Name	Venue	Remarks
Phase I – 2012 (Industry Interaction Phase)					
1.	12 Feb 12	Chairman North Zone PHMA	Mr Usman Jawaad	PHMA North Zone Office Lahore	Appendix '**C**'
2.	13 Feb 12	Secretary North Zone PRGMEA	Mr Syed Azhar Mahmood	PRGMEA North Zone Office Lahore	Appendix '**D**'
Phase II – 2013 (Execution Phase)					
1.	29 Feb 13	Central Chairman PRGMEA	Mr Sajid Saleem Minhas	PRGMEA North Zone Office Lahore	Appendix '**E**'
2.	6 Mar 13	Central chairman PHMA	Mr Jawed Bilwani	PHMA Head office Karachi	Appendix '**F**'
3.	7th Mar 13	Chairman South Zone PRGMEA	Mr Shaikh Shafiq Rafiq	PRGMEA Head Office Karachi	-
4.	9th Mar 13	Chairman South Zone PHMA	Mr Aamir Haider Butt	Telephonic Interview	-
5.	11 Mar 13	Chairman North Zone PHMA	Mr Mohammad Adil Butt	PHMA North Zone Office Lahore	Appendix '**G**'
6.	13 Mar 13	Secretary PHMA Office Faisalabad	Mr Tahir	PHMA House Faisalabad	-
7.	14 Mar 13	Principal PRGTTI[5]	Mr Kamran Yousaf	PRGTTI Lahore	-
8.	19 Mar 13	Attended training session on GIZ-NAVTTC[6] DACUM - Developing a curriculum session[7]	Consultants / Participants	PRGTTI Lahore	Appendix '**H**'
9.	20 Mar 13	Chairman North Zone PRGMEA	Mr Mir Muhammad Farooq Meyer	PRGMEA Sub-Office Sialkot	Appendix '**I**'
10.	20 Mar 13	Secretary PHMA Office Sialkot	Mr Sohail Raza Dodhy	PHMA House Sialkot	-

Moreover, Malhotra and Grover (1998, p. 420) suggested that sample size should be at least 20% to enrich the results generalizability. Obtaining a large sample size is always a sore issue in OM (Inman et al., 2011; Samson & Terziovski, 1999; Shah & Ward, 2003). A number of research studies have reported much less sample size than this study. For instance, Shah and Ward (2003), manufacturing plants 6.7%, Inman et al. (2011) (general manufacturing firms 7%, and Nahm, Vonderembse, and Koufteros (2003), manufacturing firms 7.5%. Nevertheless, studies with a bit improved sample size are also reported. For example, Yusuf et al. (2014), oil and gas industry 17.8%, and Vázquez-Bustelo et al. (2007),

[5] "Pakistan Readymade Garments Technical Training (PRGTTI) Institute offers the practices of management through training programs that makes a meaningful contribution towards the national industry development".

[6] "GIZ-NAVTTC - GIZ - Deutsche Gesellschaft Für Internationale Zusammenarbeit GmbH. "GIZ is an international enterprise owned by the German Federal Government, operating in many fields across more than 130 countries. It primarily works with states, state agencies, and the private sector and NAVTTC is National Vocational & Technical Training Commission".

[7] "A DACCUM is a facilitated process where workers from the occupation under study spend two or more days describing what they do and then determine what skills and competencies are needed to carry out the tasks. A curriculum is then developed that provides education or training to meet those needs".

22% manufacturing firms. Consistent with literature this study sample size (26.1%) is sufficient for further analysis.

3.7.3 VARIABVLES CODING

Research variables are coded for analysis purposes. Variable coding facilitates data handling and interpretation during analysis phase, and is widely used in OM research (Shah & Ward, 2007; Zu et al., 2008). Instead of entering complete item details into software, respective items are used in a proper coded form for two reasons. First, it is easy to enter a coded variable into software instead of a complete question in length. Second, less space is required to display lengthy results. Variables are coded in a proper sequential form (see Appendix '**B**') (Leech, Barrett, & Morgan, 2011). For illustration, top management commitment complete construct is coded as, "top management commitment = TMC" and the respective construct items are coded like TMC1, TMC2, TMC3 etc. Similarly, all the variables are coded with respect to construct name.

3.8 DATA ANALYSIS SCHEME

Data analysis scheme is displayed in Figure 3.9. The data analysis progress in nine inter-connected steps. At step one, descriptive statistics like; Mean, Median and Correlations are checked to have better view of variables. At step two, variables screening is undertaken to check the variables profile. At step three, nonresponse bias is tested to check the difference between responded and non-responded firms. At step four, common method bias influence is tested. At step five, items reliability analysis is undertaken to check the internal consistency. At step six, exploratory factor analysis, using principal components method with varimax rotation is performed. At step seven, confirmatory factor analysis is perform. Single factor and measurement factor model are tested. At step eight, measurement analysis is performed to check the unidimensionality, convergent and discriminant validity before performing full structural model test. At step nine, full structural model tests are performed to test the underlying theoretical concepts. Moreover, a series of five forms of Fit, using multiple statistical techniques, are tested as following:

(a) Direct Covariation Fit

(b) Mediation Fit

(c) Moderation Fit

(d) Profile Deviation Test

(e) Gestalt Fit

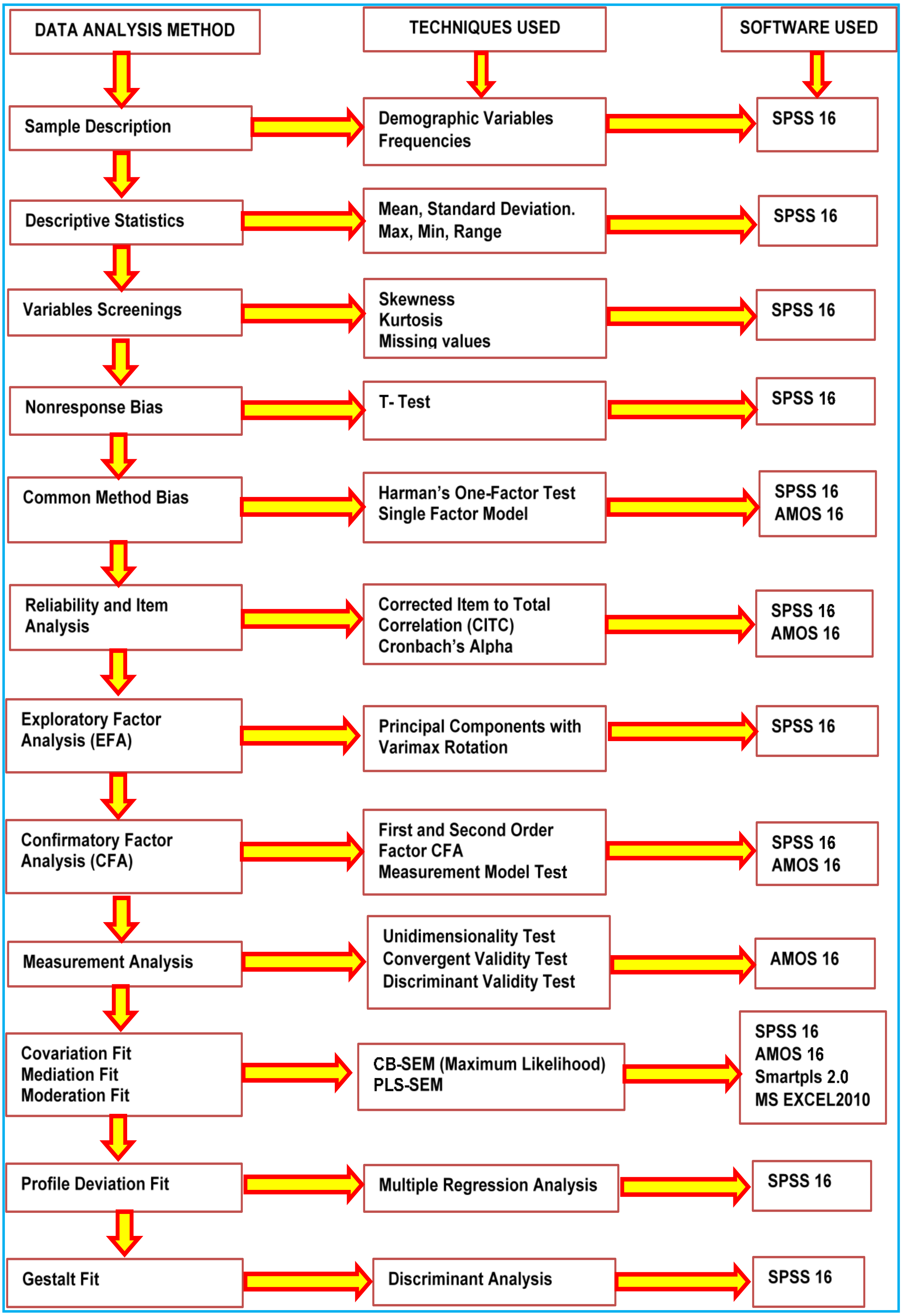
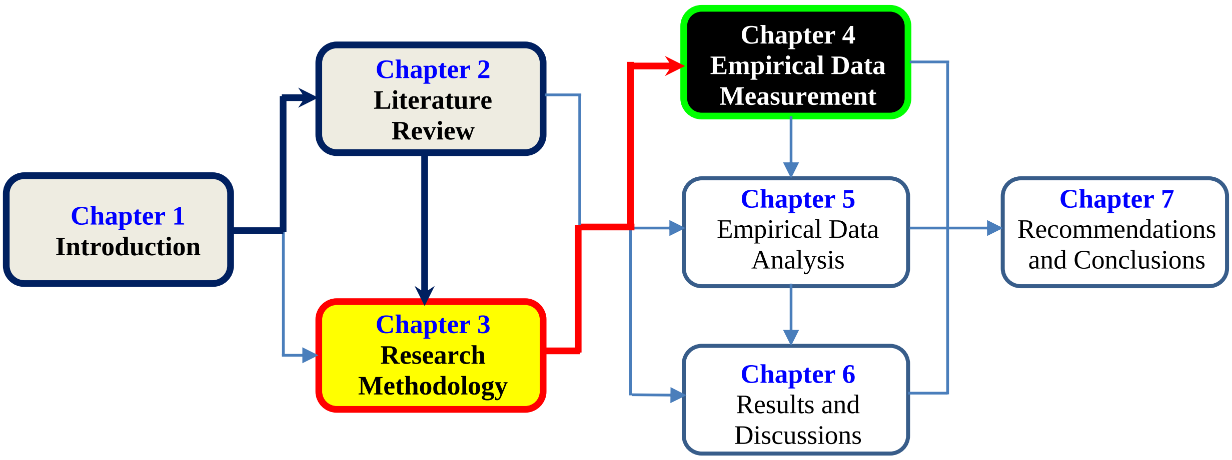


Figure 3.9. Schematic Progression of Data Analysis Process

3.9 SUMMARY

This Chapter starts with development of conceptual framework. Respective, independent, and dependent variables along with contextual factors in length are discussed. Accordingly, research hypotheses are defined in order to test the propose model relationship. Survey questionnaire is developed. Necessary, content and face validity is confirmed. Research design including research purpose, approach, strategy, and timelines are discussed in detail. Survey design, including sampling frame and data collection method and variable coding are thoroughly described. Finally, schematic progression of data analysis process is briefly described. Chapter 4 shall cover the empirical data measurement in order to test the propose model in Chapter 5.

Chapter-3 Direction to the Chapter-4



CHAPTER 4

EMPIRICAL DATA MEASUREMTN

4.1 INTRODUCTION

This Chapter deals with the empirical part of the research study. Empirical data required to test the theory as developed in Chapter-2 and Hypotheses as presented in Chapter-3 is scrutinized to assess the reliability and validity. Data measurement is assessed using following assessment tools:

- Potential Bias Assessment
- Reliability Assessment
- Exploratory Factor Analysis (EFA)
- First Order and Second Order Confirmatory Factor Analysis (CFA)
- Discriminant Validity Assessment

It comprises six, sequentially linked, sections. In second Section, research study sample profile is provided. In the third Section, descriptive statistics measures (Mean, Standard Deviation, Maximum, Minimum, and Range) are given. Moreover, variables screening for normality (Skewness and Kurtosis) issues are tested along with outliers, if any, are checked. In the fourth Section, presence of any potential biasness (Non-response bias, Common method bias) in data is investigated. Constructs and Items Reliability Assessment is undertaken in the fifth Section. In sixth Section, constructs validity is confirmed through EFA and first order and second order CFA. Unidimensionality, Convergent Validity, Nomological Validity and Discriminant Validity are assessed in this Section. Last section summarises the chapter. Section wise brief description of the chapter is presented in Table 4.1.

Table 4.1. Chapter Overview

Section	Description
Section 4.2	Provides detail profile of the research study sample.
Section 4.3	Descriptive statistics measures (Mean, Standard Deviation, Maximum, Minimum, and Range) are given. Variables screening for normality issues are tested.
Section 4.4	Data is scrutinized for presence of any potential bias.
Section 4.5	Constructs and items reliability assessment is carried out.
Section 4.6	Constructs validity is established.
Section 4.7	Summarise the empirical data analysis Chapter.

4.2 SAMPLE DESCRIPTION

This Section provides an in-depth view of the respondent's job position, job experience, respondent firm's major export business, geographical location, size of the firm, firm's export experience, major export market, type and ownership of business and ISO-9001 registration. Detailed description of Sample is presented in Table 4.2. A satisfactory representation, less serial **"9"** i.e., Type of Ownership, is presented from all quarters to undertake this empirical study from different perspective.

4.3 DESCRIPTIVE STATISITICS AND VARIABLES SCREENING

Descriptive statistics of research variables are given in Appendix '**J**'. It includes Mean, Standard Deviation (SD), Skewness, kurtosis, Minimum, Maximum and Range Values of each research variables. Mean and SD values represent degree of industry compliance to these practices. To undertake different analytical (uni-variate or multivariate) test data normal distribution assumption is mandatory. Hair et al. (2010, p. 72) explained normality and sample size relationship as, "larger sample sizes reduce the detrimental effects of non-normality. In small sample size, with 50 or fewer observations, and especially, if, the sample size is less than 30 or so, significant departures from normality can have a substantial impact on the results. For sample sizes of 200 or more, however, these same effects may be negligible". This study sample size is 248 and is likely to overcome detrimental normality concern. For this purpose, Frequency Distributions for each variable are checked and Skewness and Kurtosis values are critically evaluated. Hair et al. (2010, p. 71), argued that for multivariate analysis a data set should be normally distributed. For this purpose, first, uni-variate normality is tested and then multivariate normality is checked. It is very much possible that a data set with Uni-variate normal distribution may, or may not, represent multivariate normality. Nevertheless, in no case, a data set with non-normal uni-variate distribution will represent multivariate normal distribution. Hair et al. (2010, p. 36) recommended that a normally distributed data set should have Skewness Values with in "**-1** to **+1**". All the Skewness values of our research variables are within recommended range of **"-1** to **+1**" as shown in Appendix '**J**'. However, majority Skewness Values are negative and depicts that generally, data is distributed towards right side, however, few small values are towards left tail and pull frequency distribution tail towards left side. Similarly, Kurtosis Values are also distributed within "**-1** to **1**". Only one item "ET2 - Suppliers certification and training are handled by empowered teams" has value (-1.387) outside the recommended range of "**±1**". However, this value is marginally outside the recommended value of "**-1**".

Table 4.2. Summary of Respondents Profile

Ser. No	Category	Respondent Group	Count (NOs)	Percentage (%)	Cumulative Percentage (%)
1.	Respondent Job Position	CEO	32	12.9	12.9
		GM	49	19.8	32.7
		Production Manager	60	24.2	56.9
		Quality Manager	45	18.1	75.0
		Export Manager	40	16.1	91.1
		Supervisor	22	8.9	100.0
2.	Respondent Job Experience (Years)	< 3	6	2.4	2.4
		3-5	39	15.7	18.1
		6-10	101	40.7	58.9
		11-20	71	28.6	87.5
		20+	31	12.5	100.0
3.	Firm Major Export Business	Ready Made Garments	97	39.1	39.1
		Knitwear and Hosiery	151	60.9	100.0
4.	Firm Location	Lahore	46	18.5	18.5
		Faisalabad	36	14.5	33.1
		Sialkot	60	24.2	57.3
		Karachi	106	42.7	100.0
5.	Firm Size (Number of Employees)	1-50 (Small)	49	19.8	19.8
		51-250 (Medium)	101	40.7	60.5
		>250 (Large)	98	39.5	100.0
6.	Firm in Export Business (Years)	1-5	22	8.9	8.9
		6-10	38	15.3	24.2
		11-15	76	30.6	54.8
		15-20	76	30.6	85.5
		20+	36	14.5	100.0
7.	Major Export Market	American Region Countries	110	44.4	44.4
		European Region Countries	113	45.6	89.9
		Asian Region Countries	12	4.8	94.8
		Australian Region Countries	9	3.6	98.4
		African Region Countries	4	1.6	100.0
8.	Type of Business	Sole Proprietorship	36	14.5	14.5
		Partnership	95	38.3	52.8
		Private Limited	111	44.8	97.6
		Public Limited	6	2.4	100.0
9.	Ownership Type	Pakistani Owned	248	100.0	100.0
		Foreign Owned	-	-	-
		Joint Venture	-	-	-
10.	ISO-9001 Registration	Non ISO – 9001 Registered	74	29.8	29.8
		ISO - Registered	174	70.2	100.0

Data set is also checked for missing values and apart from 13 respondents (already excluded from data set), very few cases with missing values ranging from 3-6% are found and are replaced with median using data imputation method. This data imputation method helps to prepare data sets for different analytical techniques like CFA or Structural Equation Modelling (SEM), which primarily runs based on complete data sets. Complete data sets are primary requirement for calculation of modification indices which helps in improving Model Fit while conducting CFA or SEM (Arbuckle, 2010, p. 461).

4.4 ASSESMENT OF POTENTIAL BIASES

The next step, before under-taking analytical test, is to check the potential biasness of the data-set. Data-set may be predisposed by these biases and, therefore, should be free from such potential biases. The most frequent biases that a data-set may possess are non-response bias (Armstrong & Overton, 1977) and common method bias (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003; Podsakoff & Organ, 1986).

4.4.1 NON RESPONSE BIAS ASSESSMENT

A mail survey is always assessed for non-response bias. A non-response bias assumes that there is a significant difference on the subjective and objective measures, between those who respond and those who do not respond, may be for any reason. Therefore, results may not be true reflection of the entire sample under investigation. The best guard against such potential bias is the elimination of such bias or at least diminish the potential effects of such bias (Armstrong & Overton, 1977, p. 396). There are two ways to reduce non-response bias. One is to include non-respondents in the study sample by reaching them again (Hansen. Morris H & W. N. Hurwitz, 1946), which may not be possible every time. The other one is to approximate, as true estimation may not be possible, the potential effects of non-response. Armstrong and Overton (1977, p. 396) suggested three methods for estimating the potential non-response bias. The first method is "comparison with known values for population", where, values obtained from sample are compared with values already obtained through some other means and can be a plausible reason of response bias. In this case, it is not possible, as no such database exist for comparison. The second method is "subjective estimates", where response and non-response are compared for certain "socioeconomics" parameters like personality or education. This method is also not free from interest bias (Franzen & Lazarsfeld, 1945), and results obtained through this method may, or may not, be valid. The third method is "extrapolation method". The first two methods are not commonly being used as a practice in social science studies (Atanasova, 2007, p. 128). However, extrapolation method has wide acceptance in OM literature (D. Y. Kim et al., 2012; Vázquez-Bustelo et al., 2007).

To check the potential non-response bias sample is split into two parts the early respondents (195 firms) and the late respondents (53 firms) e.g., D. Y. Kim et al. (2012, p. 301). It is assumed that late respondents are similar to those who did not respond for any reason (Armstrong & Overton, 1977, p. 399). A t-test is conducted on randomly selected 10 independent, 5 dependent variables and 4 control variables, to check the non-response bias.t-test results are presented in Table 4.3.

Table 4.3. Non Response Bias Assessment

Code	Variables	Mean Difference	t-value	Significance (*p*-value)
Independent Variables				
TMC2	Top Managers promote the use of quality tools & techniques in manufacturing processes	0.090	0.776	0.438
SVP3	Top management regularly reviews and updates long-range strategic plans	-0.087	-0.736	0.462
ET4	Independent decision-making done by empowered teams is encouraged in the firm	0.149	1.184	0.238
RWC4	A systematic process exists to translate customer requirements into new/improved products/services	-0.042	-0.349	0.727
PD5	Customer requirements are thoroughly analysed/reviewed in the new product design process	0.062	0.558	0.578
CI3	All employees analyse their work to look for ways and means of improvement	-0.003	-0.025	0.980
STR3	Low equipment set-up time is assured in the firm	0.026	0.196	0.845
CP2	Production processes are flexible in terms of product models and configurations	0.201	1.782	0.076
KM5	Employees are encouraged to share technical, and work, information	0.090	0.776	0.438
AM4	Firm uses Robotics in production system	.138	1.13	.258
Dependent Variables				
OP1	Firm unit cost of manufacturing is lower than major competitors	0.098	0.643	0.521
OP4	Firm delivery speed to the customer is better than major competitors	-0.0006	-0.005	0.996
OP5	Firm has more flexibility to change product (variety) mix as compare to major competitors	0.140	0.985	0.326
MP2	Market share growth performance of the firm for the last three years	0.246	1.384	0.168
FP1	Return on Asset (ROA) performance of the firm for the last three years	0.184	1.066	0.287
Demographic Variables				
DG4	Please tick your firm major export business	.078	1.036	.301
DG11	How many full time plant employees (less administrative staff) are working in your firm?	-.204	-1.780	.076
CPr2	Competitive moves in market are rapid and deliberate, with short time for companies to react	.111	.696	.487
MD3	Demand for products and services is sought from new customers	-.050	-.305	.761

From Table 4.2., it is evident that non-response bias is not present as all the p-values are insignificant at $p < 0.05$. Therefore, data is free from potential non-response bias. Moreover, in most of the cases late respondents are towards higher side on ratings as compare to early respondents.

4.4.2 COMMON METHOD BIAS ASSESSMENT

Like other OM studies, this study also relies on single respondent using a single instrument. Single respondent and single instrument approach is prone to common method variance (Podsakoff et al., 2003; Podsakoff & Organ, 1986). Although, researchers do not like self-report approach, but at the same time they eventually have to rely on this approach due to certain constraints (Podsakoff et al., 2003, p. 531). OM research is replete with self-report studies (D. Y. Kim et al., 2012; Shah & Ward, 2003; Vázquez-Bustelo et al., 2007), however, a few studies, with multiple instruments and multiple respondents, are also reported (Flynn et al., 1995a; Nakamura et al., 1998; Sakakibara et al., 1997). It is likely, once the data is obtained through self-report, the data may get contaminate on different measures under study and may seriously affect the results. The measures under study may demonstrate extraordinary correlation, and may be seriously away from the true relationship and eventually distract the results (Podsakoff et al., 2003, p. 534).

To safe-guard against the potential bias threat two measures are taken, one is precautionary, and; second is statistical measure. First, S. R. Das and Joshi (2012, p. 406) suggested that respondent should be assured that information, provided by him, will not be shared with any one and anonymity of his identity will be maintained. Respondents are ensured through covering letter that their identity will be kept secret. This approach encourages respondents to feel free and answer without any pressure. Secondly, Podsakoff et al. (2003, p. 536) suggested a statistical remedy to test the potential common method variance existence employing “Harman single-factor test”. Harman single-factor test assumption to test for common method variance is that once all the measures under investigation, using an un-rotated factor analysis result into one general factor extracting major portion of the variance. If the resulted variance is more than 50% then under investigation measures are seriously affected by common method variance. A CFA using SPSS-16, employing un-rotated limiting number of factors to one approach, resulted into a single factor and accounts for only 22.85% of the total variance, which is much below the cut-off value of 50%. Similarly, to confirm the above results, a CFA using AMOS-16 is also conducted. The underlying hypothesis is that once all the study measures are loaded on a single factor and the model is run to check for common method variance bias (Bou-Llusar, Escrig-Tena, Roca-Puig, & Beltrán-Martín, 2009; D. Y. Kim et al., 2012, p. 302; S. W. Kim, 2009). A non-convergent or weak model fit depicts the absence of potential common method variance bias. The one factor model resulted into a poor model fit (χ^2 = 16167, df = 3740, χ^2/df = 4.323, CFI = 0.267, BBNFI = 0.222, NNFI or TLI = 0.250, RMSEA = 0.116, RMR = .093) i.e., showing much deviation from the recommended cut-off values. The above results show that common method variance is not a serious concern. However, these results do not fully guarantee the complete absence of common method variance bias.

4.5 CONSTRUCT ITEMS ANALYSIS AND RELIABILITY

The next analytical step in assessing the data suitability is the reliability test. Reliability is defined as the consistency notch among multiple measures representing an underlying theme or concept. Hair et al. (2010, p. 125) described two forms for reliability measurement. The first form of reliability is test-retest. It assumes that response of an individual is recorded at two different points in time. The underlying assumption is to check the respondent's degree of agreement on the same measures at two points on a timeline scale at t_0 and t_1. This form checks response consistency as well as stability. However, this study does not support test-retest approach as respondents' responses are measured at one time only. The other form is internal consistency and is widely used in organizational research. This approach, contrary to first, based on the consistency notch among the different variables measuring an underlying theme or concept. The logic behind internal consistency is that all the indicators or items measures the same scale and correlation among these indicators or items should be considerably high (Nunnally & Bernstein, 1994).

Internal consistency assessment is based on different diagnostic measures (Hair et al., 2010, p. 125) . The first diagnostic measure is based on individual items correlation. The two measures, corrected-item-to-total-correlation (**CITC**) and the inter-item-correlation. The threshold values for CITC is .50, and for inter-item correlation is .30 (MacCallum, Roznowski, Mar, & Reith, 1994). The second diagnostic measure to assess the internal consistency is Cronbach's coefficient alpha value (Cronbach, 1951). As Churchill (1979, p. 68) also affirmed that "coefficient alpha absolutely should be the first measure one calculates to assess the quality of an instrument". Similarly, Nunnally and Bernstein (1994, p. 212) described Cronbach's coefficient alpha(α) as, "Cronbach's coefficient alpha (α) is perhaps the most important outcome, as it provides actual estimates of reliability. The α is basically the ratio of the sum of the covariances among the components of the linear combination (items), which estimates true variance, to the sum of all elements in the variance-covariance matrix of measures, which equals the observed variance". The suggested threshold value for Cronbach's coefficient alpha (α) is 0.7 (Nunnally & Bernstein, 1994, p. 265), however, a value of 0.6 for exploratory studies is also acceptable (MacCallum et al., 1994). Coefficient alpha (α) is eloquently being used as reliability assessment measure in OM research (Cua et al., 2001; Jayaram et al., 2010; Kaynak, 2003; Kealey, Protheroe, MacDonald, & Vulpe, 2005; Shah & Ward, 2007). Reliability assessment results for both diagnostic measures (corrected item-to-total correlation and Cronbach's alpha α coefficient) are presented in Table 4.4.

Cronbach's coefficient alpha (α) values for all the constructs (independent, dependent and contextual) are above recommended value of 0.7. Overall cronbach's coefficient alpha (α) values range from 0.82 to 0.95. CITC of one item is below the threshold level of 0.5 and eventually dropped from constructs (Churchill, 1979; MacCallum et al., 1994; Shah & Ward, 2007) for further analysis. The item is, "ET2 - Suppliers certification and training are handled by empowered teams". After removal of this item, construct reliability for the constructs is re-assessed. Empowered teams construct Cronbach's coefficient alpha (α) improved from 0.85 to 0.923.

4.6 CONSTRUCTS VALIDITY

Variables reliability should be assessed before undertaking factor analysis (Nunnally & Bernstein, 1994, p. 453). After assessing the reliability, the next logical step suggested by Churchill (1979, p. 66), Nunnally and Bernstein (1994) and O'Leary-Kelly and J. Vokurka (1998, p. 398) is to assess the constructs validity (unidimensionality, convergent validity and discriminant validity). It is usually, performed in two stages. At stage one, through exploratory factor analysis and at stage two through confirmatory factor analysis. Bagozzi and Phillips (1982, p. 468) defined construct validity as, "construct validity is the extent to which an observation measures the concept it is intended to measure". Similarly, Hair et al. (2010, p. 94) defined validity as "extent to which a measure, or set of measures, correctly represents the concept of study - the degree to which it is free from any systematic or nonrandom error". Nunnally and Bernstein (1994), and Hair et al. (2010, p. 94), proposed factor analysis, a best mean, to express empirical validity of a construct comprising of multiple items.

Table 4.4. Constructs Reliability Assessment

Constructs and Items		Corrected Item-to-Total Correlation (CITC)	Cronbach's Coefficient Alpha (α)
1. INDEPENDENT CONSTRUCTS			
a. Top Management Commitment (TMC)			**0.905**
TMC1	Top Managers anticipate change in business/market and make plans to respond	.785	
TMC2	Top Managers promote the use of quality tools & techniques in manufacturing processes	.752	
TMC3	Top Managers have received adequate training on quality tools & techniques	.791	
TMC4	Top Managers provides adequate resources for product and process quality improvement	.744	
TMC5	Top Managers are held accountable for achieving quality, innovation and improvement targets	.737	
b. Cross Training (CT)			**0.935**
CT1	Employees receive different training to be capable to perform multiple tasks	.857	
CT2	Shop floor employees are rotated regularly among different jobs	.847	
CT3	Employees are rewarded for learning new skills & techniques	.827	
CT4	Employees are evaluated on continual professional development criteria	.857	
c. Empowered Teams (ET)			**0.855/0.923**[b]
ET1	Production scheduling is handled by empowered teams	.716/.830 [a]	
ET2	Suppliers certification and training are handled by empowered teams	*.085/-*	
ET3	Labour scheduling/job assignment is handled by empowered teams	.710/.810 [a]	
ET4	Independent decision-making done by empowered teams is encouraged in the firm	.618/.748 [a]	
ET5	Performance reviews are handled by empowered teams	.733/.811 [a]	
ET6	Empowered working teams operate together with suppliers and customers	.720/.797[a]	
d. Information System (IS)			**0.883**
IS1	Information on productivity is readily available to employees	.732	
IS2	Feedback on strategic and economic information is provided to employees	.765	
IS3	Generic operational data is shared with suppliers to improve supplies	.787	
IS4	Frequent contact and communication is maintained with suppliers and customers	.699	
e. Strategic Vision and Planning (SVP)			**0.917**
SVP1	The management follows a formal strategic planning process resulting in written mission, long-term goals and implementation strategies	.799	
SVP2	Plant management is included in the strategic planning process	.775	
SVP3	Top management regularly reviews and updates long-range strategic plans	.821	
SVP4	Formal and well-defined strategy is implemented in the plant	.843	

f. Plant Environment (PE)			**0.904**
PE1	Plant and equipment is in a high state of readiness for production at all times	.790	
PE2	Emphasis is placed on putting all tools and fixtures at their place after use	.780	
PE3	Pride is felt in keeping plant neat and clean	.796	
PE4	Maintenance department train machine operators to perform routine preventive maintenance	.770	
g. Relationship with Customers (RWC)			**0.917**
RWC1	Close contact with customers is maintained	.764	
RWC2	Results of customer satisfaction surveys are shared with all employees	.824	
RWC3	Opportunities for employee–customer interactive sessions are created	.813	
RWC4	A systematic process exists to translate customer requirements into new/improved products/services	.764	
RWC5	Customer service employees are empowered to resolve customer’s complaints quickly	.766	
h. Relationship with Suppliers (RWS)			**0.931**
RWS1	Strives to establish long-term relationships with suppliers based on quality, price and reliability	.815	
RWS2	Suppliers are actively involved in new product development process	.811	
RWS3	Collaborates with key suppliers to improve their quality of supplies in the long-term	.855	
RWS4	Quality and reliability is priority one in selecting suppliers	.800	
RWS5	Firm relies on a few high quality and reliable suppliers	.805	
i. Product Design (PD)			**0.924**
PD1	There is considerable involvement of production and quality assurance people in the early design of products	.793	
PD2	Manufacturing engineers are involved to a great extent in new product design and development	.823	
PD3	Employees are involved to a great extent (teams or consultants) for introducing new products or making product changes	.780	
PD4	Composite teams are made from major functions (marketing, manufacturing, etc.) to introduce new products	.801	
PD5	Customer requirements are thoroughly analyzed/reviewed in the new product design process	.815	
j. Process Management Using Statistical Process Control (SPC)			**0.919**
SPC1	A large number of the processes on the shop floor are controlled through statistical process control techniques	.845	
SPC2	Statistical techniques are extensively used to reduce variance in processes/supplies	.859	
SPC3	SPC charts are used to determine manufacturing processes capabilities	.799	
k. Continuous Improvement (CI)			**0.902**
CI1	Quality improvement is the responsibility of every employee in the firm	.799	
CI2	Continuous improvement of quality is stressed in all work processes throughout the firm	.824	
CI3	All employees analyse their work to look for ways and means of improvement	.795	
l. Lot Size Reduction (LSR)			**0.870**
LSR1	Small lot sizes are used in the firm	.709	
LSR2	Small lot sizes are used in master schedule	.784	
LSR3	Aggressively working to lower lot sizes in plant	.761	
m. Set-Up Time Reduction (STR)			**0.876**
STR1	Aggressively working to reduce set-up times in the firm	.736	

STR2	Workers carryout practices to reduce set-up time	.783	
STR3	Low equipment set-up time is assured in the firm	.764	
n. Pull Production System (Kanban) (PPS)			**0.929**
PPS1	Pull system for production control is used	.810	
PPS2	Production is pulled by the delivery of finished goods	.848	
PPS3	Production at current work station is pulled by the current demand of the next work station	.847	
PPS4	Kanban squares, containers of signals for production control are used	.826	
o. JIT Scheduling (JS)			**0.916**
JS1	Production schedule is met each day	.815	
JS2	There is time in the schedule for machine breakdowns or production stoppages	.863	
JS3	Production schedule is designed to allow time for catching up due to production stoppages for quality problems	.813	
p. Change Proficiency (CP)			**0.952**
CP1	Capabilities necessary to sense, perceive and anticipate market changes exist	.834	
CP2	Production processes are flexible in terms of product models and configurations	.837	
CP3	Immediately reacts to incorporate changes into manufacturing processes and systems	.868	
CP4	Appropriate technology capabilities exist to quickly respond to changes in customer demand	.843	
CP5	Strategic vision is used to emphasize the need for flexibility and agility to respond to market changes	.825	
CP6	The firm has the capabilities to deliver products to customers in time and quickly respond to changes in delivery requirements	.827	
CP7	Firm can quickly get new products to market	.818	
q. Knowledge Management (KM)			**0.911**
KM1	Employees are encouraged to learn from work experiences and share innovative ideas with each other's and management	.761	
KM2	Teams are prepared to constantly assess, apply and update knowledge of work	.781	
KM3	Databases containing organizational information are easily accessible to respective employees	.787	
KM4	Firm information system allow extensive dissemination of work knowledge throughout the organization	.757	
KM5	Employees are encouraged to share technical and work information	.785	
r. Advance Manufacturing Technology (AMT)			**0.888**
AMT1	Firm uses Computer Aided Design (CAD)	.776	
AMT2	Firm uses Computer Aided Manufacturing (CAM)	.695	
AMT3	Firm uses Flexible Manufacturing Systems (FMS)	.749	
AMT4	Firm uses Robotics in production system	.699	
AMT5	Firm uses Rapid Prototyping for product development and design validation	.735	
2. DEPENDENT CONSTRUCTS			
a. Operational Performance			**0.916**
Cost	Firm unit cost of manufacturing is lower than major competitors	.767	
Quality	Firm product quality (conformance to specification) is better than major competitors	.765	
Reliability	Firm on-time delivery performance is better than major competitors	.763	
Speed	Firm delivery speed to the customer is better than major competitors	.785	

Variety	Firm has more flexibility to change product (variety) mix as compare to major competitors	.758	
Volume	Firm has more flexibility to change product (volume) mix as compare to major competitors	.741	
b. Market Performance			**0.895**
MP1	Sales growth (volume) performance of the firm for the last three years	.814	
MP2	Market share growth performance of the firm for the last three years	.814	
MP3	Sales performance of the firm for the last three years	.754	
c. Financial Performance			**0.851**
FP1	Return on Asset (ROA) performance of the firm for the last three years	.729	
FP2	Return on Investment (ROI) performance of the firm for the last three years	.719	
FP3	Profitability performance of the firm for the last three years	.712	
3. INTERNAL & EXTERNAL CONTEXTUAL CONSTRUCTS			
a. Information Technology (IT) (Internal)			**0.944**
IT1	Firm has direct computer-to-computer links with key suppliers	.836	
IT2	Firm has direct computer-to-computer links with key customers	.802	
IT3	Inter-organizational coordination is achieved using electronic links	.811	
IT4	Firm uses information technology-enabled orders processing	.782	
IT5	Firm has electronic mailing capabilities with key suppliers and customers	.842	
IT6	Firm uses electronic transfer of purchase orders, invoices, and funds etc.	.798	
IT7	Firm uses advanced information systems to track and expedite shipments	.824	
b. Competitive Pressures (CPr) (External)			**0.877**
CPr1	Competitive pressure in Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry is extremely high	.753	
CPr2	Competitive moves in market are rapid and deliberate, with short time for companies to react	.790	
CPr3	Much attention is paid to main competitors	.743	
c. Market Dynamics (MD) (External)			**0.855**
MD1	Customers' product preferences change very quickly	.720	
MD2	Customers tend to look for new products all the time	.709	
MD3	Demand for products and services is sought from new customers	.749	
d. Technological Dynamics (TD) (External)			**0.834**
TD1	Technological changes provide big opportunities in Apparel (Readymade Garments, knitwear and Hosiery) Export Industry	.711	
TD2	A large number of new product ideas have been made possible through technological breakthroughs in Apparel (Readymade Garments, knitwear and Hosiery) Export Industry	.706	
TD3	Major technological developments are taking place in Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry	.723	

"[a] Revised corrected item to total correlation."
"[b] Revised Cronbach's coefficient alpha."

4.6.1 EXPLORATORY FACTOR ANALYSIS

Most of the research constructs are already theoretical and empirical valid. However, partially newly formed Agile manufacturing constructs' inclusion merits for EFA. A separate EFA approach for independent and dependent constructs is employed as proposed by Zu et al. (2008, p. 640), Kaynak (2003, p. 421) and Cua (2000). This is performed for two reasons, first to have better factors convergence (Atanasova, 2007, p. 128; Kaynak, 2003, p. 421) and secondly due to sample size limitations (Field, 2009, p. 645; Nunnally & Bernstein, 1994). Especially, independent construct's items are 78 as compared to 12 items of dependent constructs. Sample size adequacy has significant contribution towards factor extraction. Nunnally (1978) recommended a more stringent criteria, a ratio of 10 times cases to the number of variables. Nunnally and Bernstein (1994, p. 454) recommended that sample size should be large enough to safeguard against sampling error.

Whereas, Kass and Tinsley (1979) suggested a relaxed criteria of 5 to 10 cases per variable up to a sample size of 300. They further argued that sample size cases vis-à-vis variables requirements become irrelevant once sample size is 300. The underlying logic is that test parameters become stable enough and are not much affected by cases vis-à-vis variable ratio (Field, 2009). Whereas, Guadagnoli and Velicer (1988, p. 265) questioned the cases to number of variables ratio criteria and argued that "these rules, however, lack both empirical support and a theoretical rationale". MacCallum, Widaman, Zhang, and Hong (1999) contended that sample size for factor analysis also depends upon other research design parameters apart from cases vis-à-vis variables ratio. They maintained that higher items communalities lower the sample size stringent requirement criteria. Items having communalities 0.6 or greater, a small sample size is sufficient for a factor analysis. Similarly, Guadagnoli and Velicer (1988) found that if absolute magnitude of the factor loading is greater than 0.6 then sample dependency becomes irrelevant.

Consistent with MacCallum et al. (1999) and Guadagnoli and Velicer (1988) approach, initial communalities for independent constructs' items and absolute magnitude of factor items are investigated for sample size adequacy. This study sample size is 248. Initial communalities for independent construct items are presented in Table 4.5. All the communalities are above 0.7 and meet the factor analysis criteria of 0.6 as suggested by MacCallum et al. (1999).

Table 4.5. Initial Communalities Extraction of Independent Variable Construct Items

Item	Communalities	Item	Communalities	Item	Communalities
TMC1	0.76	**RWC1**	0.73	**PPS1**	0.83
TMC2	0.74	**RWC2**	0.80	**PPS2**	0.84
TMC3	0.78	**RWC3**	0.81	**PPS3**	0.84
TMC4	0.72	**RWC4**	0.76	**PPS4**	0.83
TMC5	0.76	**RWC5**	0.74	**JS1**	0.84
CT1	0.86	**RWS1**	0.80	**JS2**	0.89
CT2	0.84	**RWS2**	0.81	**JS3**	0.84
CT3	0.82	**RWS3**	0.83	**CP1**	0.79
CT4	0.85	**RWS4**	0.78	**CP2**	0.79
ET1	0.81	**RWS5**	0.79	**CP3**	0.83
ET3	0.80	**PD1**	0.78	**CP4**	0.798
ET4	0.73	**PD2**	0.79	**CP5**	0.797
ET5	0.78	**PD3**	0.77	**CP6**	0.80
ET6	0.77	**PD4**	0.76	**CP7**	0.78
IS1	0.75	**PD5**	0.80	**KM1**	0.74
IS2	0.78	**SPC1**	0.86	**KM2**	0.78
IS3	0.80	**SPC2**	0.88	**KM3**	0.76
IS4	0.71	**SPC3**	0.85	**KM4**	0.76
SVP1	0.79	**CI1**	0.82	**KM5**	0.77
SVP2	0.77	**CI2**	0.87	**AMT1**	0.79
SVP3	0.84	**CI3**	0.82	**AMT2**	0.69
SVP4	0.81	**LSR1**	0.76	**AMT3**	0.71
PE1	0.81	**LSR2**	0.82	**AMT4**	0.67
PE2	0.79	**LSR3**	0.79	**AMT5**	0.72
PE3	0.82	**STR1**	0.78		
PE4	0.78	**STR2**	0.83		
		STR3	0.81		
“**Extraction Method**: Principal Component Analysis”					

Moreover, a separate EFA for environmental contextual constructs is also performed. All EFA are performed using the "principle components extraction method with varimax rotation"(Atanasova, 2007, p. 128) for better unidimensionality establishment (Kaynak, 2003, p. 421). Items are retained, meeting the cut-of criteria of factor loading **0.4** a minimal and **0.5** of practical significance frequently mentioned in the OM literature (Hair et al., 2010; D. Y. Kim et al., 2012; Nunnally & Bernstein, 1994; Samson & Terziovski, 1999; Shah & Ward, 2007). These loadings are seriously sample size dependent. Hair et al. (2010, p. 117) suggested that a factor loading of **0.35** is significant with a sample size of 250 (study sample size is 248). Whereas, factor loading of **0.7** explicitly indicate items clear loading on a specific factor and it is the most desired outcome of any factor analysis (Hair et al., 2010, p. 117).

Table 4.6 presents the Kaiser-Meyer-Olkin (KMO) (knkasnnfkjn & Kaiser, 1970) and Bartlett's test for each domain respectively (independent constructs, performance constructs and environmental constructs). KMO sampling measure values range from "**0 - 1**" (knkasnnfkjn & Kaiser, 1970). A lower value like '0' reflects "that the sum of partial correlations is large relative to the sum of correlations, indicating diffusion in the pattern of correlations" (Kaiser, 1974) hence reflects an inappropriateness of factor analysis (Field, 2009, p. 647). Kaiser recommended a bare minimum value of **0.5** for appropriateness of a factor analysis.

Hutcheson and Sofroniou (1999), demarcated different cut-off KMO's values. The values between **0.5** to **0.7** as mediocre, from **0.7** to **0.8** simply good, from **0.8** to **0.9** great and any value greater than **0.9** is superb (Field, 2009, p. 647). KMO's values for all the domains are higher than the cut-off value of 0.5 and range from **0.773** to **0.813** and are good enough to undertake factor analysis. Bartlett's test measures that "whether our correlation matrix is significantly different from an identity matrix" (Field, 2009, p. 248). If Bartlett's test value is significant, it can be assumed that variables do not emerge as identity matrix and correlations between them are significantly different from zero. Bartlett's "Sphericity Test Chi-Square Statistics" for each domain is significant at $p < 0.01$. Both the, KMO's values and Bartlett's test Chi-Square Statistics meet the qualifying criteria to undertake factor analysis.

Table 4.7 presents the EFA results of all independent constructs. Scree plots and Eigen values' evaluation reveals that items are explicitly loaded on eighteen explicitly identifiable factors with an Eigen value greater than "**1**". Eigen values of all these factors range from minimum **1.003** to maximum **19.25.** All the items are significantly loaded on respective factors, ranging from **0.64** to **0.86.** EFA results also confirmed the reliability results. All the factors explained a cumulative variance of **79.66%** sufficient in OM studies (Shah & Ward, 2003; Zu et al., 2008). Change proficiency extracted maximum variance **25.00%** and minimum variance **1.302 %** extracted by continuous improvement. No significant/problematic factor cross-loading is observed (Hair et al., 2010; Shah & Ward, 2003).

Table 4.6. Domain Wise – KMO's and Bartlett's Test

Test		Domain 1	Domain 2	Domain 3
Kaiser-Meyer-Olkin measure of sampling adequacy		.889	.873	.854
Bartlett's Test of Sphericity	**Approx. Chi-Square**	1.646E4	1.824E3	1.1813
	df	2926	66	36
	Significance	.000	.000	.000
"Domain 1 = Independent Constructs, Domain 2 = Dependent Constructs, Domain 3 = Environmental Context Constructs"				

Table 4.8 presents the EFA results of all dependent constructs. Scree plots and Eigen values evaluation reveals that items are explicitly loaded on three explicitly identifiable factors with an Eigen value greater than **"1"**. Eigen values of these three factors range from **1.217** to **5.057**. Initial communalities extracted are also presented in Table 4.8. All the items are significantly loaded on respective factors, ranging from **0.81 to 0.89**, meeting the normal cut-off criteria of **0.5** and **0.7** for exceptionally good cut-off criteria (Hair et al., 2010). All the factors explained a cumulative variance of **75.42%**. Operational performance extracted max variance **42.14**% and min variance **10.14%** extracted by financial performance (Cua, 2000, p. 147).

Table 4.9 presents the EFA results of all dependent constructs. Scree plots and Eigen values evaluation reveals that items are explicitly loaded on three identifiable factors with an Eigen value greater than **"1"**. Eigen values of these three factors range from **1.023 to 4.528**. Initial communalities extracted are also presented in Table 4.8. All the items are significantly loaded on respective factors, ranging from **0.81 to 0.87,** meeting the normal cut-off criteria of **0.5** and exceptionally good cut-off criteria of **0.7** of (Hair et al., 2010). All the factors explained a cumulative variance of **78.18%.** Competitive pressure factor extracted maximum variance **50.31%** and minimum variance **11.36%** extracted by market dynamics factor (Wang et al., 2012).

Table 4.7. Exploratory Factor Analysis of Independent Variables Constructs

Construct Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
TMC1	**0.808**	0.062	0.034	0.073	0.101	0.124	0.152	0.139	0.092	-0.022	0.096	0.053	0.032	0.036	0.016	0.081	0.000	0.047
TMC2	**0.795**	0.082	0.039	0.108	0.005	0.103	0.172	0.062	0.056	0.055	-0.017	0.063	-0.040	0.070	0.136	0.070	0.009	0.063
TMC3	**0.820**	0.073	-0.005	0.089	0.083	0.132	0.090	0.145	0.071	0.083	0.109	0.022	0.027	0.084	0.091	0.049	0.067	0.044
TMC4	**0.772**	0.124	0.001	0.063	0.060	0.038	0.170	0.125	0.170	0.006	0.023	0.064	0.108	0.066	-0.007	0.074	-0.007	0.085
TMC5	**0.803**	0.000	0.185	0.037	0.142	-0.014	0.154	0.078	0.069	0.022	-0.020	-0.035	-0.013	-0.080	0.024	0.052	0.107	0.095
IS1	0.118	**0.698**	0.319	0.169	0.163	0.159	0.046	0.089	0.103	0.018	0.108	0.105	0.075	-0.021	0.109	0.074	0.072	-0.004
IS2	0.099	**0.753**	0.234	0.158	0.177	0.181	-0.071	0.006	0.163	0.007	0.088	-0.003	0.035	0.050	0.096	0.053	0.075	0.085
IS3	0.094	**0.769**	0.247	0.216	0.166	0.084	-0.008	0.048	0.130	0.014	-0.056	0.039	-0.001	0.110	0.064	0.143	0.073	0.034
IS4	0.121	**0.672**	0.286	0.187	0.169	0.114	0.088	-0.028	0.178	0.066	0.010	0.012	-0.036	0.168	-0.063	0.081	0.044	0.039
ET1	0.020	0.175	**0.802**	0.207	0.154	0.177	0.016	0.037	0.081	0.023	0.038	-0.017	0.065	0.040	0.039	0.004	0.109	0.092
ET3	0.044	0.172	**0.810**	0.187	0.176	0.074	0.037	0.018	0.030	0.095	0.022	0.001	-0.044	0.078	0.068	0.108	0.019	0.108
ET4	0.070	0.196	**0.743**	0.162	0.149	0.089	0.031	0.080	0.089	0.053	0.141	0.083	0.112	0.052	0.033	-0.012	0.113	0.082
ET5	0.042	0.154	**0.786**	0.149	0.142	0.160	0.094	0.044	0.105	0.088	-0.022	0.078	0.018	0.044	0.018	0.094	0.122	0.099
ET6	0.075	0.157	**0.773**	0.146	0.218	0.191	0.087	0.024	0.077	0.050	-0.042	0.014	0.004	0.103	0.053	0.076	0.034	0.074
SVP1	0.117	0.118	0.208	**0.764**	0.250	0.199	-0.024	-0.005	0.106	0.017	0.041	0.006	0.005	0.088	0.059	0.024	0.104	0.047
SVP2	0.117	0.178	0.213	**0.765**	0.190	0.179	0.063	0.045	0.046	0.061	-0.025	0.087	-0.048	0.025	0.060	0.014	0.062	0.022
SVP3	0.078	0.184	0.219	**0.797**	0.162	0.188	0.060	0.035	0.086	0.037	0.058	-0.017	-0.005	0.028	0.053	0.063	0.061	0.058
SVP4	0.099	0.151	0.262	**0.801**	0.203	0.193	0.021	0.020	0.064	-0.020	0.049	0.063	0.056	0.004	0.019	0.035	0.066	0.072
CT1	0.152	0.149	0.236	0.178	**0.814**	0.157	0.006	-0.019	0.124	0.086	0.069	0.025	0.057	0.085	0.001	0.033	-0.036	0.061
CT2	0.103	0.242	0.249	0.209	**0.770**	0.170	-0.008	0.051	0.063	0.072	0.073	0.004	0.058	0.041	0.058	0.060	0.000	0.136
CT3	0.112	0.159	0.242	0.300	**0.744**	0.218	-0.008	-0.008	0.093	0.022	0.068	0.019	0.011	0.035	0.057	0.092	0.073	0.091
CT4	0.113	0.124	0.291	0.249	**0.776**	0.191	0.020	0.033	0.110	0.058	0.072	0.030	0.078	0.044	0.036	0.093	0.042	0.010
PE1	0.132	0.111	0.215	0.248	0.217	**0.750**	0.081	0.001	0.043	0.142	0.022	0.000	0.037	0.095	0.143	0.098	0.005	0.005
PE2	0.152	0.158	0.165	0.199	0.166	**0.769**	0.052	0.000	0.107	0.034	0.140	0.024	0.035	0.081	0.021	0.066	0.010	0.116
PE3	0.091	0.136	0.242	0.202	0.151	**0.778**	-0.043	0.160	0.050	0.110	0.053	0.017	0.069	-0.007	0.040	0.125	0.033	0.029
PE4	0.119	0.133	0.224	0.265	0.239	**0.673**	0.013	0.142	0.187	-0.003	0.124	0.091	0.091	0.134	0.013	0.042	0.058	0.104

RWC1	0.178	0.016	0.107	0.063	-0.007	0.023	**0.757**	0.258	0.018	0.020	0.123	0.053	0.114	0.001	0.053	0.069	0.011	0.086
RWC2	0.161	0.025	0.051	0.014	-0.040	0.005	**0.816**	0.211	0.057	0.046	0.088	0.085	0.053	0.077	0.083	0.115	0.069	0.099
RWC3	0.121	-0.031	0.034	-0.028	0.046	0.000	**0.823**	0.206	0.199	0.010	0.067	0.112	-0.039	0.042	0.070	0.035	0.023	0.094
RWC4	0.135	0.072	0.025	0.087	-0.011	0.056	**0.811**	0.157	0.028	0.083	0.073	-0.033	0.019	0.052	0.130	0.101	0.065	0.046
RWC5	0.177	-0.046	0.031	-0.023	0.030	-0.003	**0.772**	0.242	0.132	0.046	0.093	0.051	0.026	0.009	0.039	0.128	0.021	-0.014
RWS1	0.102	0.059	0.031	-0.013	-0.007	0.090	0.228	**0.805**	0.137	0.122	0.029	0.003	0.035	-0.022	0.088	0.115	0.153	0.025
RWS2	0.098	0.000	0.001	0.045	0.051	0.086	0.249	**0.800**	0.109	0.121	-0.048	0.100	-0.070	0.084	0.142	0.091	0.081	0.043
RWS3	0.107	-0.011	0.067	0.008	0.001	0.054	0.255	**0.829**	0.155	0.050	0.060	0.058	0.024	0.061	0.069	0.098	0.027	0.106
RWS4	0.166	0.022	0.091	-0.036	-0.011	-0.002	0.188	**0.795**	0.132	0.017	0.099	0.043	0.082	0.079	0.062	0.093	0.066	0.147
RWS5	0.113	0.036	0.004	0.096	0.024	0.011	0.192	**0.812**	0.061	0.031	0.137	0.039	0.015	0.065	0.073	0.082	0.098	0.139
PD1	0.079	0.087	0.078	0.109	0.092	0.094	0.065	0.112	**0.812**	0.133	0.074	0.016	0.106	0.021	0.009	0.103	0.092	0.029
PD2	0.103	0.132	0.068	-0.009	0.070	0.050	0.091	0.174	**0.778**	0.193	0.120	-0.029	0.082	0.011	0.089	0.185	0.042	0.107
PD3	0.119	0.093	0.052	0.093	0.067	0.055	0.071	0.112	**0.799**	0.091	0.108	0.035	-0.105	0.090	0.025	0.153	0.101	0.041
PD4	0.101	0.126	0.045	0.030	0.034	0.061	0.089	0.095	**0.786**	0.194	0.171	-0.001	-0.042	0.001	0.052	0.094	0.074	0.106
PD5	0.080	0.048	0.132	0.069	0.065	0.032	0.111	0.087	**0.821**	0.136	0.141	0.050	0.065	0.026	0.018	0.111	0.017	0.118
SPC1	0.030	0.037	0.132	0.000	0.152	0.041	0.104	0.149	0.314	**0.782**	0.205	-0.049	0.055	-0.041	0.037	0.135	0.037	0.109
SPC2	0.049	-0.012	0.132	0.015	0.029	0.094	0.075	0.114	0.326	**0.805**	0.209	0.013	0.044	-0.032	-0.018	0.105	0.072	0.126
SPC3	0.072	0.061	0.067	0.079	0.047	0.119	0.052	0.098	0.273	**0.816**	0.143	0.041	-0.056	0.004	-0.012	0.157	0.036	0.111
CI1	0.060	-0.009	0.054	0.035	0.115	0.077	0.205	0.120	0.273	0.183	**0.765**	0.029	0.037	0.061	0.031	0.131	0.103	0.102
CI2	0.090	0.098	0.061	0.081	0.073	0.090	0.160	0.112	0.203	0.193	**0.821**	-0.032	0.007	0.047	0.098	0.141	0.092	0.049
CI3	0.071	0.039	0.016	0.009	0.081	0.157	0.174	0.081	0.338	0.213	**0.722**	0.032	0.026	0.030	0.049	0.213	0.117	0.014
LSR1	0.027	0.078	0.012	0.061	0.092	-0.016	0.081	0.095	0.024	0.029	0.019	**0.792**	0.199	0.185	0.135	0.070	-0.005	0.066
LSR2	0.117	0.004	0.078	0.035	-0.064	0.047	0.060	0.099	-0.013	-0.002	0.030	**0.814**	0.237	0.199	0.155	0.053	0.021	0.000
LSR3	0.020	0.025	0.046	0.022	0.026	0.054	0.103	0.021	0.051	-0.018	-0.032	**0.804**	0.246	0.196	0.158	0.059	0.054	0.025
STR1	0.073	-0.004	0.042	0.082	0.075	0.030	0.048	0.040	-0.022	0.048	0.005	0.227	**0.790**	0.233	0.135	0.073	-0.041	0.066
STR2	0.022	0.028	0.057	-0.049	0.063	0.045	0.077	-0.007	0.072	0.001	-0.015	0.228	**0.835**	0.188	0.078	0.090	0.054	0.055
STR3	0.007	0.029	0.026	-0.024	0.025	0.096	0.024	0.043	0.039	-0.019	0.071	0.236	**0.799**	0.216	0.136	0.009	0.174	0.060
PPS1	0.046	0.037	0.057	0.024	-0.041	0.047	0.025	0.033	0.057	0.007	0.062	0.158	0.208	**0.855**	0.081	0.067	0.037	0.057
PPS2	-0.008	0.063	0.037	0.044	0.027	0.036	0.049	0.035	0.034	0.000	0.025	0.154	0.191	**0.849**	0.167	0.071	0.113	0.056

PPS3	0.066	0.056	0.066	0.022	0.071	0.076	0.037	0.073	0.029	-0.018	0.003	0.127	0.091	**0.841**	0.192	0.169	0.113	0.027
PPS4	0.075	0.091	0.141	0.047	0.138	0.062	0.063	0.110	0.013	-0.047	0.023	0.140	0.130	**0.792**	0.184	0.200	0.118	0.046
JS1	0.126	0.057	0.080	0.048	0.030	0.055	0.184	0.160	0.063	-0.028	0.076	0.221	0.196	0.243	**0.758**	0.041	0.084	0.111
JS2	0.095	0.088	0.074	0.063	0.041	0.061	0.126	0.149	0.081	-0.014	0.046	0.195	0.092	0.244	**0.841**	0.031	0.069	-0.015
JS3	0.087	0.046	0.067	0.087	0.062	0.079	0.137	0.173	0.051	0.047	0.057	0.138	0.142	0.271	**0.786**	0.139	0.054	0.064
CP1	-0.041	-0.010	0.045	-0.007	0.034	0.108	0.106	0.068	0.153	0.056	0.045	0.011	0.002	0.042	0.059	**0.813**	0.161	0.203
CP2	0.060	0.011	0.061	0.019	0.035	0.128	0.052	0.072	0.206	0.077	0.063	0.017	0.024	0.079	0.003	**0.808**	0.110	0.197
CP3	0.075	0.051	0.133	0.077	0.004	0.030	0.082	0.022	0.103	0.045	0.107	0.032	0.054	0.121	0.009	**0.850**	0.089	0.151
CP4	0.098	0.115	0.000	-0.001	0.069	0.009	0.084	0.056	0.087	0.052	0.054	0.030	0.047	0.098	-0.005	**0.828**	0.111	0.192
CP5	0.072	0.084	-0.004	-0.021	0.085	-0.022	0.062	0.023	0.125	0.020	0.088	0.004	0.090	0.080	0.057	**0.832**	0.182	0.068
CP6	0.065	0.054	0.006	0.062	0.025	0.013	0.063	0.085	-0.020	0.020	0.068	0.069	-0.014	0.094	0.078	**0.845**	0.143	0.130
CP7	0.030	0.004	0.054	0.030	0.001	0.046	0.030	0.150	0.040	0.108	-0.003	0.042	0.000	0.005	0.008	**0.837**	0.127	0.153
KM1	0.105	0.094	0.006	0.123	0.055	0.030	0.045	0.098	0.049	0.015	0.009	-0.003	0.066	0.092	0.044	0.147	**0.793**	0.158
KM2	-0.067	0.018	0.014	0.025	0.072	0.031	0.030	0.078	0.007	0.057	0.126	0.110	-0.004	0.138	0.009	0.220	**0.787**	0.217
KM3	0.007	0.038	0.143	0.134	-0.047	-0.018	0.046	0.093	0.090	0.000	0.083	0.061	0.025	0.087	-0.031	0.157	**0.797**	0.165
KM4	0.053	0.014	0.099	0.003	-0.037	0.046	0.053	0.078	0.090	0.045	-0.005	-0.062	0.050	0.046	0.063	0.189	**0.827**	0.018
KM5	0.058	0.049	0.091	-0.015	0.030	-0.002	0.011	0.041	0.074	0.017	0.056	-0.002	0.035	0.013	0.087	0.172	**0.819**	**0.195**
AMT1	0.063	0.000	0.093	0.009	0.072	0.025	0.087	0.051	0.114	0.028	0.052	-0.015	0.031	0.037	0.040	0.210	0.133	**0.824**
AMT2	0.088	0.015	0.013	0.039	0.028	0.038	0.056	0.043	0.046	0.115	0.047	-0.066	0.094	0.070	0.000	0.233	0.215	**0.734**
AMT3	0.106	0.011	0.105	0.085	0.032	0.004	0.020	0.148	0.037	0.110	0.051	0.071	0.055	0.055	0.008	0.281	0.159	**0.726**
AMT4	0.079	0.153	0.072	0.064	0.040	0.129	0.059	0.148	0.097	0.100	-0.005	0.183	0.058	-0.010	0.068	0.308	0.167	**0.640**
AMT5	0.046	0.019	0.184	0.027	0.090	0.055	0.108	0.122	0.133	0.001	0.010	0.008	-0.025	0.042	0.043	0.217	0.166	**0.746**
Eigenvalues	**2.791**	**1.397**	**7.034**	**1.883**	**1.628**	**1.506**	**3.341**	**4.964**	**5.373**	**1.177**	**1.003**	**1.247**	**1.319**	**2.087**	**1.024**	**19.251**	**2.387**	**1.936**
Variance (%) Explained by each factor	**3.625**	**1.814**	**9.135**	**2.446**	**2.115**	**1.955**	**4.34**	**6.447**	**6.977**	**1.529**	**1.302**	**1.619**	**1.713**	**2.71**	**1.33**	**25.001**	**3.1**	**2.514**
Cumulative (%) Variance Explained	**3.625**	**5.439**	**14.574**	**17.02**	**19.135**	**21.09**	**25.43**	**31.877**	**38.854**	**40.383**	**41.685**	**43.304**	**45.017**	**47.727**	**49.057**	**74.058**	**77.158**	**79.672**

“Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.”
“a. Rotation converged in 8 iterations.”

Table 4.8. Exploratory Factor Analysis of Dependent Variables Constructs

Construct Items	Communalities*	1	2	3
Cost	**.716**	**.840**	.076	.063
Speed	**.718**	**.837**	.040	.124
Reliability	**.716**	**.840**	.015	.105
Quality	**.731**	**.841**	.146	.054
Variety	**.698**	**.817**	.162	.070
Volume	**.683**	**.810**	.161	.002
MP1	**.841**	.157	**.864**	.265
MP2	**.859**	.073	**.895**	.229
MP3	**.782**	.169	**.843**	.207
FP1	**.774**	.082	.221	**.848**
FP2	**.768**	.090	.219	**.844**
FP3	**.764**	.078	.208	**.845**
Eigenvalues		**5.057**	**2.776**	**1.217**
Percent Variance Explained by each factor		**42.14**	**23.13**	**10.14**
Cumulative (%) Variance Explained	**38.45**	**42.14**	**65.27**	**75.42**

* = "Initial communalities extracted"
"**Extraction Method:** Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 5 iterations."

Table 4.9. Exploratory Factor Analysis of Contextual Variables Constructs

Construct Items	Communalities*	1	2	3
CPr1	**.801**	**.871**	**.120**	**.167**
CPr2	**.831**	**.879**	**.195**	**.144**
CPr3	**.781**	**.839**	**.170**	**.219**
TD1	**.775**	**.137**	**.837**	**.234**
TD2	**.756**	**.159**	**.815**	**.258**
TD3	**.796**	**.203**	**.838**	**.228**
MD1	**.759**	**.199**	**.251**	**.810**
MD2	**.762**	**.200**	**.210**	**.823**
MD3	**.776**	**.150**	**.268**	**.826**
Eigenvalues		**4.528**	**1.486**	**1.023**
Percent Variance Explained by each factor		**50.31**	**16.50**	**11.36**
Cumulative (%) Variance Explained		**50.31**	**66.82**	**78.18**

* = "Initial communalities extracted"
"**Extraction Method:** Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 5 iterations."

4.6.2 FIRST ORDER CONFIRMATORY FACTOR ANALYS

First Order Confirmatory Factor Analysis, using AMOS-16 with Maximum Likelihood (ML) Approach, is performed to assess the psychometric properties like

Unidimensionality, Convergent Validity and Construct Reliability of each single order construct. CFA is the best option to test unidimensionality of a construct (O'Leary-Kelly & J. Vokurka, 1998, p. 394). CFA results are presented in Table 4.10. First order factor detailed measurement model results (standardized factor loadings and t-values) are presented in Appendix '**K**'.

4.6.2.1 UNIDIMENSIONALITY

Unidimensionality reflects the degree of association among scale items and are representative of single hypothetical concept. A Goodness of Fit Index (GFI) value > 0.95 (Ahire & Dreyfus, 2000, p. 561; Jayaram et al., 2010, p. 349), Comparative Fit Index value > 0.90 (Bentler & Bonett, 1980) or near to 0.95 (Hu & Bentler, 1999), Normed Chi-Square Value < 3 (Bollen, 1989b; Carmines & McIver, 1981; Hair et al., 2010) and Root Mean Residual (RMR) value < 0.05 (Byrne, 2010), provide strong evidence for construct unidimensionality. GFI, CFI and normed Chi-Square values of each construct, as shown in Table 4.10, meet the specified unidimensionality criteria.

4.6.2.2 CONVERGENT VALIDITY

Bagozzi and Phillips (1982, p. 468) defined convergent validity as**,** "the degree to which two or more attempts to measure the same concept through maximally dissimilar methods are in agreement. If two or more measures are true indicators of a concept, then they should necessarily be highly correlated". Similarly, Campbell and Fiske (1959, p. 82) defined convergent validity as, a construct can be said convergent when correlations among items measuring the same concept through different methods are "significantly different from zero and sufficiently large". Convergent validity can be assessed using three approaches. First, factor loadings should be significantly high (Bagozzi, Yi, & Phillips, 1991, p. 425; Sila, 2007, p. 98; Wang et al., 2012, p. 123), such that the variance explained (expressed as factor loading square) by these items is slightly more than the error variance (un-explained variance) (O'Leary-Kelly & J. Vokurka, 1998, p. 402), secondly average variance extracted by each construct should be > 0.5 or 50% (Bagozzi & Yi, 1988) and third Bentler-Bonnet Normed Fit Index (BBNFI) value should be > 0.95 (Ahire & Dreyfus, 2000, p. 561; Jayaram et al., 2010, p. 349). All constructs standardized factor loadings range from 0.62 to 0.93 along with t-values are highly significant, AVE for each construct is greater than 0.5 and BBNFI values are well above the cut-off criteria of 0.95, as shown in Table 4.10, indicate a strong convergent validity. AVE is calculated using following formula (Fornell & Larcker, 1981, p. 46; Hair et al., 2010, p. 709):

$$\text{AVE} = \frac{\sum_{i=1}^{n} \lambda_i^2}{\sum_{i=1}^{n} \lambda_i^2 + \sum_{i=1}^{n} Var(\varepsilon_i)}$$

λ_i = standardized factor loading of *ith* item in a construct
i = number of items in a construct
Var (ε_i) = sum of the variance error terms of a construct

4.6.2.3 CONSTRUCT RELIABILITY

Construct reliability is measured through two indices composite reliability (ρ_c) (Fornell & Larcker, 1981; Werts, Linn, & Jöreskog, 1974) and Cronbach's alpha (Cronbach, 1951). A value of ρ_c greater than 0.6 (Bagozzi & Yi, 1988, p. 82) or in some cases 0.5 and α-value greater than 0.7 indicate good scale reliability (O'Leary-Kelly & J. Vokurka, 1998). All the α-values already obtained through reliability assessment and ρ_c values obtained through CFA, as shown in Table 4.10, are well above the cut-off criteria for ρ_c 0.6 and α = 0.7 and indicate high scale reliability. Construct composite reliability is calculated using following formulae (Fornell & Larcker, 1981, p. 45; Hair et al., 2010, p. 710):

$$\text{CR} = \frac{\left(\sum_{i=1}^{n} \lambda_i\right)^2}{\left(\sum_{i=1}^{n} \lambda_i\right)^2 + \left(\sum_{i=1}^{n} \text{Var}(\varepsilon_i)\right)}$$

λ_i = standardized factor loading of *ith* item in a construct
i = number of items in a construct
Var (ε_i) = sum of the variance error terms of a construct

4.6.2.4 DISCRIMINANT VALIDITY

Hair et al. (2010, p. 710), defined Discriminant Validity as, "Extent to which a construct is truly distinct from other constructs both in terms of how much it correlates with other constructs and how distinctly measured variables represent only this single construct". Fornell and Larcker (1981, p. 46) devised empirical method for discriminant validity measurement. They proposed that two constructs are said to be distinct, if the square root of the average variance extracted (AVE) of a construct is larger than its correlation with all other constructs or in other words if the average variance extracted of a construct is greater than the square of the correlation of that construct with all other constructs. Mathematically it can be described as $\sqrt{\textbf{AVE}} > \gamma$ or $\textbf{AVE} > \gamma^2$. To assess the discriminant validity, full correlated measurement model (Figure 4.1) is performed. The model fit well and fit statistics are, χ^2/df = 1.217, CFI = 0.95, NNFI = 0.95, IFI = 0.95, RMR = 0.026 and RMSEA = 0.03. AVE, CR, square root of AVE and correlations are presented in Table 4.11. First two columns present the AVE and CR value of each construct, whereas, square root of AVE of each construct is on the diagonal. All the constructs meet the defined discriminant validity criteria $\sqrt{\mathbf{AVE}} > \gamma$ or $\mathbf{AVE} > \gamma^2$. All the constructs are clearly distinct from other constructs and indicate strong discriminant validity. Mean and Standard Deviation (SD) of summated scales are also presented in Table 4.11. Mean values for managerial practices range from **4.96** min (AMT) to a **5.58** max (IS) and SD values range from **0.6** min to a **1.05** max. Similarly, mean values for performance measures range from **4.23** min (MP) to **5.23** max (OP) and SD values range from min to max **0.78** to **1.05** respectively.

4.6.3 SECOND ORDER CONFIRMATORY FACTOR ANALYSIS

Core TQM practices, Core JIT Practices, Core AM Practices, CII and CEI practices are conceived as the second order factors in the literature. Transforming first order factors into the second order factors is consistent with the literature and this is a regular practice in organizational research. For example, Core TQM (Ahire & Ravichandran, 2001; Cua et al., 2001, 2006; Konecny & Thun, 2011; McKone et al., 1999; McKone & Weiss, 1999; Sila, 2007; Yang et al., 2011; Zelbst et al., 2010), Core JIT (Cua et al., 2001, 2006; Inman et al., 2011; McKone et al., 1999; McKone & Weiss, 1999; Sakakibara et al., 1997; Yang et al., 2011; Zelbst et al., 2010), Core AM (Vázquez-Bustelo et al., 2007), CII (Cua et al., 2001, 2006; Flynn et al., 1995a), CEI (Jayaram et al., 2004; Jayaram et al., 2008). Apart from this, it is being practiced in other fields of organizational research. For example, supply chain management (Bayraktar, Demirbag, Koh, Tatoglu, & Zaim, 2009; S. W. Kim, 2009; Li et al., 2006; Min, Mentzer, & Ladd, 2007), total productive maintenance (Konecny & Thun, 2011; McKone & Weiss, 1999), internal and external Lean Production (Hofer et al., 2012), organizational learning (Santos-Vijande, López-Sánchez, & Trespalacios, 2012), environmental management (Yang et al., 2011), organizational competitive intensity (Hallgren & Olhager, 2009) etc., Second order CFA is perform to test for unidimensionality, convergent validity, reliability and finally nomological and discriminant validity. It is performed in two steps. At step one, Second Order CFA is performed to check the unidimensionality, convergence validity and reliability. At step two, discriminant and nomological validity is tested through correlated measurement model for each second order construct.

Table 4.10. Results of First Order Confirmatory Factor Analysis

Construct	No of Items	Unidimensionality							Convergent Validity				Reliability	
		$\chi 2$	df	χ^2/df	CFI	GFI	RMR	*p*-Value	BBNFI (Δ)	SFL (min-max)	t-value (min-max)	Percent Variance Explained (%)	CR	α
Criteria				< 3	> 0.95	> 0.95	< 0.05		> 0.95	> 0.5	> 1.95	> 0.5	> 0.6	> 0.7
TMC	5	5.54	4	1.386	0.99	0.99	.009	0.236	0.99	0.76 - 0.85	13.42 – 15.33	0.64	0.90	0.905
IS	4	0.4	2	0.204	1.00	0.99	.003	0.815	0.99	0.75 - 0.86	12.19 – 14.31	0.65	0.88	0.883
ET	5	8.29	4	2.073	0.99	0.98	.009	0.081	0.98	0.79 – 0.89	15.67 – 18.78	0.69	0.91	0.923
SVP	4	5.30	2	2.655	0.99	0.99	.009	0.071	0.99	0.81 – 0.90	15.25 – 17.98	0.73	0.91	0.917
CT	4	2	2	1.00	1.00	0.99	.004	0.375	0.99	0.86 – 0.89	19.28 – 20.94	0.78	0.93	0.935
PE	4	1.39	1	1.398	0.99	0.99	.003	0.237	0.99	0.77 – 0.87	14.03 – 16.72	0.68	0.89	0.904
RWC	5	2.37	2	1.187	1.00	0.98	.006	0.305	0.98	0.79 – 0.90	13.48 – 16.86	0.69	0.92	0.917
RWS	5	5.26	4	1.316	0.99	0.99	.009	0.261	0.99	0.83 – 0.89	16.32 – 18.44	0.73	0.93	0.931
PD	5	3.41	4	0.853	1.00	0.99	.004	0.491	0.99	0.79 – 0.87	14.66 – 16.95	0.69	0.91	0.924
SPC	3	0.00	0	0.00	1.00	1.00	.000	0.00	1.00	0.83 – 0.92	18.09 – 21.07	0.79	0.92	0.919
CI	3	0.00	0	0.00	1.00	1.00	.000	0.00	1.00	0.85 – 0.89	16.43 – 17.26	0.75	0.90	0.902
LSR	3	0.00	0	0.00	1.00	1.00	.000	0.00	1.00	0.76 – 0.88	13.23 – 13.40	0.69	0.87	0.870
STR	3	0.00	0	0.00	1.00	1.00	.000	0.00	1.00	0.80 – 0.87	13.87– 14.12	0.70	0.87	0.876
PPS	4	1.95	1	1.958	0.99	0.99	.003	0.162	0.99	0.76 – 0.93	15.47 – 20.75	0.73	0.91	0.929
JS	3	0.00	0	0.00	1.00	1.00	.000	0.00	1.00	0.85 – 0.93	17.57 – 19.34	0.78	0.91	0.916
CP	7	17.9	9	1.994	0.99	0.97	.011	0.036	0.99	0.80 – 0.89	16.53 – 21.76	0.73	0.95	0.952
KM	5	3.67	4	0.919	1.00	0.99	.006	0.451	0.99	0.75 – 0.85	12.88 – 15.04	0.66	0.90	0.911
AMT	5	7.56	3	2.521	0.99	0.98	.011	0.056	0.98	0.64 – 0.87	11.70 – 13.92	0.61	0.88	0.888

OP	6	11.7	7	1.674	0.99	0.98	.015	0.110	0.98	0.78 – 0.84	13.17 – 14.83	0.64	0.91	0.916
MP	3	0.00	0	0.00	1.00	1.00	.000	0.00	1.00	0.08 – 0.89	15.48 – 17.48	0.74	0.89	0.895
FP	3	0.00	0	0.00	1.00	1.00	.000	0.00	1.00	0.80 – 0.82	12.39 – 12.47	0.65	0.85	0.851
IT	7	29.98	10	2.98	0.98	0.96	.015	0.001	0.98	0.80 – 0.87	15.33 – 18.69	0.69	0.94	.944
CPr	3	0.00	0	0.00	1.00	1.00	.000	0.00	1.00	0.81 – 0.88	13.91 – 14.66	0.70	0.87	.877
MD	3	0.00	0	0.00	1.00	1.00	.000	0.00	1.00	0.78 – 0.85	12.40 – 12.83	0.66	0.85	.855
TD	3	0.00	0	0.00	1.00	1.00	.000	0.00	1.00	0.80 – 0.82	12.01 – 12.18	0.64	0.84	.846

- **χ^2:** (Hu & Bentler, 1999)
- **χ^2/df:** (Carmines & McIver, 1981), (Bollen, 1989b), and (Hair et al., 2010)
- **CFI:** (Bentler, 1990), (Byrne, 1998, 2010), (Jöreskog & Sörbom, 1993a) and (Jaccard & Wan, 1996)
- **GFI:** (Jöreskog & Sörbom, 1984) and (Hu & Bentler, 1998, 1999)
- **RMR** (Byrne, 1998, 2010)
- **NFI** or **Delta (Δ):** (Bentler & Bonett, 1980) and (Bollen, 1989b)
- **SFL** (Standardized Factor Loading)**:** (Hair et al., 2010) and (Wang et al., 2012)
- **t-vAlue:** (Hair et al., 2010)
- **AVE:** (Bagozzi & Yi, 1988, p. 82) and Fornell & Larcker (1981, p.46)
- **CR:** (Bagozzi & Yi, 1988, p. 82) and Fornell & Larcker (1981, p.45)
- **Cronbach's Alpha (α):** (Cronbach, 1951)

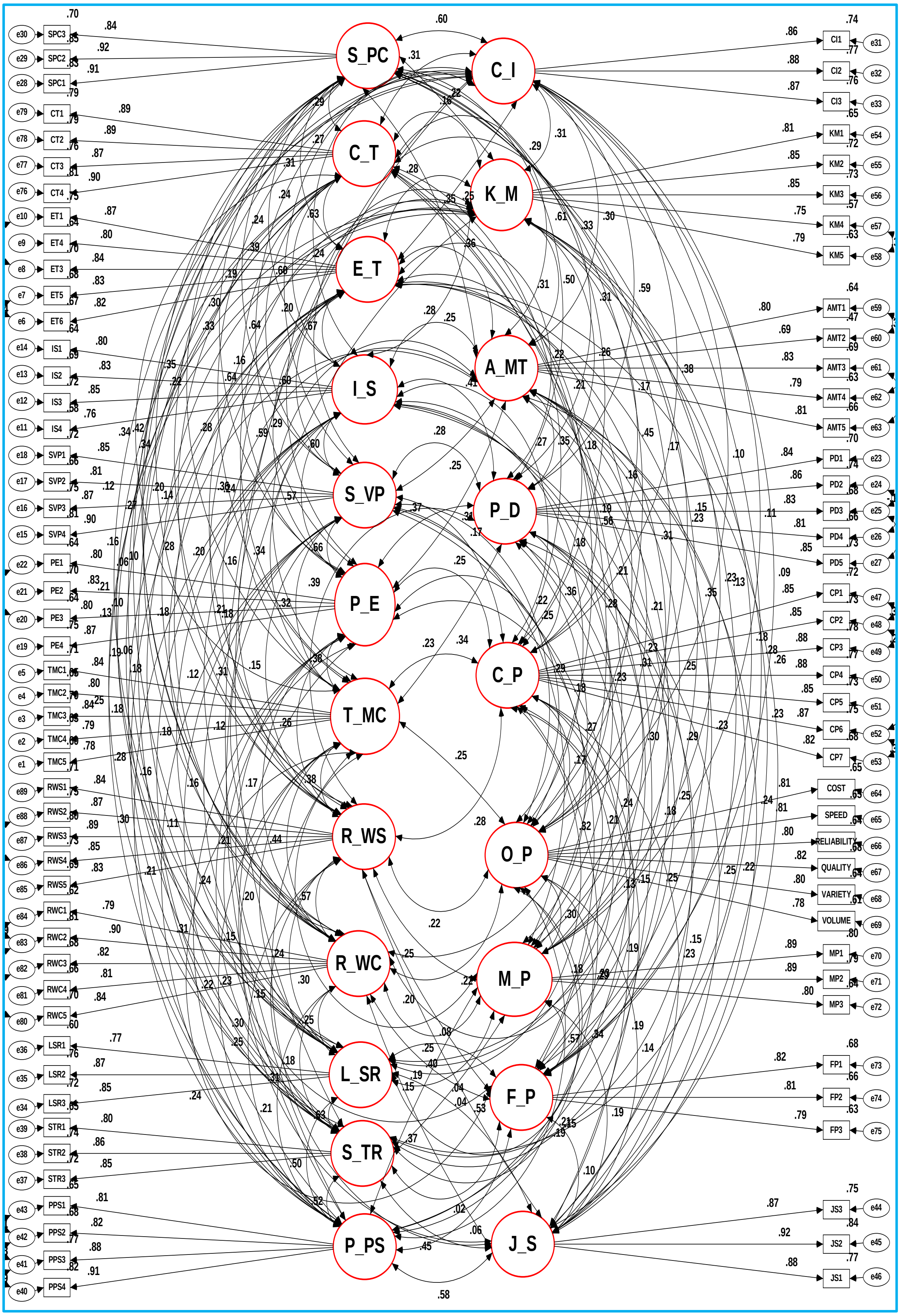


Figure 4.1. First Order Complete Measurement Model (computer-generated view)

Table 4.11. Mean, SD, Correlation, AVE, CR, SQRT-AVE (Discriminant Validity) Results

	AVE	CR	TMC	IS	ET	SVP	CT	PE	RWC	RWS	PD	SPC	CI	LSR	STR	PPS	JS	CP	KM	AMT	OP	MP	FP
TMC	0.64	0.9	*0.800*																				
IS	0.65	0.88	.307**	*0.806*																			
ET	0.69	0.91	.227***	.605***	*0.831*																		
SVP	0.73	0.91	.290***	.544***	.549***	*0.854*																	
CT	0.78	0.93	.312***	.557***	.577***	.602***	*0.883*																
PE	0.68	0.89	.334***	.509***	.531***	.593***	.586***	*0.825*															
RWC	0.69	0.92	.409***	.132**	.182***	.133**	0.108*	.167***	*0.831*														
RWS	0.7	0.93	.350***	.167***	.182***	.141**	.129**	.235***	.544***	*0.837*													
PD	0.69	0.91	.307***	.373***	.283***	.255***	.300***	.317***	.299***	.356***	*0.831*												
SPC	0.79	0.92	.207***	.228***	.282***	.189***	.273***	.307***	.249***	.315***	.566***	*0.889*											
CI	0.75	0.9	.262***	.251***	.225***	.213***	.290***	.340***	.389***	.333***	.539***	.546***	*0.866*										
LSR	0.69	0.87	.170***	.171***	.160**	.146**	.131**	.173***	.221***	.214***	0.115**	0.062	0.112*	*0.831*									
STR	0.7	0.87	.136**	.143**	.162**	0.096*	.177***	.207***	.161**	.139**	0.124*	0.079	.141**	.556***	*0.837*								
PPS	0.73	0.91	.170***	.254***	.236***	.175***	.205***	.250***	.177***	.211***	.160**	0.055	.179***	.455***	.474***	*0.854*							
JS	0.78	0.91	.280***	.260***	.242***	.226***	.214***	.277***	.352***	.373***	.226***	.126**	.257***	.479***	.414***	.526***	*0.883*						
CP	0.73	0.95	.212***	.241***	.201***	.153**	.203***	.238***	.254***	.275***	.337***	.305***	.347***	.165***	.168***	.281***	.217***	*0.854*					
KM	0.66	0.9	.160**	.225***	.248***	.210***	.147**	.171***	.176***	.264***	.241***	.196***	.275***	.126**	.177***	.261***	.220***	.412***	*0.812*				
AMT	0.61	0.88	.266***	.241***	.311***	.222***	.259***	.268***	.259***	.330***	.321***	.329***	.280***	.162**	.198***	.218***	.226***	.531***	.460***	*0.781*			
OP	0.64	0.91	.224***	.170***	.149**	.202***	.166***	.233***	.188***	.206***	.212***	.164***	0.094	.192***	.140**	.181***	.132**	.158**	.215***	.188***	*0.80*		
MP	0.74	0.89	.281***	.244***	.281***	.261***	.170***	.161**	.226***	.225***	.270***	.159**	0.111*	0.039	0.033	0.116*	.174***	.192***	.218***	.210***	.280***	*0.86*	
FP	0.65	0.85	.213***	.269***	.307***	.240***	.189***	.201***	.166***	.175***	.229***	.144**	0.092	0.066	0.016	0.037	0.082	.126**	.151**	.181***	.196***	.490***	*0.81*
MEAN			5.26	5.58	5.52	5.54	5.37	5.36	5.12	5.10	5.17	5.12	5.10	5.47	5.51	5.45	5.50	5.07	5.09	4.96	5.23	4.83	4.90
SD			0.67	0.67	0.71	0.76	0.72	0.63	0.67	0.81	0.62	0.60	0.61	0.78	0.77	0.77	0.75	0.73	0.65	0.65	0.78	1.05	0.96

“ ***. Correlation is significant at the $p < 0.01$ level (2-tailed)”.

“ **. Correlation is significant at the $p < 0.05$ level (2-tailed)”.

“ *. Correlation is significant at the $p < 0.1$ level (2-tailed)”.

“(SQRT-AVE) Square Root of Average Variance Extracted is on the diagonal”.

4.6.3.1 UNIDIMENSIONALITY AND CONVERGENT VALIDITY

Second order CFA is performed to assess the unidimensionality, reliability, convergence, discriminant and nomological validity for Core TQM, Core JIT, Core Agile, CII and CEI Practices. Thus, first order dimensions form to make second order factors. Separate CFA is performed for each second order factor to check for unidimensionality, convergent validity, nomological validity and discriminant validity of respective second order factor. Four separate second order CFA are perform for Core TQM, Core JIT, Core AM and CII respectively as presented in Figure 4.2 to Figure 4.5. CFA for CEI cannot be perform as it comprises only two first order dimensions and sufficient information required to perform CFA is not available (Hair et al., 2010). However, a correlated measurement model is performed to test for psychometric properties of this high order factor. Moreover, a second order factor with two dimensions can be used in a full measurement as well as in a structural model, where it shares the information from other factors (Hair et al., 2010) for convergence and is consistent with OM literature (Hallgren & Olhager, 2009; Vázquez-Bustelo et al., 2007). Second order CFA results are presented in Table 4.12. All the first order dimensions clearly converge on respective second order factors. Unidimensionality and convergence statistics meet the prescribed criteria. GFI value for Core JIT 0.94, Core AM 0.94 and CII 0.93, are marginally less than 0.95, however, a value over 0.9 represents a good fit (Hu & Bentler, 1998, 1999). All the second order factor loadings are over 0.5 and significant enough to indicate unidimensionality (Bagozzi et al., 1991). Factor loadings significantly correlate and AVE extracted for each construct is greater than 0.5 or 50% and indicate strong second order factor convergence. Few modification indices are incorporated to improve the model fit through correlating some of the items.

4.6.3.2 RELIABILITY

Cronbach’s Alpha (α) and composite reliability ($\boldsymbol{\rho_c}$) values range from 0.72 to 0.86 and 0.76 to 0.89 respectively are presented in Table 4.12. All the values are well above the threshold criteria of 0.7 for ($\boldsymbol{\alpha}$) and 0.6 for ($\boldsymbol{\rho_c}$) thus indicate high factor’s reliability.

Table 4.12. Results of Second Order Confirmatory Factor Analysis

Construct	No of First Order Items	Unidimensionality							Convergent Validity				Reliability	
		χ^2	df	χ^2/df	CFI	GFI	RMSEA	RMR	BBNFI (Δ)	SFL* (min-max)	t-value (min-max)	AVE	CR	α
Criteria				< 3	> 0.95	> 0.95	< 0.08	< 0.05	> 0.95	> 0.5	> 1.95	> 0.5	> 0.6	> 0.7
Core TQM Practices	3	38.77	32	1.212	0.99	0.97	0.029	0.013	0.98	0.76 - 0.79	8.10 – 8.20	0.58	0.81	0.78
Core JIT Practices	3	98.49	60	1.642	0.98	0.94*	0.051	0.034	0.96	0.69 - 0.77	7.64 – 7.84	0.52	0.81	0.79
Core AM Practices	3	136.35	107	1.274	0.99	0.94*	0.033	0.022	0.96	0.64 – 0.80	6.02 – 6.03	0.51	0.76	0.72
Common Internal Infrastructure	5	208.99	180	1.161	0.99	0.93*	0.026	0.021	0.95	0.77 – 0.80	9.45 – 9.91	0.62	0.89	0.86

- **χ^2:** (Hu & Bentler, 1999)
- **χ^2/df:** (Carmines & McIver, 1981), (Bollen, 1989b) and (2011) (Hair et al., 2010)
- **CFI:** (Bentler, 1990), (Byrne, 2010), (Jöreskog & Sörbom, 1993a) and (Jaccard & Wan, 1996)
- **GFI:** (Jöreskog & Sörbom, 1984), > 0.8 marginal fit; > 0.9 good fit (Hu & Bentler, 1998, 1999)
- **NFI** or **Delta 1(Δ):** (Bentler & Bonett, 1980) and (Bollen, 1989b)
- **RMSEA:** (Steiger & Lind, 1980) and (Browne & Cudeck, 1993)
- **RMR:** (Byrne, 1998, 2010)
- **SFL*:** (Standardized Factor Loading) (Hair et al., 2010) and (Wang et al., 2012)
- **t-value:** (Hair et al., 2010)
- **AVE:** (Bagozzi & Yi, 1988, p. 82) and Fornell & Larcker (1981, p.46)
- **CR:** (Bagozzi & Yi, 1988, p. 82) and Fornell & Larcker (1981, p.45)
- **Cronbach's Alpha (α):** (Cronbach, 1951)

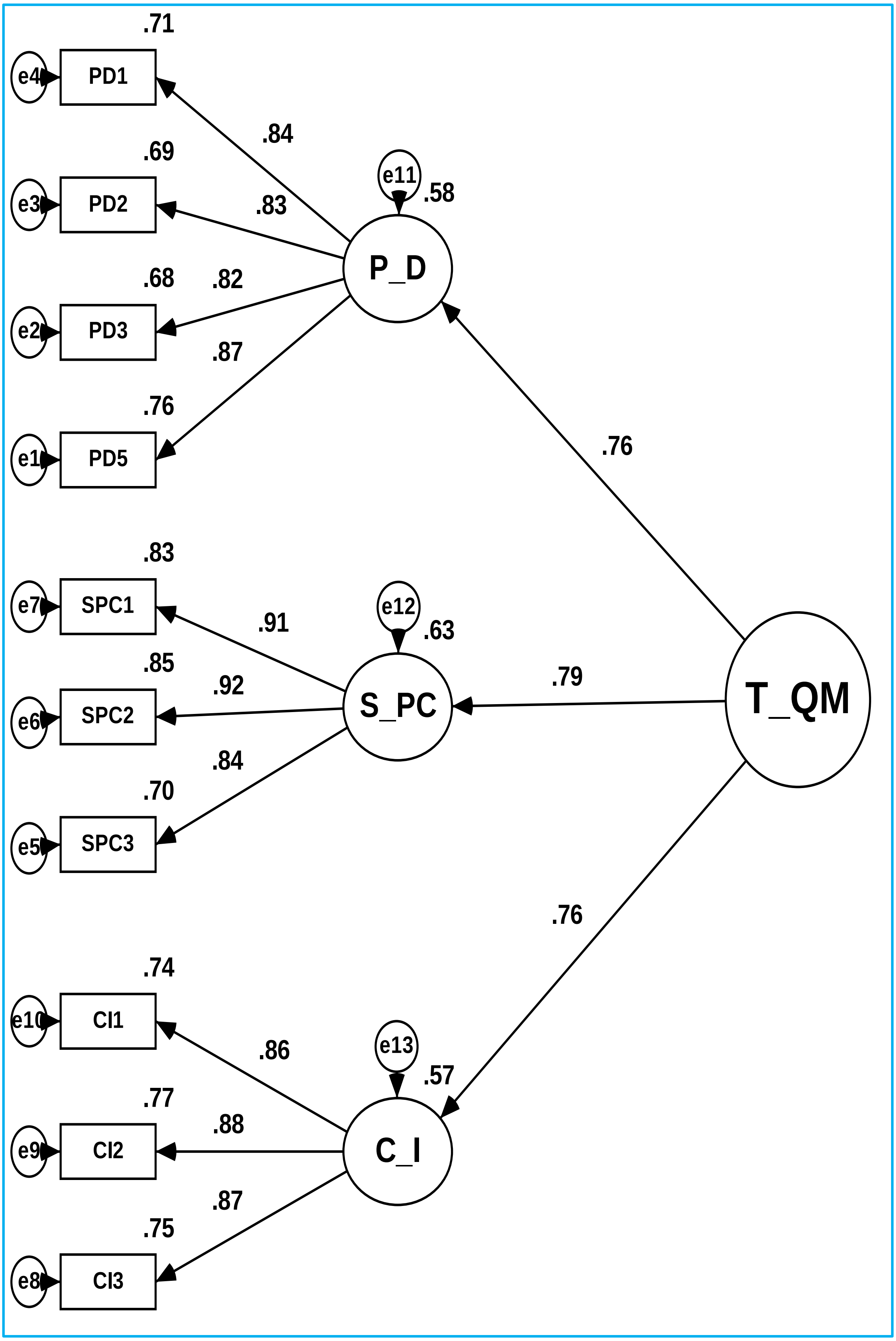


Figure 4.2. Second Order CFA for Core TQM Practices (computer-generated view)

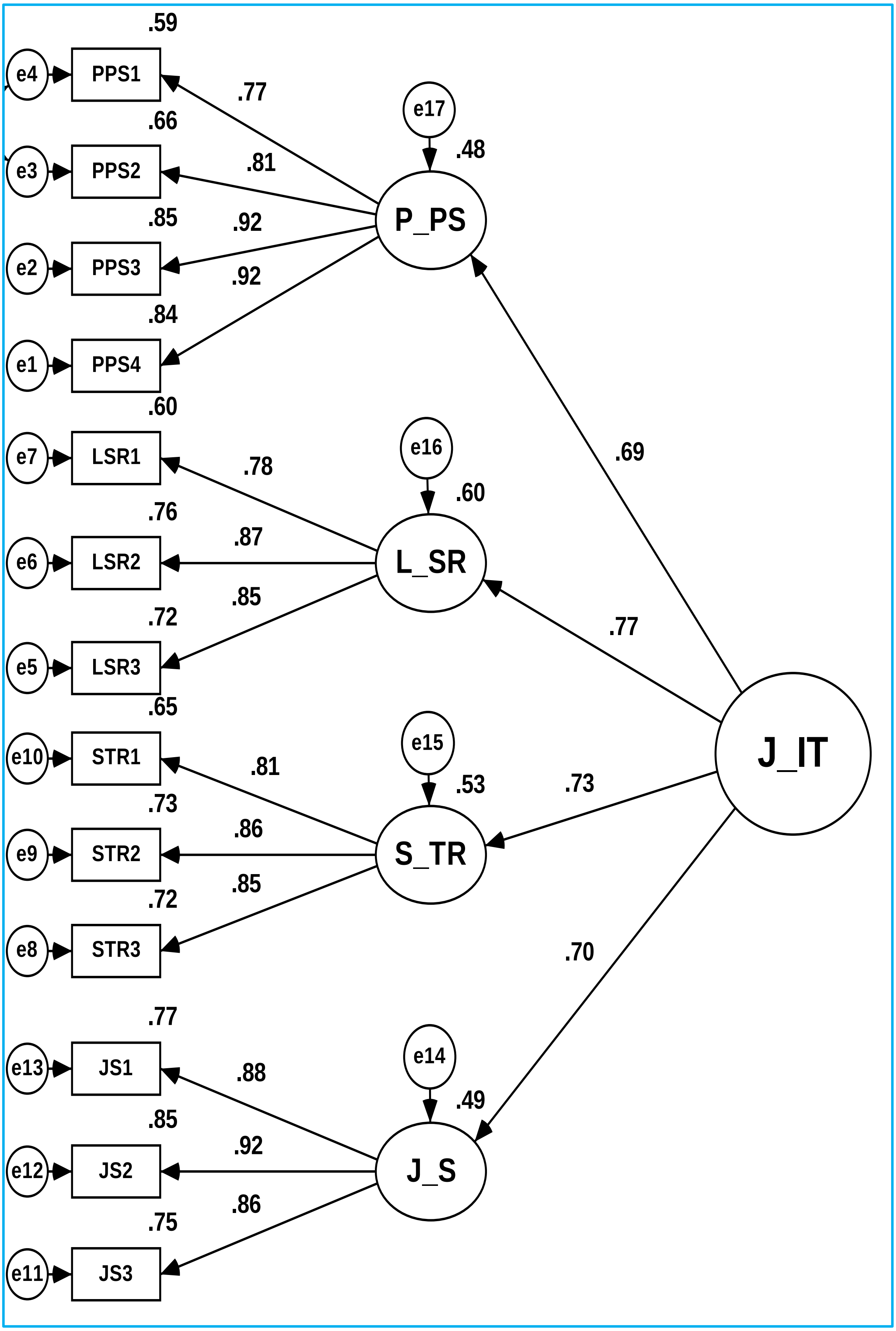


Figure 4.3. Second Order CFA for Core JIT Practices (computer-generated view)

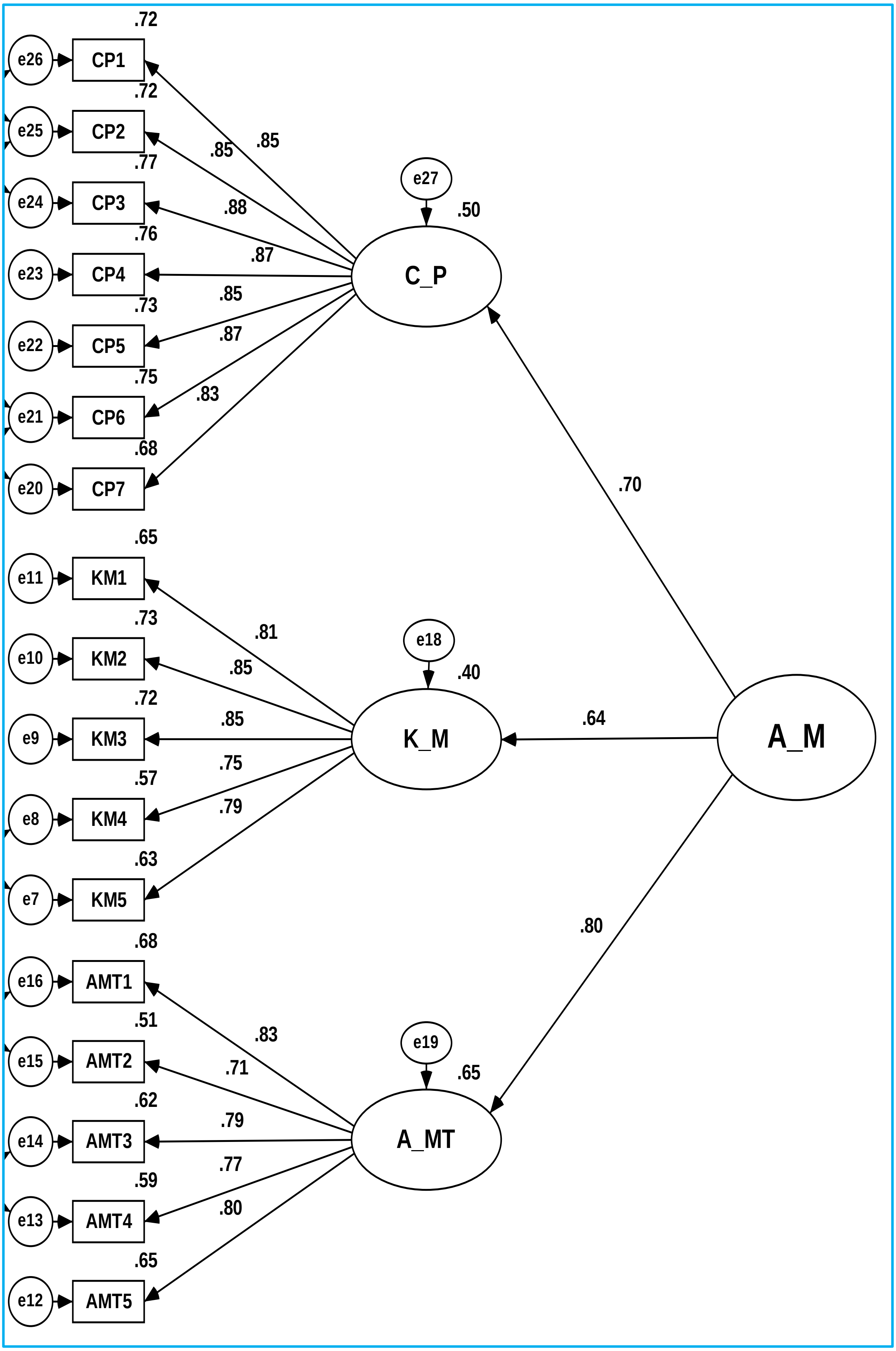


Figure 4.4. Second Order CFA for Core AM Practices (computer-generated view)

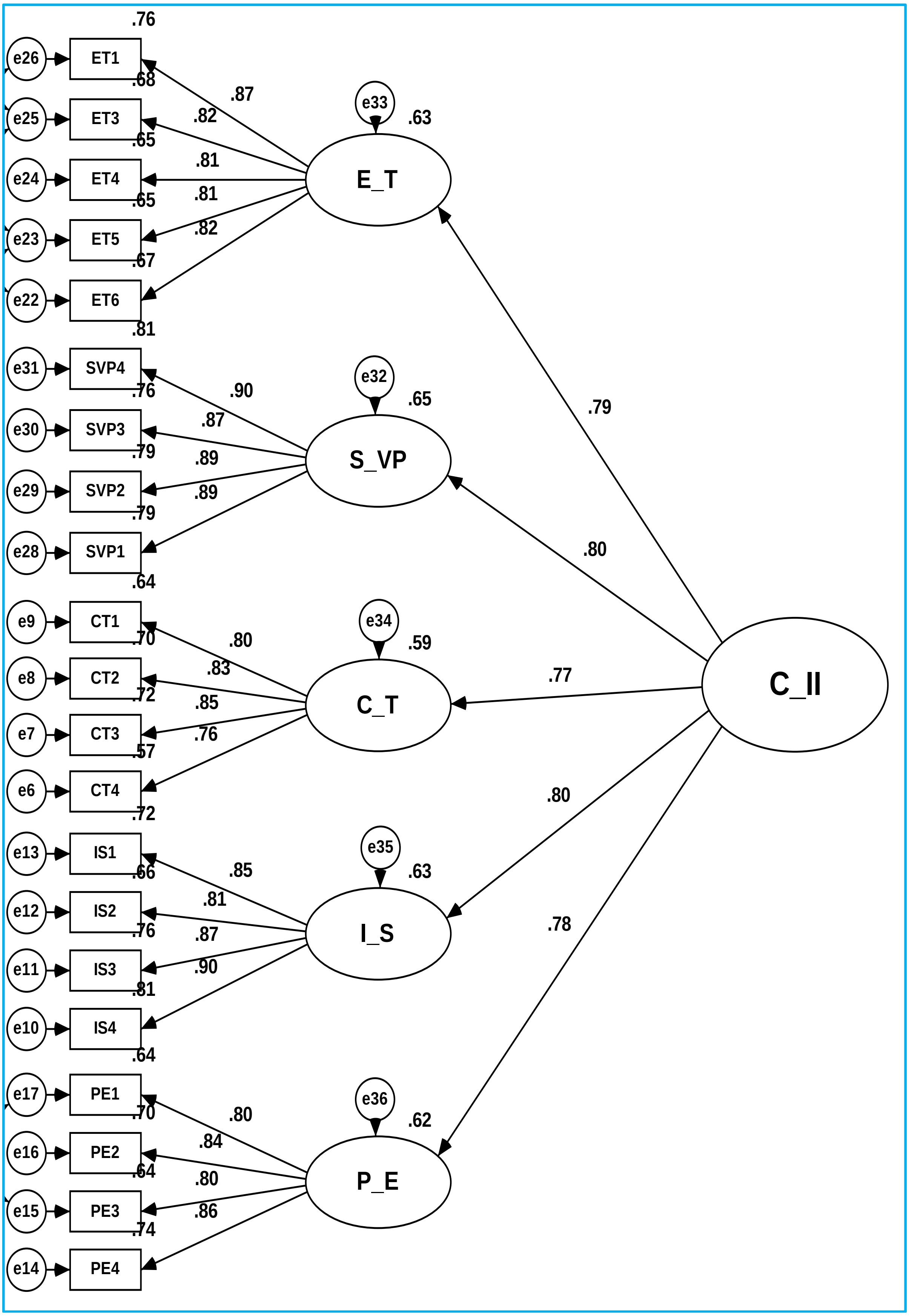


Figure 4.5. Second Order CFA for Common Internal Infrastructure Practices
(computer-generated view)

4.6.3.3 NOMOLOGICAL VALIDITY

Hair et al. (2010, p. 691), defined Nomological Validity as, “test of validity that examines whether the correlations between the constructs in the measurement theory make sense”. Bagozzi (1980) signifies Nomological Validity as a mean to confirm a link between constructs in a theoretical framework in scale testing phase (O'Leary-Kelly & J. Vokurka, 1998). Hair et al. (2010, p. 757), further emphasized that a second-order factor should pass through rigorous Nomological Validity testing to eliminate any chance of confounding explanations that are likely to be occur for a higher-order factor. Moreover, a second order factor must exhibit a superior Nomological Validity (Hair et al., 2010, p. 757). Second order factors must pass Nomological Validity as suggested by Cua (2000, p. 139) as following:

(a) A better second order CFA model fit results represent that first order dimensions belong to the respective second order factor.

(b) Significant convergence (factor loadings) of first order dimensions on respective second order factor.

(c) Average variance explained and reliability indices of second order factors indicate the internal consistency of second order factor and it can be said that second order factor adequately extracted the desired variability from first order dimensions.

(d) Significant construct correlations among first order dimensions indicate acceptable Nomological Validity.

Second order factors meet the above-mentioned criteria. All four models fit well with model fit statistics as, χ^2/df < 1.70, CFI > 0.95, GFI > 0.92, NFI > 0.95, RMR < 0.035 and RMSEA < 0.052 represented in Table 4.12. First order factor loadings on second order factor are significant at $p < 0.01$ ($t > 2.58$). Hair et al. (2010, p. 711) suggested a threshold criteria for standardised residuals, an absolute value should be less than |2.58| for better model fitting, while testing measurement model. None of the standardized residuals are greater than |2.58| in each model. To check for correlation significance among first order construct of each second order factor a separate correlation measurement model is performed for respective second order factor as presented in Figure 4.6 to Figure 4.10. Second order factor measurement models fit statistics are presented in Table 4.13. Nomological Validity (first order constructs correlations) results for each second order factor are presented in Table 4.14 to Table 4.18 respectively. All the correlations among first order dimensions of each second order factor are significantly correlated with each other’s at $p < 0.01$. Moreover, a full measurement model, as presented in Figure 4.11, with first order factors and newly developed second order factors is performed to test for model fit. Measurement model fit statistics are presented in Table 4.13.

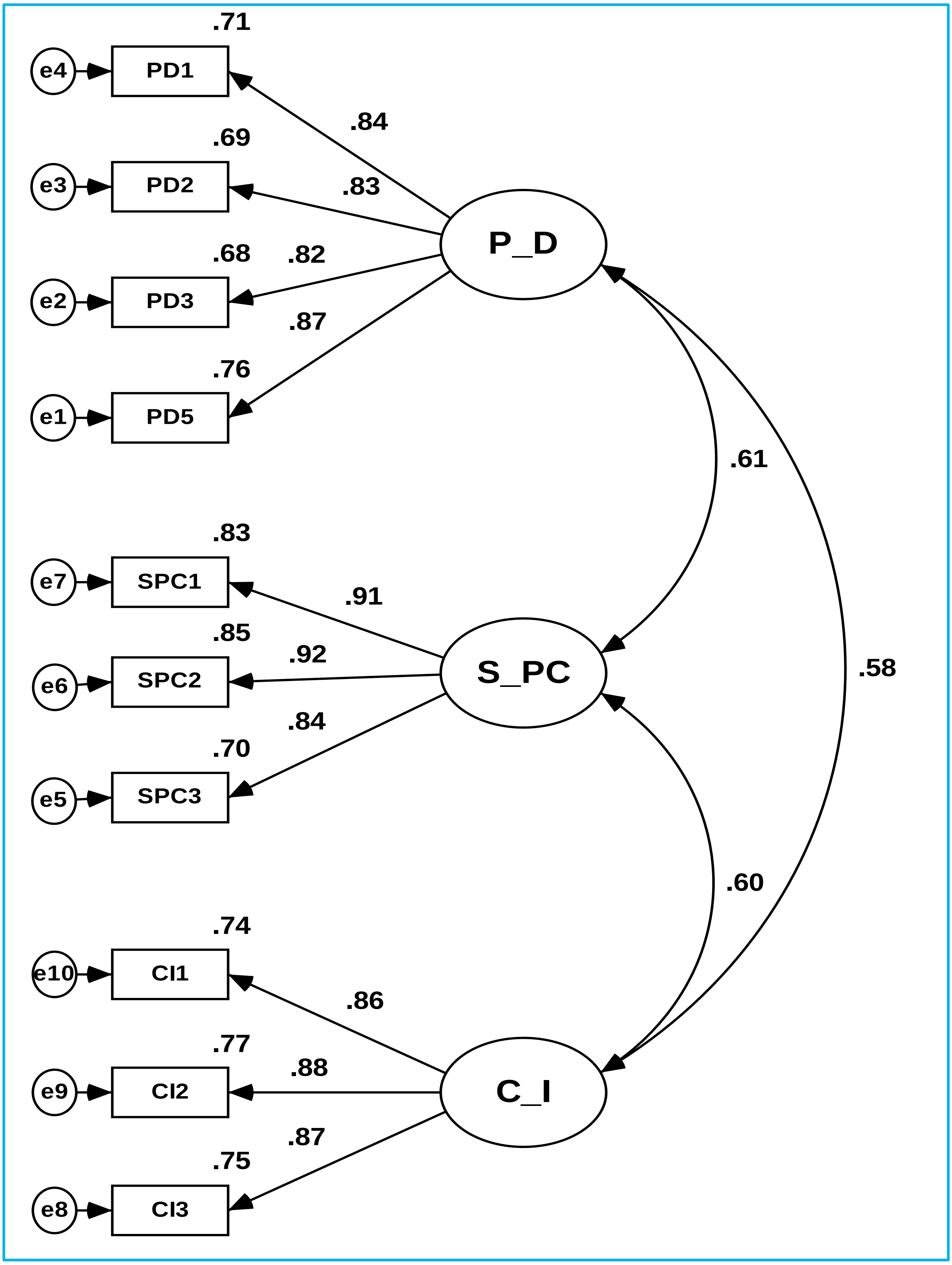


Figure 4.6. Measurement Model for Core TQM Practices (computer-generated view)

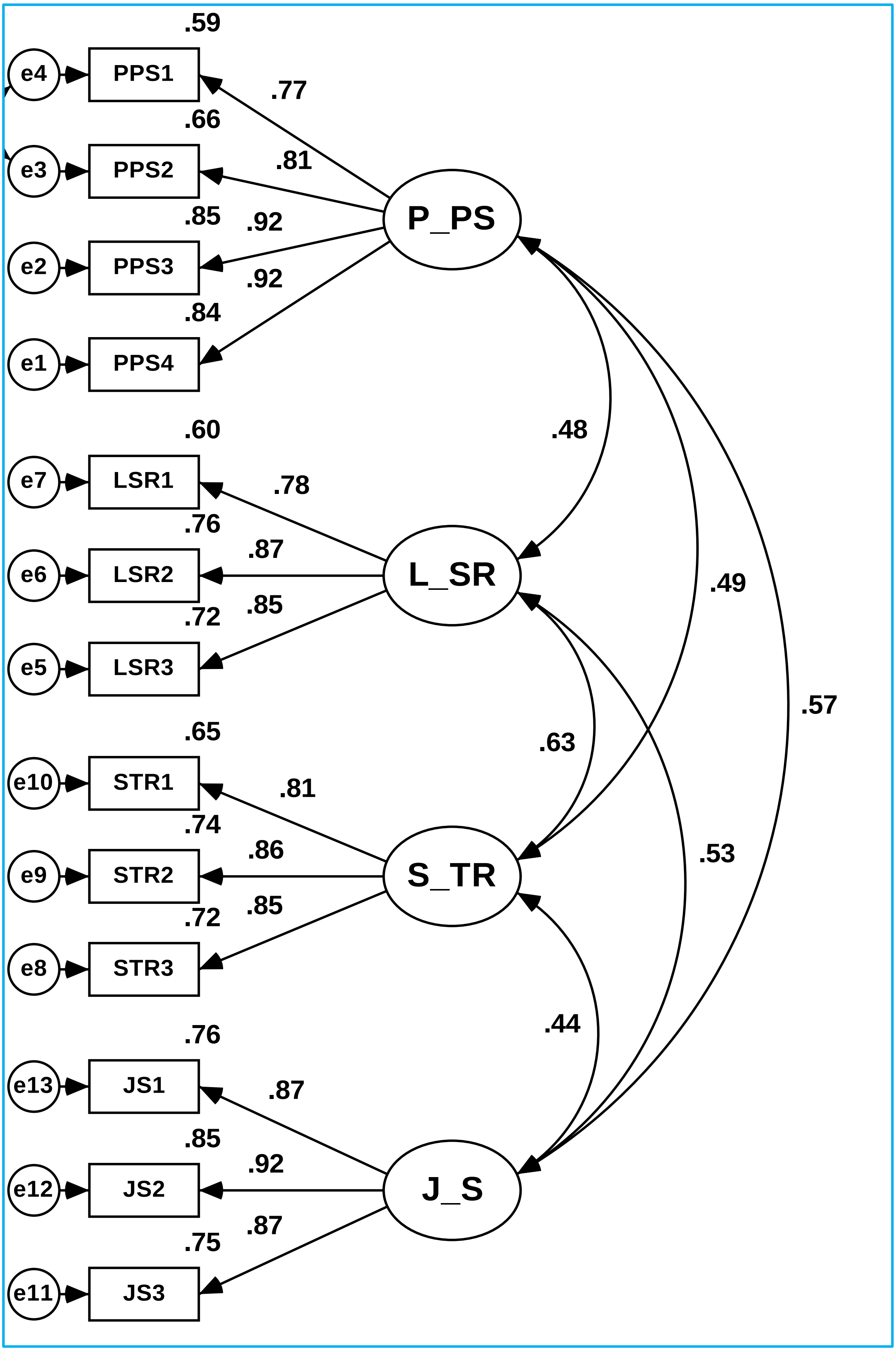


Figure 4.7. Measurement Model for Core JIT Practices (computer-generated view)

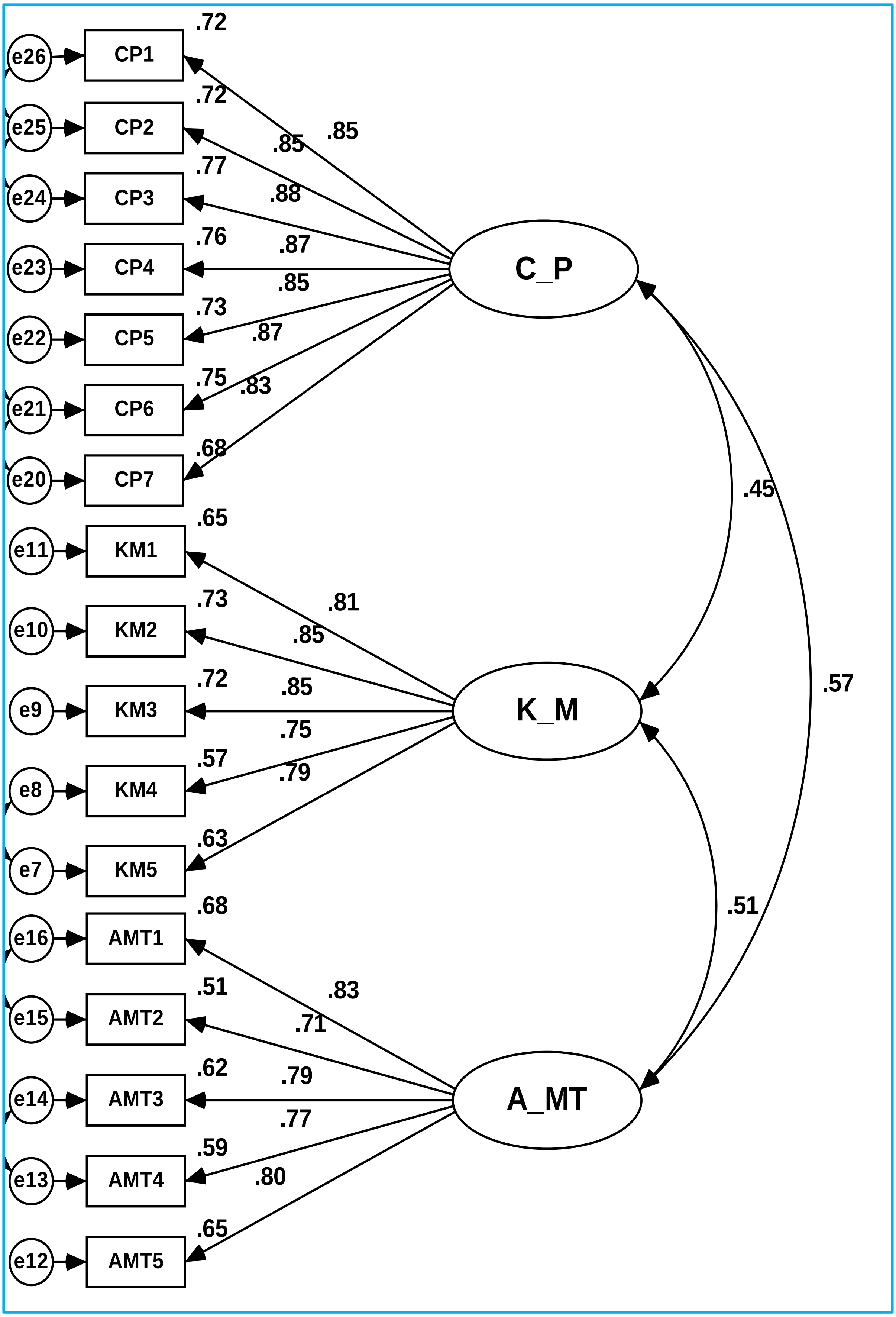


Figure 4.8. Measurement Model for Core AM Practices (computer-generated view)

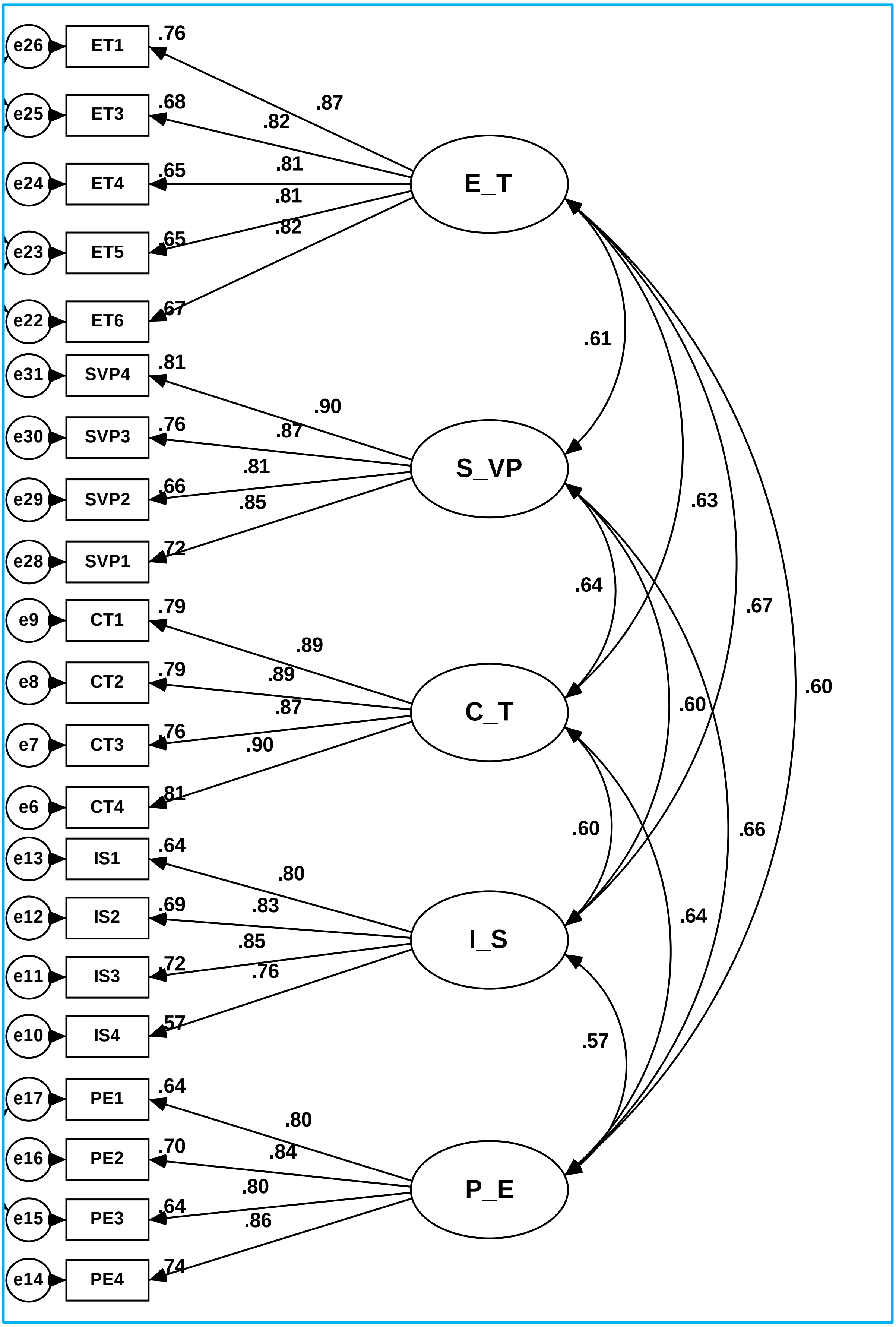


Figure 4.9. Measurement Model for Common Internal Infrastructure Practices
(computer-generated view)

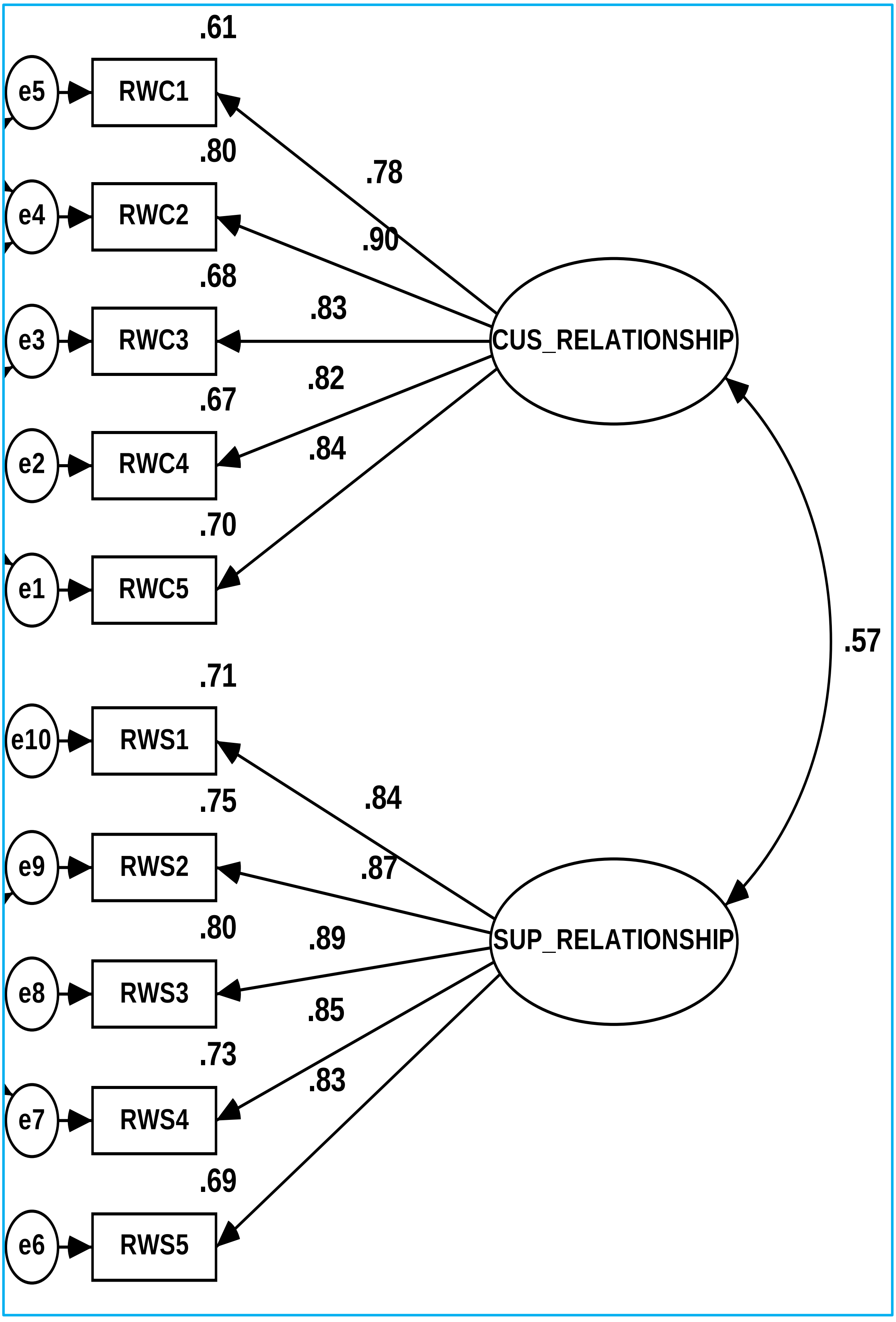


Figure 4.10. Measurement Model for Common External Infrastructure Practices
(computer-generated view)

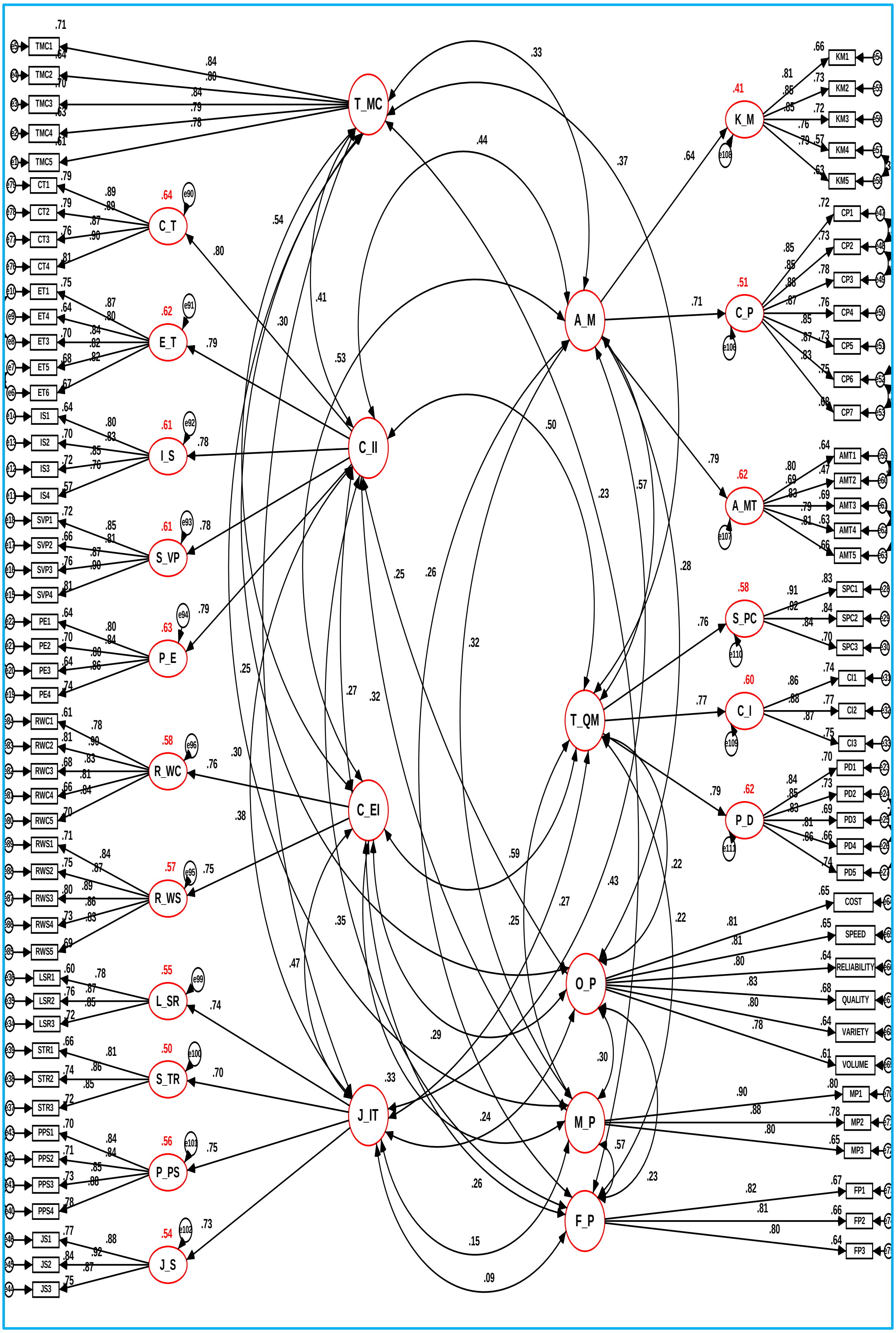


Figure 4.11. First and Second Order Full Measurement Model (computer-generated view)

Table 4.13. Second Order Measurement Models Fit Statistics

Model Fit Criteria		Core TQM	Core JIT	Core AM	CII	CEI	Full Model
χ2/df	**< 3.00**	1.274	1.468	1.212	1.154	1.145	1.215
CFI	**> 0.95**	0.99	0.98	0.99	0.99	0.99	0.95
IFI	**> 0.95**	0.99	0.98	0.99	0.99	0.99	0.95
NNFI	**> 0.95**	0.98	0.98	0.99	0.99	0.99	0.95
PNFI	**> 0.5**	0.756	0.718	0.697	0.79	0.655	0.75
PGFI	**> 0.5**	0.658	0.606	0.564	0.70	0.531	0.69
RMR	**< 0.05**	0.022	0.027	0.013	0.018	0.016	0.033
RMSEA	**< 0.08**	0.033	0.044	0.029	0.025	0.024	0.030
CAIC	**Default model***	435.96	300.10	188.57	566.72	197.18	6212.54
CAIC	**Saturated model**	996.55	592.72	358.23	1504.60	358.23	26086.28
CAIC	**Independence model**	3580.20	2593.18	1968.20	4506.89	2050.12	22061.18
***p* - value**		0.191	0.012	0.029	0.079	0.267	0.000

PNFI: (Byrne, 2010) and (Mulaik et al., 1989)

PGFI: (Byrne, 2010) and (Mulaik et al., 1989)

CAIC: (Bozdogan, 1987)

* Consistent Akaike's Information Criterion (CAIC) of default model should be less than saturated and independence model: (Byrne, 2010, p. 82; Hu & Bentler, 1995; Jöreskog & Sörbom, 1993a)

Table 4.14. Nomological and Discriminant Validity Results of Core TQM Practices

SQRTAVE		PD	SPC	CI
0.83	**PD**	***0.69***	0.320	0.290
0.88	**SPC**	.566***	***0.79***	0.298
0.86	**CI**	.539***	.546***	***0.75***

1. *****.** Correlation is significant at the 0.01 level (2-tailed).
2. **AVE** (bold / italic) is on the diagonal. Correlations at lower part of the diagonal and squared correlations are on the upper part of the diagonal.
3. **SQRTAVE:** square root of the average variance extracted.

Table 4.15. Nomological and Discriminant Validity Results of Core JIT Practices

SQRTAVE		LSR	STR	PPS	JS
0.83	**LSR**	***0.69***	0.309	0.207	0.229
0.84	**STR**	.556***	***0.70***	0.225	0.171
0.85	**PPS**	.455***	.474***	***0.73***	0.277
0.88	**JS**	.479***	.414***	.526***	***0.78***

1. *****.** Correlation is significant at the 0.01 level (2-tailed).
2. **AVE** (bold / italic) is on the diagonal. Correlations at lower part of the diagonal and squared correlations are on the upper part of the diagonal.
3. **SQRTAVE**: square root of the average variance extracted.

Table 4.16. Nomological and Discriminant Validity Results of Core AM Practices

SQRTAVE		CP	KM	AMT
0.85	**CP**	***0.73***	0.169	0.281
0.81	**KM**	.412***	***0.66***	0.211
0.78	**AMT**	.531***	.460***	***0.61***

1. *****.** Correlation is significant at the 0.01 level (2-tailed).
2. **AVE** (bold / italic) is on the diagonal. Correlations at lower part of the diagonal and squared correlations are on the upper part of the diagonal.
3. **SQRTAVE:** square root of the average variance extracted.

Table 4.17. Nomological and Discriminant Validity Results of Common Internal Infrastructure Practices

SQRTAVE		IS	ET	SVP	CT	PE
0.80	**IS**	***0.65***	0.366	0.296	0.310	0.259
0.83	**ET**	.605***	***0.69***	0.301	0.333	0.282
0.85	**SVP**	.544***	.549***	***0.73***	0.362	0.352
0.88	**CT**	.557***	.577***	.602***	***0.78***	0.343
0.82	**PE**	.509***	.531***	.593***	.586***	***0.68***

1. *****.** Correlation is significant at the 0.01 level (2-tailed).
2. **AVE** (bold / italic) is on the diagonal. Correlations at lower part of the diagonal and squared correlations are on the upper part of the diagonal.
3. **SQRTAVE:** square root of the average variance extracted.

Table 4.18. Nomological and Discriminant Validity Results of Common External Infrastructure Practices

SQRTAVE		RWC	RWS
0.83	**RWC**	***0.69***	0.295
0.85	**RWS**	.544***	***0.73***

1. *****.** Correlation is significant at the 0.01 level (2-tailed).
2. **AVE** (bold / italic) is on the diagonal. Correlations at lower part of the diagonal and squared correlations are on the upper part of the diagonal.
3. **SQRTAVE:** square root of the average variance extracted .

4.6.3.4 DISCRIMINANT VALIDITY

Discriminant Validity among first order dimensions of each second order factor is tested as per criteria $\sqrt{}$**AVE > γ** or **AVE >** γ^2 (Fornell & Larcker, 1981, p. 46) (see Section 4.6.3.4). Discriminant Validity results are presented in Table 4.14 to Table 4.18. All the first order factors in each second order factor are significantly correlated at p < 0.01|**t-value > 2.58|,** but not at the level that seriously can challenge the Discriminant Validity among constructs.

4.6.4 FIRST ORDER COMPOSITE SCALES

This study is design to test the integrated relationship of management, internal and external infrastructure, Core TQM, Core JIT and CORE AM Practices. However, variables to represent all these concepts are moderately high and limit the effective use of structural equation modelling using all the measurement items at once. These 17 sub-scales, are transformed into composite measures by taking average of these scales. Composite measure or summated scale "is formed by combining several individual variables into a single composite measure". For example, four items of cross training (CT1, CT2, CT3, CT4) are summed and then divided by the number of items, i.e., four. The resulting single variable is representative of complete CT scale and can be called as composite measure or summated scale. A composite measure has two benefits, first measurement error is reduced by combining all the scale variables into one measure and secondly a single item can represent the multidimensional concept. The composite measures distribution is as following.

(a) CII: Five composite measures (CT, ET, IS, SVP, PE)
(b) CEI: Two composite measures (RWS, RWC)
(c) CORE TQM: Three composite measures (PD, SPC, CI)
(d) CORE JIT: Four composite measures (LSR, STR, PPS, JS)
(e) CORE AM: Three composite measures (CP, KM, AMT)

Uni-variate normality is assessed and a few composite measures are found violating mild uni-variate normality. None of the composite measure violated Skewness, however, a Kurtosis values are found to be partially above **"1"** but less than **"1.5"** but are very much within upper limit of **±3** (Byrne, 2010, p. 103). However, West, Finch, and Curran (1995) define more relax criteria and limit the rescaled β_2 values to **±7** before variable start violating Kurtosis (Byrne, 2010, p. 103). To acquire uni-variate normality affected variables are normalized through Box-Cox transformation (Cua, 2000, p. 141).

4.6.5 FULL MEASUREMENT MODEL WITH COMPOSITE SCALES

A full-scale measurement model with composite scales is performed as presented in Figure 4.12. The model fit well with fit statistics as, $\chi^2/df = 1.114$, CFI = 0.98, IFI = 0.98, NNFI = 0.98, PGFI = 0.71, PNFI = 0.76, SRMR = 0.041 and RMSEA = 0.021.

4.6.5.1 DISCRIMINANT VALIDITY

Before performing structural equation modelling full model (with composite measures) Discriminant Validity is checked using three methods (Bagozzi et al., 1991; Bou-Llusar et al., 2009; Fornell & Larcker, 1981; Ghiselli, Campbell, & Zedeck, 1981).

(a) **METHOD - 1**

Two constructs are said to be distinct if the square root of the Average Variance Extracted (AVE) of a construct is greater than its correlation with other construct or in other words if the average variance extracted of a construct is greater than the square of the correlation of that construct with other construct (Fornell & Larcker, 1981, p. 46). Mathematically it can be described as $\sqrt{\textbf{AVE}} > \gamma$ or $\textbf{AVE} > \gamma^2$. AVE, square root of AVE and correlations are presented in Table 4.19. First two columns present the AVE and CR value of each construct, whereas, square root of AVE of each construct is on the diagonal. All the constructs meet the defined discriminant validity criteria $\sqrt{\textbf{AVE}} > \gamma$ or $\textbf{AVE} > \gamma^2$. All the constructs are clearly distinct from other constructs and indicate strong discriminant validity. Mean and SD of composite variables are presented in Table 4.19.

(b) **METHOD - 2**

In this method, discriminant validity is checked by correlating constructs in pairs. Constructs are correlated twice (as Nested Models). First, constructs are allowed to correlate freely. Secondly, construct's correlation is constrained to one **"1"** and a significant Chi-Square difference for a difference of one degree of freedom indicate Discriminant Validity (Bagozzi et al., 1991, p. 429; O'Leary-Kelly & J. Vokurka, 1998, p. 403). Results are presented in Table 4.20. All nine model constructs are correlated in pairs with each other. **36**, unconstrained and constrained pair wise correlation models are tested. Chi-Square difference at one degree of freedom for all pair-wise unconstrained/constrained models is significant at $p < 0.001$ indicate strong discriminant validity (Ahire & Dreyfus, 2000; Bagozzi et al., 1991; Narasimhan et al., 2006; Venkatraman, 1989; Wong et al., 2011) .

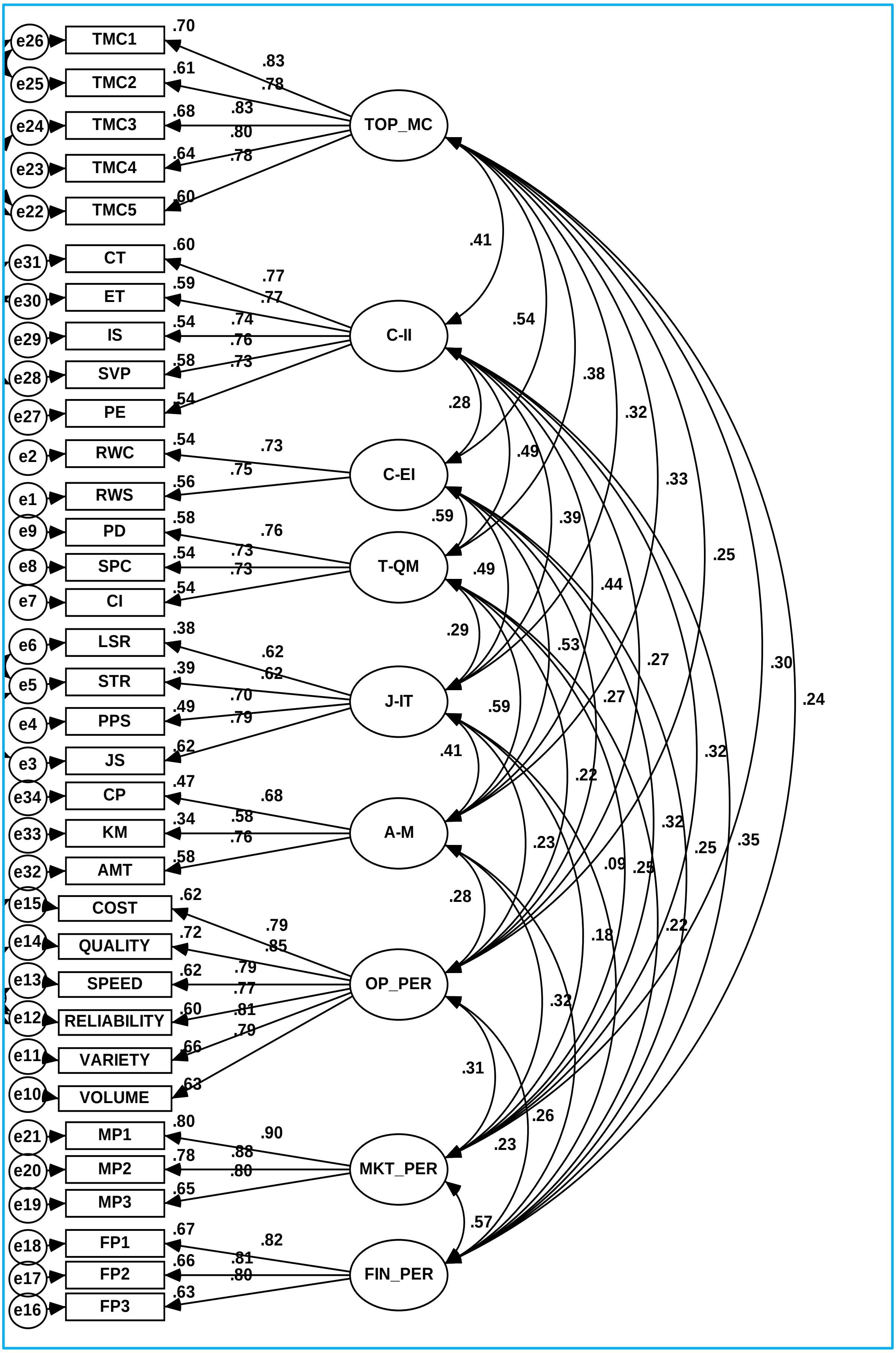


Figure 4.12. Full Measurement Model with Composite Scales (computer generated view)

Table 4.19. Discriminant Validity Results – Method No 1

SQRT (AVE)		TMC	CII	CEI	TQM	JIT	AM	OP	MP	FP
0.81	**TMC**	***0.65***	0.132	0.183	0.096	0.058	0.070	0.050	0.079	0.045
0.79	**CII**	.363***	***0.62***	0.049	0.163	0.094	0.116	0.052	0.077	0.089
0.76	**CEI**	.428***	.222***	***0.57***	0.194	0.112	0.138	0.051	0.066	0.038
0.77	**TQM**	.310***	.404***	.441***	***0.59***	0.043	0.191	0.035	0.047	0.035
0.73	**JIT**	.240***	.306***	.334***	.208***	***0.53***	0.102	0.042	0.013	0.004
0.72	**AM**	.265***	.341***	.372***	.437***	.320***	***0.51***	0.053	0.066	0.036
0.80	**OP**	.224***	.227***	.225***	.188***	.206***	.231***	***0.64***	0.078	0.038
0.86	**MP**	.281***	.278***	.256***	.216***	0.115*	.256***	.280***	***0.74***	0.240
0.81	**FP**	.213***	.299***	.195***	.186***	0.064	.189***	.196***	.490***	***0.65***
	Mean	**5.25**	**5.47**	**5.11**	**5.13**	**5.48**	**5.04**	**5.23**	**4.82**	**4.89**
	SD	**0.67**	**0.56**	**0.64**	**0.51**	**0.59**	**0.54**	**0.77**	**1.05**	**0.95**

*****.** Correlation is significant at $p < 0.01$ (2-tailed).
****.** Correlation is significant at $p < 0.05$ (2-tailed).
*. Correlation is significant at $p < 0.1$ (2-tailed).

AVE (bold / italic) is on the diagonal. Correlation at lower part and squared correlations are on the upper part of the diagonal.

Table 4.20. Discriminant Validity Results – Method No 2

Constructs' Pair	Unconstrained Model (Correlation = free to correlate)		Constrained Model (Correlation = 1)		Discriminant Validity		
	χ^2	*df*	χ^2	*df*	$\Delta\chi2$	Δdf	Significance
Top Management Commitment							
TMC ↔ CII	50.5	31	383.8	32	333.3	1	***
TMC ↔ CEI	5.5	10	61.7	11	56.2	1	***
TMC ↔TQM	80	24	254.6	25	174.6	1	***
TMC ↔ JIT	28	21	182.8	22	154.8	1	***
TMC ↔ AM	5.9	16	138.5	17	132.6	1	***
TMC ↔ OP	62.6	40	446.2	41	383.6	1	***
TMC ↔ MP	12.5	16	425.5	17	413	1	***
TMC ↔ FP	8.4	16	309	17	300.6	1	***
Common Internal Infrastructure Practices							
CII ↔ CEI	14.2	13	93	14	78.8	1	***
CII ↔ TQM	185.3	36	332.5	37	147.2	1	***
CII ↔ JIT	498	79	641.3	80	143.3	1	***
CII ↔ AM	21.5	19	138.2	20	116.7	1	***
CII ↔ OP	81	43	570.6	44	489.6	1	***
CII ↔ MP	24.1	19	434.3	20	410.2	1	***
CII ↔ FP	29.8	19	295.6	20	265.8	1	***

Common External Infrastructure Practices							
CEI ↔ TQM	51.1	9	98.2	10	47.1	1	***
CEI ↔ JIT	13.1	6	71.5	7	58.4	1	***
CEI ↔ AM	1.4	4	57.1	5	55.7	1	***
CEI ↔OP	37.3	19	117.2	20	79.9	1	***
CEI ↔ MP	4.9	4	82	5	77.1	1	***
CEI ↔ FP	0.7	4	81.5	5	80.8	1	***
Core Total Quality Management Practices							
TQM ↔ JIT	10.9	11	168.1	12	157.2	1	***
TQM ↔ AM	6.7	8	84.7	9	78	1	***
TQM ↔ OP	49.6	26	248.4	27	198.8	1	***
TQM ↔ MP	22.8	8	216.5	9	193.7	1	***
TQM ↔ FP	6.4	8	204.1	9	197.7	1	***
Core Just-in-Time Practices							
JIT ↔ AM	7.2	11	112.6	12	105.4	1	***
JIT ↔ OP	34	32	197.8	33	163.8	1	***
JIT ↔ MP	15.3	11	184.9	12	169.6	1	***
JIT ↔ FP	8.1	11	183.1	12	175	1	***
Core Agile Manufacturing Practices							
AM ↔ OP	37.1	26	166.9	27	129.8	1	***
AM ↔ MP	11.2	8	136.5	9	125.3	1	***
AM ↔ FP	3.5	8	135.6	9	132.1	1	***
Operational Performance							
OP ↔ MP	53.1	26	476.1	27	423	1	***
OP ↔ FP	33	26	335.3	27	302.3	1	***
Market Performance							
MP ↔ FP	5.1	8	212.8	9	207.7	1	***
***. Significant at $P < 0.01$ as t-value is larger than 2.58.							

(c) METHOD - 3

A Construct Discriminant Validity is established, if the Cronbach's Alpha (α) value of that constuct is sufficiently greater than the average inter scale correlation of that construct with other model constructs (Ghiselli et al., 1981). To assess discriminant validity, first of all, AVISC of each construct is calculated by taking average of its correlation with all other constructs of the model. Then AVISC is subtracted from Cronbach's Alpha to test for Discriminant Validity. Results are presented in Table 4.21. Cronbach's Alpha (α) and AVISC difference is sufficiently greater than 0.3 and indicate strong disriminant validity (Ahire & Dreyfus, 2000; Jayaram et al., 2010; Sila & Ebrahimpour, 2005).

Table 4.21. Discriminant Validity Results – Method No 3

Construct	Cronbach's Alpha (α)	AVISC	α - AVISC
TMC	0.91	0.33	0.57
CII	0.78	0.31	0.47
CEI	0.79	0.23	0.56
TQM	0.72	0.31	0.41
JIT	0.86	0.30	0.56
AM	0.70	0.40	0.51
OP	0.91	0.19	0.72
MP	0.895	0.26	0.63
FP	0.85	0.29	0.56

4.7 FINIDNGS OF EMPIRICAL DATA MEASUREMENT

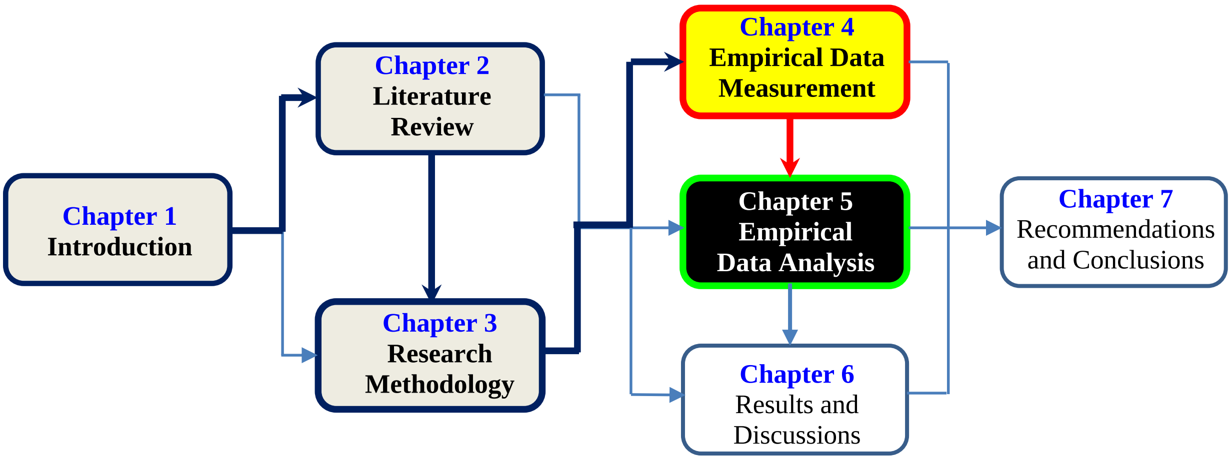
In this chapter, from Section 4.2 to Section 4.6, empirical data is measured, thoroughly, for further analysis. Data is collected form 248 respondents' sample comprising of 97 Readymade Garments and 151 Knitwear and Hosiery Units. It started with basic data measures like descriptive statistics and thoroughly investigated the sample data. Data normality is assessed through Skewness and Kurtosis. Only one item violated the critical value of "**±1**". Thorough investigation of the data includes, test for presence of potential data biasness. Non-response and common method bias assessment are tested and data is found to be free of any serious biasness. Constructs' and items' reliability is assessed using a criteria **CITC > 0.5** for and Cronbach's Alpha **(α) > 0.7**. Only one item fail to meet he prescribed criteria and eliminated. Constructs validity is established through EFA and CFA as well. First separate EFA for independent, performance and environmental context variables are performed. EFA is performed using Principal component with varimax rotation. Eighteen (18) factors for independent, three (3) factors for performance and three (3) factors for environmental variables resulted. Further CFA is performed for each construct to assess the Unidimensionality, Convergent Validity, Reliability and Discriminant Validity. Further, five second-order factors are formed. CFA for each second factor is also performed to assess the Unidimensionality, Convergent Validity, Reliability and Discriminant Validity. Moreover, Nomological Validity is also assessed for each second order factor and is found valid. Five measurement models are tested for each second order factor as well as one for full model. All

Measurement Models Fit well and meet the prescribed criteria. Discriminant Validity for each second order factor and overall model is assessed. First order constructs are converted into composite measures to meet the sample requirement for advance level testing like Structural Equation Modelling. Constructs Validity is confirmed to undertake advance level analysis.

4.8 SUMMARY

This Chapter starts with presentation of sample data description for this research study. First, basic data measures (descriptive statistics) thoroughly investigated the sample data. Second, empirical data measurement is assessed using multiple data assessment tools like Potential Bias Assessment, Reliability Test, Unidimensionality Assessment, Convergent, Nomological and Discriminant Validity Assessment. Chapter 5 shall undertake the Advance Empirical Testing to confirm the Proposed Theory.

Chapter-4 Direction to the Chapter-5



CHAPTER 5

EMPIRICAL DATA ANALYSIS

5.1 INTRODUCTION

This Chapter focuses on the second part of the empirical data testing. Data collected from **248** firms is analysed to test the research theory developed in Chapter-2 and Chapter-3 and three respectively. This Chapter comprises four sequential Sections. Second Section further describes different analysis methods. Third Section pertains to Empirical Data Results. Fourth section describes the final framework developed. Fifth Section provides the findings of Empirical Data Analysis. Finally, the Sixth Section summarizes the Chapter. Section-wise brief description of the Chapter is presented in Table 5.1.

Table 5.1. Chapter Overview

Section	Description
Section 5.2	Empirical data analysis methods used and criteria to test the proposed theory are explained in detail. Structural Equation Modelling, multiple regression analysis and discriminant analysis are used as data analysis methods are discussed in detail.
Section 5.3	Research study results for Universal, Contingency and Configurational perspectives are described in length. Five forms of fit Direct Covariation Fit, Indirect Covariation (Mediation) Fit, Moderation Fit, Profile Deviation Fit and Gestalt Fit are used to test the proposed hypotheses.
Section 5.4	Proposed conceptual framework is transformed into final Lean (TQM & JIT) and AM integrated manufacturing framework using multiple statistical analysis methods.
Section 5.5	Findings of Empirical Data Analysis are provided.
Section 5.6	Summarizes the Chapter

5.2 ANALYSIS METHODS USED

In Chapter 3, analysis methods' schematic progression is explicitly delineate. In this Section, those statistical methods are discussed in detail and how results obtained through these methods are evaluated and interpreted. Different forms of Fit (Universal, Contingency and Configurational) are verified using these statistical methods. Venkatraman (1989), delineated six exclusive fit test choices as (1) Covariation fit, (2) Mediation fit, (3) Moderation fit, (4) Profile deviation fit, (5) Gestalts fit, and (6) Matching fit, to test the structural relation between strategy, structural and performance measures. Out of these six fits, first five forms of fit are employed to test the proposed relationship among management, infrastructure practices, core practices and performance measures. Covariation and mediation fit is employed to test the universal perspective. Moderation fit is employed to test the contingency perspective fit, whereas, profile deviation and gestalts fit are employed to test the configurational perspective fit. The methods to test these forms of fit are structural equation modelling for universal perspective fit, multi-group structural equation modelling for contingency perspective fit and configurational perspective fit is tested using multiple regression analysis and discriminant analysis.

5.2.1 STRUCTURAL EQUATION MODELLING

SEM use is extensively growing (Anderson & Gerbing, 1988, p. 411) and is being widely used in marketing, customer behavior and OM research (Atanasova & Senn, 2011; Flynn et al., 1995b; Inman et al., 2011; Jayaram et al., 2010; Sila, 2007; Sila & Ebrahimpour, 2005; Vázquez-Bustelo et al., 2007; Yang et al., 2011). Byrne (2010, p. 3) stated that "SEM is a statistical methodology that takes a confirmatory (i.e., hypothesis-testing) approach to the analysis of a structural theory". Arbuckle (2010, p. 1), defines this approach as "analysis of covariance structure, or causal modelling". SEM represents series of causal relationships generating observations among multiple variables simultaneously (Bentler, 1988). SEM is preferred over other multivariate techniques (like correlation, regression) in different perspectives. In Statistical Perspective, it is much suitable for hypotheses testing, (a) confirmatory assessment, (b) simultaneously measurement error assessment of multiple indicators. In Functional Perspective, it has three advantages, (a) the causal relationships under investigation are represented with Structural (Regression) Equations, (b) these relations can be modelled pictorially for clear visualization of the proposed theory, and (c) direct and indirect relationships among several independent (exogenous) and dependent (endogenous) constructs can be assessed simultaneously.

When proposed fit is modelled on the base of co-variation fit or indirect fit, the recommended approach to test such type of theoretical fit is exploratory or confirmatory factor analysis (Bagozzi, 1980; Venkatraman, 1989, p. 436). While deciding between two approaches (Bagozzi, 1980; Jöreskog & Sörbom, 1979) confirmatory factor analysis approach is prefer over exploratory factor analysis approach (Venkatraman, 1989, p. 436). Venkatraman (1989, p. 435) conceptualize covariation fit as, "a pattern of covariation or internal consistency among a set of underlying theoretically related variables" and mediation fit as "the existence of a significant intervening mechanism" and the mediation fit functional form based on indirect effects. These forms of fit, analytically and conceptually, can encompass multiple variables simultaneously (Duncan, 1972). Based on Venkatraman (1989), to test the universal perspective, two approaches are hypothesized, (1) Direct (Covariation) and (2) Indirect (Mediation), (see Figure 5.1) to test the theoretical relationship between structural variables and performance (Cua et al., 2006). The direct covariation model (Figure 5.1-A) is compared with indirect mediation model (Figure 5.1-B) to check the plausible relationship among management, infrastructure (internal and external) practices, and Core TQM, Core JIT and Core AM practices with performance.

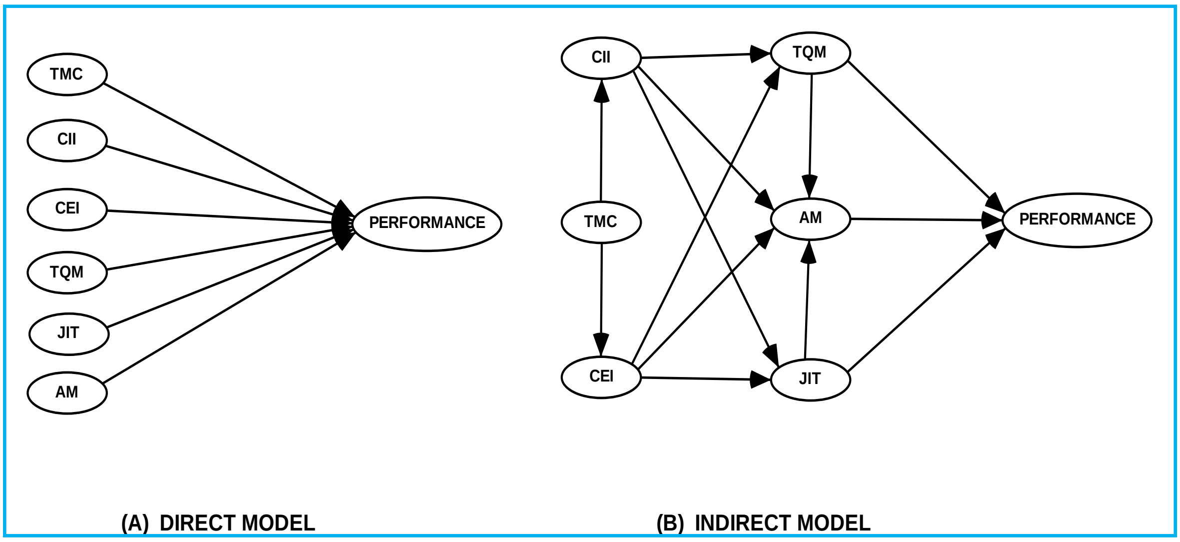


Figure 5.1 (A & B). Direct and Indirect Models of Practices Effects on Performance

Source: Adapted from (Venkatraman, 1989)

SEM, using Analysis of moments structures (AMOS) software, is the most appropriate method to test the hypothesized theory (Byrne, 2010; Hair et al., 2010). Assumptions required to undertake SEM are methodically verified. All the models meet the identification criteria.

5.2.1.1 MODEL FIT ASSESSMENT CRITERIA

A significant issue in model testing is the model fit. A number of model fit indexes are common in model fit assessment (Byrne, 2010; Hair et al., 2010; Hu & Bentler, 1998, 1999; Kline, 2005). Generally, these indices have been grouped into three main groups, (a) Absolute-Fit-Indices, (b) Incremental Fit Indices and (c) Parsimony Fit Indices (Byrne, 2010; Hair et al., 2010). Hair et al. (2010, p. 672), recommended that one incremental fit index and one absolute fit index along with χ^2 and degree of freedom are sufficient to assess the goodness of model fit. Whereas, Byrne (2010, p. 84) overtly put the model fit assessment responsibility on the researcher's shoulder and recommended that model fit assessment, apart from fit indices, must base on a rational criteria that simultaneously account for statistical significance as well as theoretical perspectives and practical contemplations. Based on the disagreement on what constitute the best model fit (Bagozzi & Yi, 1988; Hu & Bentler, 1998, 1999), model fit assessment criteria cannot be ignore. A set of eight fit indices is recommended, comprises three absolute, three incremental and two parsimony fit indices, to assess the “goodness-of-model fit”.

(a) **ABSOLUTE FIT INDICES**

Three Absolute Fit Indices are recommended to assess the model fit.

(1) **NORMED CHI-SQUARE (CMIN/DF)**

It is the simple ratio of the χ^2 to the degree of freedom of a model also termed as CMIN/DF. Generally, a χ^2/df ratio ≤ “3” is considered good for a better-fitting model (Carmines & McIver, 1981, p. 80; Hair et al., 2010, p. 668) , but in certain cases a value of ≤ “5” is also acceptable with other acceptable fit indices (Marsh & Hocevar, 1985; Wheaton, Muthén, Alwin, & Summers, 1977).

(2) **ROOT MEAN SQUARE ERROR OF APPROXIMATION (RMSEA)**

RMSEA proposed by Steiger and Lind (1980), has been recognized as most informative criteria in covariance modelling structures (Byrne, 2010, p. 80). It indicates a better model fit as population, going one step ahead, not merely like a sample used for estimation (Hu & Bentler, 1999). Browne and Cudeck (1993) demarcated its cut-off values, a value of < “0.08” indicate reasonable fit and a value of < “0.05” indicate good fit. Whereas, Hu and Bentler (1999) defined a cut-off value of “0.06” for a good model fit.

(3) **STANDARDISED ROOT MEAN RESIDUAL (SRMR)**

SRMR is another absolute fit index for model fit assessment. To overcome the associated RMR problem with model fit assessment, as its value is dependent upon the true covariance scale, SRMR is recommended to assess the model fit statistics (Hair et al., 2010, p. 667). A low value of SRMR indicates good model fit (Bagozzi & Yi, 1988, p. 82). Preferably a value < “0.08” indicates perfect fit (Hu & Bentler, 1999, p. 27), a value from “0.08 to 0.1” reflects good fit value over “0.1” indicate a poor fit (Hair et al., 2010, p. 668).

(b) **INCREMENTAL FIT INDICES**

Three Incremental Fit Indices are recommended to assess the model fit.

(1) **COMPARATIVE FIT INDEX (CFI)**

Bentler (1990) revised BBNFI (Bentler & Bonett, 1980) as CFI by taking sample size into account. CFI is computed by comparing hypothesised model with null model. This is normed and its value ranges between 0-1. Initially, a value of “0.9” was considered sufficient for good model fit(Bentler, 1992), but Hu and Bentler (1999) devised the new threshold criteria of “0.95” for a better fitting model.

(2) **INCREMENTAL FIT INDEX (IFI)**

Bollen (1989b) developed IFI to address the NFI limitations of parsimony and sample size while comparing a model with its null model. Its value ranges from “**0 to 1**”. A value of “0” indicates a worse model fit, whereas, a value close to “**1**” indicate good model fit. There is no specific cut-off criteria for this index, but a value above “0.95” indicates a good model fit.

(3) **TUCKER-LEWIS INDEX (TLI)**

TLI is similar to that of NFI, its value is computed by comparing normed Chi-Square of hypothesised and null model and model complexity is also taken into account to some extent (Tucker & Lewis, 1973). It is not normed and value can fall below “0” or can go above to “1”. However, a value close to “1 or > 0.95” indicates a good model fit.

(c) **PARSIMONY FIT INDICES**

Two Parsimony Fit Indices are recommended to assess the model fit and comparison respectively.

(1) **PARSIMONY NORMED FIT INDEX (PNFI)**

PNFI is computed by taking Parsimony Ratio (PR) into account. BBNFI is multiplied with PR to compute the PNFI. A value of over “0.5” with other fit indices values at least over “0.9” indicate a good model fit (Mulaik et al., 1989).

(2) **AKAIKE‘S INFORMATION CRITERIA (AIC)**

Akaike‘s Information Criteria (AIC) (Akaike, 1987), is also linked with the parsimony model fit assessment (Byrne, 2010, p. 82). It is also used to assess for model comparison (Kaplan, 2000, p. 117). It incorporates two major aspects of a model fit, (a) statistical significance of "goodness-of-fit" and the number of free parameters estimated (Byrne, 2010, p. 82). A model with smaller value of AIC provides much information and is preferred over a model with larger AIC value as it provides less information (Swink & Calantone, 2004, p. 478).

5.2.1.2 NESTED MODELS COMPARISON CRITERIA

During theory development phase, a researcher has to test a number of models having similar degree of complexity, however, theoretical implications may be different in such cases. Nested-models also known as Hierarchical model comparison is the most appropriate approach in this regard (Kline, 2005, p. 145). Nested-MODELS base on one-baseline model and subsequent models are formed basing on that same baseline model by adding or deleting certain paths to test the different theoretical links among model variables presenting different theoretical perspectives. The most appropriate method to check the Nested-models is χ^2 difference test (Hair et al., 2010; Kline, 2005).

(a) χ^2 DIFFERENCE TEST

χ^2 Difference Test entirely base on χ^2 distribution value of the baseline model. Let's suppose if there is a baseline model (A) and it has to be compare with other nested-model (B). The χ^2 value for both models is calculated. Let's suppose model (A) is less restrictive model, with less number of degree of freedom, and model (B) is more restrictive model with more number of degree of freedom. χ^2 value of more constrained model (B) is higher than less restrictive model (A). χ^2 value of less restrictive model (A) is subtracted from more constrained model (B) and the difference is the χ^2 distribution against the difference of number of freedom. Mathematically, it can be represented as following;

$$\Delta\, \chi^2_{\Delta df} = \chi^2_{df\,(\mathrm{B})} - \chi^2_{df\,(\mathrm{A})}$$

$$\Delta\, df = df_{(\mathrm{B})} - df_{(\mathrm{A})}$$

Let's suppose, if the degree of freedom difference is 1. The thumb rule is if the χ^2 distribution for 1 degree of freedom is more than the cut-off value of 3.84 at $p < 0.05$. The less restrictive model (A) is accepted, as it is better model with statistical significant reduction in χ^2 and is providing more information as compare to more constrained model (B) for the difference of 1 degree of freedom and is accepted. If the χ^2 distribution for 1 degree of freedom is less than the cut-off criteria of "**3.84**" at $p <$

0.05, the more constrained model (B) is accepted, as compare to less restrictive model (A), as reduction in χ^2 distribution is statistical insignificant for using an additional "1" degree of freedom (Hair et al., 2010, p. 676; Kline, 2005, p. 147).

5.2.2 MULTI-GROUP MODERATION

Multi-group moderation SEM is best suitable for contingency perspective assessment like testing the group differences based on gender, or firm size, etc. Multi-group moderation, using SEM, helps in assessing difference among two, or more than two, groups for the same theoretical model (Hair et al., 2010, p. 771). Here, differences among individual groups, emerging from same sample or population, are assessed for the same structural paths. It can be used for metric and non-metric groups. Preferably, sample is distributed into non-metric sub-groups like high or low performers, small and large firms, male or female, etc. Multi-group moderation is different from Nested-models where models are different from each other. In this case, structural model remains the same, the only thing under test is the difference among sub-groups, of the same sample, for the same theoretical model or more precisely for different paths of that model (Hair et al., 2010, p. 770).

5.2.2.1 MODERATOR GROUP FORMULATION

Moderator Groups can be metric or non-metric. These metric or non-metric groups' selection should be strongly supported with theoretical background (Hair et al., 2010, p. 770).

(a) NON-METRIC MODERATOR

Non-metric moderating groups often are categorical variables. Non-metric groups generally represent demographic characteristics or contextual perspective of the sample (Hair et al., 2010, p. 771). For the purpose of this study, firm size, ISO registration and industry type are Non-metric Moderating Groups.

(b) METRIC MODERATOR

Metric moderating variables are continuous and generally are difficult to be differentiated. A metric moderating variable should clearly indicate two different dimensions of the variable like high or low. If, it is difficult to differentiate between high and low moderating groups. Then group sample is distributed into three groups, each group comprising of 33% of the sample, the upper and lower two groups are clearly different from the in-between group and can be used for multi-group moderation analysis (Hair et al., 2010). Hair et al. (2010, p. 771) suggested two perspectives for undertaking metric variables multi-group moderation. In first case, interaction terms are used to assess the moderation impact. However, for a number of variables in SEM it becomes difficult to assess such type of moderation effects and makes model more complex. The alternative and most suitable method is to categorize sample into two non-metric sub-groups. For this study, this approach is used. Metric variables environmental contextual factors and information technology are transform into to non-metric moderating variables by splitting into sub-groups.

5.2.2.2 MULTI-GROUP MODERATION ASSESSMENT

Multi-group Moderation Assessment also base on χ^2 difference test (see Section 5.2.1.2). The only difference is that in this case no path is added or deleted. Rather, paths are constrained to be equal between two or more than two groups. Suppose, if there is a model with two groups like male and female. First, the baseline model fitment is assessed. In the second stage, depending on the theoretical justification, whole or few specific paths are constrained to be equal between groups of the same model. The model without constrained is known as less restrictive model and model with constraints is known as much restrictive model. χ^2 value is calculated for both models and difference is calculated as following.

$$\Delta\,\chi^2_{\Delta df} = \chi^2_{df\,\text{(groups constrained)}} - \chi^2_{df\,\text{(groups un-constrained)}}$$

$$\Delta\, df = df_{\text{(groups constrained)}} - df_{\text{(groups un-constrained)}}$$

The criterion is, if the resultant χ^2 of constrained group is significantly higher than the χ^2 of un-constrained group for the difference of degree of freedom. It means that groups are different for that specific path or number of paths constrained to be equal between groups and that specific path or number of paths is moderated and different between male and female group. In other case, if the χ^2 of constrained group is significantly not different from the χ^2 of un-constrained group. Then group's effect for that path or number of paths are not moderated by male and female group (Hair et al., 2010, p. 772).

5.2.3 MULTIPLE REGRESSION ANALYSIS

Multiple regression analysis is well-known statistical method technique in OM Research (Ahmad et al., 2003; Flynn et al., 1995a; Shah & Ward, 2003; D. Zhang, Linderman, & Schroeder, 2012). Multiple regression analysis is employed in this study to test the profile deviation fit (configurational perspective fit) between management, infrastructure, core practices and performance measures. Profile deviation fit is calculated using Euclidean weighted distance measurement method, where a fit or more specifically "misfit" is tested (Drazin & Van de Ven, 1985, p. 533). The misfit is theoretically a point which is operationalized in the multi-dimensional space, where alignment between two profiles, i.e. (a) Ideal profile and (b) study profile is measured. An ideal profile has been operationalized in two ways in the organizational research (Venkatraman, 1989), (a) in one case it is recommended to select a profile base on the strong theoretical foundations, (b) in the second case, it is recommended to create a calibration sample benchmarking top performers in the study sample (Ahmad et al., 2003; Fuentes-Fuentes et al., 2011; Venkatraman & Prescott, 1990). Cua (2000) used the highest score, on the measurement scale "5", as an ideal profile score, whereas, it is strongly recommended to use the top 10% as calibration sample to generate an empirical profile and then study sample is generated by aligning the remaining 90% sample with this 10% sample (Fuentes-Fuentes et al., 2011; Venkatraman, 1989; Venkatraman & Prescott, 1990) as it reflects the true relationship between sample participants. Because there are, likely chances that firms participating in the study sample may or may not acquire the ideal top most performance point. For this study, second approach is preferred over first, the potential benefit of second approach is; the calibration sample reflects the true implementation level of an empirical ideal profile for each practice and provides a better foundation for calculating deviation for study sample. It is performed in two steps. In first step, empirical ideal profile is generated by taking mean of top 10% performers for each practice and in the second step, study sample profile is generated by aligning practices with this reference point (mean of top 10% performers) for each practice respectively. The misfit is calculated between empirical ideal plant and study sample is calculated using the following formula (Drazin & Van de Ven, 1985, p. 533).

$$\textbf{Misfit or Alignment } (\mathbf{FIT}\boldsymbol{i}) = \sqrt{\sum_{k=1}^{18} W_k (X_k - X_{ki})^2}$$

Misfit = the distance between an empirically generated ideal plant and study sample plant *i*

X_k = the score of K_{th} variable of an empirical ideal plant

X_{ki} = the score of a particular plant from sample for K_{th} variable

W = importance weight of the K_{th} variable

K = identification index for **18** variables

"W" is the importance score for each practice in the research model (Venkatraman, 1989). There are two approaches to give weightage score (Ahmad et al., 2003). One is equal weightage score method. In this approach, all the practices are given equal weightage to minimize the biasing effects by any particular practice. In the second approach, each practice is given independent weightage score based on its contribution in performance improvement (Venkatraman, 1989), but at the same time this approach is likely to potentially offset other practice's effects. For this study, first approach is adopted to minimize the overarching effect of any particular practice and each practice is given a weightage score of "**1**". Moreover, as no previous theoretical support is available, where Lean and Agile Practise are jointly tested, to give weightage score, therefore, each practice is given equal score in order to neutralize the biasing effects (Cua, 2000).

Misfit measure the degree of departure between empirical ideal plant and study sample plant. Ideally, distance between empirical ideal profile and study sample profile should be minimum for a better fit (Drazin & Van de Ven, 1985; Venkatraman, 1989). On the other hand, in an undesired situation, a larger distance reflects poor fit. A significant negative impact of misfit on performance measure will indicate strong configurational fit.

To undertake multiple regression analysis, all the preconditions are methodically evaluated. All the variables meet the specified criteria of normality, multi-collinearity, homoscedasticity. Variance inflation factor for all the variables are less than the lower most threshold criteria of "3" (Hair et al., 2010, p. 205). Moreover, residuals probability plots indicate that residual clusters' distribution is almost straight line with an inclination of 45 degree. Residuals plots between response and predictors do not indicate any sign of autocorrelation.

5.2.4 DISCRIMINANT ANALYSIS

Discriminant analysis is used in organizational research (Hair et al., 2010), to testify the Gestalts fit, especially once sample has been explicitly grouped (Narasimhan et al., 2006; Z. Zhang & Sharifi, 2007). It is good to test for contingency perspective (Hambrick, 1983b) and configurational perspective (Venkatraman, 1989) simultaneously. Discriminant analysis is a bit different from multiple regression analysis, as it is capable to deal with non-metric dependent variables against the metric independent variables. Moreover, it enables explicit identification of an observation (participant) with respect to its group, and is helpful in analytical investigation of underlying difference among different groups (two or more than two) for a number of metric independent variables simultaneously (Hair et al., 2010). Gestalts fit can be tested using two methods (Venkatraman, 1989), descriptive gestalt fit, using discriminant analysis (Milligan & Cooper, 1985) and predictive gestalt fit, using cluster analysis (Hambrick, 1983b). For the purpose of this study, descriptive gestalt fit is employed. It helps to identify the internal consistency of several factors for a specific strategy (Venkatraman, 1989).

Performance measures (operational, market, and financial) are grouped into two groups high and low performance. The independent variables (micro systems) used for discriminant analysis are 18 practices (management, infrastructure, and core manufacturing) to test the configurational perspective fit and organizational contextual factors (firms size, ISO-9001 registration and industry type) to test the contingency perspective fit respectively.

To undertake discriminant analysis, all the preconditions are methodically evaluated. All the variables meet the specified criteria of normality, multi-collinearity. Variance inflation factor for all the variables are less than the lower most threshold criteria of "3" (Hair et al., 2010). Sample size is sufficient to undertake discriminant analysis and meets the criteria suggested by Hair et al. (2010, p. 353), (a) minimum group observation should be more than the independent variables in the analysis, (b) minimum group observations should exceed 20. Box's M test indicate that all the independent variables do not violate the multi-collinearity assumption of respective groups (Hair et al., 2010, p. 255). With-in group variance-covariance classification approach is used for classification of sample into respective performance group.

Discriminant analysis validity power is assessed using following criteria (Hair et al., 2010);

(a) Wilk's Lambda Value
(b) Significant Canonical Correlation Coefficient
(c) Significant Chi-Square Value
(d) Hit-Ratio Value (chance-based value) should be at least 25% higher than the C_{PRO}[8] value, as groups are unequal whereas C_{PRO} is calculated based on respective group proportion in the total sample

"[8] C_{PRO} is $C_{Proportional}$ and it differentiate from normal (C_{equal}) where all groups are equal and is calculated as: C_{equal} = 1 / Number of groups, for two groups and three groups chance value is 0.5 and 0.33 respectively. In case of unequal two groups size C_{PRO} is calculated as: $C_{PRO} = p^2 + (1 - p)^2$
where p = proportion of observations in group 1 and $1 - p$ = proportion of observations in group 2".

(e) A sufficient acceptability using Jack-Knife classification approach, in which, each observation is used as holdout observation and reaming sample is classified

(f) A significant independent factor discriminant loading of at-least **≥ ±0.3** and more stringent threshold value of **≥ ±0.4**

5.3 ANALYSIS RESULTS

Universal perspective fit, contingency perspective fit and configurational perspective fit results are presented respectively.

5.3.1 UNIVERSAL PERSPECTIVE FIT RESULTS

Universal perspective fit is tested using direct (covariation fit) and indirect (mediation fit) to ascertain that these practices have direct effects on performance or there is underlying theoretical thread that core practices become instrumental once required infrastructure (internal and external) become fully functional before effective implementation of core practices bloc.

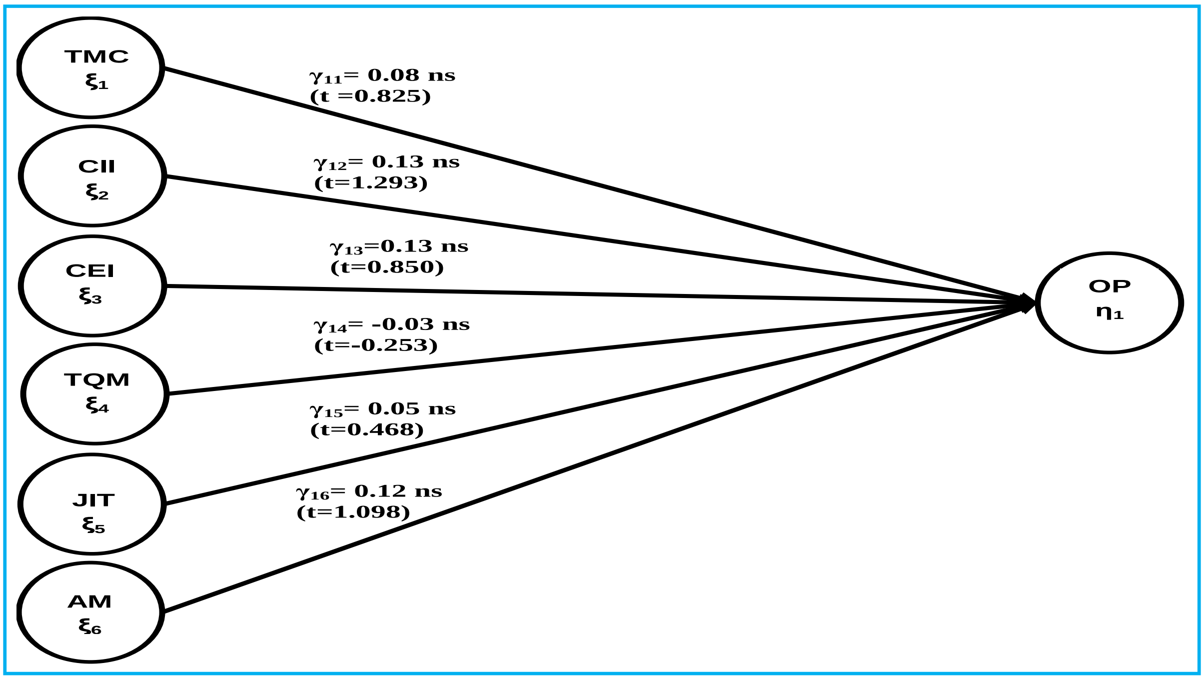
5.3.1.1 DIRECT FIT ASSESSMENT – COVARIATION FIT

Direct fit is employed to investigate the mutually supportive and mutually exclusive effects.

(a) **MUTUALLY SUPPORTIVE / COMPLEMENTARY EFFECTS**

Direct fit is tested to ascertain that management, infrastructure (internal and external) and core practices (TQM, JIT and AM) once applied simultaneously ("Mutually Supportive or Complementary approach") generate positive impact on performance measures (OP, MP & MP). Three independent but similar models to ascertain proposed direct link are tested, where, management, infrastructure and core practices are directly linked with performance measures (operational, market and financial) respectively, as shown in the figures from Figure (5.2 to 5.4). Results in the Figure 5.2 show that none of the practices (management, infrastructure and core) significantly contributes directly to the operational performance once applied simultaneously ("Mutually Supportive or Complementary approach").

Results in the Figure 5.3 show that none of the practices (management, infrastructure and core), except internal infrastructure practices, significantly contribute directly to the market performance once applied simultaneously ("Mutually Supportive or Complementary approach"). More important is that none of the core practices significantly relate to market performance once applied simultaneously. Similarly, results in the Figure 5.4 show that none of the practices (management, infrastructure and core), except internal infrastructure practices, significantly contribute directly to the financial performance once applied simultaneously. More important is that none of the core practices significantly relate to market performance once applied simultaneously ("Mutually Supportive or Complementary approach"). These results indicate that there is a disagreement among practices once applied, all at once, and indicate that these are not "Mutually Supportive or Complementary" and provide justification to explore the underlying theoretical thread for sequential implementation of these practices (Inman et al., 2011; Zelbst et al., 2010).



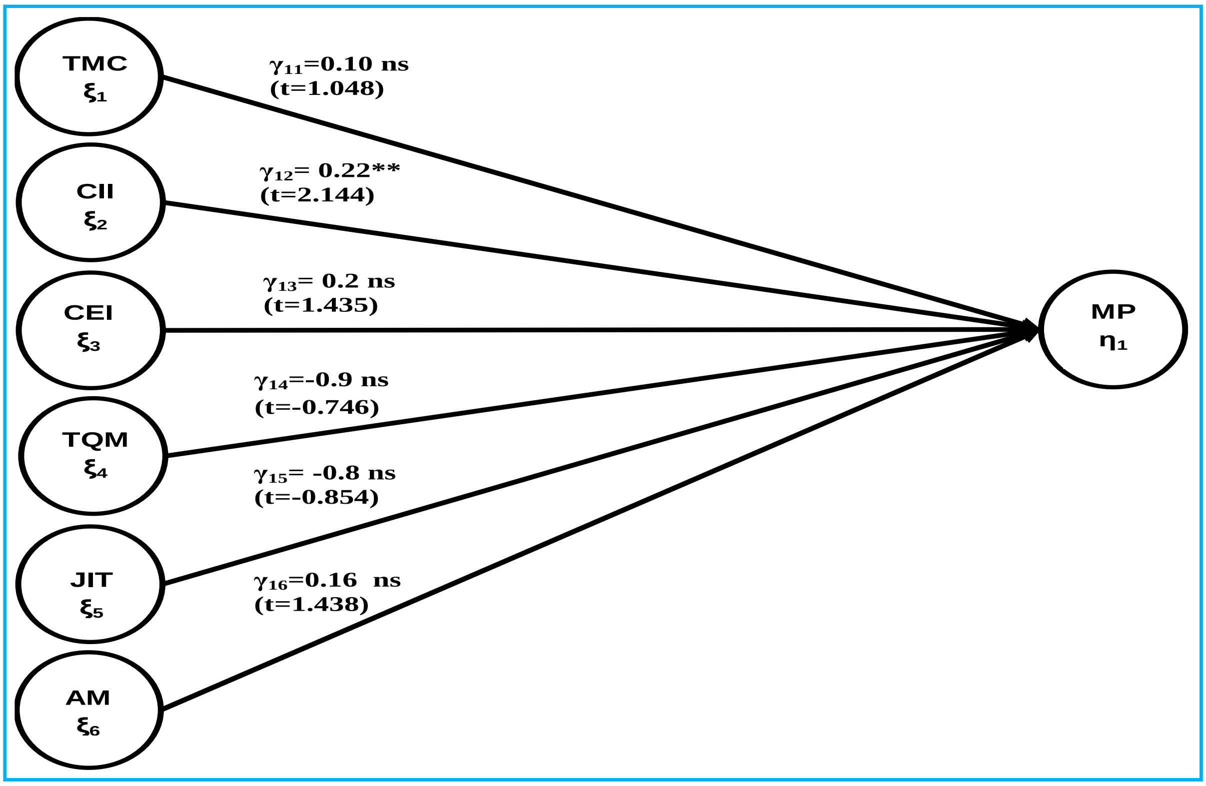
ns = not supported

Figure 5.2. All Practices Direct Effect on OP

Model fit statistics for above-mentioned three models are presented in Table 5.2. All three models' fit statistics show an absolute good model fit and indicate that there is a valid link among these practices and performance measures, the only issue here can be postulate is with the employment sequence of these practices.

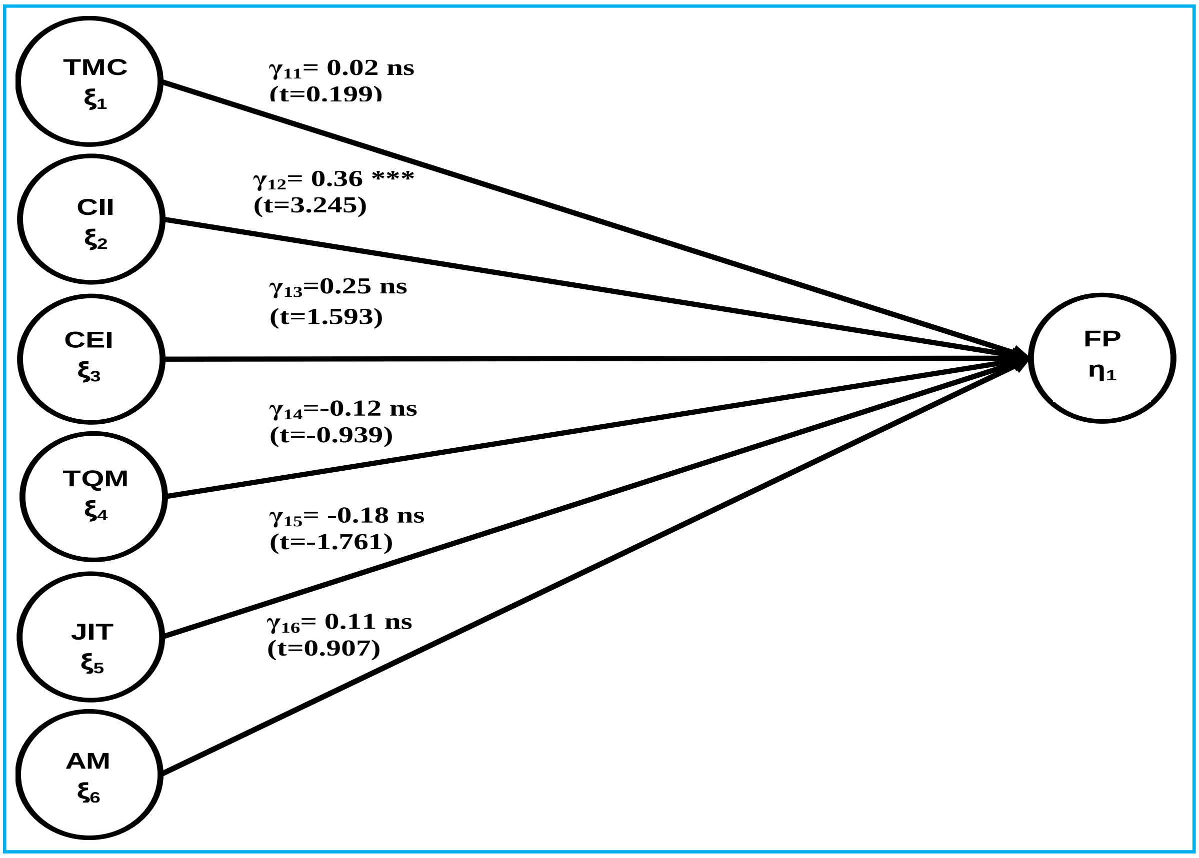
Table 5.2. Model Fit Statistics - Mutually Supportive Approach Models

Model	χ^2/df	CFI	IFI	TLI	SRMR	RMSEA	PNFI	Remarks
Criteria	**≤ 3**	**> 0.95**	**> 0.95**	**> 0.95**	**< 0.1**	**< 0.08**	**> 0.5**	
OP	1.228	0.97	0.97	0.97	0.04	0.013	0.765	All three models meet the specified criteria
MP	1.190	0.98	0.98	0.98	0.04	0.028	0.751	
FP	1.042	0.99	0.99	0.99	0.03	0.013	0.757	



**Significant at $p < 0.05$, ns = not supported

Figure 5.3. All Practices Direct Effect on MP



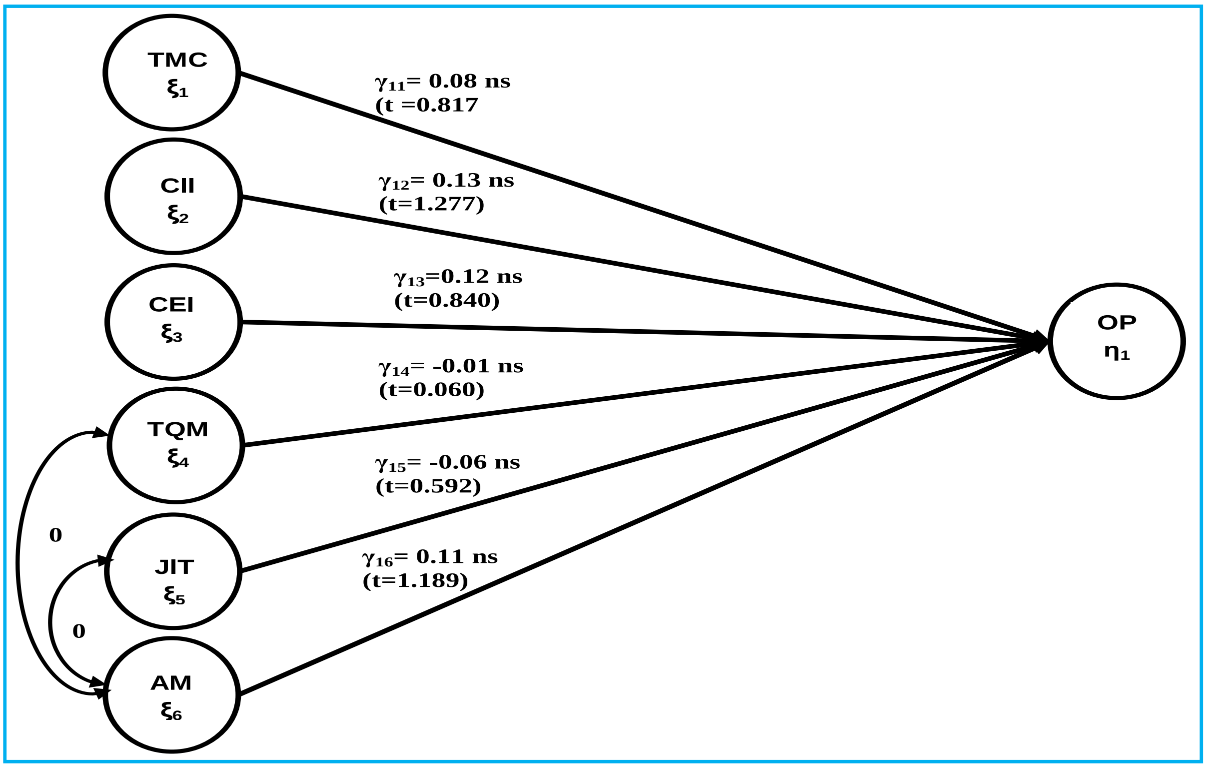
**Significant at $p < 0.05$, ns = not supported

Figure 5.4. All Practices Direct Effect on FP

(b) **MUTUALLY EXCLUSIVE / COMPETING EFFECTS**

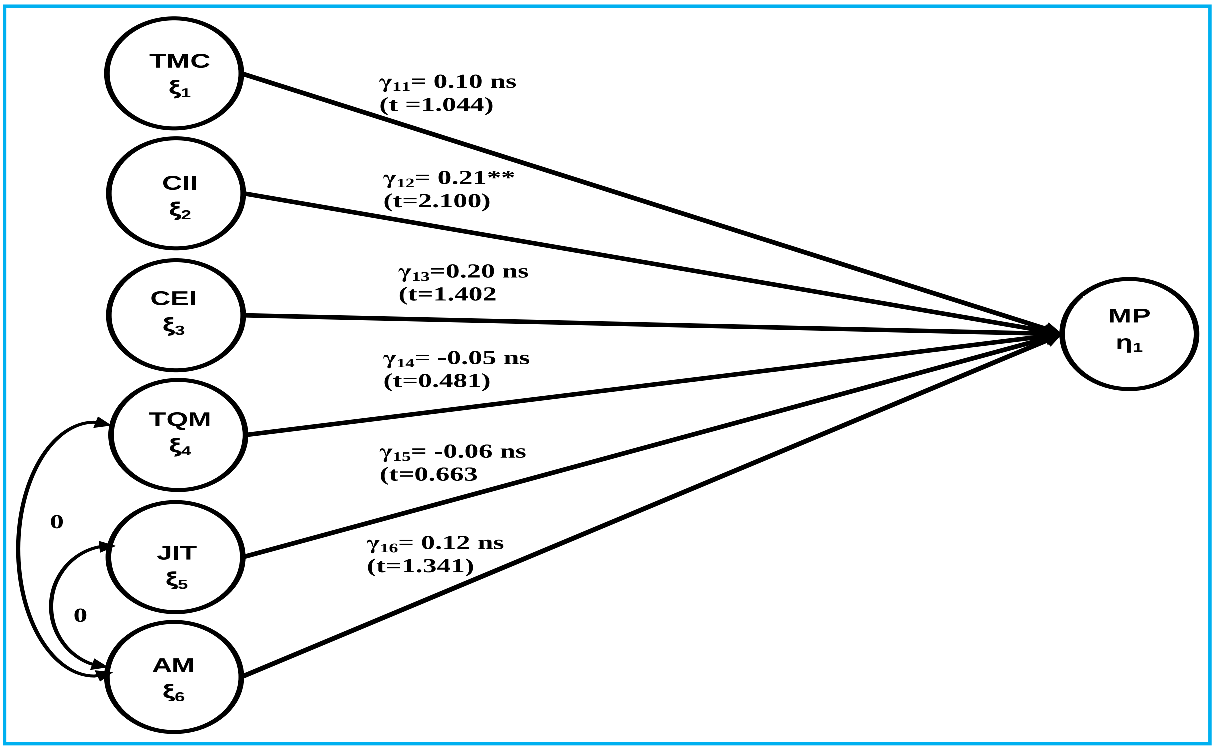
Direct fit is also useful to ascertain that Core TQM & JIT and Core AM Practices are mutually exclusive once applied along with common management and infrastructure practices to investigate their impact on performance measures (OP, MP & FP). Three independent, but similar, models to ascertain proposed mutually exclusive relationship are tested. The direct fit employment approach, in this case, is a bit different from the one used in testing mutual supportive relationship. In this approach, two correlation paths (AM to TQM & AM to JIT) are constrained to zero. Then a χ^2 difference test is performed, to ascertain whether mutually exclusive model performs better than mutually supportive model. The test criteria is, if, χ^2 difference test for *2df* is insignificant then mutually exclusive model (constrained) is assumed to be better than mutually supportive (un-constrained). In other case, χ^2 difference test for *2df* is significantly different then, it means that it performed worse than mutually supportive model and as a result mutually supportive (un-constrained) model is accepted while mutually exclusive (constrained) model is rejected.

Results are shown in Figures (5.5 to 5.7) for different performance measures (OP, MP & FP) respectively. Results in the Figure 5.5 show that none of the practices (management, infrastructure and core) significantly contribute directly to the operational performance once applied in "Mutually Exclusive or Competing approach". Results in the Figure 5.6 also show that none of the practices (management, infrastructure and core), except internal infrastructure practices, significantly contribute directly to the market performance once applied simultaneously ("Mutually Exclusive or Competing Approach"). More important is that none of the core practices significantly relate to market performance once applied assuming Core AM and Core TQM & JIT independent of each other. Similarly, Results in the Figure 5.7 show that none of the practices (management, infrastructure and core), except internal infrastructure practices, significantly contribute directly to the financial performance once applied simultaneously. Like MP results none of the core practices significantly contribute in financial performance once assuming Core AM and Core TQM & JIT independent of each other. These results indicate that there is a disagreement among practices once applied, assuming Core AM and Core TQM & JIT independent of each other, and indicate that these are not "Mutually Exclusive or Competing" and provide justification to explore the underlying theoretical thread for sequential (antecedent approach) implementation of these practices



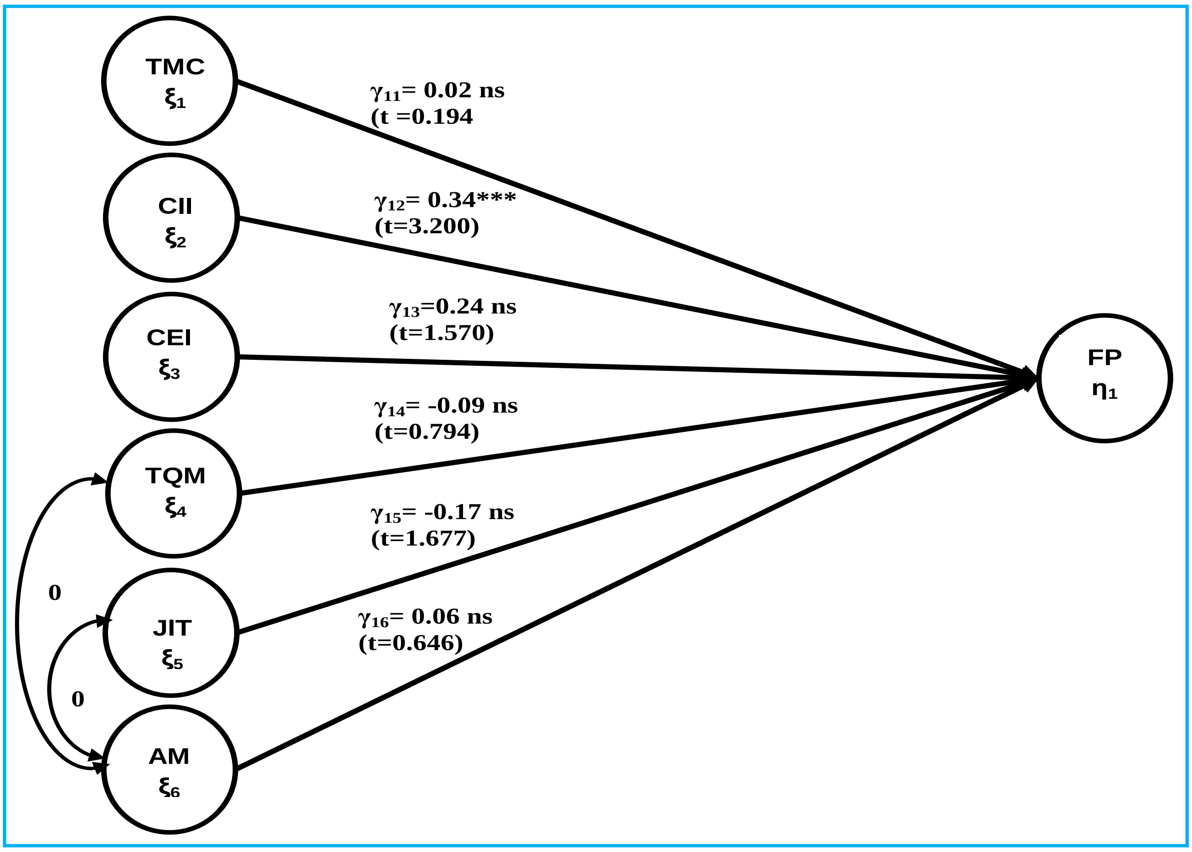
ns = not supported

Figure 5.5. All Practices Direct Effect on OP (AM to TQM & JIT Constrained = 0)



**Significant at $p < 0.05$, ns = not supported

Figure 5.6. All Practices Direct Effect on MP (AM to TQM & JIT Constrained = 0)



**Significant at $p < 0.01$, ns = not supported

Figure 5.7. All Practices Direct Effect on FP (AM to TQM & JIT Constrained = 0)

Model fit statistics for above-mentioned three models are presented in Table 5.3. All the three models' fit statistics show an absolute good model fit and indicate that there is a valid link among these practices and performance measures, the only issue here, e.g., mutual support case, can be assumed the employment sequence of these practices.

Table 5.3. Model Fit Statistics – Mutually Exclusive Approach Models

Model	χ^2/df	CFI	IFI	TLI	SRMR	RMSEA	PNFI	Remarks
Criteria	**≤ 3**	**> 0.95**	**> 0.95**	**> 0.95**	**< 0.1**	**< 0.08**	**> 0.5**	
OP	1.436	0.96	0.95	0.95	0.08	0.042	0.753	All three models meet the specified criteria
MP	1.460	0.96	0.96	0.95	0.08	0.043	0.738	
FP	1.313	0.97	0.97	0.96	0.08	0.043	0.736	

Moreover, χ^2 difference test to ascertain the best model fit between mutually supportive and mutually exclusive is performed. Results are presented in Table 5.4. Chi-Square χ^2 difference results, pertaining to OP, MP & FP models, confirm that mutually exclusive models fit worse than mutually supportive models. Therefore, mutually exclusive models are rejected in favour of mutually supportive approach.

Table 5.4. Mutually Supportive and Mutually Exclusive- Nested Model Results

Model	**Mutually Supportive**		**Mutually Exclusive**		**χ^2 Statistics**			**Remarks**
	Unconstrained Model @		**Constrained Model ***					
Criteria	**χ^2**	***df***	**χ^2**	***df***	**$\Delta\chi^2$**	**Δdf**	**Significance**	
OP	397.8	324	468.2	326	70.4	2	***	Constrained model is rejected
MP	296.2	249	366.5	251	70.3	2	***	Constrained model is rejected
FP	259.3	249	329.5	251	70.2	2	***	Constrained model is rejected

@ : In Un-constrained model paths from Core AM to Core TQM & JIT are freely estimated.
***** : In constrained model paths from Core AM to Core TQM & JIT are constrained to zero
******* : $\Delta\chi^2$ value is greater than 5.99 for a Δdf of 2 at $p < 0.001$.

Salient features from above mentioned results reflect that once organizations employ these practices (management, infrastructure and core) mutually supportive or mutually exclusive, while ignoring their employment sequence, fail to acquire the desired performance objectives. It is worth mentioning that merely employing these practices randomly do not produce any results, rather it is more important to understand their implementation sequence to extract maximum benefits of these practices. These results also indicate that organizations may fail to understand while improving one area, how much others improvement areas also do need attention. These results are in line with the earlier proposed theoretical link that Agility is the ultimate goal of manufacturing evolution (Hormozi, 2001; Jin-Hai et al., 2003; Sharp et al., 1999) and empirical strings of earlier studies that organizations striving for AM, first has to realize Lean (TQM and JIT) manufacturing proficiency (Narasimhan et al., 2006; Zelbst et al., 2010). These results also significantly confirm that CII practices alone can contribute in MP and FP (Lakhal et al., 2006; Powell, 1995). These results provide a solid foundation to test the indirect (TQM & JIT antecedent to AM) relationship among practices (management, infrastructure and core) and their impact on performance measures (OP, MP and FP) as proposed in conceptual framework (see Figure 3.1).

5.3.1.2 INDIRECT FIT ASSESSMENT – MEDIATION FIT

Indirect fit is employed to investigate the Lean (TQM & JIT) as antecedent to AM effects.

(a) **LEAN (TQM & JIT) AS ANTECEDENT TO AM EFFECTS**

The indirect model fit is empirically tested to explore the proposed theoretical implementation sequence of the management, infrastructure, core practices and their impact on performance measures (Flynn et al., 1995b; Inman et al., 2011; Jayaram et al., 2010; Lakhal et al., 2006; Zelbst et al., 2010). Indirect fit (mediation fit) is tested in four Phases. In **Phase-I**, hypotheses proposed from H1 to H15 are tested. In **Phase-II**, hypotheses proposed from 16 to 18 are tested. In **Phase-III**, nested models are tested vis-à-vis baseline model to confirm whether the practices sequential link base on valid theoretical foundation or a result of hodgepodge relationship. Whereas, in **Phase-IV**, Mediation effects as well as Total, Direct and Indirect effects among practices are calculated.

Phase-I, hypotheses from H1 to H15, results are presented in Table 5.5 and Figure 5.8 respectively. Model fit statistics for indirect mediation model are absolutely within specified criteria as χ^2/df = 1.23, CFI = 0.97, IFI = 0.97, TLI or NNFI = 0.96, PNFI = 0.778, RMSEA = 0.03 and SRMR = 0.06. These model fit indices reflect a perfect model fit. All the hypotheses, except the hypotheses (H10, H11 and H12), are significant at $p < 0.01$. Hypotheses H10, H11 and H12 apparently seem to be troublesome. However, the support for H10 (JIT → AM) can be linked to earlier study (Inman et al., 2011, p. 350), where it is found that JIT alone directly does not contribute in AM, however, the same relationship is positively mediated by supplier relationship (JIT supply) (Inman et al., 2011, p. 351) in line with the earlier study of (Frohlich & Westbrook, 2001). Frohlich and Westbrook (2001, p. 193) established based on "arcs of integration", those outward facing organizations, "strong relationship with customer and suppliers", enjoy superior business performance. Similarly, Furlan et al. (2011a, p. 493) also empirically validated that upstream JIT (suppliers relationship) and downstream JIT (customers relationship) synergy effects strengthen internal JIT (JIT production) and outperform firms lacking in upstream JIT or downstream JIT. Likewise, Hofer et al. (2012, p. 250) also found a positive association between internal Lean (e.g., Pull system, Set-up time reduction) and external Lean (e.g., relationship with customers and suppliers) practices. JIT practices primarily help to acquire delivery proficiency. Apparel Industry, especially export industry, is highly unpredictable and due to its inherent volatile demand characteristics and shorter product life cycle, due to seasonality, merit a strong relationship with customer and suppliers (Fisher, Hammond, Obermeyer, & Raman, 1994; Wagner et al., 2012). Wagner et al. (2012, p. 348) also found that a strong supplier's relationship is the essence of Apparel Industry. Consistent with earlier studies the JIT path to

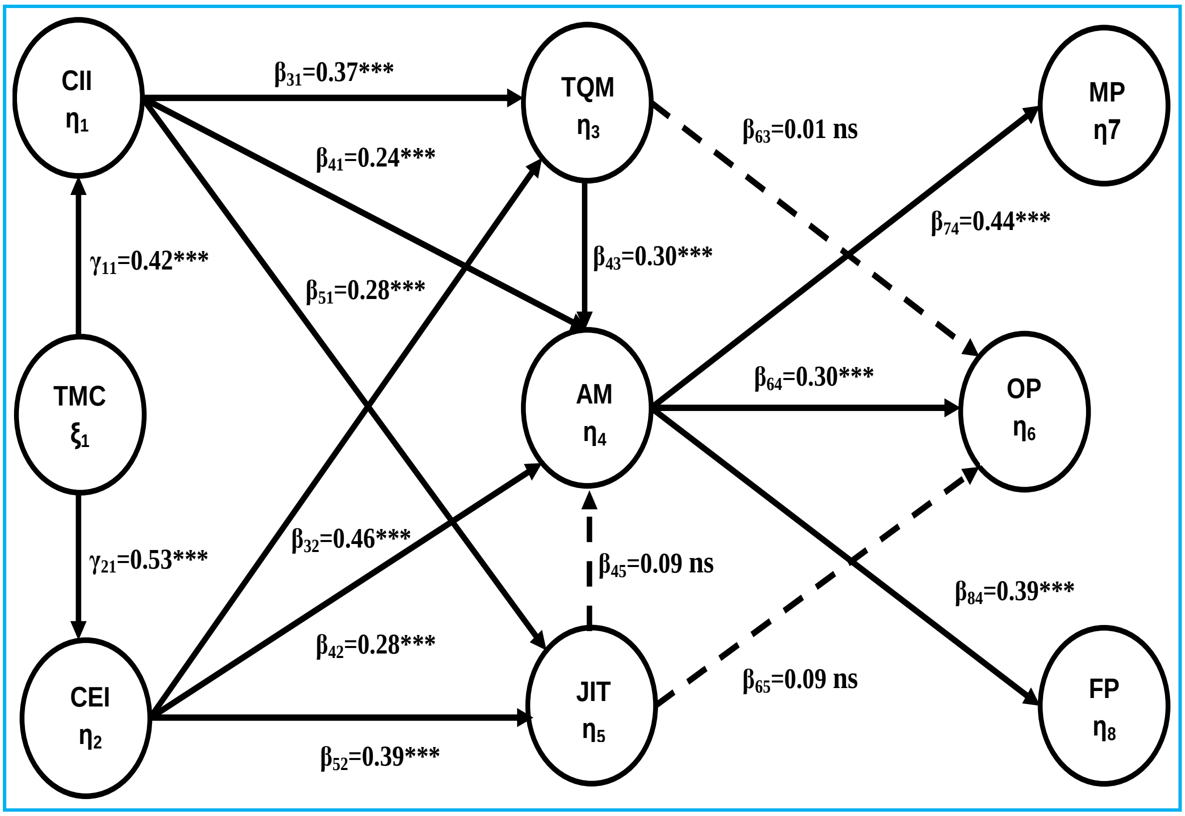
AM is removed and re-specified through CEI (Frohlich & Westbrook, 2001; Inman et al., 2011).

Table 5.5. Indirect Fit Baseline Model Results

Hypotheses	Proposed Relationship	Standardised Path Estimate	t-value	Significance	Results
H1	TMC → CII	0.428	5.66	***	H1 supported
H2	TMC → EII	0.533	6.42	***	H2 supported
H3	CII → TQM	0.372	4.921	***	H3 supported
H4	CII → AM	0.243	2.752	***	H4 supported
H5	CII → JIT	0.284	3.598	***	H5 supported
H6	EII → TQM	0.469	5.43	***	H6 supported
H7	EII → AM	0.287	2.609	***	H7 supported
H8	EII → JIT	0.398	4.387	***	H8 supported
H9	TQM → AM	0.304	2.75	***	H9 supported
H10	JIT → AM	0.099	1.102	0.27	H10 *not-supported*
H11	TQM → OP	0.019	0.184	0.854	H11 *not-supported*
H12	JIT → OP	0.099	1.169	0.242	H12 *not-supported*
H13	AMF → OP	0.306	2.589	***	H13 supported
H14	AMF → MP	0.447	5.453	***	H14 supported
H15	AMF → FP	0.39	4.638	***	H15 supported

*** significant at $p < 0.01$.

Similarly, insignificant relationship of TQM and JIT with OP (H11 and H12) is linked with earlier studies (Green Jr et al., 2014; Sakakibara et al., 1997; Zelbst et al., 2010). Although TQM and JIT are performance improvement initiatives, however, in an Agile working environment these performance initiatives' programs are merely not sufficient to improve organizational performance (Zelbst et al., 2010, p. 649). Similarly, Vokurka and Lummus (2000, p. 96) also proposed that future business competitive priorities will be highly customer preferences oriented with attributes of "low cost, high quality products in a greater variety". Consistent with the literature, path from TQM and JIT to OP and JIT to AM are constrained to zero.



***Significant at p < 0.01, ns = not supported

Figure 5.8. Indirect Fit Baseline Model

Before re-specification of path from JIT to CEI, a Nested-model is tested against baseline model (Figure 5.8). In Nested-model, simply two paths from JIT → AM and JIT → OP and another path from TQM → OP are removed (constrained to zero). A Chi-Square difference test indicates that more simplified (constrained) model is a better fit (insignificant $\Delta\chi^2$ value i.e., $\Delta\chi^2 = 2.8$, $\Delta df = 3$ at $p < 0.05$) than less restrictive (unconstrained) model. Nested model fit comparison is presented in Table 5.6.

Table 5.6. Indirect Fit Baseline Nested-Model Results

Unconstrained Model @		Constrained Model *		χ^2 Statistics			Remarks
χ^2	*df*	χ^2	*df*	$\Delta\chi^2$	Δdf	Significance	
622.1	502	624.9	505	2.8	3	ns	Constrained model is accepted

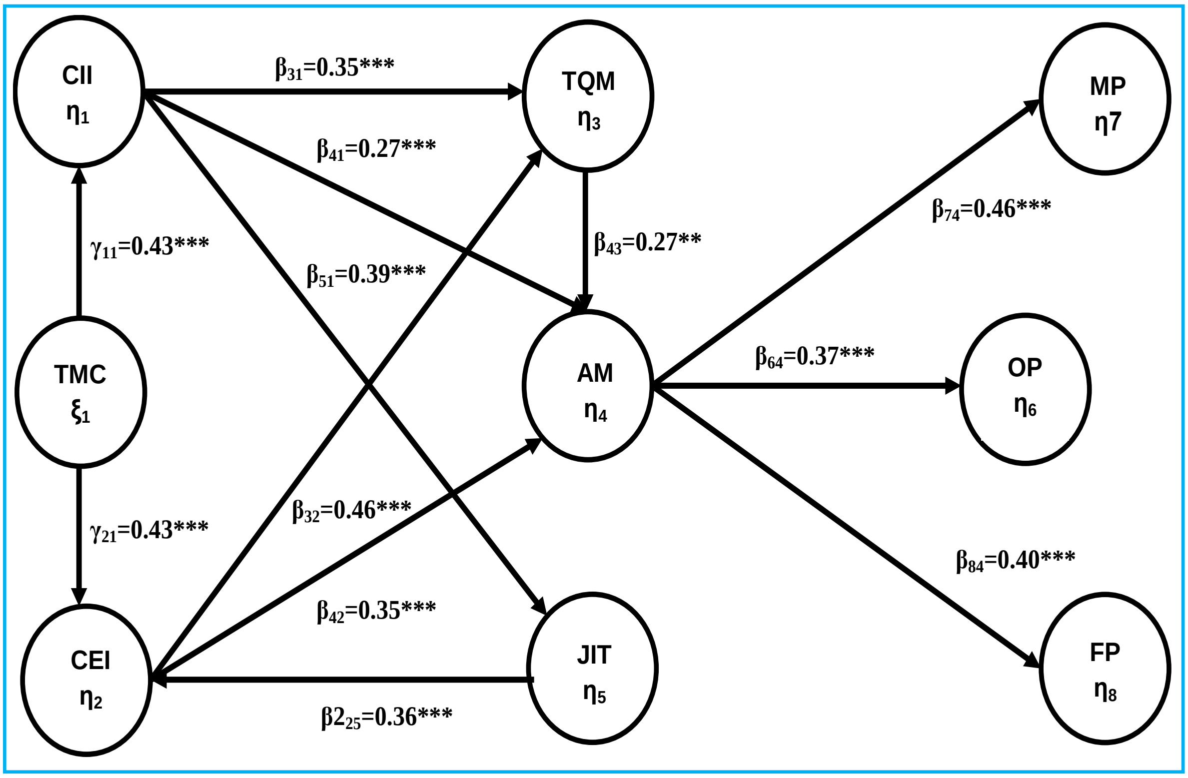
@ : In Un-constrained model paths from JIT to AM and OP, and path from TQM to OP are freely estimated
***** : In constrained model paths from JIT to AM and OP, and path from TQM to OP are constrained to zero
ns : $\Delta\chi^2$ value is less than 7.81 and 11.34 for a Δdf of 3 at $p < 0.05$ and $p < 0.01$ respectively.

In re-specified baseline model (A) indirect effects of TQM and JIT on OP are realized through AM. Similarly, JIT indirect effect on AM is realized through CEI. Re-specified model (A) hypotheses results are presented in Table 5.7 and model is presented in Figure 5.9 respectively.

Table 5.7. Indirect Fit Re-Specified Baseline Model (A) Results

Hypotheses	Proposed Relationship	Standardised Path Estimate	t-Value	Significance	Results
H1	TMC → CII	0.433	5.742	***	H1 supported
H2	TMC → EII	0.436	5.566	***	H2 supported
H3	CII → TQM	0.354	4.546	***	H3 supported
H4	CII → AMF	0.278	3.251	***	H4 supported
H5	CII → JIT	0.396	4.698	***	H5 supported
H6	EII → TQM	0.457	5.106	***	H6 supported
H7	EII → AMF	0.35	3.347	***	H7 supported
H8@	JIT → EII@	0.36	4.298	***	H8 supported
H9	TQM → AMF	0.275	2.529	**	H9 supported
H13	AMF → OP	0.378	4.642	***	H13 supported
H14	AMF → MP	0.459	5.569	***	H14 supported
H15	AMF → FP	0.403	4.764	***	H15 supported

*******: Significant at $p < 0.01$, ******: Significant at $p < 0.05$,
@ : Hypothesis EI to JIT is re-specified as JIT to CEI.



***Significant at $p < 0.01$, **Significant at $p < 0.05$

Figure 5.9. Re-Specified Indirect Fit Baseline Model (A)

Model fit statistics for indirect mediation, re-specified baseline model (A), are absolutely within specified criteria as χ^2/df = 1.24, CFI = 0.97, IFI = 0.97, TLI or NNFI = 0.96, PNFI = 0.781, RMSEA = 0.03 and SRMR = 0.06. These indices reflect a perfect model fit. It is worth noting that there is hardly any difference in model fit statistics between re-specified baseline model (A) and baseline model. However, this model is more parsimonious as compared to earlier model. All the proposed hypotheses (re-specified model) are highly significant at $p < 0.01$, with an exception of TQM to AM, which is significant at $p < 0.05$.

In **Phase-II**, hypotheses (H16, H17 and H18) are tested. Model fit statistics for re-specified baseline model (B) are also absolutely within specified criteria as χ^2/df = 1.17, CFI = 0.97, IFI = 0.98, TLI or NNFI = 0.97, PNFI = 0.787, RMSEA = 0.02 and SRMR = 0.08. Re-specified model (B) hypotheses results are presented in Table 5.8 and model is presented in Figure 5.10 respectively. All the hypotheses (except OP → FP) are significant at $p < 0.05$. The same path is positively mediated through MP. It means that organizations pursuing OP needs to be focused towards their MP in order to materialize FP. Organizations ignoring importance of MP probably will fail to acquire business FP objectives.

Table 5.8. Indirect Fit Re-Specified Model (B) Results

Hypotheses	Proposed Relationship	Standardised Path Estimate	t-value	Significance	Results
H1	TMC → CII	0.433	5.743	***	H1 supported
H2	TMC → EII	0.433	5.517	***	H2 supported
H3	CII → TQM	0.354	4.552	***	H3 supported
H4	CII → AMF	0.206	2.42	**	H4 supported
H5	CII → JIT	0.396	4.7	***	H5 supported
H6	EII → TQM	0.458	5.116	***	H6 supported
H7	EII → AMF	0.305	2.919	***	H7 supported
H8@	JIT → EII@	0.363	4.318	***	H8 supported
H9	TQM → AMF	0.321	2.858	***	H9 supported
H13	AMF → OP	0.329	4.147	***	H13 supported
H16	OP → MP	0.318	4.566	***	H16 supported
H17	OP → FP	0.064	0.957	0.338	*H17 not supported*
H18	MP → FP	0.545	7.389	***	H18 supported

***: Significant at $p < 0.01$,
**: Significant at $p < 0.05$,
@ : Hypothesis EI to JIT is re-specified to JIT to EI.

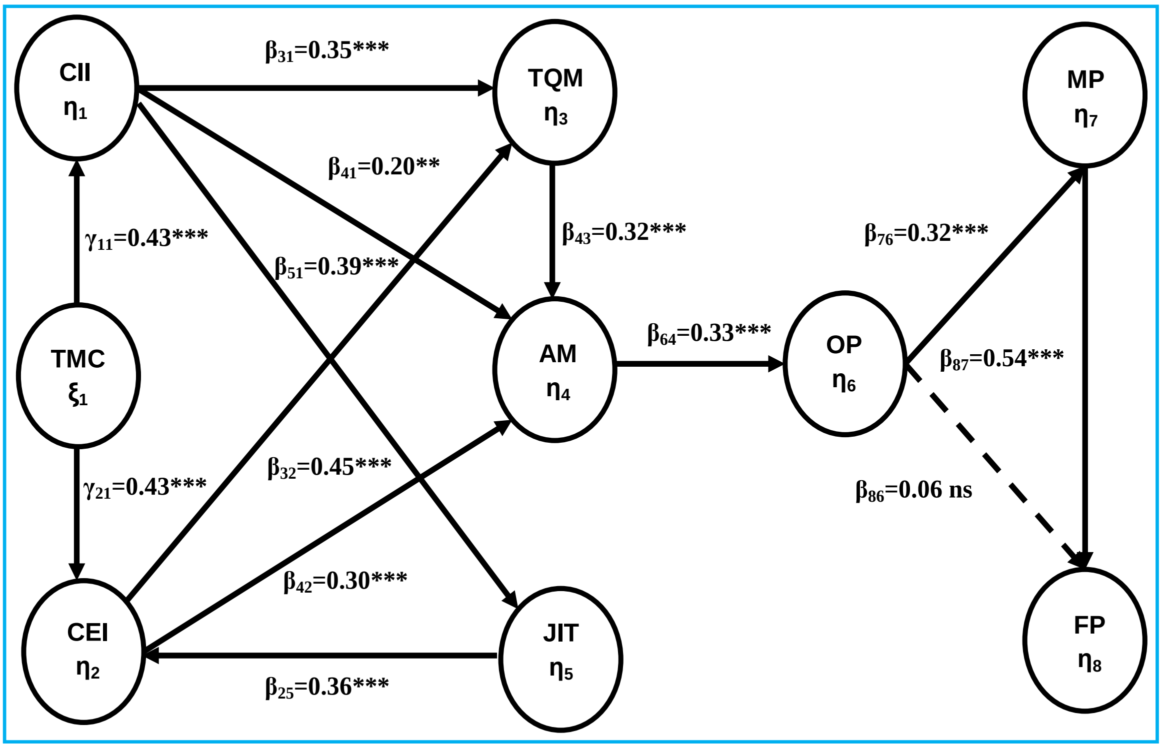


Figure 5.10. Indirect Fit Re-specified Baseline Model (B)

Above-mentioned results are consistent with the literature and provide a positive support to proposed theory. The organizations where top management is well aware of effective establishment of internal and external infrastructure for effective execution of Core TQM, Core JIT and Core AM practices enjoy superior competitive advantage than those organizations who ignore the sequential implementation of these practices and try to execute these practices in a hodgepodge (direct) sequence fail to acquire performance objectives.

In **Phase-III**, in order to further validate the implementation sequence of practices, a series of Nested-models to re-specified model (B) is also tested, through χ^2- difference test. In each nested model, one Path at one time is constrained to zero, assuming the contribution by that Path is zero. The χ^2- difference test validates the importance of that path in the proposed theoretical model. If the $\Delta\chi^2$ value is significantly large for a Δdf of 1, $\Delta\chi^2 > 3.84$ at $p < 0.05$, it indicates that the constrained model fit is worst (χ^2 value is significantly large) as compared to unconstrained model and corroborate the significant contribution of unconstrained path in the model. In this case, unconstrained model is accepted and constrained model is rejected. It indicates that unconstrained model provides much information as compare to constrained model. In other scenario if, $\Delta\chi^2$ is significantly not large for a Δdf of 1, $\Delta\chi^2 < 3.84$ at $p < 0.05$, it indicates that the constrained model fits better than unconstrained model and unconstrained model is rejected in favour of constrained model. The second method for assessing model fitness is the AIC value (see Section 5.2.1.1), a model with AIC lesser value extracts more information is accepted. The proposed Nested-models results are presented in Table 5.9 and models are presented from Figure 5.11 to Figure 5.19.

All the proposed, nine (9) Nested-models, from re-specified model (B-1) to model (B-9) are rejected at P < 0.05 in favour of re-specified model (B). All the nine Nested-models fail to qualify acceptance criteria of $\Delta\chi^2$ test and AIC. All $\Delta\chi^2$ values are significantly large (> 3.84 for 1 Δdf). Moreover, AIC values of all the models are greater than AIC value (772.63) of re-specified model (B), hence fail to extract maximum information as is being explained by the re-specified model (B). These models' rejections indicate that none of the practice is mis-placed in the proposed theoretical model and confirm the significant contribution by each practice in the overall model.

In **Phase-IV**, at stage 1, Mediation effects across the proposed model are tested to further evaluate the sequential position of common (internal and external) infrastructure and Core Lean (TQM & JIT) practices for effective implementation of AM. Each intervening set of practices effects are explored to establish, whether it significantly links the forerunner set of practices with ensuing set of practices. The thumb rule is, if the effects of an intervening factor between two practices is significant, then it can be said that intervening factor positively, or negatively, mediate the effect between forerunner and ensuing factor.

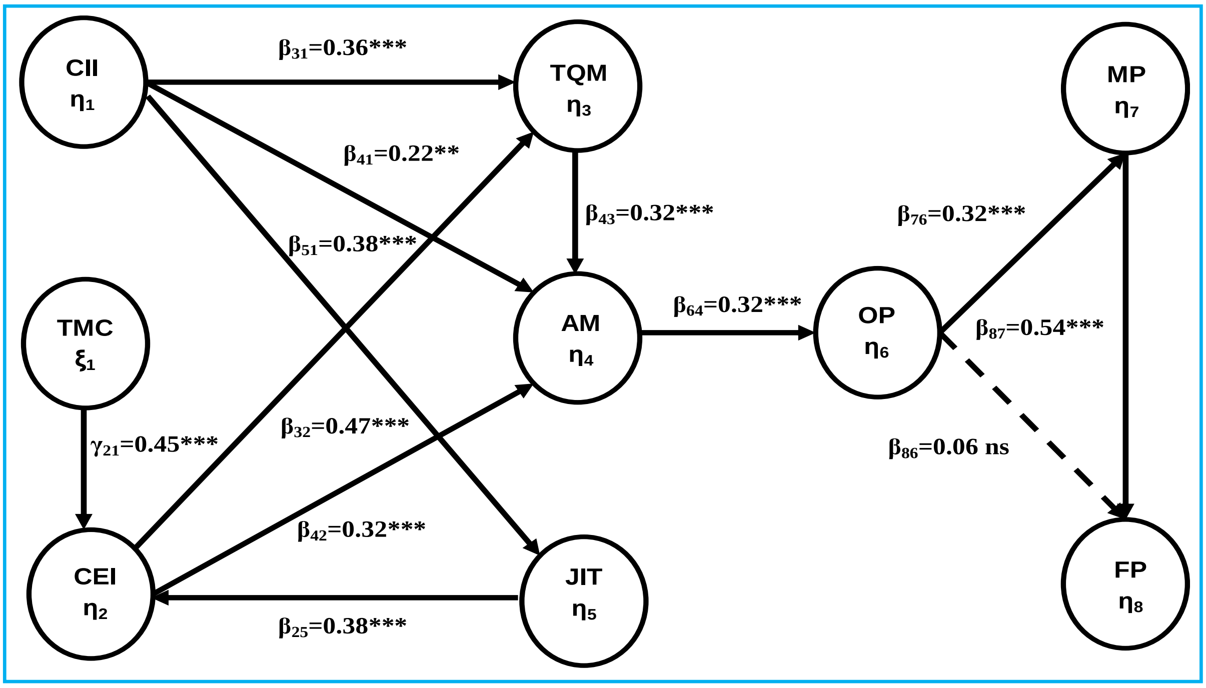


Figure 5. 11. Nested Baseline Model (B – 1) TMC to CII (Constrained = 0)

Table 5.9. Nested Models Comparison with Re-Specified Baseline Model (B)

Models	Constrained Paths	χ^2	*df*	χ^2/df	CFI	IFI	TLI	SRMR	RMSEA	*p*-value	$\Delta\chi^2$	Δdf	Significance	AIC	Results
Criteria				< 3	> 0.95	> 0.95	> 0.95	< 0.1	< 0.08		< 3.84			Min is Best	
Baseline Re-Specified Model (B)	**Unconstrained**	590.62	504	1.172	0.97	0.98	0.97	0.08	0.02	0.005	-	-	-	772.63	**Accepted**
Nested Models	**Constrained**														
Model (B -1)	**TMC → CII**	628.82	505	1.245	0.97	0.97	0.96	0.11	0.03	0.000	38.195	1	P < 0.01	791.49	**Rejected**
Model (B -2)	**TMC → EII**	623.36	505	1.234	0.97	0.97	0.96	0.09	0.03	0.000	32.733	1	P < 0.01	803.36	**Rejected**
Model (B -3)	**CII → TQM**	613.94	505	1.216	0.97	0.97	0.97	0.09	0.03	0.001	23.315	1	P < 0.01	793.94	**Rejected**
Model (B -4)	**CII → AMF**	596.66	505	1.182	0.97	0.97	0.97	0.08	0.02	0.003	6.035	1	P < 0.05	776.66	**Rejected**
Model (B -5)	**CII → JIT**	618.71	505	1.225	0.97	0.97	0.9	0.10	0.03	0.000	28.08	1	P < 0.01	798.71	**Rejected**
Model (B -6)	**EII → TQM**	625.30	505	1.238	0.97	0.97	0.96	0.09	0.03	0.000	34.674	1	P < 0.01	805.30	**Rejected**
Model (B -7)	**EII → AMF**	599.98	505	1.188	0.97	0.97	0.97	0.08	0.02	0.002	9.358	1	P < 0.01	779.99	**Rejected**
Model (B -8)	**JIT → EII**	611.49	505	1.211	0.97	0.97	0.97	0.09	0.02	0.001	20.862	1	P < 0.01	791.49	**Rejected**
Model (B -9)	**TQM → AMF**	598.99	505	1.186	0.97	0.97	0.97	0.09	0.02	0.002	32.733	1	P < 0.01	779.00	**Rejected**

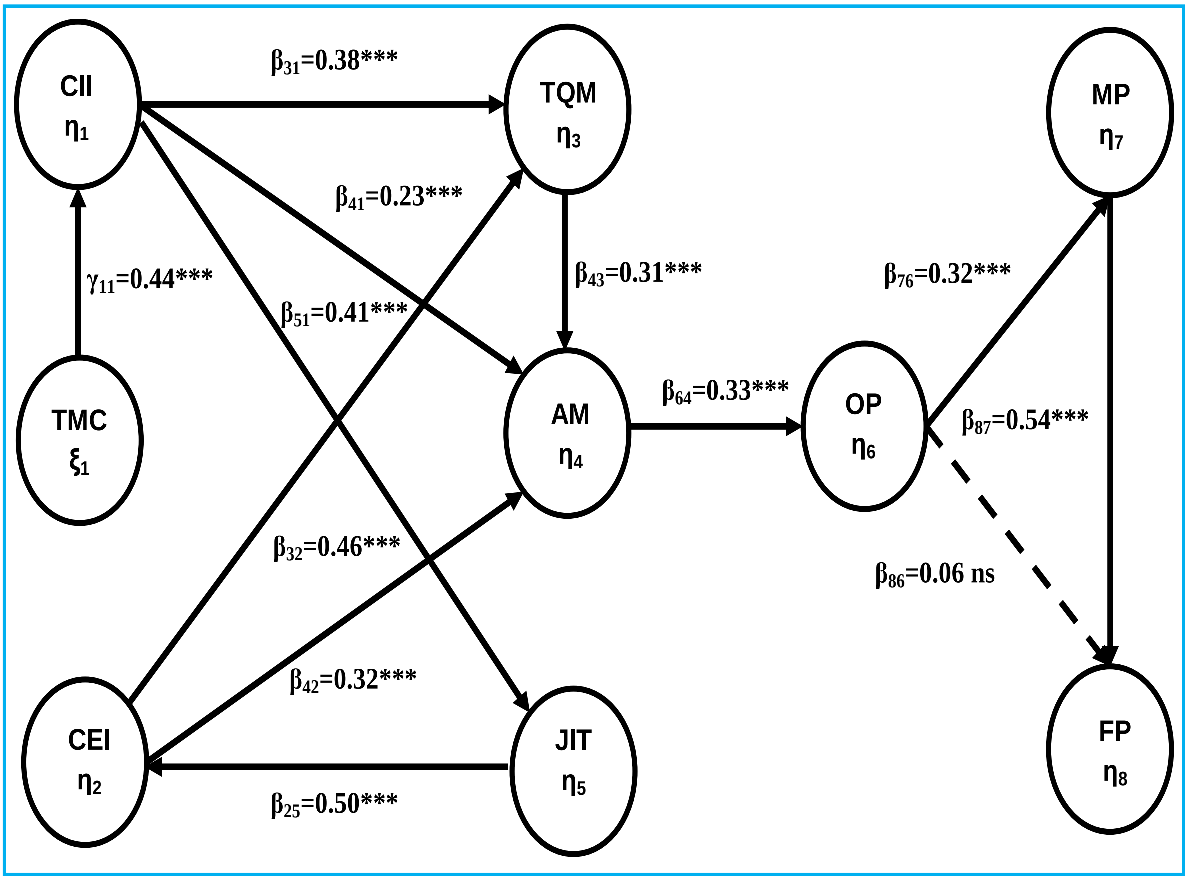


Figure 5.12. Nested Baseline Model (B – 2) TMC to CEI (Constrained = 0)

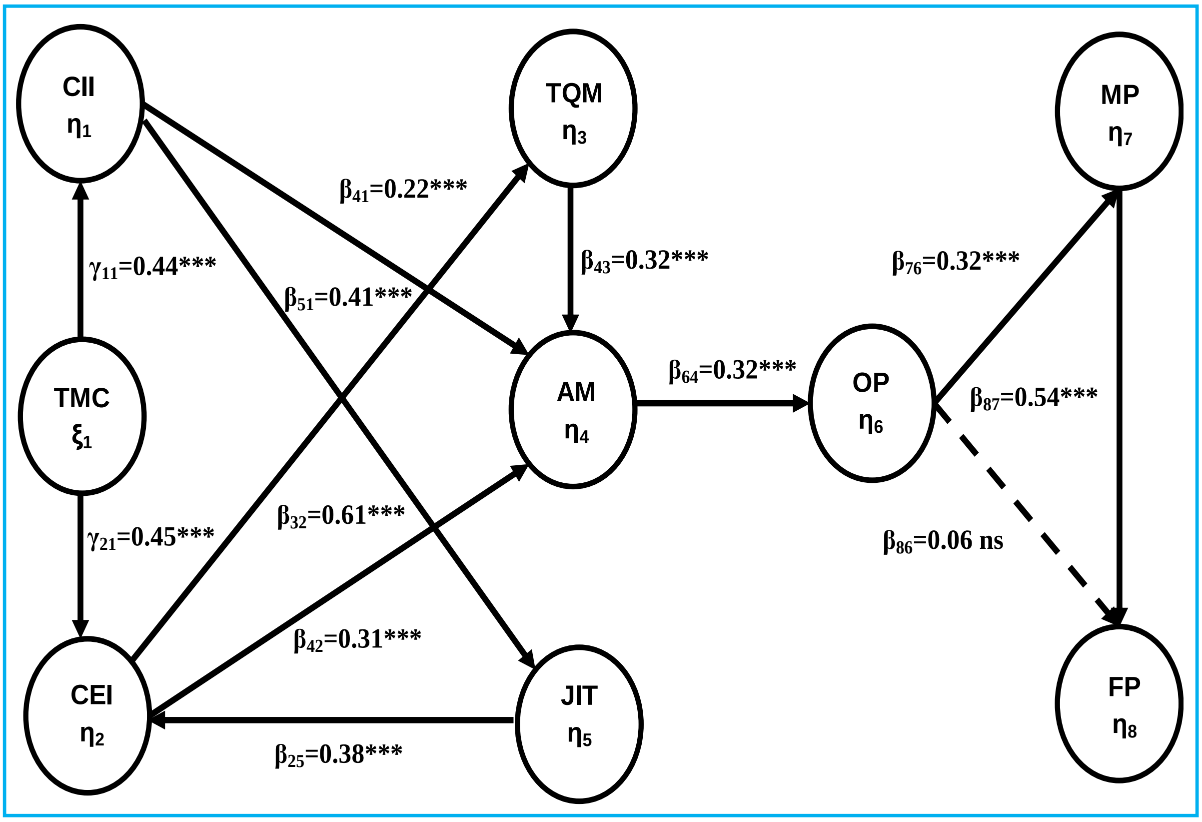


Figure 5. 13. Nested Baseline Model (B – 3) CII to TQM (Constrained = 0)

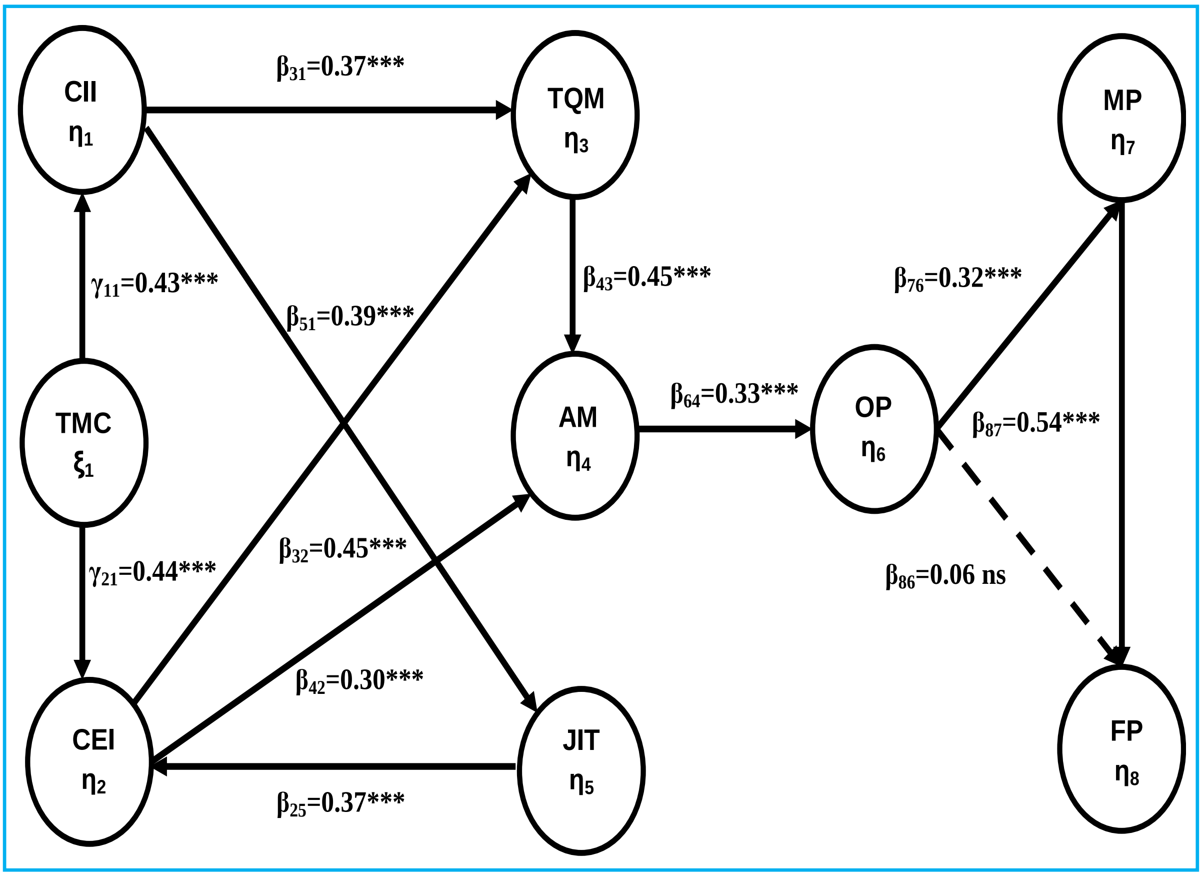


Figure 5. 14. Nested Baseline Model (B – 4) CII to AM (Constrained = 0)

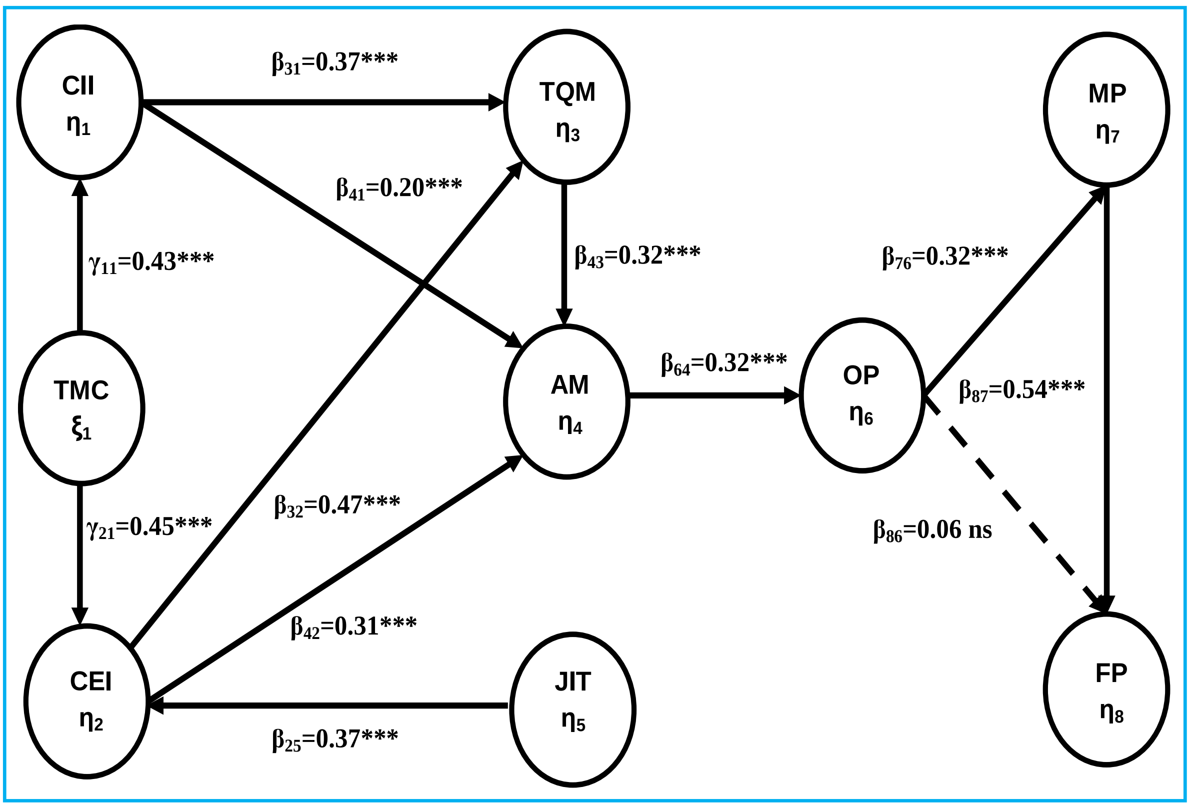


Figure 5. 15. Nested Baseline Model (B – 5) CII to JIT (Constrained = 0)

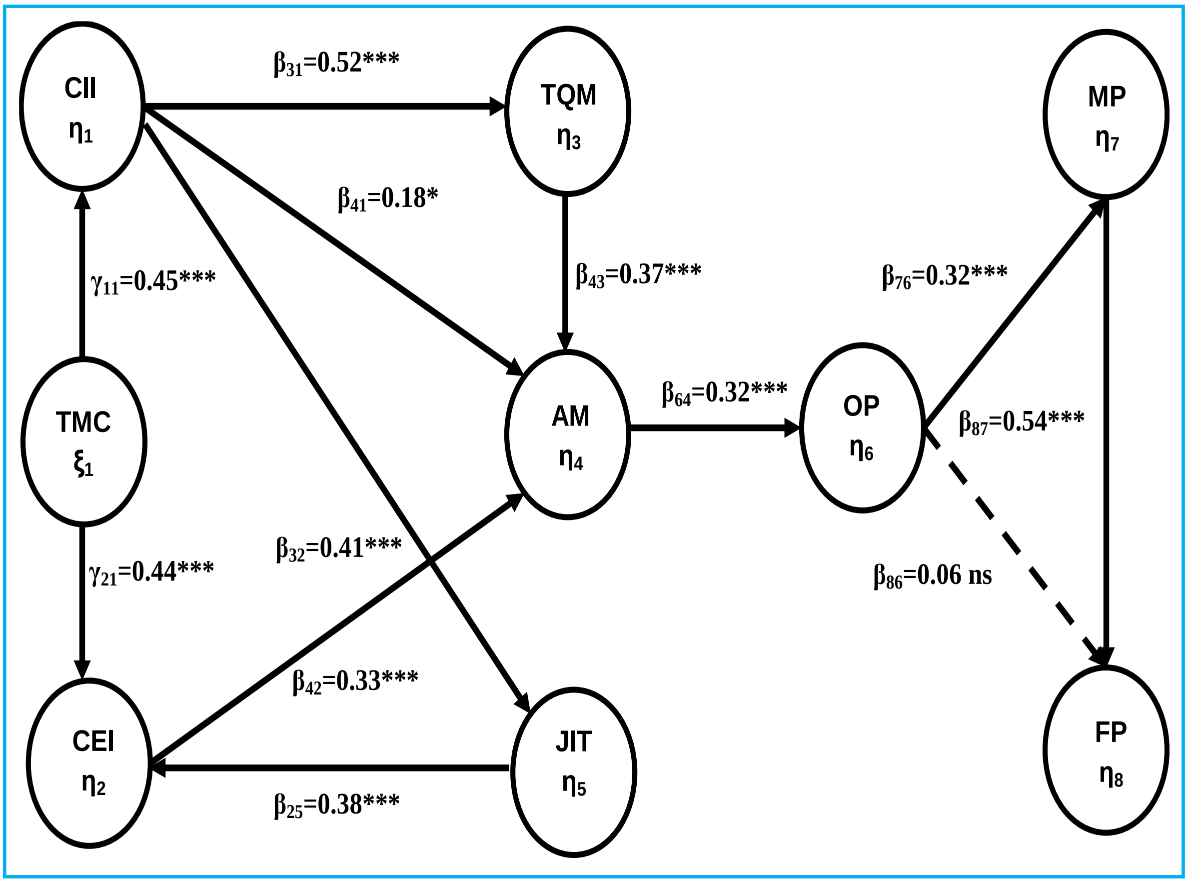


Figure 5. 16. Nested Baseline Model (B – 6) CEI to TQM (Constrained = 0)

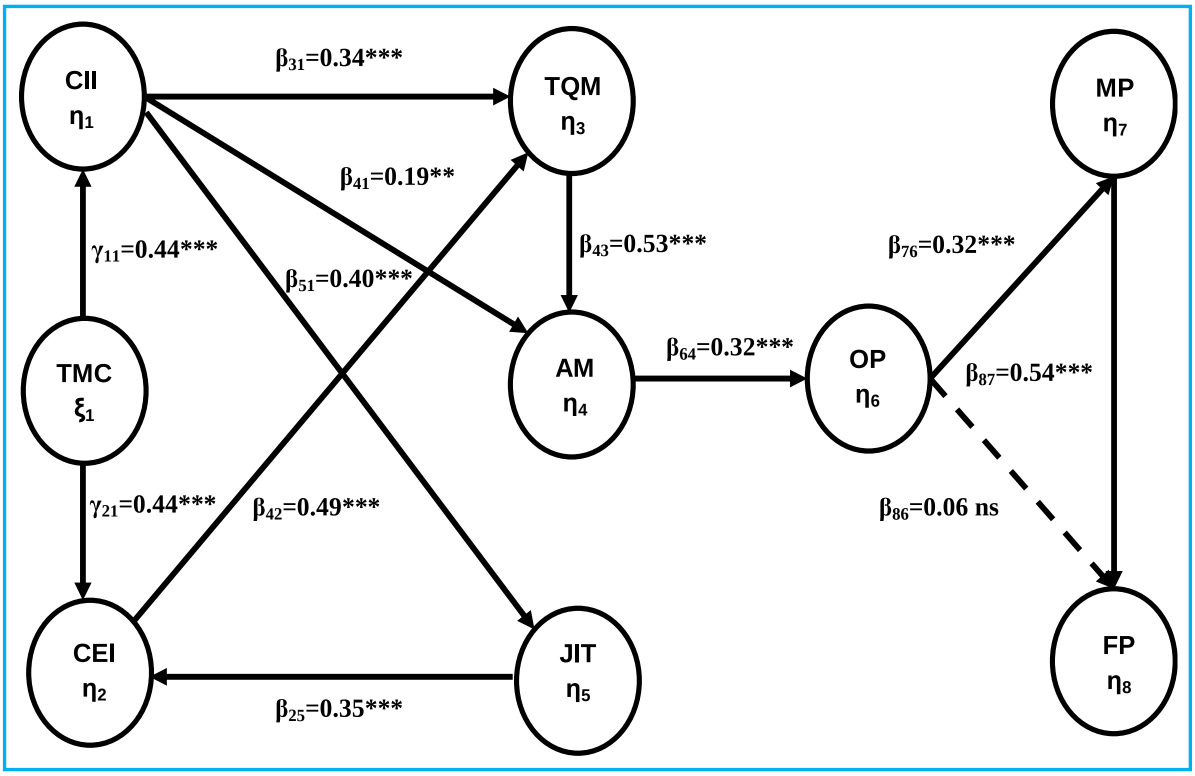


Figure 5. 17. Nested Baseline Model (B – 7) CEI to AM (Constrained = 0)

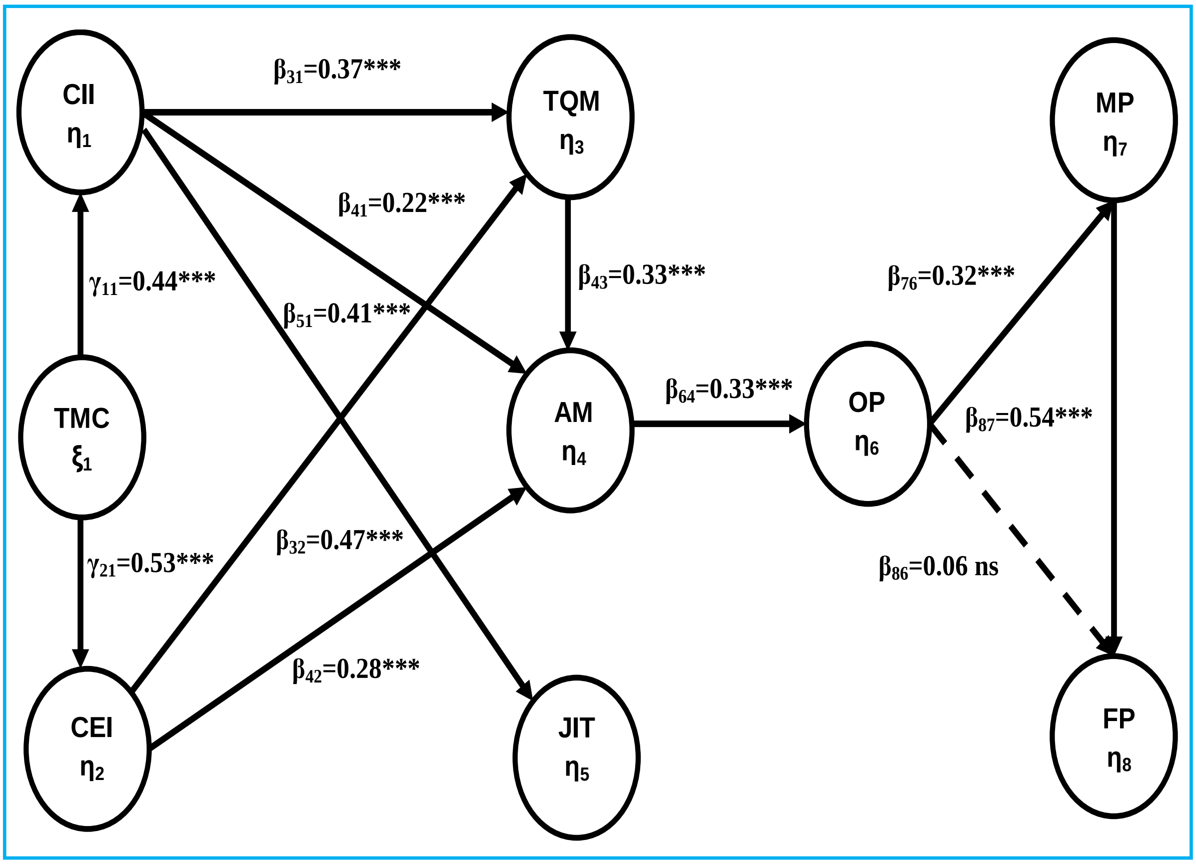


Figure 5. 18. Nested Baseline Model (B – 8) JIT to CEI (Constrained = 0)

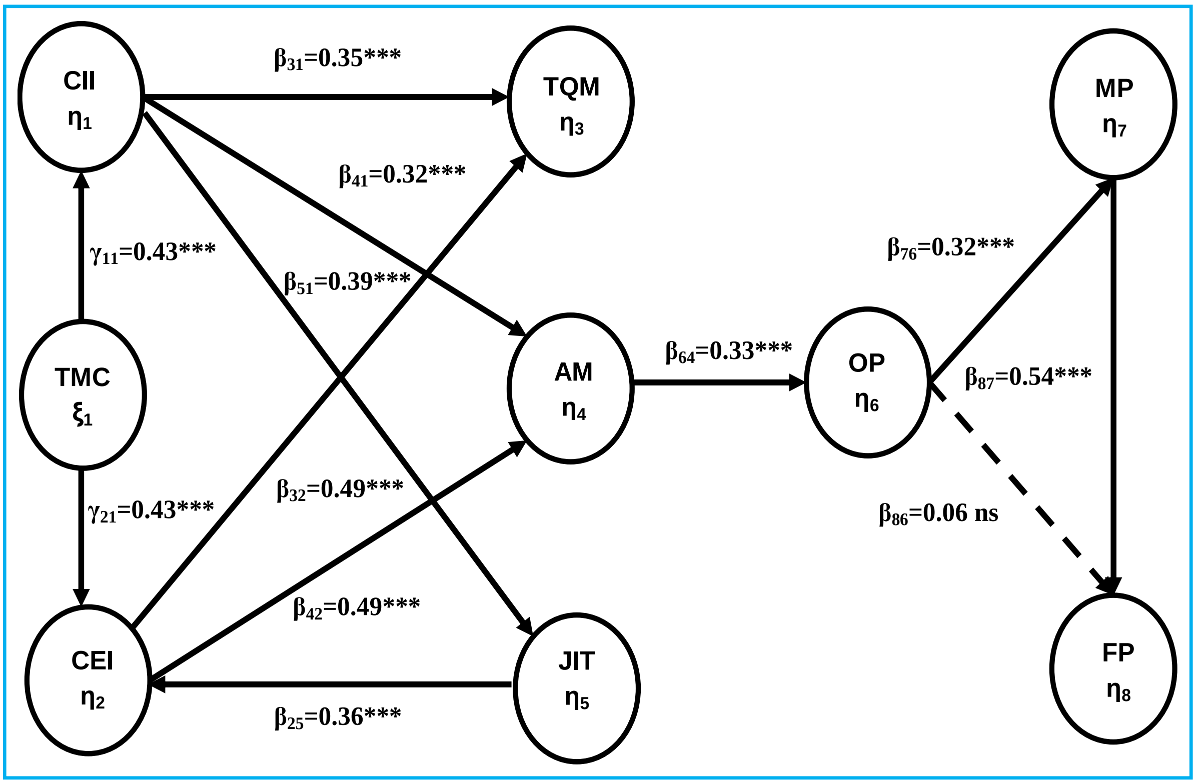


Figure 5. 19. Nested Baseline Model (B – 9) TQM to AM (Constrained = 0)

Intervening effects can be partial or full. In partial mediation, intervening effects between an independent and a dependent factor through intervening factor are significant, as well as direct effects between an independent and a dependent variables also remains significant, once an intervening variable is plugged in. On the other hand, in full mediation, the direct path between an independent and a dependent variable become insignificant once an intervening variable is plugged in and the relationship between an independent and a dependent variable is fully mediated through an intervening variable. Mediation effects are checked using three approaches (i.e., Sobel, Aroian and Goodman) (Aroian, 1944/1947; Baron & Kenny, 1986; Goodman, 1960; MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002; Sobel, 1982; Zhu, Cordeiro, & Sarkis, 2013). Equations used to test mediation effects by respective approach are as following:

(a) Sobel (1982) Test Equation $= \dfrac{a*b}{\sqrt{(b^2*SE_{a^2}+a^2*SE_{b^2})}}$

(b) Aroian (1944/1947) Test Equation $= \dfrac{a*b}{\sqrt{(b^2*SE_{a^2}+a^2*SE_{b^2}+SE_{a^2}*SE_{b^2}}}$

(c) Goodman (1960) Test Equation $= \dfrac{a*b}{\sqrt{(b^2*SE_{a^2}+a^2*SE_{b^2}-SE_{a^2}*SE_{b^2}}}$

Baseline Model (B) mediation test results are presented in Table 5.10. All the mediators significantly mediate the path between forerunner and ensuing variables. All the mediation paths are significant at $p < 0.05$, except OP do not mediate the path between AM and FP. Primarily, it is because of the significant contribution of MP. Organizations ignoring MP, are ultimately going to lose market share and overall there is a sure slump in business financial results (Green Jr et al., 2012; Inman et al., 2011). The significant link, between forerunners and ensuing variables, confirmed that each element in the model is well placed and leads to acquire higher agility standards.

Finally, in Stage-2, Total, Direct and Indirect effects for re-specified Baseline Model (B) are calculated. Total, Direct and Indirect, effects are presented in Table 5.11. These results explicitly clarify that there is an underlying common thread among practices. Importantly, all the practices though may not be linked directly (**H10** JIT → AM, **H11** TQM → OP, and **H12** JIT → OP) or may be fail to produce direct impacts but indirectly all the practices are significantly interrelated (Total and Indirect) and ultimately all the practices (management, infrastructure and core practices) significantly contribute (directly or Indirectly) in OP, MP and FP.

Table 5.10. Results of Baseline Model (B) Mediation Effects

MEDIATOR	RELATIONSHIP	SOBEL TEST			AROIAN TEST			GOODMAN TEST			MEDIATION EFFECTS
	IV → M → DV	t-value	S.E	p-value	t-value	S.E	p-value	t-value	S.E	p-value	Full / Partial
CII as Mediator	**TMC → CII → TQM**	3.57	0.029	0.00***	3.53	0.029	0.00***	3.60	0.029	0.00***	**Full**
	TMC → CII → AM	2.23	0.30	0.02**	2.20	0.310	0.02**	2.26	0.30	0.02**	**Full**
	TMC → CII → JIT	3.63	0.035	0.00***	3.60	0.035	0.00***	3.67	0.034	0.00***	**Full**
CEI as Mediator	**TMC→ CEI → TQM**	3.77	0.036	0.00***	3.73	0.036	0.00***	3.80	0.036	0.00***	**Full**
	TMC → CEI → AM	2.58	0.393	0.00***	2.55	0.393	0.01***	2.61	0.388	0.00***	**Full**
	JIT → CEI → AM	2.41	0.474	0.01**	2.37	0.483	0.01**	2.46	0.465	0.01**	**Full**
	JIT → CEI → TQM	3.30	0.046	0.00***	3.27	0.047	0.00***	3.34	0.046	0.00***	**Full**
TQM as Mediator	**CII → TQM → AM**	2.41	0.482	0.01**	2.37	0.490	0.01**	2.46	0.473	0.01**	**Partial**
	CEI → TQM → AM	2.49	0.191	0.01**	2.46	0.193	0.01**	2.53	0.188	0.01**	**Partial**
JIT as Mediator	**CII → JIT → CEI**	3.17	0.143	0.00***	3.13	0.145	0.00***	3.21	0.141	0.00***	**Partial**
OP as Mediator	**AM → OP → MP**	3.10	0.006	0.00***	3.06	0.006	0.00***	3.14	0.006	0.00***	**Partial**
	AM → OP → FP	*0.93*	*0.003*	*0.34[ns]*	*0.91*	*0.003*	*0.34[ns]*	*0.96*	*0.003*	*0.34[ns]*	***not supported***
MP as Mediator	**OP →MP → FP**	3.86	0.050	0.00***	3.84	0.050	0.00***	3.89	0.049	0.00***	**Full**

***: significant at $p < 0.01$ as t-value is larger than 2.58
** : significant at $p < 0.05$ as t-value is larger than 1.95
ns : not supported

Table 5.11. Total, Direct and Indirect Effects for Re-Specified Model (B)

	Independent Variables	**TMC**	**CII**	**CEI**	**TQM**	**JIT**	**AM**	**OP**	**MP**
Dependent Variables	**Effects Type**	↓	↓	↓	↓	↓	↓	↓	↓
CII	**Total**	**0.43*****							
	Direct	**0.43*****							
	Indirect								
CEI	**Total**	**0.50*****	**0.15*****			**0.36*****			
	Direct	**0.43*****				**0.36*****			
	Indirect	**0.06*****	**0.15*****						
TQM	**Total**	**0.38*****	**0.42*****	**0.46*****		**0.17*****			
	Direct		**0.35*****	**0.46*****					
	Indirect	**0.38*****	**0.07*****			**0.17*****			
JIT	**Total**	**0.18*****	**0.41*****						
	Direct		**0.41*****						
	Indirect	**0.18*****							
AM	**Total**	**0.36*****	**0.39*****	**0.45*****	**0.32****	**0.17*****			
	Direct		**0.21*****	**0.31****	**0.32****				
	Indirect	**0.36*****	**0.18*****	**0.15****		**0.17*****			
OP	**Total**	**0.12*****	**0.13*****	**0.15*****	**0.11****	**0.06*****	**0.33*****		
	Direct						**0.33*****		
	Indirect	**0.12*****	**0.13*****	**0.15*****	**0.11****	**0.06*****			
MP	**Total**	**0.04*****	**0.04*****	**0.05*****	**0.03****	**0.02*****	**0.11*****	**0.32*****	
	Direct							**0.32*****	
	Indirect	**0.04*****	**0.04*****	**0.05*****	**0.03****	**0.02*****	**0.11*****		
FP	**Total**	**0.03*****	**0.03*****	**0.04*****	**0.03****	**0.01*****	**0.08*****	**0.24*****	**0.55*****
	Direct							*0.06*^{ns}	**0.55*****
	Indirect	**0.03*****	**0.03*****	**0.04*****	**0.03****	**0.01*****	**0.08*****	**0.18*****	

***: significant at $p < 0.01$ as t-value is larger than 2.58
** : significant at $p < 0.05$ as t-value is larger than 1.95
ns : not supported

5.3.2 CONTINGENCY PERSPECTIVE FIT RESULTS

Contingency perspective fit, using Moderation Fit or Reductionist Approach, is tested to ascertain the potential heterogeneity effects upon implementation of practices. These heterogeneity issues are likely to occur due to sub-populations, as "different population parameters are likely for different subpopulations" (Henseler, Ringle, & Sinkovics, 2009, p. 771). Moderation fit addresses the heterogeneity issues, may be due to internal or external factors, affecting implementation of management, infrastructure and core manufacturing practices (Meyer et al., 1993; Narasimhan et al., 2006; Shah & Ward, 2003; Venkatraman, 1989; Z. Zhang & Sharifi, 2007). Organizational internal contextual factors are firm size, industry type, ISO-9001 registration and information technology, whereas, external contextual factors are competitive pressure, market dynamics and technological dynamics. Moreover, cumulative environmental effects are also tested by combining all external environmental factors.

5.3.2.1 MODERATION FIT

Moderation Fit is assessed using χ^2 difference test (Hair et al., 2010, p. 771). Firm size, industry type and ISO-9001 registration are categorical variables (nonmetric moderators) and are classified as sub-groups based on their membership to respective sub-populations. However, information technology, competitive pressure, market dynamics, technological dynamics and cumulative environmental effects are metric variables (moderators). These metric variables (moderators) are transformed into nonmetric variables (moderators) by dividing these variables into two groups based on overall sample median for respective variable (Hair et al., 2010, p. 771). Firm size (variable) is divided into two major groups (Large and SMEs), by combining small and medium firms as one group (SMEs), due to very small sample size representation of small firms. Overall moderation effects are tested using AMOS-16 software.

χ^2 difference test results are presented in Table 5.12. All the internal and external contextual variables, except internal factor industry type, significantly moderate the overall relationship among management, infrastructure, core manufacturing practices and performance measures. Industry type effects are found insignificant. Primarily the insignificant effects are due to similar working environment of Readymade Garment and Knitwear and Hosiery Industry and it is difficult to differentiate due to similar kind of operations (SMEDA, 2005). Organizational internal contextual factors, except industry type,

Table 5.12. Structural Invariance Test for Organizational and Environmental Contextual Factors

Hypotheses	Contingency Factor	Unconstrained		Constrained		χ^2 Difference		Significance	Results
		χ^2	*df*	χ^2	*df*	$\Delta\chi^2$	Δdf		
H19a	**Firm Size**	1253.2	1010	1304.1	1022	50.9	12	0.00***	H19a supported
H20a	**Industry Type**	1233.4	1010	1246.2	1022	12.8	12	*ns*	*H20a not-supported*
H21a	**ISO-9001 Registration**	1322.6	1010	1344.0	1022	22.6	12	0.03**	H21a supported
H22a	**Information Technology**	1312.2	1010	1333.2	1022	21.0	12	0.1*	H22a supported
H23a	**Competitive Pressures**	1260.4	1010	1289.0	1022	29.0	12	0.00***	H23a supported
H24a	**Market Dynamics**	1263.0	1010	1294.5	1022	31.5	12	0.00***	PH24a supported
H25a	**Technological Dynamics**	1265.2	1010	1296.6	1022	31.4	12	0.00***	H25a supported
H26a	**Cumulative Environmental Effects**	1197.6	1010	1224.7	1022	27.1	12	0.00***	H26a supported

* . Structural invariance is not significant at $p < 0.1$ as t-value is larger than 1.65.

** . Structural invariance is not significant at $p < 0.05$ as t-value is larger than 1.95.

***. Structural invariance is not significant at $p < 0.01$ as t-value is larger than 2.58.

ns. Structural invariance is supported as t-value is less than 1.65.

moderation effects are consistent with earlier studies like firm size (Jayaram et al., 2010; Narasimhan et al., 2006; Yang et al., 2011), ISO-9001registration (Clougherty, 2009; Martincus et al., 2010; Rao et al., 1997a), information technology use (Dowlatshahi & Cao, 2006; Gunasekaran, 1998; Gunasekaran et al., 2008; Mo, 2009; Narasimhan et al., 2006; Prajogo & Olhager, 2012; Sharifi & Zhang, 2001). Similarly, external contextual factors moderation effects are also consistent with earlier studies like competitive pressures (Hallgren & Olhager, 2009; Vázquez-Bustelo et al., 2007; Wang et al., 2012; Yauch, 2010), market dynamics (Vázquez-Bustelo et al., 2007; Wang et al., 2012; Yauch, 2010) and technological turbulence (Dröge et al., 2003; Terawatanavong et al., 2011; Wang et al., 2012; Yauch, 2010; Yusuf & Adeleye, 2002).

5.3.2.2 POST-HOC ANALYSIS

Hypotheses from **H19b** to **H26b** are tested through Post-hoc analysis employing multi-group partial least square structural equation modelling technique (PLS-SEM) (Wold, 1975) using Smartpls 2.0 software (Ringle, Wende, & Will, 2005). PLS-SEM is also widely being used in multi-group analysis in management research (Elbanna, Child, & Dayan, 2013; Lew & Sinkovics, 2013; Sarstedt, Henseler, & Ringle, 2011). Overall sample is split into respective sub-groups, in order to undertake sub-group moderation analysis. Due to sample size constraint, results obtained through covariance based structural equation modelling (CB-SEM) are likely to be biased (Hair, Sarstedt, Ringle, & Mena, 2012; Hu & Bentler, 1995). Sub-groups sample size is not sufficient to undertake CB-SEM, hence, warrant use of PLS-SEM. PLS-SEM has edge over CB-SEM due to its capability of handling small sample size, non-normal data as well as formative constructs (Hair et al., 2010; Hair et al., 2012; Peng & Lai, 2012). Hair et al. (2012, p. 415), described the major difference between these two approaches as, “CB-SEM estimates model parameters so that the discrepancy between the estimated and sample covariance matrices are minimized. In contrast, PLS-SEM maximizes the explained variance of the endogenous latent variables by estimating partial model relationships in an iteration sequence of ordinary least squares (OLS) regressions”. However, minimum sample size require by PLS-SEM is the 10-times the utmost complex relationship of the research model (Hair et al., 2012, p. 420; Peng & Lai, 2012, p. 469). Apart from sample size requirement, (Peng & Lai, 2012) outlined two requirements, that data should meet, to perform model testing. These requirements are, reliability characteristics i.e., AVE > 0.5 and CR > 0.7 (Peng & Lai, 2012, p. 474) and the Largest Structural Equation (LSE) statistical power ≥ 0.8 (Peng & Lai, 2012, p. 475). LSE statistical power is calculated using

Soper (2013) calculator through statistical method devised by Cohen (1988). It is not possible to test the PLS-SEM model fit like CB-SEM, however, (Tenenhaus, Vinzi, Chatelin, & Lauro, 2005, p. 173) propose a global criterion to test the model GoF using following formula;

$$\text{Goodness of Fit (GoF)} = \sqrt{\overline{\text{communality}} \times \overline{R^2}}$$

There is no cut-off value of GoF statistics (Hair et al., 2012; Peng & Lai, 2012). There are three methods to test groups-difference (Elbanna et al., 2013) as $t_{Parametric}$ approach (Keil et al., 2000), $P_{Henseler}$ (Henseler, 2007) and $t_{Permutation}$ approach (Sarstedt et al., 2011). Multi-groups differences are tested using parametric approach proposed by Keil et al. (2000). Equation to calculate t-statistics between group differences is as following (Keil et al., 2000, p. 315; Sarstedt et al., 2011, p. 200);

$$t = \frac{\tilde{\theta}^{(1)} - \tilde{\theta}^{(2)}}{\sqrt{((n^{(1)}-1)^2/(n^{(1)}+n^{(2)}-2)) \cdot SE^2_{\theta^{(1)}} + ((n^{(2)}-1)^2/(n^{(1)}+n^{(2)}-2)) \cdot SE^2_{\theta^{(2)}}} \cdot \sqrt{(1/n^{(1)})+(1/n^{(2)})}}$$

Degrees of freedom for t-distribution is calculated as (Chin, 2000).

$df = n^{(1)} + n^{(2)} - 2.$

Whereas;

$\theta^{(1)}$ = Path coefficient for group1.

$\theta^{(2)}$ = Path coefficient for group 2.

$n^{(1)}$ = sample size of group 1.

$n^{(2)}$ = sample size of group 2.

$SE_{(1)}$ = standard error of group 1.

$SE_{(2)}$ = standard error of group 2.

However, once Levene's Test is significant then test statistics is calculated using following equation (Chin, 2000; Sarstedt et al., 2011, p. 200);

$$t = \frac{\tilde{\theta}^{(1)} - \tilde{\theta}^{(2)}}{\sqrt{((n^{(1)}-1)/(n^{(1)}) \cdot SE^2_{\theta^{(1)}} + ((n^{(2)}-1)/(n^{(2)}) \cdot SE^2_{\theta^{(2)}}}}$$

Whereas;

$\theta^{(1)}$ = Path coefficient for group1.

$\theta^{(2)}$ = Path coefficient for group 2.

$n^{(1)}$ = sample size of group 1.

$n^{(2)}$ = sample size of group 2.

$SE_{(1)}$ = standard error of group 1.

$SE_{(2)}$ = standard error of group 2.

PLS-SEM sample size requirements are fully met as each sub-group sample size exceeds the minimum requirement, based on utmost complex relationship of AM construct, of 30. AVE, CR, statistical power of LSE and GoF results are presented in Table 5.13 and Table 5.14. All the AVE, CR values, except AVE of FP, for competitive pressures and technological dynamics, and CR of FP for technological dynamics are marginally below the threshold value, are well above the specified criteria. Statistical power of LSE of each sub-group model is well above the cut-off value of 0.8. Moreover, GoF statistics for all sub-models range from **0.22** to **0.35** and represent satisfactory model GoF (Peng & Lai, 2012, p. 475).

Sub-group models path results are obtained using bootstrapping technique (Hair et al., 2012) with a bootstrap sample of 2000 for each model (Peng & Lai, 2012, p. 473). Sub-group models' path results and difference between groups for organizational contextual factors are presented in Table 5.15; and for environmental contextual factors are presented in Table 5.16 respectively. Absolute value of groups-path coefficients' differences for respective contextual factors are also presented (Elbanna et al., 2013). Few path coefficients' differences between groups, except industry type, are observed. These results also confirm the results obtained using CB-SEM (AMOS-16, see Section 5.3.2.1). Hypotheses, from H19b to H26b, results are presented in Table 5.17. For organizational contextual factors, out of total 12 Paths, three Paths (TMC-CI $p < 0.05$, TMC-CEI $p < 0.05$ and JIT-CEI $p < 0.05$) between firm size, one path (CII-AM $p < 0.05$) between ISO - 9001 certified groups and three Paths (CII-TQM $p < 0.1$, CII-JIT $p < 0.1$ and CEI-AM $p < 0.01$) between information technology groups are different. Similarly, for environmental contextual factors, out of total 12 Paths, two Paths (TMC-CII $p < 0.01$ and CII-JIT $p < 0.05$) in competitive pressures groups, one Path (CII-TQM $p < 0.05$) between market dynamics groups, two Paths (CII-TQM $p < 0.1$ and JIT-CEI $p < 0.05$) between technological dynamics groups and one Path (CII-JIT $p < 0.1$) in cumulative environmental uncertainty groups are different. A partial support for path group difference, in each sub-group, is observed. The most alarming aspect is the directionality issue between significant paths (Jayaram et al., 2010).

Table 5.13. Constructs Reliability Statistics for Organizational Contextual Factors

	Firm Size (No of Employees)				Industry Type			
	SMEs ≤ 250		Large > 250		Ready-made Garments		Knitwear and Hosiery	
Sample	*n = 150*		*n = 98*		*n = 97*		*n = 151*	
Model GoF	**0.32**		**0.29**		**0.33**		**0.31**	
LSE Statistical Power	**0.99**		**0.99**		**0.97**		**1.00**	
Construct	**AVE**	**CR**	**AVE**	**CR**	**AVE**	**CR**	**AVE**	**CR**
TMC	0.73	0.93	0.69	0.92	0.77	0.94	0.69	0.92
CII	0.66	0.91	0.63	0.89	0.57	0.87	0.70	0.92
CEI	0.76	0.86	0.80	0.89	0.77	0.87	0.77	0.87
TQM	0.73	0.89	0.64	0.84	0.71	0.88	0.69	0.87
JIT	0.61	0.86	0.61	0.86	0.62	0.87	0.60	0.86
AM	0.69	0.87	0.57	0.80	0.68	0.86	0.62	0.83
OP	0.69	0.93	0.72	0.94	0.70	0.93	0.71	0.94
MP	0.83	0.93	0.76	0.90	0.85	0.95	0.81	0.93
FP	0.76	0.91	0.71	0.88	0.78	0.91	0.76	0.90
Criteria	AVE > 0.5 CR > 0.7. Largest Structural Equation (LSE) statistical power should be greater than 0.8.							

Continued Table 5.13.

	ISO - 9001 Registration				Information Technology			
	Yes		No		High		Low	
Sample	***n = 174***		***n = 74***		***n = 167***		***n = 81***	
Model GoF	**0.33**		**0.28**		**0.23**		**0.34**	
LSE Statistical Power	**1.00**		**0.96**		**0.99**		**0.99**	
Construct	**AVE**	**CR**	**AVE**	**CR**	**AVE**	**CR**	**AVE**	**CR**
TMC	0.68	0.91	0.83	0.96	0.68	0.92	0.76	0.94
CII	0.64	0.90	0.67	0.91	0.60	0.88	0.69	0.92
CEI	0.74	0.85	0.81	0.90	0.77	0.87	0.72	0.84
TQM	0.68	0.86	0.75	0.90	0.68	0.87	0.70	0.87
JIT	0.60	0.86	0.62	0.87	0.59	0.85	0.56	0.84
AM	0.63	0.84	0.66	0.86	0.55	0.78	0.71	0.88
OP	0.72	0.94	0.67	0.92	0.68	0.93	0.72	0.94
MP	0.78	0.92	0.85	0.95	0.83	0.94	0.79	0.92
FP	0.72	0.88	0.75	0.90	0.76	0.90	0.69	0.87
Criteria	AVE > 0.5 CR > 0.7 Largest Structural Equation (LSE) statistical power should be greater than 0.8.							

Table 5.14. Reliability Statistics for Environmental Contextual Factors

	Competitive Pressures				Market Dynamics			
	High		Low		High		Low	
Sample	***n = 163***		***n = 85***		***n = 161***		***n = 87***	
Model GoF	**0.24**		**0.35**		**0.23**		**0.33**	
LSE Statistical Power	**1.00**		**0.99**		**0.99**		**0.99**	
Construct	**AVE**	**CR**	**AVE**	**CR**	**AVE**	**CR**	**AVE**	**CR**
TMC	0.71	0.92	0.74	0.93	0.68	0.91	0.78	0.95
CII	0.62	0.89	0.66	0.91	0.63	0.90	0.62	0.89
CEI	0.76	0.86	0.76	0.87	0.70	0.82	0.83	0.90
TQM	0.67	0.86	0.73	0.89	0.62	0.83	0.74	0.90
JIT	0.58	0.85	0.64	0.88	0.60	0.86	0.60	0.86
AM	0.59	0.81	0.67	0.86	0.58	0.81	0.68	0.86
OP	0.69	0.93	0.68	0.93	0.66	0.92	0.74	0.95
MP	0.81	0.93	0.79	0.92	0.78	0.91	0.71	0.88
FP	0.77	0.91	*0.40*	0.57	0.72	0.88	0.73	0.89
Criteria	AVE > 0.5 CR > 0.7. Largest Structural Equation (LSE) statistical power should be greater than 0.8.							

Continued Table 5.14.

	Technological Dynamics				Cumulative Environmental Effects			
	High		Low		High		Low	
Sample	***n* = 165**		***n* = 83**		***n* = 128**		***n* = 120**	
Model GOF	**0.24**		**0.31**		**0.22**		**0.32**	
LSE Statistical Power	**0.99**		**0.99**		**0.99**		**0.99**	
Construct	**AVE**	**CR**	**AVE**	**CR**	**AVE**	**CR**	**AVE**	**CR**
TMC	0.69	0.92	0.76	0.94	0.70	0.92	0.73	0.93
CII	0.59	0.88	0.71	0.92	0.58	0.87	0.67	0.91
CEI	0.71	0.83	0.83	0.91	0.71	0.83	0.80	0.89
TQM	0.66	0.85	0.73	0.89	0.64	0.84	0.72	0.88
JIT	0.61	0.86	0.57	0.84	0.57	0.80	0.65	0.85
AM	0.55	0.78	0.72	0.89	0.61	0.86	0.59	0.85
OP	0.66	0.92	0.72	0.94	0.68	0.93	0.68	0.92
MP	0.77	0.91	0.76	0.91	0.74	0.89	0.77	0.91
FP	0.72	0.88	*0.30*	*0.40*	0.74	0.90	0.70	0.87
Criteria	AVE > 0.5 CR > 0.7. Largest Structural Equation (LSE) statistical power should be greater than 0.8.							

Table 5.15. Sub-Group Models Path Coefficients Difference for Organizational Contextual Factors

	Firm Size (No of Employees)				**Industry Type**			
Model Paths	**SMEs ≤ 250**	**Large > 250**	|Δ|	Path Coefficients Difference is Significant at	**Ready-made Garments**	**Knitwear and Hosiery**	|Δ|	Path Coefficient Difference is Significant at
Construct	***n = 150***	***n = 98***			***n = 97***	***n = 151***		
TMC → CII	0.492***	0.138	0.354	***p < 0.05***	0.480***	0.294***	0.186	
TMC → CEI	0.214***	0.507***	0.293	***p < 0.05***	0.444***	0.320***	0.124	
CII → TQM	0.310***	0.328***	0.018		0.291***	0.351***	0.060	
CII → AM	0.164**	0.185***	0.021		0.159**	0.226***	0.067	
CII → JIT	0.344***	0.291***	0.053		0.331***	0.334***	0.003	
CEI → TQM	0.436***	0.22***	0.216		0.43***	0.313***	0.117	
CEI → AM	0.271***	0.195***	0.076		0.071	0.311***	0.240	
JIT → CEI	0.391***	0.110	0.281	***p < 0.05***	0.345***	0.217***	0.128	
TQM → AM	0.161*	0.451***	0.290		0.285***	0.283***	0.002	
AM → OP	0.23***	0.242***	0.012		0.199***	0.268***	0.069	
AM →MP	0.203***	0.333***	0.130		0.294***	0.255***	0.039	
AM → FP	0.112	0.285***	0.173		0.148**	0.270***	0.122	

***. Significant at $p < 0.01$ as t-value is larger than 2.58.
** . Significant at $p < 0.05$ as t-value is larger than 1.95.
** . Significant at $p < 0.1$ as t-value is larger than 1.65.

Continued Table 5.15.

	ISO-9001 Certification				Information Technology			
Model Paths	**Yes**	**No**	|Δ|	Path Coefficients Difference is Significant at	**High IT**	**Low IT**	|Δ|	Path Coefficients Difference is Significant at
Construct	***n = 174***	***n = 74***			***n = 167***	***n = 81***		
TMC → CII	0.403***	0.312***	0.091		0.337***	0.266**	0.071	
TMC → CEI	0.363***	0.335***	0.028		0.281***	0.419***	0.138	
CII → TQM	0.363***	0.260***	0.103		0.236***	0.451***	0.215	***P < 0.1***
CII → AM	0.041	0.370***	0.329	***p < 0.05***	0.144**	0.208**	0.064	
CII → JIT	0.386***	0.296***	0.090		0.208***	0.444***	0.236	***P < 0.1***
CEI → TQM	0.402***	0.328***	0.074		0.332***	0.395***	0.063	
CEI → AM	0.242***	0.176**	0.066		0.006	0.486***	0.480	***P < 0.01***
JIT → CEI	0.24***	0.331***	0.091		0.245**	0.270***	0.025	
TQM → AM	0.397***	0.089	0.308		0.308***	0.117***	0.191	
AM → OP	0.26***	0.198***	0.062		0.138**	0.257***	0.119	
AM →MP	0.315***	0.184***	0.131		0.170**	0.252***	0.082	
AM → FP	0.261***	0.097	0.164		0.131*	0.187***	0.056	

***. Significant at p < 0.01 as t-value is larger than 2.58.
** . Significant at p < 0.05 as t-value is larger than 1.95.
** . Significant at p < 0.1 as t-value is larger than 1.65.

Table 5.16. Sub-Group Models Path Coefficients Difference for Environmental Contextual Factors

	Competitive Pressures				**Market Dynamics**			
Model Paths	**High**	**Low**	**|Δ|**	Path Coefficient Difference is Significant at	**High**	**Low**	**|Δ|**	Path Coefficients Difference is Significant at
Construct	***n = 163***	***n = 85***			***n = 161***	***n = 87***		
TMC → CII	0.230**	0.546***	0.316	***p < 0.01***	0.260**	0.437***	0.177	
TMC → CEI	0.308***	0.381***	0.073		0.308***	0.326***	0.018	
CII → TQM	0.274***	0.377***	0.103		0.220***	0.474***	0.254	***p < 0.05***
CII → AM	0.207***	0.077	0.130		0.229***	0.043	0.186	
CII → JIT	0.204***	0.469***	0.265	***p < 0.05***	0.241***	0.395***	0.154	
CEI → TQM	0.280***	0.451***	0.171		0.426***	0.207*	0.219	
CEI → AM	0.221**	0.109	0.112		0.103	0.31**	0.207	
JIT → CEI	0.198**	0.350***	0.152		0.138	0.407**	0.269	
TQM → AM	0.232***	0.361***	0.129		0.193	0.324**	0.131	
AM → OP	0.160***	0.213***	0.053		0.148**	0.251***	0.103	
AM →MP	0.174***	0.165***	0.009		0.166*	0.096	0.070	
AM → FP	0.206***	0.081	0.125		0.148	0.097	0.051	

***. Significant at p < 0.01 as t-value is larger than 2.58.
** . Significant at p < 0.05 as t-value is larger than 1.95.
** . Significant at p < 0.1 as t-value is larger than 1.65.

Continued Table 5.16.

	Technological Dynamics				**Cumulative Environmental Uncertainty**			
Model Paths	**High**	**Low**	**|Δ|**	Path Coefficient Difference is Significant at	**High**	**Low**	**|Δ|**	Path Coefficients Difference is Significant at
Construct	***n* = *165***	***n* = *83***			***n* = *128***	***n* = *120***		
TMC → CII	0.316***	0.351***	0.035		0.304***	0.351**	0.047	
TMC → CEI	0.384***	0.307***	0.077		0.334***	0.338***	0.004	
CII → TQM	0.235***	0.423***	0.188	***p* < *0.1***	0.238***	0.394***	0.156	
CII → AM	0.111*	0.256***	0.145		0.113	0.218*	0.105	
CII → JIT	0.269***	0.327***	0.058		0.183*	0.403***	0.22	***p* < *0.1***
CEI → TQM	0.321***	0.388***	0.067		0.218*	0.446***	0.228	
CEI → AM	0.158*	0.255***	0.097		0.164	0.217*	0.053	
JIT → CEI	0.121*	0.436***	0.315	***p* < *0.05***	0.195**	0.309***	0.114	
TQM → AM	0.343***	0.127	0.216		0.272**	0.219	0.053	
AM → OP	0.115	0.293***	0.178		0.133	0.242***	0.109	
AM →MP	0.136*	0.204***	0.068		0.088	0.215***	0.127	
AM → FP	0.196***	0.176	0.02		0.188***	0.082	0.106	

***. Significant at p < 0.01 as t-value is larger than 2.58.
** . Significant at p < 0.05 as t-value is larger than 1.95.
** . Significant at p < 0.1 as t-value is larger than 1.65.

Table 5.17. Structural Invariance Test between Sub-groups for Organizational and Environmental Contextual Factors

Hypotheses	Organizational and Business Environmental Contingency Factor	Results
H19b	**Firm Size**	H19b. partially supported
H20b	**Industry Type**	H*20b. not-supported*
H21b	**ISO-9001 Registration**	H21b. partially supported
H22b	**Information Technology**	H22b. partially supported
H23b	**Competitive Pressures**	H23b. partially supported
H24b	**Market Dynamics**	H24b. partially supported
H25b	**Technological Dynamics**	H25b. partially supported
H26b	**Cumulative Environmental Effects**	H26b. partially supported

5.3.3 CONFIGURATIONAL PERSPECTIVE FIT

Configurational Perspective Fit, using Profile Deviation Fit, is tested to ascertain the holistic (synergy) effects among practices. Profile deviation fit, deviation reflects the degree of synergy among management, infrastructure and core manufacturing practices (Ahmad et al., 2003; Cua, 2000; Fuentes-Fuentes et al., 2011; Venkatraman, 1989; Venkatraman & Prescott, 1990).

5.3.3.1 PROFILE DEVIATION FIT

Profile deviation fit is tested using hierarchical multiple regression analysis as shown in the equations (a, b, & c). A negative β-coefficient of Misfit (β_5) indicates support for configurational perspective fit. It indicates that higher the misfit among the practices will lead to negative impact on performance (Cua, 2000; Venkatraman, 1989; Venkatraman & Prescott, 1990). Multi-collinearity is assessed through variance inflation factor (VIF). None of the VIF value is beyond the threshold criteria of "3" (Hair et al., 2010, p. 205). Moreover, dependent variables residuals plots (Histogram and P-P plots), presented in Figures from Figure 5.20 to Figure 5.22, indicate that residuals are normally distributed and no auto-correlation warning is observed.

(a) $OP_i = \beta_0 + \beta_1 FIRM\_SIZE_i + \beta_2 INDUSTRY\_TYPE_i + \beta_3 ISO\_REG_i + \beta_4 IT_i + \beta_5 MISFIT_i + \varepsilon_i$

(b) $MP_i = \beta_0 + \beta_1 FIRM\_SIZE_i + \beta_2 INDUSTRY\_TYPE_i + \beta_3 ISO\_REG_i + \beta_4 IT_i + \beta_5 MISFIT_i + \varepsilon_i$

$FP_i = \beta_0 + \beta_1 FIRM\_SIZE_i + \beta_2 INDUSTRY\_TYPE_i + \beta_3 ISO\_REG_i + \beta_4 IT_i + \beta_5 MISFIT_i + \varepsilon_i$

Where:

Firm_size is the respondent's firm size based on number of employees.

Industry_Type is Readymade Garments or Knitwear and Hosiery.

ISO_Reg is the respondent firms' ISO-Registration status.

IT is the degree of use of Information Technology by the respective firm

Configurational perspective misfit results are presented in Table 5.18. Four different models are tested for each performance measure (OP, MP, and FP). Two models are tested based on contingency (organizational contextual factors) perspective results. In Contingency Perspective, it is established that firm-size, ISO-9001 registration and Information Technology moderate the relationship, whereas, industry-type moderating effects are insignificant. Nonetheless, configurational perspective is a holistic approach, two separate models ignoring the contingency perspective results, industry-type included and excluded respectively, are tested to check the configuration perspective results robustness (Ahmad et al., 2003, p. 186).

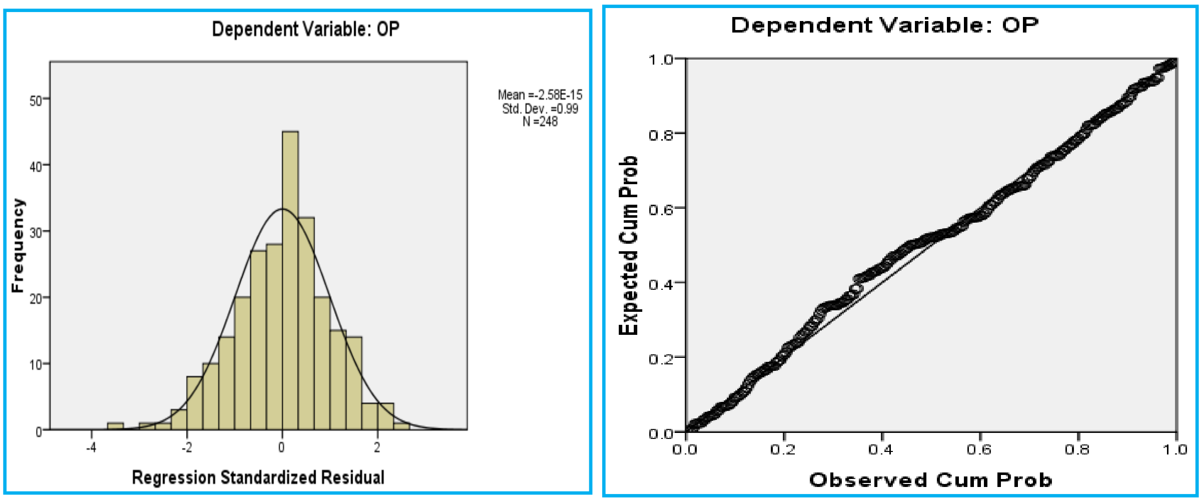


Figure 5.20. Histogram and Normal P-P plot of Regression Standardized Residuals of OP

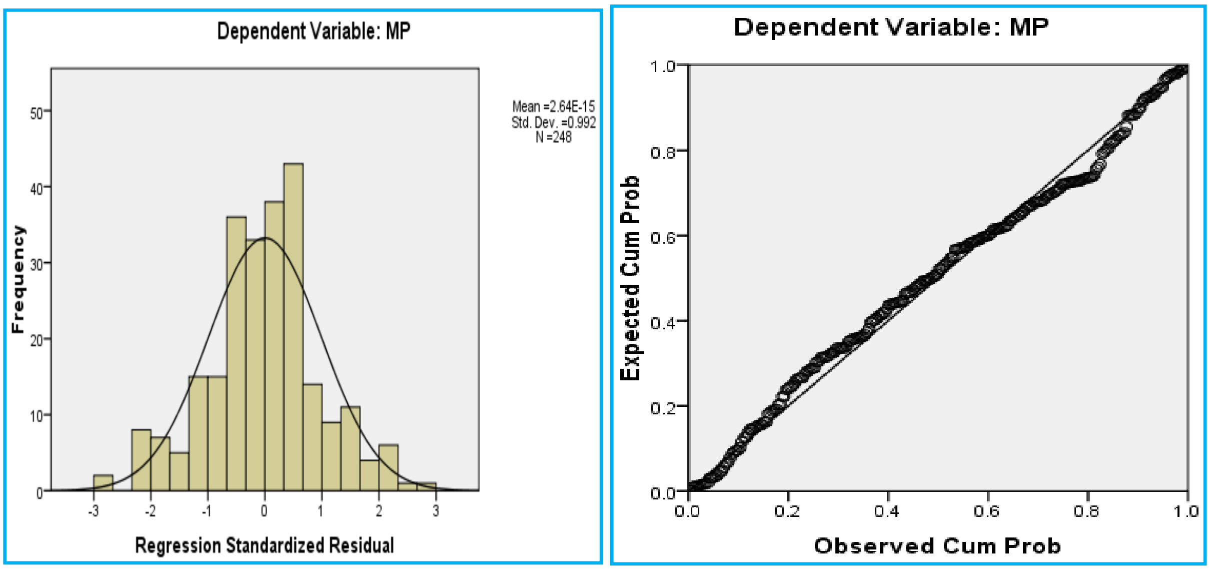


Figure 5.21. Histogram and Normal P-P plot of Regression Standardized Residuals of MP

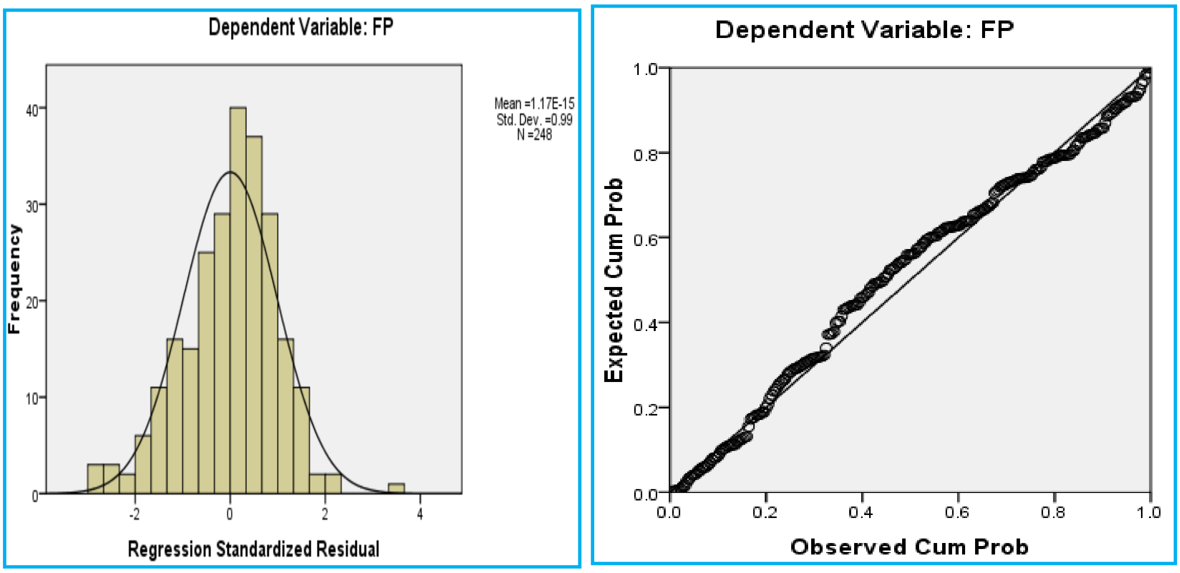


Figure 5.22. Histogram and Normal P-P plot of Regression Standardized Residuals of FP

Table 5.18. Configurational Perspective Fit (Misfit) Results

Performance Measure	OP				MP				FP			
	Industry-Type Included[a]		Industry Type Excluded[b]		Industry Type Included[a]		Industry Type Excluded[b]		Industry Type Included[a]		Industry Type Excluded[b]	
Independent Variables	Model 1[c]	Model 2[d]	Model 1[c]	Model 2[d]	Model 1[c]	Model 2[d]	Model 1[c]	Model 2[d]	Model 1[c]	Model 2[d]	Model 1[c]	Model 2[d]
Intercept	3.244***	4.251***	3.237***	4.222***	1.677***	2.850***	1.684***	2.831***	2.914***	3.921***	2.378***	3.321***
Firm Size	0.177**	0.168**	0.177**	0.168**	0.296***	0.288***	0.296***	0.288***	0.392***	0.385***	0.490***	0.374***
Industry Type	0.002[ns]	0.009[ns]	-	-	0.001[ns]	-0.004[ns]	-	-	0.144***	0.149***	-	-
ISO - 9001 Registration	-0.061 [ns]	-0.132 [ns]	-0.061 [ns]	-0.077 [ns]	0.053 [ns]	0.039 [ns]	0.053 [ns]	0.039 [ns]	0.023 [ns]	0.009 [ns]	0.052 [ns]	-0.012 [ns]
Information Technology	o.304***	0.222***	0.305***	0.223***	0.292***	0.221***	0.292***	0.221***	0.193***	0.126**	0.270***	0.146**
Misfit	-	**-0.187*** **	-	**-0.187*** **	-	**-0.162** **	-	**-0.162** **	-	**-0.152** **	-	**-0.145** **
R	0.351	0.388	0.351	0.388	0.466	0.488	0.466	0.488	0.491	0.509	0.470	0.487
R^2	0.123	0.151	0.123	0.151	0.217	0.238	0.217	0.238	0.241	0.259	0.221	0.237
Adjusted R^2	0.109	0.133	0.113	0.137	0.204	0.222	0.207	0.225	0.228	0.244	0.211	0.225
Change in R^2	0.123	0.028	0.123	0.027	0.217	0.021	0.217	0.021	0.241	0.018	0.211	0.017
F Statistics	8.54***	8.59***	11.438***	10.783***	16.848***	15.091***	22.556***	18.94***	119.28***	16.927***	23.015***	18.887***
Change in F^2	8.54***	7.846***	11.438***	7.856***	16.848***	6.529**	22.556***	6.551**	19.289***	5.919**	23.015***	5.290
Model Fit Significance	0.00***	0.00***	0.000***	0.000***	0.00***	0.011**	0.000***	0.011**	0.000***	0.016**	0.000***	0.022**
Results	H27 supported				H28 supported				H29 supported			

[a], Industry Type Included.
[b], Industry Type Excluded.
[c], Misfit excluded.
[d], Misfit included.
*****: significant at $p < 0.01$ as t-value is larger than 2.58.
**** : significant at $p < 0.05$ as t-value is larger than 1.95.
[ns] **:** not supported. Standardized beta (**β**) coefficients are reported, whereas intercept coefficient is unstandardized.

Further, these two models, using a hierarchical multiple regression analysis, to control the significant contribution of contextual factors as firm size, industry type, ISO-registration and information technology are performed. In first model, contextual variables' effects are assess and in the second model after accounting variance for the contextual factors misfit effects are assessed. All the models are significant at $p < 0.05$.

Misfit β_5 in all the models is significantly (negatively) associated with performance measures and positively support Hypotheses H27, H28 and H29. Only firm size and information technology significantly contributed in all the models, whereas, industry type (except industry type contributed only in OP) and ISO-9001 registration effects are insignificant in all the models. Moreover, models (industry type included and excluded) results are almost similar, and reflects strong support for configurational perspective results robustness. These results indicate that only partial implementation of these practices is not sufficient, organizations must try to implement all these practices to the utmost level to acquire higher standards of competitiveness.

5.3.4 GESTALT FIT RESULTS

Gestalt fit, using discriminant analysis, is employed to identify the significant practices that differentiate between high and low performers (OP, MP and FP). Gestalt fit is good enough to test Configuration of practices (management, common infrastructure and core practices) in Universal and Contingency Perspectives simultaneously (Cua, 2000; Cua et al., 2001). A series of models (universal and contingency perspectives) are tested. Four models for each performance measure are tested, two for each perspective, one with super-scales (Macro-Level) and one with subscale (Micro-Level) practices respectively. In Universal perspective, two models are tested for each performance measure, one with super scales (Macro-level) of management, internal and external infrastructures, core manufacturing practices (TQM, JIT and AM) and in the second model sub-scales (Micro-Level) of management, internal / external infrastructures and core manufacturing practices (TQM, JIT and AM) are incorporated. Similarly, in contingency perspective, similar models as in universal perspective are tested, however, firm size (an most significant organizational contextual factor) is included in each model to test for contingency perspective fit. Only firm size is used as contextual factor as industry type and ISO-9001 Registration fail to significantly contribute in performance (see section 5.3.3.1).

Before performing discriminant analysis complete sample is divided into two halves, based on median, as high and low performers. T-test for each performance measure is performed to check for the group (high and low performers) differences. T-test results for each performance measure (OP, MP and FP) are presented in Table 5.19 respectively. Sub-groups (high and low performers) are significantly different at $p < 0.01$. Moreover, to assess the operational practices significant contribution, a χ^2 difference test is performed to test the operational practices contribution after accounting for the contextual (firm size) effects. First model is tested using firm size as an independent variable and in the second model, super-scale and sub-scale alternatively are incorporated. All the χ^2 difference tests are significant and indicate that operational practices (management, infrastructure and core practices) significantly contribute in each performance measure after catering for firm size effects (see Table 5.20).

Table 5.19. t-test Results for OP, MP and FP

Test Variable	Full Sample	Group 0 Size	Group 1 Size	t-value	*p-value*
OP	248	123	125	21.198	0.000***
MP	248	105	143	22.497	0.000***
FP	248	111	137	17.786	0.000***
*****:** significant at p < 0.01 as t-value is larger than 2.58.					

Table 5.20. χ^2 Difference Tests with and without Contextual Variables

Model	Contextual factor		Contextual and Operational Practices		Model Significance		
	χ2	*df*	χ2	*df*	Δχ2	Δ*df*	Significance
OP with Super Scale	5.157	1	36.620	7	31.463	6	0.000***
MP with Super Scale	5.157	1	60.039	7	54.882	6	0.000***
FP with Super Scale	5.157	1	86.053	7	80.896	6	0.000***
OP with Sub-Scale	5.157	1	48.156	19	42.999	18	0.000***
MP with Sub-Scale	5.157	1	67.691	19	62.534	18	0.000***
FP with Sub-Scale	5.157	1	94.483	19	89.326	18	0.000***
***. Significant at P < 0.01 as t-value is larger than 2.58.							

Gestalt fit results, for universal perspective and contingency perspectives, are presented in Table 5.21 and Table 5.22 respectively. Test statistics like C_{pro}, Hit ratio, Jack-knife Hit Ratio, Canonical Correlation, Wilk's Lambda and Chi-Square meet the specified criteria (see section 5.2). All the super-scales like; management, common infrastructure and Core TQM, JIT & AM Practices, except Core JIT do not contribute in FP, and it significantly differentiate between high and

Table 5.21. Gestalt Fit Results – Universal Perspective Results

MEASUREMENT SCALE		CONFIGURATIONAL PERSPECTIVE					
		OP		MP		FP	
Super Scale (SS)	Sub-Scale Practices (SSP)	Structure Loadings		Structure Loadings		Structure Loadings	
		(SS)	(SSP)	(SS)	(SSP)	(SS)	(SSP)
TMC		0.493***		0.635***		0.712***	
CII		0.504***		0.626***		0.736***	
CEI		0.700***		0.646***		0.472***	
TQM		0.447***		0.542***		0.792***	
JIT		0.746 ***		0.344**		0.057	
AM		0.680***		0.676***		0.510***	
	TMC		0.421***		0.572***		0.603***
	IS		0.385**		0.451***		0.529***
	ET		0.285		0.481***		0.567***
	SVP		0.387**		0.512***		0.542***
	CT		0.328**		0.389**		0.38**
	PE		0.368**		0.377**		0.474***
	RWC		0.58***		0.55***		0.355**
	RWS		0.47***		0.457***		0.344**
	PD		0.393**		0.543***		0.489***
	CI		0.301***		0.281		0.149
	SPC		0.258		0.392**		0.404***
	LSR		0.487***		0.154		0.094
	STR		0.463***		0.188		0.029
	JS		0.397**		0.408***		0.125
	PPS		0.615***		0.226		0.037
	CP		0.394**		0.494***		0.237
	KM		0.536***		0.56***		0.376**
	AMT		0.452***		0.549***		0.407***
Test Statistics							
Sample		248	248	248	248	248	248
Group 0 size		123	123	105	105	111	111
Group 1 Size		125	125	143	143	137	137
C*pro*		49.6%	49.6%	51.0%	51.0%	50.5%	50.5%
Hit Ratio		62.9%	66.5%	70.25%	69.8%	64.5%	70.2%
Jack-knife Hit Ratio		60.9%	58.9%	67.7%	61.3%	63.7%	62.9%
Canonical Correlation		0.364	0.416	0.389	0.425	0.374	0.430
$(\text{Canonical Correlation})^2$		0.132	0.173	0.151	0.159	0.140	0.185
Wilk's Lambda		0.868	0.827	0.849	0.820	0.860	0.815
Chi-Square		34.487	45.016	39.858	47.098	36.623	48.523
Degree of Freedom		6	18	6	18	6	18
Significance		0.000***	0.000***	0.000***	0.000***	0.000***	0.000***

Structure loading ***. Cut-off criteria is ≥ 0.4 and **. Cut-off criteria is ≥ 0.3
***. Model is significant as p-value is larger than 2.58

Table 5.22. Gestalt Fit Results – Contingency Perspective Results

MEASURING SCALE		CONTINGENCY PERSPECTIVE					
		OP		MP		FP	
		Structure Loadings		Structure Loadings		Structure Loadings	
Super Scale (SS)	Sub-Scale Practices (SSP)	(SS)	(SSP)	(SS)	(SSP)	(SS)	(SSP)
TMC		0.477***		0.506***		0.440***	
CII		0.468***		0.499***		0.453***	
CEI		0.658***		0.514***		0.292	
TQM		0.432***		0.431***		0.304**	
JIT		0.721***		0.274		0.035	
AM		0.678***		0.611***		0.315**	
FIRM SIZE		0.361**		0.676***		0.811***	
	TMC		0.405***		0.466***		0.41***
	IS		0.371**		0.367**		0.36**
	ET		0.274		0.392**		0.386**
	SVP		0.372**		0.417***		0.369**
	CT		0.316**		0.317**		0.258
	PE		0.354**		0.307**		0.322**
	RWC		0.558***		0.448***		0.242
	RWS		0.452***		0.372**		0.234
	PD		0.378**		0.442***		0.333**
	CI		0.29		0.229		0.102
	SPC		0.249		0.32**		0.275
	LSR		0.469***		0.126		0.064
	STR		0.446***		0.153		0.02
	JS		0.382**		0.332**		0.085
	PPS		0.592***		0.184		0.025
	CP		0.379**		0.402***		0.161
	KM		0.516***		0.456***		0.255
	AMT		0.435***		0.447***		0.277
	FIRM SIZE		0.307**		0.622***		0.755***
Test Statistics							
Sample		248	248	248	248	248	248
Group 0 size		123	123	105	105	111	111
Group 1 Size		125	125	143	143	137	137
Cpro		49.6%	49.6%	51.0%	51.0%	50.5%	50.5%
Hit Ratio		64.5%	67.7%	69.8%	71.0%	75.4%	77.0%
Jack-knife Hit Ratio		61.3%	57.3%	67.7%	65.7%	73.8%	72.2%
Canonical Correlation		0.374	0.429	0.468	0.499	0.547	0.574
$(\text{Canonical Correlation})^2$		0.140	0.184	0.219	0.249	0.30	0.33
Wilk's Lambda		0.860	0.816	0.781	0.751	0.701	0.671
Chi-Square		36.620	48.156	60.039	67.691	86.053	94.48
Degree of Freedom		7	19	7	19	7	19
Significance		0.000***	0.000***	0.000***	0.000***	0.000***	0.000***

Structure loading ***. Cut-off criteria is ≥ 0.4 and **. Cut-off criteria is ≥ 0.3
***. Model is significant as p-value is larger than 2.58

low performers in all forms of performance measures (OP, MP and FP). These results are consistent with literature once all practices (management, infrastructure and core practices) are employed produce significant positive results (Cua et al., 2001; Inman et al., 2011; Zelbst et al., 2010).

In Sub-Scale model (Micro-Level) with OP, all practices, with an exception of SPC (0.258) and ET (0.85 marginally below the threshold criteria of $\geq \pm 3$) significantly contribute in OP. Similarly, TMC and micro practices, pertaining to CII, CEI, TQM and AM, significantly differentiate in MP and FP (high and low performers). AM (CP, KM and AMT) significantly contributes in all forms of the performance measures. JIT (Micro-level practices) effects are not much significantly realized in FP (Jayaram et al., 2008), however, it significantly contributes in OP (Shah & Ward, 2003).

In contextual perspective firm size effectively affects OP, MP and FP in super scales as well as sub-scales models (Narasimhan et al., 2006; Shah & Ward, 2003). All the loadings remain significant as in Universal Perspective, however, loadings tend to lower once firm size effects are realized, especially, JIT (Micro-level practices) effects are further reduced after firm size is incorporated in the model. Overall, at Micro level, top management commitment, inward focus (employees training and empowerment, strategic vision & planning, information system), outward focus (relationship with customer and suppliers), and Core AM (change proficiency, knowledge management and advance manufacturing technology) significantly differentiate between high and low performers. These results provide a guideline regarding significance of Macro and Micro level practices to the managers of large and SMEs firms of Apparel Export Industry to re-adjust their strategic focus to acquire different performance (OP, MP and FP) milestones.

5.4 FINAL LEAN (TQM & JIT) AND AM INTEGRATED MANUFACTURING DEVELOPED FRAMEWORK

Propose conceptual research framework is transformed into a final 3-Stage business-wide strategic framework for Lean (TQM & JIT) and AM integrated manufacturing through in-depth statistical analysis as shown in Figure 5.23. The 3-stage strategic framework holds good for Apparel (Readymade Garments and Knitwear & Hosiery) Export Industry of Pakistan to improve export business performance. Moreover, this framework holds equally good for Readymade Garments and Knitwear & Hosiery Industry, as industry-type moderation effects are negligible. Detail explanation of final framework is as following;

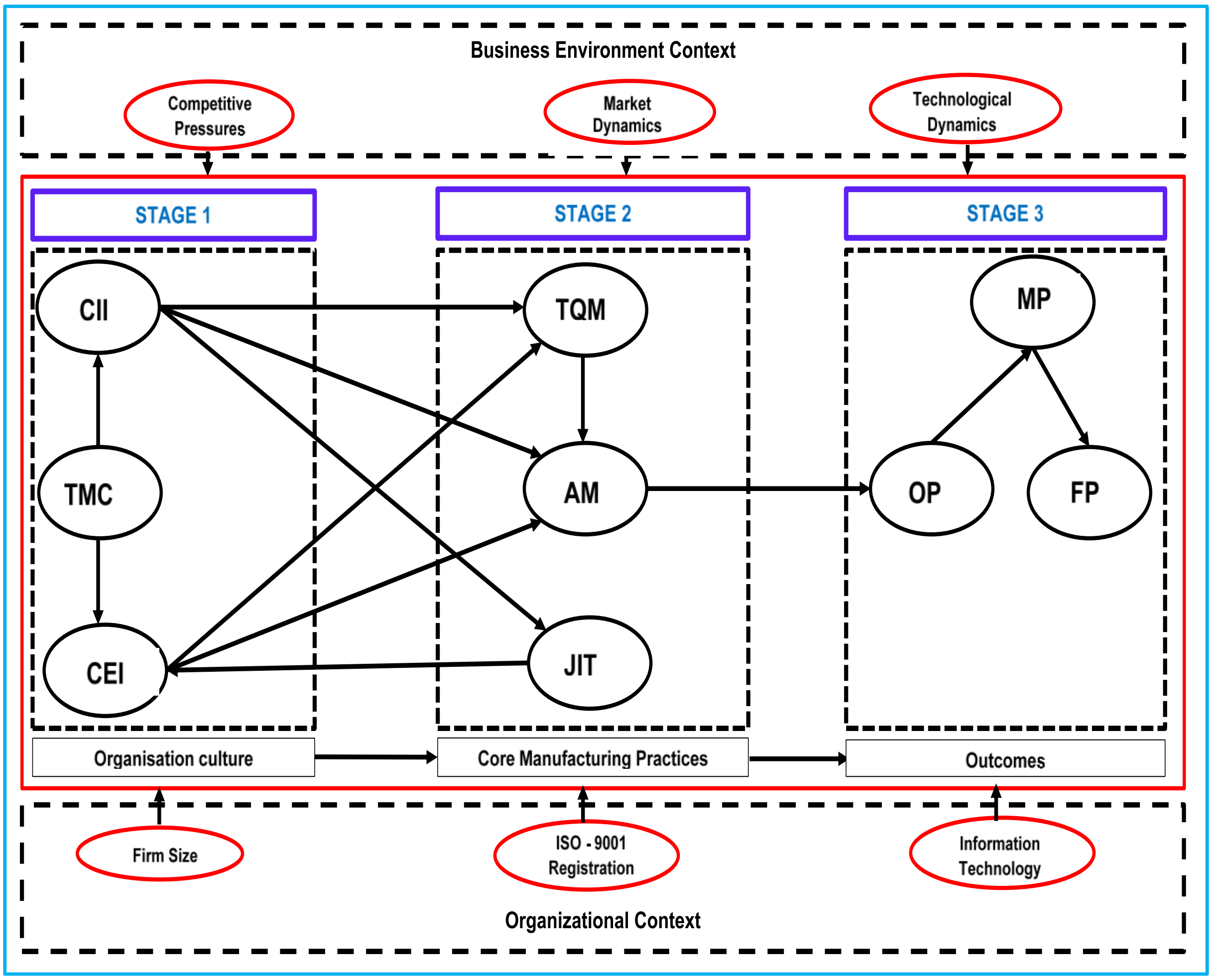


Figure 5.23. Business-Wide Strategic Framework for Lean (TQM & JIT) and AM Integrated Manufacturing

At **Stage-1**, organization culture, there is no change in proposed theoretical/conceptual framework. All the Hypotheses, H1 & H2, confirm the proposed relationship. At **Stage-2**, Hypotheses, H3 to H9, also confirm the proposed relationship. However, Hypothesis H10, Core JIT Practices → Core AM Practices) fails to prove the propose relationship. The same relationship is re-routed through CEI practices (core JIT practices → CEI practices → core AM practices). CEI practices positively mediate the relationship between Core JIT Practices and Core AM Practices (Inman et al., 2011). Inman et al. (2011), suggested that Core JIT practices do not directly contribute in core AM practices, however, JIT supply (relationship with suppliers) positively mediates the same relationship. Similarly, Frohlich and Westbrook (2001) also suggested that organizations, having outward focus (strong relationship with customers and suppliers), are at par than inward focus (weak relationship with customers and suppliers). Similarly, Furlan et al. (2011a), also confirmed that upstream JIT (suppliers relationship) and downstream JIT (customers relationship) synergy effects improve JIT production.

At **Stage-3**, outcomes stage, Hypotheses, H11 & H12, Core TQM → OP and Core JIT → OP, also fail to confirm the proposed relationship. Although, in a traditional working environment, TQM and JIT can positively improve organizational performance (OP). However, in an Agile working environment, TQM and JIT alone may not be able to contribute in OP and require AM to be in place to improve OP (Zelbst et al., 2010). Similarly, Vokurka and Lummus (2000, p. 96) also proposed that future business priorities tend to shift from traditional requirements comprising of attributes like, "low cost, high products quality in a greater variety". Core AM practices positively mediate the relationship between Core TQM and OP. Similarly, indirect effects from Core JIT to OP are positive through CEI and core AM practices (Core JIT → CEI → Core AM → OP).

Moreover, at outcomes stage, Hypothesis H17, OP → FP, fails to confirm the proposed relationship. However, the same relationship is positively mediated through MP (OP → MP → FP). The plausible justification is that in an Agile working environment OP may, or may not, directly contribute in business FP. Organizations needs to be extra vigilant toward market performance. Improved MP (market share) in combination with improved OP will improve business FP (Green Jr et al., 2014; Inman et al., 2011).

Organization contextual factors, except industry type (H20a & H20b), confirm the proposed relationship (H19a, H19b, H21a, H21b, H22a & H22b) and significantly moderate the relationship among management, infrastructure, core manufacturing practices and business performance. Industry type moderating effects, H20a & H20b, are insignificant plausibly due to similar working environment of Readymade Garments and Knitwear & Hosiery Export Industry. Especially, large firms are at par in implementation and, on performance frontiers as compare to SMEs. Large firms primarily enjoy this supremacy due to having advanced production set-ups and better MP. However, Hypotheses; H19b, H21b, H22b, results are partially confirmed and need to be observed with due caution. Directionality is a serious concern and needs further investigation using a large sample size.

Business environmental contextual factors confirm the proposed relationship (H23a, H23b, H24a, H24b, H25a, H25b, H26a, H26b) and significantly moderate the relationship among management, infrastructure, core manufacturing practices and business performance. However, Hypotheses, H23b, H24b, H25b, H26b, results are partially confirmed and need to be observed with due caution. Directionality is a serious concern and needs further investigation, using a large sample size. Organizations need to continuously monitor competitor's moves, customer's preference trends and respective industrial technological up-gradation and make necessary changes in organizational structural and technological capabilities to meet volatile market challenges.

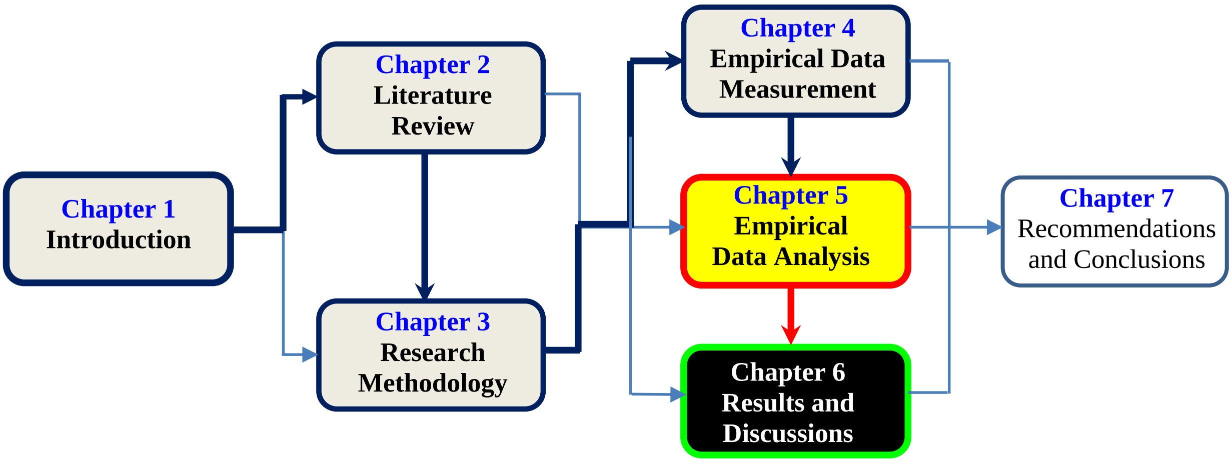
5.5 FINIDINGS OF EMPIRICAL DATA ANALYSIS

This Chapter starts with description of analysis methods require to test this research study. Three methods SEM (CB-SEM & PLS-SEM), multiple regression analysis and discriminant analysis are described in detail. Test criteria for each method is also spelled out. Five, out of six forms of fit, proposed by Venkatraman (1989) are tested using these methods. Direct covariation, mediation and moderation fits are tested using SEM (CB-SEM and PLS-SEM) technique. Profile deviation fit is tested using multiple regression analysis technique, whereas, Gestalt fit is tested using discriminant analysis technique. A total **37 Hypotheses, 29 Main H1-H29 and 8 Auxiliary H19b-H26b,** are tested using these three techniques. Hypotheses, H10, H11, H12 and H17, fail to support the proposed Hypotheses. Similarly, Hypotheses, **H20a and H20b,** fail to support the proposed Hypotheses. Whereas a partial support for Hypotheses, **H19b to H26b, except H20b**, is found. Through, rigorous statistical techniques a 3-stage strategic framework is developed for effective implementation of management, common infrastructure (internal and external), Lean (TQM & JIT), AM in working environment of Export Apparel Industry of Pakistan (see Section 5.3).

5.6 SUMMARY

This Chapter comprises two parts, (1) data analysis methods, (2) empirical data analysis. Three data analysis methods are described. Research Hypotheses are tested employing five forms of fit to ascertain the Lean (TQM & JIT) and AM implementation under universal, contingency and configurational perspectives. Finally, a 3-Stage model is developed for implementation of Lean (TQM & JIT) and AM to improve export performance in Apparel Export Industry of Pakistan. Chapter 6 shall provide the discussion on results of each research questions.

Chapter-5 Direction to the Chapter-6



CHAPTER 6

RESULTS AND DISCUSSIONS

6.1 INTRODUCTION

This Chapter provides detailed discussion on results of each research question and objectives defined in Chapter 1. This Chapter comprises three Sections. The Second Section provides detailed discussion on results of each research question and research objective duly investigated through Chapter 2 to Chapter 5. The third section summarizes the discussion chapter.

6.2 RESULTS DISCUSSIONS

The research study clearly defined interrelated, though, independent nine research questions and ten research objectives. The research study is designed in a way to thoroughly investigate each research question and acquire possible research solutions for Apparel (Readymade and Knitwear and Hosiery) Export Industry of Pakistan. Detailed discussion on each research question is provided in succeeding Sections.

6.2.1 RESULTS OF QUESTION 1

Research Question 1 aims to investigate the research objectives 1 & 2 as following:

RQ1. What are the Management, Common Infrastructure (internal and external), Core Lean (TQM & JIT) and Core Agile Manufacturing practices reported in the literature and how these can be integrated in a single conceptual framework in the export environment of Apparel (Readymade Garments, Knitwear and Hosiery) Industry of Pakistan?

The answer to first part of this question is given in Section 2.10 (see Table 2.15) and, answer to the second part is given in Section 2.14 and Section 3.2 (see Figure 2.30 & Figure 3.1). Management practices, along with set of micro practices, related to each macro element e.g., common infrastructure (internal and external), Core TQM, Core JIT, and Core AM, are identified through extensive review of extant literature. Management practices reflect the top management commitment. Common internal infrastructure practices are measured using a sub-set of five practices i.e., cross training, empowered teams, information system, strategic vision & planning and plant environment. Common external infrastructure practices are measured using a sub-set of two practices i.e., relationship with suppliers and relationship with customers). Core TQM Practices are measured using a sub-set of three practices i.e., continuous improvement, product design, and process control). Core JIT Practices are measured using a sub-set of four practices i.e., JIT scheduling, lot size reduction, set-up time reduction, and pull production system. Similarly, Core AM practices are measured using a sub-set of three practices i.e., change proficiency, knowledge management and advance manufacturing technology.

Proposed conceptual framework comprised three stages. At Stage-1, combine effects of management, common internal and external infrastructure practices, reflect organization culture. Effective establishment of Stage-1, enables core-manufacturing Stage–2 like core TQM, Core JIT and Core AM Practices. Finally, effective establishment of organization culture (Stage-1) and core practices (Stage-2) positively contributes in export business performance (operational, market and financial) of Apparel (Readymade garments, Knitwear and Hosiery) Export Industry of Pakistan. Answer to RQ1 also accomplishes Research objectives 1 & 2.

6.2.2 RESULTS OF QUESTION 2

Research Question 2 aims to investigate Research Objective 3 as following:

RQ2. What level of Management, Common Infrastructure (internal and external), Core Lean (TQM & JIT) and Core Agile Manufacturing practices are being implemented in the export environment of Apparel (Readymade garments, Knitwear and Hosiery) Industry of Pakistan?

The detailed answer, to this question is given in Section 4.6.5.4 (see Table 4.11). Management, Infrastructure (internal and external) Practices, Core Lean (TQM & JIT) and Core Agile Manufacturing (AM) practices are measured on a scale of 1-7. If, this scale is measured on percentile scale then all the practices' implementation range between 70 to 80% i.e., information system mean 5.58 max and advance manufacturing technology mean 4.96 min. Moreover, low SD measures indicate better understanding of these practices. This level of implementation indicates a fair acceptance and implementation level of these practices in export environment of Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan. However, advance manufacturing technology, lowest score of 4.96, implementation needs serious attention as it can provide organizations an edge over market competitors. On the other hand, obsolete technology may become a source of low quality, high rework ratio which indirectly also increase the lead-time. Advance manufacturing technology may also provide flexibility to handle variation in product variety. Managers need to thoroughly evaluate organization technical capability vis-à-vis market requirements. Future business plans must incorporate up-gradation of technical capabilities. Government also shall step into this matter to resolve technical competence problems. Technology up-gradation needs huge investment, which, especially, SMEs are unable to do due to limited resources. At National level, there is a dire need to provide flexible technology up gradation loans to facilitate SMEs players to upgrade their technical competence to meet the International market requirements. Moreover, profile deviation fit also provides an insight of management, infrastructure and core manufacturing practices implementation.

Profile deviation misfit results reveal that there is a significant implementation gap between actual practices' implementation from empirical ideal profile. Especially, practices implementation is significantly different across firms. As firm size increases, adoption of these practices shift towards empirical ideal profile. Therefore, SMEs' managers are advised to seriously implement these practices within their organizations. Answer to RQ2 also accomplishes Research Objective 3.

6.2.3 RESULTS OF QUESTION 3

Research Question 3 aims to investigate Research Objective 4 as following:

RQ3. How do Management, Common Infrastructure (internal and external), Core Lean (TQM & JIT) and Core Agile Manufacturing practices interrelate in the export environment of the Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan?

The detailed answer, to this question, is given in Section 4.6.5.4 (see Table 4.11 at micro- level) and Section 4.6.5.1 (see Table 4.19 at Macro level). All the Management, Infrastructure (internal and external) Practices, Lean (TQM & JIT) and Agile manufacturing (AM) Practices are significantly correlated with each-others within respective major domain practices (micro-level), like internal infrastructure practices with other internal infrastructure practices and other domain's practices, e.g., internal infrastructure practices with external infrastructure practices or management practices etc., as well. Similarly, at macro level, systems like, management practices, internal infrastructure, external infrastructure, Core TQM, Core JIT and Core AM Practices are positively correlated with each-other. Moreover, nomological validity test also confirms a comprehensive relationship among micro and macro set of systems. Answer to RQ3 also accomplishes Research Objective 4.

6.2.4 RESULTS QUESTION 4

Research Question 4 aims to investigate Research Objective 5 as following:

RQ4. Are Core Lean (TQM & JIT) and Agile Manufacturing practices “Mutually Supportive or Complementary” to each other in the export environment of Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan?

The detailed answer, to this question, is given in Section 5.3.1.1.(a). Once the direct link among Management, Infrastructure (internal and external) Practices, Core Lean (TQM & JIT), Core AM Practices, and three performance measures i.e., OP, MP and FP, is tested. The results reveal that none of the practices, except CII with MP & FP, significantly relate to performance measures (OP, MP & FP). These results endorse that these initiatives are not mutually supportive or complementary. However, model fit statistics for these three models are perfectly within specified criteria. Model fit statistics indicate that there is a significant theoretical relationship among these managerial initiatives and provide sufficient evidence to investigate the mutual support relationship from antecedent Core TQM & JIT antecedent to core AM standpoint. Managers are advised, not to implement these initiatives simultaneously, as it is possible that they may ignore importance of Lean (TQM & JIT) and directly focus on AM. This way true benefits of AM may not be realized as desired. Answer to RQ4 also accomplishes Research Objective 5.

6.2.5 RESULTS QUESTION 5

Research Question 5 aims to investigate research objective 6 as following:

RQ5. Are core Lean (TQM & JIT) Manufacturing and Core Agile Manufacturing competeing, thus, the two are ‘Mutually Exclusive or Competeing’ in the export environment of Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan?

The detailed, answer to this question, is given in Section 5.3.1.1.(b). Once the direct link among Management, Infrastructure (internal and external) Practices, Core Lean (TQM & JIT), core AM practices and three performance measures (OP, MP and FP), is tested. These practices, hypothesising an independent relationship between core Lean (TQM & JIT) and core AM practices by constraining correlation path to zero from Core AM to Core TQM & JIT, fail to contribute in three performance measures (OP, MP and FP). Then a χ^2 difference test is performed to ascertain that whether mutually exclusive model performs better than mutually supportive model or otherwise. χ^2 difference test reveals that there is sufficient evidence available to determine, that Core Lean (TQM & JIT) and Core AM practices are not

"Mutually Exclusive or Competing" in the export environment of Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan. Moreover, a significant correlation between Core Lean (TQM & JIT) and Core AM practices (see Table 4.19) indicates that these practices are not mutually exclusive or competing rather these practices are supportive, in a way that one is antecedent to the other, in an Agile working environment. This answer also refute the notion, that Lean (TQM & JIT) and AM are competing in nature and cannot be implement simultaneously. Managers are cautioned to refrain from considering these initiatives as independent entity. They must not ignore the importance of one while implementing other and must implement both to get max benefit of mutual effects of these improvement initiatives. Answer to RQ5 also accomplishes Research Objective 6.

6.2.6 RESULTS OF QUESTION 6

Research Question 6 aims to investigate Research Objective 7 as following:

RQ6. Are Core Lean (TQM & JIT) antecedent to Core Agile Manufacturing, in the export environment of Apparel (Readymade Garments, Knitwear and Hosiery) Industry of Pakistan?

The detailed answer, to this question, is given in Section 3.2 and Section 5.3.1.2. The research framework, based on literature review in Chapter-2, propose that Lean (TQM & JIT) Manufacturing practices are antecedent to AM. However, during theory testing phase (see Section 5.3.1.2), JIT (**H-10**) failed to relate directly to AM. Moreover, JIT indirectly relates, through external infrastructure practices, to AM (Frohlich & Westbrook, 2001; Furlan et al., 2011a; Hofer et al., 2012; Inman et al., 2011; Zelbst et al., 2010). Moreover, nine alternative models are also tested to confirm the AM relationship with management, infrastructure (internal and external) practices and Core Lean (TQM & JIT). None of the alternative model proves to be better than the proposed model (see Table 4.9), hence confirm the best suitability of the proposed relationship of Core Lean (TQM & JIT) as antecedent to AM (Bottani, 2010; Narasimhan et al., 2006; Sharp et al., 1999), among management, Infrastructure (internal and external) practices and Lean (TQM & JIT) and AM. Moreover, significant mediation results (see Table 5.10) and Direct and Indirect results (see Table 5.11) indicate best stage-wise implementation of proposed theory. These results provide a detailed insight for Apparel managers to understand the best implementation format of these performance improvement initiatives. Managers should refrain themselves from fractional implementation of these improvement initiatives as effective establishment of precursor enables the forerunner. Answer to RQ6 also accomplishes Research Objective 7.

6.2.7 RESULTS OF QUESTION 7

Research Question 7 aims to investigate Research Objective 8 as following:

RQ7. How do Organizational Contextual Factors (Firm Size, ISO-9001 Registration, Industry Type, and Information Technology) moderates the Management, Common Infrastructure (internal and external), Core Lean (TQM & JIT) and Core Agile manufacturing practices implementation and impact on export performance in the export environment of Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan?

The detailed answer, to this question, is given in Section 5.3.2.1 and Section 5.3.2.2. Moderating effects (Hypotheses H19a to H22a and H19b to H22b) of organizational Contextual Factors (Firm Size, ISO-9001 Registration, Industry Type, and Information Technology) are tested (see Table 5.12 and Table 5.15). These effects are tested in two Phases. In Phase-I, Organizational Contextual Factors' overall moderating effects (Hypotheses H19a to H22a) are investigated (see Table 5.12). All the factors, except industry type, significantly moderate the , management, common (internal and external) infrastructure, Core Lean (TQM & JIT) and Core AM implementation and impact on export performance of Apparel (Readymade garments, Knitwear and Hosiery) Industry of Pakistan. In phase II, Organizational Contextual Factors path-by-path moderating effects (Hypotheses H19b to H22b) are investigated (see Table 5.15). Partial support for, Hypotheses H19b, H21b and H22b, is found, whereas, no support for Hypothesis H20b is found (see Table 5.17). A notably path coefficients directionality concern is observed. Path coefficients are not uni-directional for each Organizational Contextual Factor and need further investigation. Mainly large firms, with ISO-9001 registration and highly conversant with information technology outperform SMEs firms. Answer to RQ7 also accomplishes Research Objective 8.

6.2.8 RESULTS OF QUESTION 8

Research Question 8 aims to investigate Research Objective 9 as following:

RQ8. How do Business Environmental Contextual Factors (market dynamics, competitive pressures and technologialc dynamics) moderate the Management, Common Infrastructure (internal and external), Core Lean (TQM & JIT) and Core Agile manufacturing practices implementation and impact on export performance in the export environment of Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan?

The detailed answer to this question is given in Section 5.3.2.1 and Section 5.3.2.2. Moderating effects (Hypotheses H23a to H26a and H23b to H26b) of environmental contextual (competitive pressures, market dynamics and technologialc dynamics) factors are tested (see Table 5.12 and Table 5.16). These effects are tested in two Phases. In Phase-I, Environmental Contextual Factors' overall moderating effects (Hypotheses H23a to H26a) are investigated. All the factors significantly moderate the management, common (internal and external) infrastructure, Core Lean (TQM & JIT) and Core AM implementation and impact on export performance of Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan (see table 5.12). In Phase-II, Environmental Contextual Factors path-by-path moderating effects (Hypotheses H23b to H26b) are investigated (see Table 5.16). Partial support for Hypotheses H23b to H26b is found (see Table 5.17). Similarly, like Organizational Contextual Factors, a notably path coefficients directionality concern is observed. Path coefficients are not uni-directional for each environmental contextual factor and need further investigation. Apparel industry is significantly affected by rapid change in market dynamics, intense competition by the competitors and advancement in industry related technology. Managers need to be outward focus and must be watchful towards minor/major market (customer preferences) changes. At the same time, they must maintain a close liaison with suppliers and keep themselves abreast with emerging situations to minimise the change response time. Finally, technology up-gradation must be given due consideration in organization short-term and long-term strategy development process. Answer to RQ8 also accomplishes Research Objective 9.

6.2.9 RESULTS OF QUESTION 9

What are the different configurations of Macro and Micro Management, Common Infrastructure (internal and external), Core Lean (TQM & JIT) and Core Agile Manufacturing practices which significantly differentiate between high and low performance measures i.e., OP, MP and FP.

Research Question 9 aims to investigate Research Objective 10 as following:

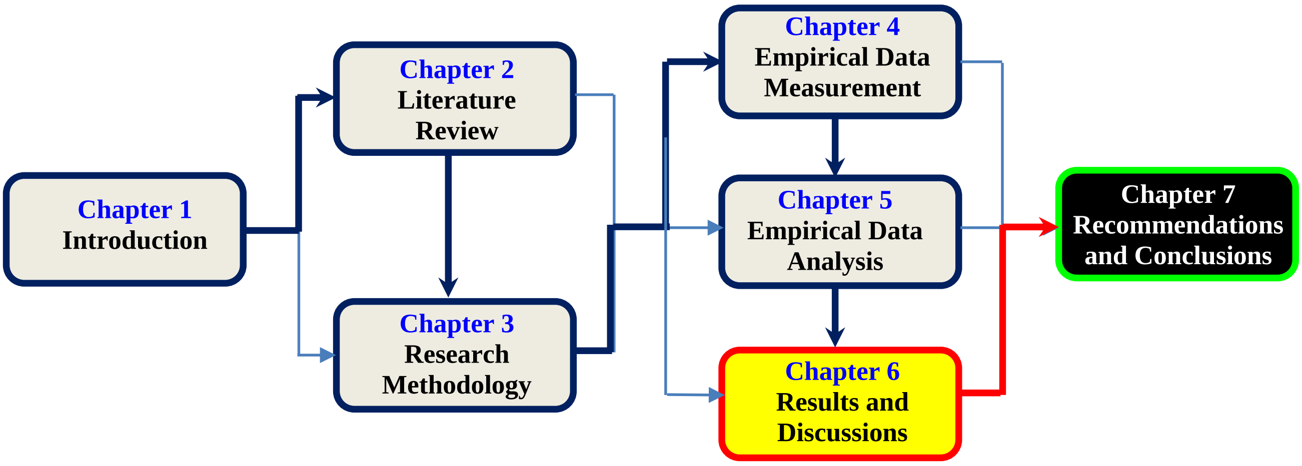
Gestalt profile results revealed that at Macro level all practices, except JIT, is unable to differentiate in FP, significantly differentiate between high and low performers under universal and contingency perspectives (see Table 5.21 and Table 5.22). Whereas, at Micro level, top management commitment, inward focus (employees training and empowerment, strategic vision & planning, information system), outward focus (relationship with customers and suppliers), and Core AM (change proficiency, knowledge management and advance manufacturing technology) significantly differentiate between high and low performers. At micro level, JIT practices significantly contribute in OP, but effects are not much realize in MP and FP. Similarly, TQM practices' effects are realized on three forms of performance measures. However, MP and FP effects are much significant as compare to OP.

Similarly, results are almost similar in contingency perspective. Firm size also significantly differentiates between high and low performers (see Table 5.22). Large firms are at par as compare to small and medium firms. These results provide an insight that SMEs managers must adopt these practices within their organization to achieve performance objectives. Answer to RQ9 also accomplishes Research Objective 10.

6.3 SUMMARY

This Chapter provided discussion on each Research Question and Objective. Each Research Question and Research Objective is discussed in detail. Theoretical and Managerial implications, in the light of each Research Questions, are provided. Research question 1 provides detail on identification of management, common internal and external infrastructure, Core TQM, JIT and AM practices through literature. Moreover, this question also answer how these factors can be integrated, together in most effective way, through the development of a conceptual framework. Answer to research question 2 provides degree of adoption of these practices in Apparel Export Industry of Pakistan. Answer to research question 3 provides detail on inter-relationship of these practices. Answers to research questions 4, 5 and 6 provide in-length discussion on inter-relationship of these practices e.g., mutually supportive, mutually exclusive and antecedent relationship respectively. Answer to research question 7 describes the moderating effects of Organizational Contextual Factors (firm size, ISO-9001 registration, industry type & Information technology) on implementation and impact of management, common internal and external infrastructure, Core TQM, JIT & AM practices on export performance. Answer to research question 8 addresses the moderating effects of business environment contextual factors (competitive pressures, market dynamics & technological dynamics) on implementation and impact of management, common internal and external infrastructure, Core TQM, JIT & AM practices on export performance. Finally, answer to research question 9 provides an insight of configurations of different practices under universal and contingency perspective across high and low performers. Results reveal that large firms are at par as compare to SMEs. Chapter 7 shall provide detail on research contributions, future research recommendations and finally research study conclusions.

Chapter-6 Direction to the Chapter-7



CHAPTER 7

RECOMMENDATIONS AND CONCLUSIONS

7.1 INTRODUCTION

This study has thoroughly investigated the Lean (TQM & JIT) and AM inter-relationship of mutually supportive, mutually exclusive and antecedent approach relationship under universal, contingency and configurational perspective. This Chapter comprises four Sections. The second Section provides detail on research contributions. This Section provides detail on research contribution as Lean (TQM & JIT) and AM integrated manufacturing theoretical framework development, theory formulation and expansion of research process. The third Section provides guidelines to managers of Apparel Export Industry of Pakistan for understanding Lean (TQM & JIT) and AM practices inter-relationship within their organizational and business environmental contexts. The fourth Section provides future research recommendations. Finally, fifth Section concludes the entire research study.

7.2 RESEARCH CONTRIBUTIONS

The core essence of this research study is to resolve the long outstanding (approximately two decades) and conflicting inter-relationship issue between Lean (TQM & JIT) and AM paradigms. Using multiple analysis (state-of-the-art statistical) methods, these paradigms mutual proposed relationship is unfolded within organizational and business environmental boundaries in Apparel Export Industry of Pakistan. Research study contributions are described in four Sub-Sections as following;

(a) Development of a Theoretical Framework of Lean (TQM & JIT) and AM Integrated Manufacturing

(b) Theory Formulation of Lean (TQM & JIT) and AM Integration

(c) Development of Research Process of Lean (TQM & JIT) and AM Integrated Manufacturing

7.2.1 DEVELOPMENT OF A THEORETICAL FRAMEWORK OF LEAN (TQM & JIT) AND AM INTEGRATED MANUFACTURING

It is evident, from previous studies, that performance improvement initiatives e.g., TQM, JIT, TPM, HRM, and AM etc., have been tested in isolation (Bottani, 2010; Dow et al., 1999; Dowlatshahi & Cao, 2006; Furlan et al., 2011a; Inman et al., 2011; Kaynak, 2003; Lakhal et al., 2006; Sharp et al., 1999; Sila, 2007; Vázquez-Bustelo et al., 2007; Z. Zhang &

Sharifi, 2000), or in a partial combination of these programs (Cua et al., 2001, 2006; Dal Pont et al., 2008; Flynn et al., 1995a; Furlan et al., 2011b; Hallgren & Olhager, 2009; McKone et al., 2001; Narasimhan et al., 2006; Shah & Ward, 2003; Zelbst et al., 2010). However, to the best knowledge of the researcher, a comprehensive study encompassing management, infrastructure (internal and external), Lean (TQM & JIT) and AM, is yet missing in the field of OM research field. Moreover, the scope of these studies mostly restricted to plant performance (Cua et al., 2001, 2006; Flynn et al., 1995a; Hallgren & Olhager, 2009; McKone et al., 1999; Narasimhan et al., 2006; Shah & Ward, 2003; Zelbst et al., 2010) and only few studies reported contribution of these performance initiatives in overall business improvement (Inman et al., 2011; Jayaram et al., 2008; Kaynak, 2003; Lakhal et al., 2006; Yang et al., 2011). Few studies proposed a close relationship among these performance improvement initiatives (e.g., TQM, JIT, AM) (Dove, 1999; Goldman & Nagel, 1993; Gunasekaran, 1999b; Sharifi & Zhang, 1999; Sharp et al., 1999; Vázquez-Bustelo & Avella, 2006) but yet a comprehensive empirical validation of these models still lacks in the field of OM research (Sharp et al., 1999; Vázquez-Bustelo et al., 2007). This research study filled this theoretical gap as following:

First, this study synthesized key Macro and Micro organization elements of this framework through literature review (see Table 2.15). These elements are arranged in a state-of-the-art Theoretical Framework, which explicitly integrates (antecedent perspective) management, infrastructure (internal and external), Core Lean (TQM & JIT) and core AM (see Section 3.2) with business performance. Further, framework boundaries are expanded from traditional Plant Performance to Business Performance (OP, MP, and FP).

Second, this framework is different from earlier studies as it clearly outlines the internal and external infrastructure boundaries of an organization. This study also explicitly segregates common internal and external infrastructure required to enable Core TQM, Core JIT and Core AM practices. Moreover, core AM construct, comprising of change proficiency, knowledge management and advance manufacturing technology, is developed and, its psychometric properties are empirically validated.

Third, this framework also facilitates to ascertain the contingency and configurational effects of these, performance improvement initiatives. This framework incorporated Organizational Contextual Factors (firm size, ISO-9001 registration, industry-type and information technology) and business environmental External Contextual Factors (competitive pressures, market dynamics, and technological dynamics). Overall, this framework provides an explicit road map for manufacturing industrial sectors in general, and to Apparel Export Industry of Pakistan in particular, to acquire agility to enhance business (export) performance.

7.2.2 THEORY FORMULATION OF LEAN (TQM & JIT) AND AM INTEGRATED MANUFACTURING

In Chapter-2 and Chapter-3, through literature review, a 3-Stage theory is proposed, integrating Management, Infrastructure (internal and external), Core Lean (TQM & JIT) and Core AM Practices and their impact on Business Performance within a coherent framework base on Theory of Systems (ToS), Contextual Theory (Contingency Theory and Institutional Theory), configurational theory under different OM perspectives (universal, contextual and configurational). Three stages of the proposed theory are; (1) culture, (2) core manufacturing, and (3) outcomes. The each stage acts, as input to the next stage to form a complete system comprises socio-technical practices.

The proposed theory is cross validated empirically using three forms of fit. In universal fit, proposed theory is validated considering model fit is free from organizational and environmental contextual effects. In this perspective, direct mutually supportive, mutually exclusive approaches are discarded, whereas, mutually supportive (antecedent approach) is empirically proved to be the best fit. Moreover, in universal perspective fit, antecedent approach, theory is partially modified, as Core JIT Practices failed to directly relate to core AM Practices, however, the same found to be the best fit once mediated (two paths) through common external infrastructure and core TQM Practices (see Section 5.3.1.2). The modified theory is in line with earlier studies. Whereas, in contingency fit, using reductionist approach, modified theory is tested under different organizational, and environmental, contexts. Similarly, in configurational fit, using holistic approach, proposed theory is tested. The proposed and partially modified theory proves to be robust under Universal, Contingency and Configurational Approach.

In Contingency Perspective Fit, reductionist approach, Organizational and Business Environment Contextual Factors moderating effects are analysed. This approach allows understanding the implementation of micro systems under different organizational contextual constraints. These effects are tested in two ways, (1) overall moderating effects, (2) path-by-path moderating effects. Overall moderating effects of internal and external contextual factors' moderating effects, except industry-type, are observed. Overall moderation effects' robustness needs further investigation as sample size limitation is a challenge to these results. In path-by-path analysis, partial moderation effects are observed. Directionality of these results is not consistent and poses a serious issue but, at the same time, it opens new arena for in-depth analysis of path-by-path analysis. The theory proposes that different contexts' effects are different and organizations should keep themselves abreast with the changes in business environment and keep on reshaping business strategy within organizational structural capabilities.

In configurational perspective fit, using holistic approach, in-depth investigation of the contribution of each Micro system is investigated. Profile deviation fit technique is applied to test holistic form of fit. Profile deviation fit results also indicate a serious deviation of actual profile from an empirical ideal profile. Large firms are at par in implementation of Lean (TQM & JIT) and AM practices as compare to SMEs.

Gestalt fit results indicate different Micro systems' configuration that differentiate between high and low performance measures, consistent with the theory of systems, allows the alignment between different practices structures and the organizations operating environment. At Macro level, all Macro systems, except JIT failed to differentiate between high and low FP measures, significantly differentiate between high and low performers. Whereas, at Micro level, management, empowered teams, employees training, strategic vision & planning, information system, relationship with customers and suppliers and Core AM Practices (AMT, CP & KM) significantly differentiate between high and low performers (OP, MP & FP). The trend remains the same across Large and SMEs firms. However, larger firms are at par as compare to SMEs.

7.2.3 DEVELOPMENT OF RESEARCH PROCESS OF LEAN (TQM & JIT) AND AM INTEGRATED MANUFACTURING

This research study accomplished three stages of Lean (TQM & JIT) and AM integrated manufacturing theory development process defined in OM i.e., "theory description", (2) "mapping and relationship building", and (3) "theory validation" (Handfield & Melnyk, 1998, p. 336). This research study also lays a strong foundation to address fourth stage of the theory development process i.e., "theory extension and refinement".

This study provides a road map to Lean (TQM & JIT) and AM integrated manufacturing theory building and development process. This process starts from theory building process, based on relevant, already established, theories in the field of OM and validation through empirical evidences. Empirical validations of proposed theory add value to the theory building process through integration of new theoretical developments, as well as modifications, into existing theories.

This study tested the proposed theory, using five different forms of fit proposed by Venkatraman (1989). The use of multiple forms of fit to test the same theory, using state of the art statistical analysis techniques, reinforces the theory assessment process and enhances resulted theory generalizability. Testing the same theory, through multiple statistical techniques, benefit to the theory development and validation process through extraction of valuable aspects, which is not possible using a single analysis method. This study proposed and empirically validated a robust relationship among management, infrastructure (internal and external), Lean (TQM & JIT) and AM practices. More importantly, a different approach from earlier studies, this study segregated internal and external infrastructure boundaries required to enable Core TQM, JIT and AM Practices.

Core AM Practices second order scale is also developed. Especially change proficiency scale, a Micro system of Core AM practices, is developed using ***Q*-sorting** technique. The resulting scale reliability is confirmed through assessment of different psychometric properties. Moreover, change proficiency, knowledge management and advance manufacturing micro systems are combined to form a Macro Core AM system. These Macro, and Micro, scales will assist OM researchers in future research studies to explore new avenues, particularly related to AM alone, as well as, Lean (TQM & JIT) and AM integrated manufacturing. Overall, this study expanded the inter-relationship boundaries of improvement initiatives, especially Lean (TQM, JIT) and AM through "theory-grounded empirical research process" which is the essence of OM research.

7.3 RECOMMENDATIONS FOR APPAREL EXPORT INDUSTRY OF PAKISTAN

This study provides a conceptual clarity and explicitly delineates the inter-relationship among management, common infrastructure (internal and external), Lean (TQM & JIT) and AM practices in Apparel Export Industry of Pakistan. This study provides a conceptually enriched and empirically validated, a 3-Stage Strategic Framework (see Figure 5.23), to the managers of Apparel Export Industry of Pakistan, to understand the implementation relationship among management practices, common internal and external infrastructure practices, Core TQM Practices, Core JIT Practices, Core AM Practices and business performance measures (OP, MP & FP) (see Section 5.4). Managers should be clear while implementing these improvement initiatives in their organization and should refrain themselves to consider these paradigms directly mutually supportive, or mutually, exclusive (competing). Performance improvement initiatives implementation should be as per proposed sequence (antecedent approach see Section 5.3.1.2), otherwise piecemeal implementation of these performance improvement initiatives is likely to produce negative results (see Section 5.3.1.1). This research study also highlighted the organizational structural importance, especially firm size, while implementing these performance improvement initiatives. Gestalt fit result provides an insight for understanding performance difference causes. Especially SMEs managers are caution to be more focused towards Micro systems implementation like employees' training and empowerment, information system, relationship with customers and suppliers, adoption of advance manufacturing technology, improve change proficiency capability and transform organization into a continuously learning organization in order to shift from low performers bloc to high performers bloc. Similarly, Profile deviation results also indicate that SMEs must be serious in adoption of these practices in order to attain a status similar of empirical ideal profile organizations. At the same time, managers are advised to closely monitor their organizational structure as well as business environment while implementing this strategic framework. A mismatch among organizational structure, business environment and improvement initiatives is likely to result in negative results.

The 3-stage strategic framework provides following stage-wise recommendation for Apparel (Readymade Garments and Knitwear & Hosiery) Export Industry of Pakistan. These recommendations holds equally good for Readymade Garments and Knitwear & Hosiery Industry, as industry's effects are negligible in implementation of these performance improvement initiatives.

(a) **STAGE–1 (ORGANIZATION CULTURE)**

At Stage–1, Top Managers of Apparel Export Firms of Pakistan must first lay a solid foundation through establishment of internal and external infrastructure. First, top managers must develop a strategic vision and a business plan, keeping organization present and future expected capabilities vis-à-vis present and future business challenges. Top Management must pay special attention on employees' training to meet present, and future, business needs. Employees must be trained on routine equipment maintenance to keep their respective machines and plant in working condition. Top Management must develop a trust-oriented organization, where, competent employees are empowered, with an explicit degree of decision making powers, in their respective fields. Employees' empowerment scope should include directly dealing with customers, and suppliers, having certain degree of decision power. An organization-wide effective information system should be established for easy access of relevant information, internally to employees within the organization and externally, to the customers and suppliers. Top Management must take concrete measures to build a long-term relationship with customers and suppliers. Customers and suppliers should not be treated in a traditional way, rather they should be considered as business strategic partners. Customers and suppliers should be part of organizations' strategic, and operational, levels decision-making process to meet future challenges.

(b) **STAGE-2 (CORE MANUFACTURING PRACTICES)**

At Stage-2, core practices execution takes place in two Phases. In Phase-I, Managers must lay a strong foundation for execution of Core AM through simultaneously implementation of Core TQM and Core JIT Practices. TQM practices help in improving product design quality, through employees, customers and suppliers input in product designing stage. Moreover, TQM Practices help to continuously improve and keep the process within control limits using process control measures and feedback from process and product changes. JIT Practices help to improve production system efficiency by keeping lot size small, set-up time reduction, strictly production schedule adherence and adopting pull production system. It helps to minimise inventory stocks due to unnecessary production. Core TQM Practices and Core JIT Practices help to improve production system quality and reduce waste by eliminating rework, and defects, which help to decrease cost and lead-time. In Phase-II, Core AM Practices take place. AM Practices help to foresee, any expected/un-expected change in the business environment. Organization's knowledge base and technological capacity should be capable and flexible enough to respond to unexpected business changes. The cumulative effects of well establish organization culture (Stage-1) and responsive core manufacturing practices (Stage-2) provide the organization an edge over its competitors to attain competitive advantage of cost, quality, delivery and flexibility.

(c) **STAGE – 3 (OUTCOMES)**

At Stage-3, business outcomes are realized. Managers need to understand, that merely acquiring operational efficiency may, or may, not increase business financial performance. This study provides a clear insight of inter-relationship among operational, market and financial performance to the managers. Managers must keep an eye on market performance by continuously monitoring market share and market share growth indicators. If at all, organization is losing its market share, or unable to increase its growth, organization must take incremental, or radical, improvement measures in organizational structural, or technological capabilities, to maintain and enhance business market share and its growth.

(d) **ORGANIZATIONAL CONTEXTUAL FACTORS EFFECTS**

Large firms are at par in implementation of these performance improvement initiatives. SMEs managers must put in extra efforts to effectively implement these business improvement initiatives to realize better export business performance results. Substantial investment is required to be made in information technology and manufacturing technology. ISO- 9001 registration and use of information technology also help in effective implementation of these initiatives and improve business performance.

(e) **BUSINESS ENVIRONMENTAL CONTEXTUAL FACTORS EFFECTS**

Business environmental contextual factors seriously affect export business performance. Therefore, Managers must keep themselves abreast with competitor’s moves, customer preferences’ changing trends, and industry-wide technological developments. A timely evaluation of competitors’ moves, market preferences’ changing trends and rapid industry technological up-gradation will assist organizations to make necessary changes in business’ structural and technological capabilities to meet customers’ demands and remain competitive.

7.4 FUTURE RESEARCH DIRECTIONS

This is the first research study in the field of OM that comprehensively examines the interrelationship among management, internal and external infrastructure, Core TQM, Core JIT and Core AM Practices, and their impact on business performance (OP, MP & FP) at Macro and Micro level. This study also incorporates the organizational contextual and environmental effects upon implementation of 3-Stage system. However, this research also does have some limitations which open new avenues where these limitations should be meticulously addressed in future research studies.

(a) First, this study scope is limited to value added part (i.e., Apparel Export Industry) of the Textile and Clothing Industry of Pakistan. This study did not incorporate other segments of the Textile and Clothing export industry, comparatively less value added sectors, like cotton yarn, cotton cloth, bed-wear, towels, raw cotton, etc. Therefore, it is recommended that future research studies should be conducted incorporating whole Textile and Clothing Export Industry of Pakistan. Moreover, a comparison can be drawn out of these practices implementation between high value added, and low value added, segments of the industry. Moreover, future research should also incorporate other manufacturing sectors of Pakistan to investigate the application of this framework across all other, exporting and non-exporting manufacturing sectors.

(b) Second, this study sample size limits to undertake the path-by-path investigation, using CB-SEM, of these practices implementation across sub-groups (e.g., firm size, ISO-9001 registration etc.). Therefore, it is recommended that a future study be conducted with a large sample size, preferably over 500 with a substantial representation of each sub-group, in order to carry out path-by-path investigations of these practices across different sub-groups. This study provides a cross sectional view of the industry due to time and other constraints. Therefore, a longitudinal study should be conducted to validate the robustness of this framework. Moreover, this study also has some limitations due to single firm–single respondent (unit of analysis) and is likely to be affected by common method bias. Therefore, it is recommended that future research studies should be conducted incorporating single firm – multiple respondents (unit of analysis) to eliminate potential common method bias. These two aspects, longitudinal and multiple respondents' approach, are likely to dig out more practical and robust understanding of this framework.

(c) Third, different contexts from organizational, and supply chain aspects, not part of this study, should be incorporated in future studies. For example, product supply chain aspects, like engineer to order (ETO), make to order (MTO), assemble to order (ATO), and make to stock (MTS) should be incorporated in future research studies. Moreover, vertical integration, an extension from supply chain perspective, should be incorporated in future research studies. Similarly, different production process types, e.g., job-shop, batch, assembly line, and continuous flow, also need due investigation with respect to this framework in manufacturing industry in general, and in Textile and Clothing industry in particular. Moreover, Information Technology and Advance Manufacturing Technology emerged as significant performance differentiators. Therefore, future research study should investigate the investment in advance manufacturing and information technology effects on export performance of the organizations.

(d) Fourth, Pakistan is working in the most competitive region of Apparel Export Industry of the world. Its major regional competitors are China, Bangladesh and India etc. Therefore, it is recommended that a study should be conducted, expanding research scope from domestic to regional level, incorporating representation of Apparel Export Firms from regional (China, Bangladesh and India) countries. This study results will definitely provide a much mature insight of application of this framework.

(e) Moreover, this study did not incorporate the government policies upon promotion and growth of this industrial segment. Recently, Pakistan Textile and Clothing Sector has been awarded General Preference System (GPS) by European market. GPS is likely to give a major boost to the growth of this sector. Government must develop investment-friendly environment, like Bangladesh, to attract foreign investment. Foreign investments will inject a new life to this sector and this sector will emerge as a major economic sector at national level and regional competitor at international level. Therefore, future research study should cater for this aspect and its effects upon the growth of this industrial segment. Moreover, this study also did not tested the major customer markets like USA region and European region effects. Therefore, future research should also investigate critical dimensions of export markets.

7.5 CONCLUSIONS

This research study develops and empirically validates a conceptual framework that resolves the long outstanding and conflicting relationship issue of Lean (TQM & JIT) and AM in the research field of OM. Moreover, this framework also incorporates management and infrastructure practices to eliminate the plausible relationship ambiguity among management, infrastructure (internal and external), Lean (TQM & JIT) and AM practices and joint impact of these practices on performance measures (OP, MP and FP). This study identified and segregated common internal infrastructure practices from external infrastructure practices require to enable Core TQM, Core JIT and particularly Core AM Practices. Moreover, Core AM construct comprising of three dimensions (CP, KM and AMT) is developed and its psychometric properties are empirically validated.

This study examines the nine Research Questions and ten Research Objectives. Proposed research framework fit under universal perspective fit, contingency perspective fit and configurational perspective fit, using a sample of 248 Apparel Export Firms of Pakistan, is empirically validated using multiple statistical techniques. Five forms of fit (direct covariation, mediation, moderation, profile deviation and gestalt) are tested using multiple analysis methods like SEM (CB-SEM and PLS-SEM) for direct covariation and indirect covariation (Mediation) and Moderation fit, multiple regression analysis for Profile Deviation fit and Discriminant analysis for Gestalt fit. Proposed conceptual framework is partially modified, based on theoretical and empirical justification as Core JIT Practices fail to directly link with Core AM Practices, however, the same is redirected through CEI practices based on theoretical and empirical justification. Moreover, core TQM practices and core JIT practices also fail to contribute in OP directly, nevertheless, AM positively mediates the same relationship. Modified framework is also tested under organizational and business environmental contexts. Gestalt fit results, indicated that management commitment plays a pivotal role to acquire three forms of performance (OP, MP, FP) objectives. Moreover, at micro level, employees training and empowerment, strategic vision & planning, information system, strategic relationship with customers and suppliers, knowledge management, change proficiency and most significantly advance manufacturing technology significantly differentiate between high and low performers. Profile deviation fit results indicate that there is significant difference between actual adoption level of these practices from empirically ideal profile. Especially, Large firms are at par as compare to SMEs.

The final 3-Stage modified framework provides a strategic roadmap, at Macro (system level) and Micro level (sub-system level), to the managers of Apparel Export Industry of Pakistan in particular, and manufacturing managers in general, to remain competitive and acquire business performance milestones (OP, MP and FP). Overall, this study resolves the long outstanding issues in the field of OM and provides a detailed theoretical, and empirical, justification for Lean (TQM & JIT) and AM implementation (antecedent approach) under Universal, Contingency and Configurational Perspectives.

APPENDIX 'A'

Conceptual Framework key Constructs Description with Literature Support

Strategic Area		Practices / Enablers	Description	Literature Support
Organisation Culture	**Management Practices**	**Top Management Commitment**	Anticipation and planning to respond to change in business/market. Promotion of use of quality tools & techniques. Essential managers training on quality tools & techniques. Provision of adequate resources for product and process quality improvement. Accountability for achieving quality, innovation and improvement targets.	Saraph et al. (1989), Mehra & Inman (1992), Flynn et al. (1994), Anderson et al. (1994), Flynn et al. (1995a, 1955b), Powell (1995), Ahire et al. (1996), Black and Porter (1996), Rungtusanatham et al. (1998), Grandzol and Gershon (1998), Gunasekaran (1998, 1999b), Samson and Terziovski (1999), Mckone et al. (1999), Zhang and Sharifi (2000, 2007), Ravichandran and Rai (2000), Cua et al.(2001), Douglas and Jr (2001), Curkovic et al. (2000), Lakhal et al. (2006), Ramesh and Devadason (2007), Vázquez-Bustelo et al. (2007), Zu et al. (2008), Yang et al. (2011), Zhang (2011)
	Common Internal Infrastructure	**Cross Training**	Provide diverse training to employees in order to perform multiple tasks. Rotating shop floor employees among different jobs. Reward for learning new skills & techniques. Evaluation based on continual professional development criteria.	Saraph et al. (1989), Mehra & Inman (1992), Flynn et al. (1994), Anderson et al. (1994), Powell (1995), Flynn et al. (1995a, 1995b), Ahire et al. (1996), McLachlin (1997), Rungtusanatham et al. (1998), Mckone et al. (1999), Dove (1999), Sharp et al. (1999), Samson and Terziovski (1999), Gunasekaran (1998,1999b), Ravichandran and Rai (2000), Zhang and Sharifi (2000, 2007), Curkovic et al. (2000), Douglas and Jr (2001), Cua et al. (2001), Shah and Ward (2003), Ahmad et al.(2003), Lakhal et al. (2006), Narasimhan et al. (2006), Ramesh and Devadason (2007), Vázquez-Bustelo et al. (2007), Shah and Ward (2007), Zu et al. (2008), Furlan et al. (2011b), Yang et al.(2011), Zhang (2011)
		Empowered Teams	Empowering teams to handle production scheduling, suppliers certification and training, labour scheduling/job assignment, independent decision-making, performance reviews and operate together with suppliers and customers.	Saraph et al. (1989), Mehra & Inman (1992), Flynn et al. (1994), Anderson et al. (1994), Powell (1995), Flynn et al. (1995a, 1995b), Ahire et al. (1996), Black and Porter (1996), McLachlin (1997), Gunasekaran (1998, 1999b), Samson and Terziovski (1999), Dove (1999), Sharp et al. (1999), Mckone et al. (1999), Curkovic et al. (2000), Ravichandran and Rai (2000), Zhang and Sharifi (2000, 2007), Cua et al. (2001), Shah and Ward (2003), Lakhal et al. (2006), Narasimhan et al. (2006), Shah and Ward (2007), Ramesh and Devadason (2007), Vázquez-Bustelo et al. (2007), Zu et al. (2008), Furlan et al. (2011b), Yang et al. (2011), Zhang (2011)
		Information System	Sharing information on productivity and providing feedback on strategic and economic information to employees for problem solving. Share generic operational data with suppliers to improve supplies. Maintain frequent contact and communicate with suppliers and customers.	Saraph et al. (1989), Flynn et al. (1994), Anderson et al. (1994), Ahire et al. (1996), Black and Porter (1996), Mckone et al. (1999), Sharp et al. (1999), Naylor et al. (1999), Cua et al. (2001), Fynes and Voss (2002), Shah and Ward (2007), Vázquez-Bustelo et al. (2007), Gunasekaran (1998, 1999b), Ravichandran and Rai (2000), Zhang and Sharifi (2000, 2007), Zu et al. (2008), Yang et al. (2011), Zhang (2011), Prajogo and Olhager (2012)

Strategic area		Practices / Enablers	Description	Literature Support
Organisational Culture		**Strategic Vision and Planning**	Formal strategic planning process, written mission, long-term goals and implementation strategies. Involvement of plant management in strategic planning process. Regular review and updating of long-range strategic plans.	Saraph et al . (1989), Mehra & Inman (1992), Flynn et al. (1994), Anderson et al. (1994), Powell (1995), Flynn et al. (1995a, 1995b), Black and Porter (1996), McLachlin (1997), Gunasekaran (1998), Samson and Terziovski (1999), Sharp et al.(1999), Zhang and Sharifi (2000, 2007), Douglas and Jr (2001), Cua et al. (2001), Ahmad et al. (2003), Vázquez-Bustelo et al. (2007), Yang et al. (2011), Zhang (2011)
		Plant Environment	Emphasis on state of readiness of Plant and equipment. Putting all tools and fixtures at their place after use. Feeling pride in keeping plant neat and clean. Providing training to machine operators on preventive maintenance.	Saraph et al. (1989), Flynn et al. (1994), Mehra & Inman (1992), Flynn et al. (1995a, 1995b), McLachlin (1997), Mckone et al. (1999), Ravichandran and Rai (2000), Cua et al.(2001), Shah and Ward (2003), Shah and Ward (2007), Zu et al. (2008), Furlan et al. (2011), Yang et al. (2011), Inman et al. (2011)
	Common External Infrastructure	**Relationship with Customers**	Maintenance of close contact with customers. Sharing customer satisfaction surveys results with employees for improvement. Creating opportunities for employee – customer interaction. Translating customer requirements into new products. Empowering customer service employees to resolve customer complaints quickly.	Flynn et al. (1994), Anderson et al. (1994), Powell (1995), Flynn et al. (1995a, 1995b), Ahire et al. (1996), Rungtusanatham et al. (1998), Gunasekaran (1998), Samson and Terziovski (1999), Dove (1999), Sharp et al.(1999), Mckone et al. (1999), Curkovic et al. (2000), Ravichandran and Rai (2000), Zhang and Sharifi (2000, 2007), Douglas and Jr (2001), Cua et al. (2001), Ahmad et al. (2003), Lakhal et al. (2006), Narasimhan et al. (2006), Shah and Ward (2007), Vázquez-Bustelo et al. (2007), Jayaram et al. (2008), Zu et al. (2008), Zelbest et al. (2010), Furlan et al. (2011a), Inman et al. (2011), Yang et al. (2011), Zhang (2011)
		Relationship with Suppliers	Establishing long-term relationships with suppliers based on quality, price and reliability. Involving suppliers in new product development process. Fewer dependable suppliers and collaborate with them to improve their quality in the long term.	Saraph et al. (1989), Mehra & Inman (1992), Flynn et al.(1994), Anderson et al. (1994), Powell (1995), Flynn et al. (1995a, 1995b), Ahire et al.(1996), Black and Porter (1996), McLachlin (1997), Rungtusanatham et al. (1998), Gunasekaran (1998), Dove (1999), Naylor et al. (1999), Samson and Terziovski (1999), Sharp et al. (1999), Mckone et al. (1999), Ravichandran and Rai (2000), Zhang and Sharifi (2000, 2007), Cua et al. (2001), Ahmad et al. (2003), Lakhal et al. (2006), Narasimhan et al. (2006), Shah and Ward (2007), Vázquez-Bustelo et al. (2007), Zu et al. (2008), Zelbest et al.(2010), Inman et al. (2011), Yang et al. (2011), Zhang (2011), Furlan et al. (2011a), Prajogo et al. (2012)

Strategic area		Practices / Enablers	Description	Literature Support
Core Manufacturing	**Core TQM Practices**	**Product Design**	Involvement of designing and manufacturing engineers, production and quality assurance people in new product design or redesigning in existing product. Composite teams formulation from major functions (marketing, manufacturing, etc.) to introduce new products. Incorporation of customer requirements / feedback in the new product design process.	Saraph et al. (1989), Flynn et al. (1994), Anderson et al. (1994), Powell (1995), Flynn et al. (1995a, 1995b), Ahire et al. (1996), Black and Porter (1996), McLachlin (1997), Gunasekaran (1998), Ravichandran and Rai (2000), Zhang and Sharifi (2000, 2007), Cua et al. (2001), Narasimhan et al. (2006), Vázquez-Bustelo et al. (2007), Zu et al. (2008), Zelbest et al. (2010), Inman et al. (2011), Zhang (2011)
Core Manufacturing	**Core TQM Practices**	**Process Management (SPC)**	Extensive use of statistical process control (SPC) techniques on shop floor. Use of SPC charts to determine manufacturing processes capabilities.	Saraph et al. (1989), Mehra & Inman (1992), Flynn et al. (1994), Anderson et al. (1994), Powell (1995), Flynn et al. (1995a, 1995b), Ahire et al. (1996), Black and Porter (1996), McLachlin (1997), Rungtusanatham et al. (1998), Gunasekaran (1998, 1999b), Samson and Terziovski (1999), Zhang and Sharifi (2000, 2007), Curkovic et al. (2000), Douglas and Jr (2001), Cua et al. (2001), Shah and Ward (2003), Shah and Ward (2007), Narasimhan et al. (2006), Zu et al. (2008), Zelbest et al. (2010), Inman et al. (2011), Furlan et al. (2011b), Yang et al. (2011), Zhang (2011)
Core Manufacturing	**Core TQM Practices**	**Continuous Improvement**	Continuous improvement through employee's participation. Emphasis be stressed upon continuous improvement in all work processes.	Flynn et al. (1994), Anderson et al. (1994), Powell (1995), Rungtusanatham et al.(1998), Gunasekaran (1998), Sharp et al. (1999), Zhang and Sharifi (2000, 2007), Curkovic et al. (2000), Douglas and Jr (2001), Shah and Ward (2003), Narasimhan et al. (2006), Inman et al. (2011), Furlan et al. (2011), Yang et al. (2011), Zhang (2011)
Core Manufacturing	**Core JIT Practices**	**Lot Size Reduction**	Use of small lot sizes in master schedule. Aggressively working to lower lot sizes in plant.	Mehra & Inman (1992), McLachlin (1997), Gunasekaran (1998), Shah and Ward (2003), Narasimhan et al. (2006), Shah and Ward (2007), Zhang and Sharifi (2000), Zelbest et al. (2010), Inman et al. (2011) Furlan et al. (2011b), Yang et al. (2011)
Core Manufacturing	**Core JIT Practices**	**Set-up Time Reduction**	Aggressively working to reduce set-up times. Workers carryout practices to reduce set-up time. Assuring low equipment set-up time.	Mehra & Inman (1992), Mckone et al. (1999), Cua et al. (2001), McLachlin (1997), Gunasekaran (1998), Zhang and Sharifi (2000), Shah and Ward (2003), Shah and Ward (2007), Ramesh and Devadason (2007), Zelbest et al. (2010), Inman et al. (2011), Furlan et al. (2011), Yang et al. (2011)

Strategic area		Practices / Enablers	Description	Literature Support
Core Integrated Manufacturing		**Pull Production System**	Use of pull production system. Current work station production is pulled by the current demand of next work station. Use of kanban squares/containers for production control.	Mehra & Inman (1992), McLachlin (1997), Gunasekaran (1998), Mckone et al. (1999), Zhang and Sharifi (2000), Cua et al. (2001), Shah and Ward (2003, 2007), Narasimhan et al. (2006), Zelbest et al. (2010), Inman et al. (2011), Furlan et al. (2011), Yang et al. (2011), Zhang (2011)
		JIT Scheduling	Meet each day production schedule. Accommodate machine breakdowns or production stoppages due to quality problems in the production schedule.	Mehra & Inman (1992), Mckone et al. (1999), Cua et al. (2001), McLachlin (1997), Gunasekaran (1998), Vokurka and Fliedner (1998), Zhang and Sharifi (2000), Shah and Ward (2003), Narasimhan et al. (2006), Shah and Ward (2007), Zu et al. (2008), Zelbest et al. (2010), Inman et al. (2011), Furlan et al. (2011), Yang et al. (2011), Zhang (2011)
	Core AM Practices	**Change Proficiency**	Capable to sense, perceive, anticipate and respond to market changes. Adequate production process flexibility in terms of product models and configurations. Technological capable to quickly respond to changes in customer demand. Use of strategic vision to emphasize flexibility and agility. Capable to deliver in time. Quickly gets new products to the market.	Goldman and Nagel (1993), Goldman et al. (1995), Kidd (1995, 1997), Booth (1996), Preiss et al. (1996), Richards (1996), Gunasekaran (1998, 1999b), Vokurka and Fliedner (1998), Sharifi and Zhang (1999), Dove (1999), Sharp et al. (1999), Zhang and Sharifi (2000, 2007), Maskell (2001), Sarkis (2001), Hormozi (2001), Gunasekaran and Yusuf (2002), Yusuf and Adeleye (2002), Jin-Hai et al. (2003), Prince and Kay (2003), Brown and Bessant (2003), Vázquez-Bustelo and Avella (2006), Vázquez-Bustelo et al. (2007), Gunasekaran et al.(2008), Zelbest et al. (2010), Bottani (2010), Zhang (2011), Yusuf et al. (2012)
		Knowledge Management	Environment is created where employees are encouraged to learn from work experiences and share innovative ideas with each-others and management. Teams are prepared to constantly access, apply and update knowledge of the work. Easy access of organisational information databases to respective employees. Use of information system for dissemination of work knowledge.	Booth (1996), Vokurka and Fliedner (1998), Dove (1999), Gunasekaran (1998, 1999b), Sharp et al. (1999), Yusuf et al. (1999), Zhang and Sharifi (2000, 2007), Meredith and Francis (2000), Sarkis (2001), Hormozi (2001), Maskell (2001), Gunasekaran and Yusuf (2002), Yusuf and Adeleye (2002), Jin-Hai et al. (2003), Brown and Bessant (2003), Vázquez-Bustelo and Avella (2006), Vázquez-Bustelo et al. (2007), Gunasekaran et al. (2008), Zhang (2011), Hakala and Kohtamaki (2011)

Strategic area		Practices / Enablers	Description	Literature Support
		Advance Manufacturing Technology	Use of latest designing and manufacturing technologies like Computer Aided Design (CAD), Computer Aided Manufacturing (CAM) and Flexible Manufacturing Systems (FMS). Use of Rapid Prototyping for product development and design validation and Robotics in production system.	Goldman and Nagel (1993), Gunasekaran (1998, 1999b), Vokurka and Fliedner (1998), Sharifi and Zhang (1999), Sharp et al. (1999), Zhang and Sharifi (2000, 2007), Sarkis (2001), Hormozi (2001), Gunasekaran and Yusuf (2002), Yusuf and Adeleye (2002), Jin-Hai et al. (2003), Prince and Kay (2003), Cao and Dowlatshahi (2005), Dowlatshahi and Cao (2006), Vázquez-Bustelo and Avella (2006), Narasimhan et al. (2006), Ramesh and Devadason (2007), Vázquez-Bustelo et al. (2007), Gunasekaran et al. (2008), Zelbest et al. (2010), Bottani (2010), Inman et al. (2011), Zhang (2011)
Outcomes	**Operational Performance**	**Cost (Manufacturing)**	Unit cost of manufacturing including overhead cost like scrap, rework, warranty etc.	Sakakibara et al. (1997), Mckone et al. (1999), Dow et al. (1999), Lau (2000), Cua et al. (2001), Yusuf & Adeleye (2002), Shah and Ward (2003), Sila and Ebrahimpour (2005), Narasimhan et al. (2006), Cua et al. (2006), Vázquez-Bustelo et al. (2007), Sila (2007), Dal Pont et al. (2008), Hallgren and Olhager (2009), Furlan et al. (2011a, 2011b), Inman et al. (2011), Yusuf et al. (2012)
		Quality (Conformance)	Conformance to specifications as defined by the customer.	Powell (1995), Flynn et al. (1995b), Sakakibara et al. (1997), Nakamura et al. (1998), Mckone et al.(1999), Lau (2000), Cua et al. (2001), Yusuf & Adeleye (2002), Shah and Ward (2003), Kannan and Tan (2005), Sila and Ebrahimpour (2005), Narasimhan et al. (2006), Cua et al. (2006), Vázquez-Bustelo et al. (2007), Sila (2007), Dal Pont et al. (2008), Furlan et al. (2011a, 2011b), Hallgren and Olhager (2009), Yusuf et al. (2012)
		Delivery Reliability	Ability to deliver on time and accurately (quantity) as promised.	Sakakibara et al. (1997), Samson and Terziovski (1999), Mckone et al. (1999), Cua et al. (2001), Yusuf & Adeleye (2002), Sila and Ebrahimpour (2005), Narasimhan et al. (2006), Cua et al.(2006), Sila (2007), Vázquez-Bustelo et al. (2007), Dal Pont et al. (2008), Hallgren and Olhager (2009), Furlan et al. (2011a, 2011b), Zelbst et al. (2010), Inman et al. (2011), Yusuf et al. (2012)
		Delivery Speed	Ability to deliver quickly.	Sakakibara et al. (1997), Mckone et al. (1999), Narasimhan et al. (2006), Dal Pont et al. (2008), Vázquez-Bustelo et al. (2007), Hallgren and Olhager (2009), Zelbst et al. (2010), Inman et al. (2011), Furlan et al. (2011b), Yusuf et al. (2012)

Strategic area		Practices / Enablers	Description	Literature Support
Outcomes		**Flexibility (Volume)**	Ability to adjust production volume mix.	Sakakibara et al. (1997), Mckone et al. (1999), Cua et al. (2001), Yusuf & Adeleye, (2002), Narasimhan et al. (2006), Cua et al. (2006), Vázquez-Bustelo et al. (2007), Dal Pont et al. (2008), Hallgren and Olhager (2009), Furlan et al. (2011a, 2011b), Yusuf et al. (2012)
		Flexibility (Product)	Ability to adjust product range mix.	Mckone et al. (1999), Yusuf & Adeleye (2002), Narasimhan et al. (2006), Dal Pont et al. (2008), Furlan et al. (2011b), Vázquez-Bustelo et al. (2007), Inman et al. (2011), Sakakibara et al. (1997), Hallgren and Olhager (2009), Yusuf et al. (2012)
	Financial / Market Performance (Export Performance)	**ROA**	Return on asset performance for the last three years.	Powell (1995), Sila and Ebrahimpour (2005), Kannan and Tan (2005), Sila (2007), Jayaram et al. (2008), Stoian et al. (2011), Ellis et al. (2011)
		ROI	Return on investment performance for the last three years.	Claycomb et al.(1999b), Dowlatshahi (2005), Dowlatshahi and Cao (2006), Jayaram et al. (2008), Inman et al. (2011), Yang et al. (2011), Stoian et al. (2011), Ellis et al. (2011)
		Profitability	Net profit performance for the last three years.	Powell (1995), Claycomb et al. (1999b), Robertson and Chetty (2000), Lau(2000), Cao and Dowlatshahi (2005), Sila and Ebrahimpour (2005), Dowlatshahi and Cao (2006), Sila(2007), Jayaram et al.(2008), Stoian et al.(2011), Ellis et al.(2011), Inman et al.(2011), Yusuf et al. (2012)
		Market Share Growth	Increase in market share for the last three years.	Powell (1995), Robertson and Chetty (2000), Akyol and Akehurst (2003), Kannan and Tan (2005), Cao and Dowlatshahi (2005), Sila and Ebrahimpour (2005), Dowlatshahi and Cao (2006), Sila (2007), Inman et al. (2011), Yang et al. (2011), Ellis et al. (2011), Stoian et al. (2011), Yusuf et al. (2012)
		Sales Volume Share	Sales volume in Dollars/Rupees performance for the last three years.	Powell (1995), Vázquez-Bustelo et al. (2007), Min et al. (2007), Inman et al. (2011), Yang et al. (2011)
		Sales Volume Growth	Increase in sales volume share for the last three years.	Powell (1995), Robertson and Chetty (2000), Akyol and Akehurst (2003), Cao and Dowlatshahi (2005), Dowlatshahi and Cao and (2006), Vázquez-Bustelo et al. (2007), Inman et al. (2011), Yang et al. (2011), Stoian et al. (2011), Ellis et al. (2011)

	Strategic area	Practices / Enablers	Description	Literature Support
Context	**Organizational context**	**Size (Number of Employees)**	Number of full time plant (shop floor) employees (less administrative staff).	Lawrence & Hottenstein (1995), Ahire and Golhar (1996), Ghobadian and Gallear (1997), Claycomb et al.(1999), Ahire & Dreyfus (2000), Cua et al. (2001), Yusuf & Adeleye (2002), Shah & Ward (2003), Droge et al. (2003), Narasimhan et al. (2006), Sila (2007), Jayaram et al. (2010), Yang et al. (2011)
		Industry Type	• Knitwear and Hosiery* (chapter - 61) • Ready-Made Garments* (chapter – 62)	Benson et al. (1991), Lawrence & Hottenstein (1995), Shah & Ward (2003), Narasimhan et al. (2006), Cao & Dowlatshahi (2005), Dowlatshahi & Cao (2006), Bottani (2010), Jayaram et al. (2010) *Not specific to readymade, Knitwear and Hosiery industry
		ISO-9000 Registration	Is firm ISO-9001 certified?	Sun(2000), Sila (2007), Clougherty and Grajekm (2009), Martincus et al. (2010)
		Information Technology	Direct computer-to-computer link with key suppliers and customers. Use of electronic links for inter-organizational coordination. Information technology-enabled orders processing. Electronic transfer of purchase orders, invoices, and funds etc. Use of advanced information systems to track and expedite shipments.	Ghobadian and Gallear (1997), Narasimhan et al. (2006), Cao & Dowlatshahi (2005), Dowlatshahi & Cao (2006), Gunasekaran et al. (2008), Mo (2009), Prajogo and Olhager (2012)
	Business Environment Context	**Competitive Pressures**	Degree of competitive pressures in Apparel (Readymade, knitwear and Hosiery).	Jaworski & Kohli (1993), Zhang & Sharifi (2007), Vázquez-Bustelo et al. (2007), Hallgren & Olhager (2009), Wang et al. (2012)
		Market Dynamics	Degree of turbulence in customer's preferences for new products.	Droge et al. (2003), Zhang & Sharifi (2007), Vázquez-Bustelo et al. (2007), Hallgren & Olhager (2009), Inman et al. (2011), Yauch (2010)
		Technological Dynamics	Degree of technological turbulence in Apparel (Readymade, knitwear and Hosiery) Industry. New product introduction through technological breakthroughs in Apparel (Readymade, knitwear and Hosiery) Industry.	Jaworski & Kohli (1993), Droge et al. (2003), Zhang & Sharifi (2007), Terawatanavong et al. (2011), Wang et al. (2012)

APPENDIX 'B'

Survey Questionnaire

Respected Sir / Madam,

It is intimated that I, Mr **Tahir Iqbal,** am a PhD student in Engineering Management at National University of Sciences and Technology (NUST), College of Electrical & Mechanical Engineering (E&ME) Islamabad. I am carrying out a Research Study on "**ANALYSIS OF IMPLEMENTATION OF LEAN AND AGILE MANUFACTURING PRACTICES IN APPAREL (READYMADE GARMENTS, KNITWEAR AND HOSIERY) EXPORT INDUSTRY OF PAKISTAN".** A survey questionnaire has been designed to collect information on the topic for academic analysis purpose and is attached with this letter. This Research study is fully endorsed / consented by both PRGMEA and PHMA.

The focus of this study is to get a complete picture and to make this study a success through contribution of the following members of your organizations.

a. CEO / GM / President
b. Operations / Production / Export Manager
c. Quality Manager / Supervisor

Your contribution by filling this questionnaire is of great importance and is highly appreciated. The feedback from this research will provide an opportunity to know strengths and areas of performance improvement of your business. Information provided by you will be used for academic research purpose only, and its confidentiality is assured. No individual data will be reported / quoted at any level.

It will just take a few minutes out of your valuable and busy schedule to complete this research study survey. Please click the following link to fill the survey questionnaire:

FILL THE SURVEY QUESTIONNAIRE NOW

We look forward to you receiving your feedback

Your's sincerely,

Tahir Iqbal

PhD Candidate NUST, CEME,

Islamabad

NATIONAL UNIVERSITY OF SCIENCES AND TECHNOLOGY (NUST)
COLLEGE OF ELECTRICAL AND MECHANICAL ENGINEERING (E&ME)

Respected Sir / Madam

I, Mr **Tahir Iqbal,** am a student of PhD in Engineering Management at NUST, College of E&ME. I am carrying out a research study on **ANALYSIS OF IMPLEMENTATION OF LEAN AND AGILE MANUFACTURING PRACTICES IN APPAREL (READYMADE GARMENTS, KNITWEAR AND HOSIERY) INDUSTRY OF PAKISTAN**. Your contribution by filling this questionnaire is highly important and is greatly appreciated. Information provided by you will be used for academic research only, and its confidentiality is assured and no individual data will be reported / quoted at any level. **It will take approximately 15-20 minutes to complete this study survey.**

SECTION I - DEMOGRAPHIC INFORMATION

Please **Tick** the most appropriate box to the **Right** of each response

Firm name ( ) Optional

Q1. Your job position in the organization					
CEO ☐	GM ☐	Production Manager ☐	Quality Manager ☐	Export Manager ☐	Supervisor ☐
Q2. Your total professional experience					
Less than 3 years ☐	3-5 years ☐	6-10 years ☐	11-20 years ☐	Greater than 20 years ☐	
Q3. Location of your firm?					
Lahore ☐	Faisalabad ☐	Sialkot ☐	Karachi ☐		
Q4. Please tick your firm major export business. **(select only one)**					
Ready-Made Garments ☐	Knitwear and Hosiery ☐	Ready-Made Garments and Knitwear / Hosiery (**both**) ☐			
Q5. For how many years your firm is in (Ready-Made Garments OR Knitwear / Hosiery) export business?					
1-5 years ☐	6-10 years ☐	11-15 years ☐	15-20 years ☐	Greater than 20 years ☐	
Q6. Your firm major export market share belongs to which market? **(select only major one)**					
American region countries ☐	European region countries ☐	Asian region countries ☐	Australian region countries ☐	African region countries ☐	
Q7. What is the type of your business?					
Sole Proprietorship ☐	Partnership ☐	Private Limited ☐	Public Limited ☐		

Q8. What is the type of ownership of your firm?		
Pakistani owned ☐	Foreign Owned ☐	Joint Venture ☐
Q9. Is your firm **ISO 9001-2008** certified?		
Yes ☐	No ☐	
Q10. How many full time plant employees (less administrative staff) are working in your firm?		
Less than 50 ☐	51-250 ☐	Greater than 250 ☐

SECTION II – LEAN AND AGILE MANUFACTURING PRACTICES

Please encircle the most appropriate answer to the following questions about your firm on Seven Point Likert Scale

1= Strongly Disagree 2 = Disagree 3 = Slightly Disagree
4 = Neutral
5 = Slightly Agree 6 = Agree 7 = Strongly Agree

		Strongly Disagree	Disagree	Slightly disagree	Neutral	Slightly agree	Agree	Strongly Agree
		1	2	3	4	5	6	7
A:	**Top Management Commitment (TMC)**							
TMC1	Top Managers anticipate change in business/market and make plans to respond	1	2	3	4	5	6	7
TMC2	Top Managers promote the use of quality tools & techniques in manufacturing processes	1	2	3	4	5	6	7
TMC3	Top Managers have received adequate training on quality tools & techniques	1	2	3	4	5	6	7
TMC4	Top Managers provides adequate resources for product and process quality improvement	1	2	3	4	5	6	7
TMC5	Top Managers are held accountable for achieving quality, innovation and improvement targets	1	2	3	4	5	6	7
B:	**Cross Training (CT)**							
CT1	Employees receive different training to be capable to perform multiple tasks	1	2	3	4	5	6	7
CT2	Shop floor employees are rotated regularly among different jobs	1	2	3	4	5	6	7
CT3	Employees are rewarded for learning new skills & techniques	1	2	3	4	5	6	7
CT4	Employees are evaluated on continual professional development criteria	1	2	3	4	5	6	7
C:	**Empowered Teams (ET)**							
ET1	Production scheduling is handled by empowered teams	1	2	3	4	5	6	7
ET2	Suppliers certification and training are handled by empowered teams	1	2	3	4	5	6	7

ET3	Labour scheduling/job assignment is handled by empowered teams	**1**	**2**	**3**	**4**	**5**	**6**	**7**
ET4	Independent decision-making done by empowered teams is encouraged in the firm	**1**	**2**	**3**	**4**	**5**	**6**	**7**
ET5	Performance reviews are handled by empowered teams	**1**	**2**	**3**	**4**	**5**	**6**	**7**
ET6	Empowered working teams operate together with suppliers and customers	**1**	**2**	**3**	**4**	**5**	**6**	**7**
D: Information System (IS)								
IS1	Information on productivity is readily available to employees	**1**	**2**	**3**	**4**	**5**	**6**	**7**
IS2	Feedback on strategic and economic information is provided to employees	**1**	**2**	**3**	**4**	**5**	**6**	**7**
IS3	Generic operational data is shared with suppliers to improve supplies	**1**	**2**	**3**	**4**	**5**	**6**	**7**
IS4	Frequent contact and communication is maintained with suppliers and customers	**1**	**2**	**3**	**4**	**5**	**6**	**7**
E: Strategic Vision and Planning (SVP)								
SVP1	The management follows a formal strategic planning process resulting in written mission, long-term goals and implementation strategies	**1**	**2**	**3**	**4**	**5**	**6**	**7**
SVP2	Plant management is included in the strategic planning process	**1**	**2**	**3**	**4**	**5**	**6**	**7**
SVP3	Top management regularly reviews and updates long-range strategic plans	**1**	**2**	**3**	**4**	**5**	**6**	**7**
SVP4	Formal and well-defined strategy is implemented in the plant	**1**	**2**	**3**	**4**	**5**	**6**	**7**
F: Plant Environment (PE)								
PE1	Plant and equipment is in a high state of readiness for production at all times	**1**	**2**	**3**	**4**	**5**	**6**	**7**
PE2	Emphasis is placed on putting all tools and fixtures at their place after use	**1**	**2**	**3**	**4**	**5**	**6**	**7**
PE3	Pride is felt in keeping plant neat and cLean	**1**	**2**	**3**	**4**	**5**	**6**	**7**
PE4	Maintenance department train machine operators to perform routine preventive maintenance	**1**	**2**	**3**	**4**	**5**	**6**	**7**
G: Relationship with Customers (RWC)								
RWC1	Close contact with customers is maintained	**1**	**2**	**3**	**4**	**5**	**6**	**7**
RWC2	Results of customer satisfaction surveys are shared with all employees	**1**	**2**	**3**	**4**	**5**	**6**	**7**
RWC3	Opportunities for employee–customer interactive sessions are created	**1**	**2**	**3**	**4**	**5**	**6**	**7**
RWC4	A systematic process exists to translate customer requirements into new/improved products/services	**1**	**2**	**3**	**4**	**5**	**6**	**7**
RWC5	Customer service employees are empowered to resolve customers' complaints quickly	**1**	**2**	**3**	**4**	**5**	**6**	**7**

H: Relationship with Suppliers (RWS)								
RWS1	Strives to establish long-term relationships with suppliers based on quality, price and reliability	**1**	**2**	**3**	**4**	**5**	**6**	**7**
RWS2	Suppliers are actively involved in new product development process	**1**	**2**	**3**	**4**	**5**	**6**	**7**
RWS3	Collaborates with key suppliers to improve their quality of supplies in the long-term	**1**	**2**	**3**	**4**	**5**	**6**	**7**
RWS4	Quality and reliability is priority one in selecting suppliers	**1**	**2**	**3**	**4**	**5**	**6**	**7**
RWS5	Firm relies on a few high quality and reliable suppliers	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I: Product Design (PD)								
PD1	There is considerable involvement of production and quality assurance people in the early design of products	**1**	**2**	**3**	**4**	**5**	**6**	**7**
PD2	Manufacturing engineers are involved to a great extent in new product design and development	**1**	**2**	**3**	**4**	**5**	**6**	**7**
PD3	Employees are involved to a great extent (teams or consultants) for introducing new products or making product changes	**1**	**2**	**3**	**4**	**5**	**6**	**7**
PD4	Composite teams are made from major functions (marketing, manufacturing, etc.) to introduce new products	**1**	**2**	**3**	**4**	**5**	**6**	**7**
PD5	Customer requirements are thoroughly analysed/reviewed in the new product design process	**1**	**2**	**3**	**4**	**5**	**6**	**7**
J: Process Management Using Statistical Process Control (SPC)								
SPC1	A large number of the processes on the shop floor are controlled through statistical process control techniques	**1**	**2**	**3**	**4**	**5**	**6**	**7**
SPC2	Statistical techniques are extensively used to reduce variance in processes/supplies	**1**	**2**	**3**	**4**	**5**	**6**	**7**
SPC3	SPC charts are used to determine manufacturing processes capabilities	**1**	**2**	**3**	**4**	**5**	**6**	**7**
K: Continuous Improvement (CI)								
CI1	Quality improvement is the responsibility of every employee in the firm	**1**	**2**	**3**	**4**	**5**	**6**	**7**
CI2	Continuous improvement of quality is stressed in all work processes throughout the firm	**1**	**2**	**3**	**4**	**5**	**6**	**7**
CI3	All employees analyse their work to look for ways and means of improvement	**1**	**2**	**3**	**4**	**5**	**6**	**7**
L: Lot Size Reduction (LSR)								
LSR1	Small lot sizes are used in the firm	**1**	**2**	**3**	**4**	**5**	**6**	**7**
LSR2	Small lot sizes are used in master schedule	**1**	**2**	**3**	**4**	**5**	**6**	**7**

LSR3	Aggressively working to lower lot sizes in plant	**1**	**2**	**3**	**4**	**5**	**6**	**7**
M:	**Set-Up Time Reduction (STR)**							
STR1	Aggressively working to reduce set-up times in the firm	**1**	**2**	**3**	**4**	**5**	**6**	**7**
STR2	Workers carryout practices to reduce set-up time	**1**	**2**	**3**	**4**	**5**	**6**	**7**
STR3	Low equipment set-up time is assured in the firm	**1**	**2**	**3**	**4**	**5**	**6**	**7**
N:	**Pull Production System (Kanban) (PPS)**							
PPS1	Pull system for production control is used	**1**	**2**	**3**	**4**	**5**	**6**	**7**
PPS2	Production is pulled by the delivery of finished goods	**1**	**2**	**3**	**4**	**5**	**6**	**7**
PPS3	Production at current work station is pulled by the current demand of the next work station	**1**	**2**	**3**	**4**	**5**	**6**	**7**
PPS4	Kanban squares, containers of signals for production control are used	**1**	**2**	**3**	**4**	**5**	**6**	**7**
O:	**JIT Scheduling (JS)**							
JS1	Production schedule is met each day	**1**	**2**	**3**	**4**	**5**	**6**	**7**
JS2	There is time in the schedule for machine breakdowns or production stoppages	**1**	**2**	**3**	**4**	**5**	**6**	**7**
JS3	Production schedule is designed to allow time for catching up due to production stoppages for quality problems	**1**	**2**	**3**	**4**	**5**	**6**	**7**
P:	**Change Proficiency (CP)**							
CP1	Capabilities necessary to sense, perceive and anticipate market changes exist	**1**	**2**	**3**	**4**	**5**	**6**	**7**
CP2	Production processes are flexible in terms of product models and configurations	**1**	**2**	**3**	**4**	**5**	**6**	**7**
CP3	Immediately reacts to incorporate changes into manufacturing processes and systems	**1**	**2**	**3**	**4**	**5**	**6**	**7**
CP4	Appropriate technology capabilities exist to quickly respond to changes in customer demand	**1**	**2**	**3**	**4**	**5**	**6**	**7**
CP5	Strategic vision is used to emphasize the need for flexibility and agility to respond to market changes	**1**	**2**	**3**	**4**	**5**	**6**	**7**
CP6	The firm has the capabilities to deliver products to customers in time and quickly respond to changes in delivery requirements	**1**	**2**	**3**	**4**	**5**	**6**	**7**
CP7	Firm can quickly get new products to market	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Q:	**Knowledge Management (KM)**							
KM1	Employees are encouraged to learn from work experiences and share innovative ideas with each	**1**	**2**	**3**	**4**	**5**	**6**	**7**

	others and management							
KM2	Teams are prepared to constantly assess, apply and update knowledge of work	**1**	**2**	**3**	**4**	**5**	**6**	**7**
KM3	Databases containing organizational information are easily accessible to respective employees	**1**	**2**	**3**	**4**	**5**	**6**	**7**
KM4	Firm information system allow extensive dissemination of work knowledge throughout the organization	**1**	**2**	**3**	**4**	**5**	**6**	**7**
KM5	Employees are encouraged to share technical and work information	**1**	**2**	**3**	**4**	**5**	**6**	**7**
R: Advance Manufacturing Technology (AMT)								
AMT1	Firm uses Computer Aided Design (CAD)	**1**	**2**	**3**	**4**	**5**	**6**	**7**
AMT2	Firm uses Computer Aided Manufacturing (CAM)	**1**	**2**	**3**	**4**	**5**	**6**	**7**
AMT3	Firm uses Flexible Manufacturing Systems (FMS)	**1**	**2**	**3**	**4**	**5**	**6**	**7**
AMT4	Firm uses Robotics in production system	**1**	**2**	**3**	**4**	**5**	**6**	**7**
AMT5	Firm uses Rapid Prototyping for product development and design validation	**1**	**2**	**3**	**4**	**5**	**6**	**7**
S: Information Technology (IT)								
IT1	Firm has direct computer-to-computer links with key suppliers	**1**	**2**	**3**	**4**	**5**	**6**	**7**
IT2	Firm has direct computer-to-computer links with key customers	**1**	**2**	**3**	**4**	**5**	**6**	**7**
IT3	Inter-organizational coordination is achieved using electronic links	**1**	**2**	**3**	**4**	**5**	**6**	**7**
IT4	Firm uses information technology-enabled orders processing	**1**	**2**	**3**	**4**	**5**	**6**	**7**
IT5	Firm has electronic mailing capabilities with key suppliers and customers	**1**	**2**	**3**	**4**	**5**	**6**	**7**
IT6	Firm uses electronic transfer of purchase orders, invoices, and funds etc.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
IT7	Firm uses advanced information systems to track and expedite shipments	**1**	**2**	**3**	**4**	**5**	**6**	**7**
SECTION – III BUSINESS ENVIRONMENT								
A: Competitive Pressures (CPr)								
CPr1	Competitive pressure in Apparel (Readymade Garments, knitwear and Hosiery) industry is extremely high	**1**	**2**	**3**	**4**	**5**	**6**	**7**
CPr2	Competitive moves in market are rapid and deliberate, with short time for companies to react	**1**	**2**	**3**	**4**	**5**	**6**	**7**
CPr3	Much attention is paid to main competitors	**1**	**2**	**3**	**4**	**5**	**6**	**7**

B: Market Dynamics (MD)								
MD1	Customer's product preferences change very quickly	**1**	**2**	**3**	**4**	**5**	**6**	**7**
MD2	Customers tend to look for new products all the time	**1**	**2**	**3**	**4**	**5**	**6**	**7**
MD3	Demand for products and services is sought from new customers	**1**	**2**	**3**	**4**	**5**	**6**	**7**
C: Technological Dynamics (TD)								
TD1	Technological changes provide big opportunities in Apparel (Readymade Garments, knitwear and Hosiery) Export Industry	**1**	**2**	**3**	**4**	**5**	**6**	**7**
TD2	A large number of new product ideas have been made possible through technological breakthroughs in Apparel (Readymade Garments, knitwear and Hosiery) Export Industry	**1**	**2**	**3**	**4**	**5**	**6**	**7**
TD3	Major technological developments are taking place in Apparel (Readymade, knitwear and Hosiery) Export Industry	**1**	**2**	**3**	**4**	**5**	**6**	**7**
SECTION - IV PERFORMANCE MEASUREMENT								
A: Operational Performance (OP)								
Please rate your Firm with respect to your main competitors in the industry on seven points Likert Scale on following measures: **1 = Well Below Average 2 = Slightly Below Average 3 = Below Average** **4 = Neutral** **5 = Above Average 6 = Slightly Above Average 7 = Well Above Average**		**Well Below Average**	**Slightly Below Average**	**Below Average**	**Average**	**Above Average**	**Slightly Above Average**	**Well Above Average**
COST	Firm unit cost of manufacturing is lower than major competitors	**1**	**2**	**3**	**4**	**5**	**6**	**7**
QUALITY	Firm product quality (conformance to specification) is better than major competitors	**1**	**2**	**3**	**4**	**5**	**6**	**7**
RELIABILITY	Firm on-time delivery performance is better than major competitors	**1**	**2**	**3**	**4**	**5**	**6**	**7**
SPEED	Firm delivery speed to the customer is better than major competitors	**1**	**2**	**3**	**4**	**5**	**6**	**7**
VARIETY	Firm has more flexibility to change product (variety) mix as compare to major competitors	**1**	**2**	**3**	**4**	**5**	**6**	**7**

VOLUME	Firm has more flexibility to change product (volume) mix as compare to major competitors	**1**	**2**	**3**	**4**	**5**	**6**	**7**
B: Market Performance (MP)								
Relative to Main Competitors(s), Tick Firm performance in last three years on seven points Likert Scale on following measures: **1 = Deteriorated More Than 20%** **2 = Deteriorated Between 11-20%** **3 = Deteriorated Between 1-10%** **4 = Stayed About The Same** **5 = Improved Between 1-10%** **6 = Improved Between 11-20%** **7 = Improved More Than 20%**								
MP1	Sales growth (volume) performance of the firm for the last three years	**1**	**2**	**3**	**4**	**5**	**6**	**7**
MP2	Market share growth performance of the firm for the last three years	**1**	**2**	**3**	**4**	**5**	**6**	**7**
MP3	Sales performance of the firm for the last three years	**1**	**2**	**3**	**4**	**5**	**6**	**7**
C: Financial Performance (FP)								
Relative to Main Competitors(s), Tick Firm performance in last 3 years on seven points Likert Scale on following measures: **1 = Deteriorated More Than 20%** **2 = Deteriorated Between 11-20%** **3 = Deteriorated Between 1-10%** **4 = Stayed About The Same** **5 = Improved Between 1-10%** **6 = Improved Between 11-20%** **7 = Improved More Than 20%**								
FP1	Return on Asset (ROA) performance of the firm for the last three years	**1**	**2**	**3**	**4**	**5**	**6**	**7**
FP2	Return on Investment (ROI) performance of the firm for the last three years	**1**	**2**	**3**	**4**	**5**	**6**	**7**
FP3	Profitability performance of the firm for the last three years	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Thank You once again for your Cooperation and contribution to this academic / research exercise, which shall help all stake holders.

APPENDIX 'C'

PHMA Support Letter 2012

PAKISTAN HOSIERY MANUFACTURERS & EXPORTERS ASSOCIATION
(NORTH ZONE)

(GOVT. APPROVED SOLE REPRESENTATIVE BODY OF HOSIERY INDUSTRY)

P.H.M.A. HOUSE: 33-D, NEW MUSLIM TOWN LAHORE-PAKISTAN
TEL: 92-42-35833868, 35830694 FAX: 92-42-35832213
E-mail: phmalhr@gmail.com Website: www.phmaonline.com

Ref: PHMA/06.34/020
Date: March 22, 2012

To: Members of PHMA
Lahore, Faisalabad, Sialkot.

Re: STUDY ON KNITWEAR INDUSTRY

Dear Sir,

National University of Science and Technology is a prestigious name in the Universities of Pakistan. Mr. Tahir Iqbal of said university is going to conduct a Doctoral Study on the topic of "IMPLEMENTATION OF LEAN MANUFACTURING PRACTICES IN KNITWEAR UNITS AND THEIR IMPACT ON ORGANIZATIONAL PERFORMANCE". He will contact you for an interview to collect information and data about industry.

I shall be grateful if you could spare some of your valuable time to give an interview to Mr. Tahir Iqbal so that he could undertake his study.

Thanking you for your cooperation.

Yours sincerely,

USMAN JAWAAD
Chairman
(0321) 4472144

APPENDIX 'D'

PRGMEA Support Letter 2012

PRGMEA

PAKISTAN READYMADE GARMENTS MANUFACTURERS & EXPORTERS ASSOCIATION

Zonal Office:
PRGMEA House" 343-A, Bhabrra Market Main Ferozepur Road,Lahore.
Ph: +92-42-35852946, 35851277, 35858221 Fax: +92-42-35858231
E-mail:prgmealhr@cyber.net.pk

Recognised by Govt. Of Pakistan www.prgmea.org

February 16, 2012

M/s ________________________

Dear Sir,

We have received a letter (copy enclosed) from National University of Sciences and Technology, College of Electrical and Mechanical Engineering, Peshawar Road, Rawalpindi, recommending Mr. Tahir Iqbal, a research scholar from the department of Engineering Management of this University. Mr. Tahir is pursuing his PHD Thesis in implementation of Lean Manufacturing Practices in Readymade Garment Industry and their impact on Organizational performances. He wishes to conduct a field survey of Lean manufacturing practices in Readymade Garment units in Pakistan and will call on your good-self, getting appointment for a meeting with you.

PRGMEA will highly appreciate if your company helps the gentleman to successfully complete his field survey, enabling him to complete his research project

Thanking you,

S. Azhar Mahmood

Secretary

PRGMEA (NZ)

To Mr. Tahir Iqbal.
This letter has sent to some prominent members.
Kindly co-ordinate prgmea, Lahore office, for getting appointment with the units, PRGMEA, members list is available on its website www.prgmea.org.

Head Office: 18-A, Shaheen View Building, Block-VI, P.E.C.H.S., Shahra-e-Faisal, Karachi-75400, Pakistan
Tel: 021-4549073, 4547912, Fax: (92-21)453-9669 e-mail: prgmea@cyber.net.pk,www.prgmea.org
Sub Office : Oberoi Building, Near Pakistan Muslim League House, Paris Road Sialkot. Tel/Fax: 052-4592683, 4597128
E-mail: prgmea_skt@hotmail.com

APPENDIX 'E'

PRGMEA Central Chairman Support Letter 2013

PRGMEA

PAKISTAN READYMADE GARMENTS MANUFACTURERS & EXPORTERS ASSOCIATION

Zonal Office:
PRGMEA House" 343-A, Bhabrra Market Main Ferozepur Road,Lahore.
Ph: +92-42-35852946, 35851277, 35858221 Fax: +92-42-35858231
E-mail:prgmealhr@cyber.net.pk

Recognised by Govt. Of Pakistan www.prgmea.org

To: **Members of PRGMEA**
(North/South Zone)

Subject: **Doctoral Research Study on Readymade Garments Industry of Pakistan**

Respected Members;

We have received a research study request from College of Electrical and Mechanical Engineering, National University of Sciences and Technology (NUS), Islamabad, recommending, Mr Tahir Iqbal, a PhD Research scholar from the Department of Engineering Management. Mr Tahir Iqbal is pursuing his PhD thesis in "**Analysis of Implementation of Lean and Agile Manufacturing Practices in Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan**". The scholar wishes to conduct a field survey of Readymade Garments export industry of Pakistan. The Gentleman will contact you for filling of research study questionnaire.

I shall be grateful if you could spare some of your valuable time to fill the research study questionnaire so that Mr Tahir Iqbal can accomplish his research objectives.

Mr Tahir Iqbal will insure his commitment to research ethics and data confidentiality of the participating units. He will also share the information based on the analysis with participating units for business improvement.

Thanking you for your cooperation.

Your's sincerely,

Sajid Saleem Minhas

Central Chairman PRGMEA

Date: _9_ March 2013

Head Office: 18-A, Shaheen View Building, Block-VI, P.E.C.H.S., Shahra-e-Faisal, Karachi-75400, Pakistan
Tel: 021-4549073, 4547912, Fax: (92-21)453-9669 e-mail: prgmea@cyber.net.pk,www.prgmea.org
Sub Office : Oberoi Building, Near Pakistan Muslim League House, Paris Road Sialkot. Tel/Fax: 052-4592683, 4597128
E-mail: prgmea_skt@hotmail.com

APPENDIX 'F'

PHMA Central Chairman Support Letter 2013

PAKISTAN HOSIERY MANUFACTURERS & EXPORTERS ASSOCIATION
(Government approved sole representative body of Knitted goods & Apparel Manufacturers)

Ref: PHMA/2013/13/123
Dated: 26th February, 2013

To

All Members,
PHMA

SUBJECT: STUDY ON KNITWEAR INDUSTRY

National University of Science and Technology is a prestigious name in the Universities of Pakistan. Mr. Tahir Iqbal of said university is going to conduct a Research Study on "**ANALYSIS OF IMPLEMENTATION OF LEAN AND AGILE MANUFACTURING PRACTICES IN APPAREL (READYMADE GARMENTS, KNITWEAR AND HOSIERY) EXPORT INDUSTRY OF PAKISTAN**".

He will contact you for an interview to collect information and data about industry.

I shall be grateful if you could spare some of your valuable time to give an interview to Mr. Tahir Iqbal and fill the study Survey Questionnaire so that he could undertake his study.

Thanking you for your cooperation.

Yours truly,
For Pakistan Hosiery Manufacturers & Exporters Association

M. Jawed Bilwani
Central Chairman

Central Office: P.H.M.A. House, 37-H, Block 6, P.E.C.H.S., Karachi-Pakistan
T +92 21 34522769, 34522685, 34544765 F +92 21 34543774
E info@phmaonline.com, U www.phmaonline.com

USA Office: 1407 Broadway, 39th Street, Suit# 1710, New York, USA 10018
T +1 212 7646041 F +1 646 3907165 +1 212 6561018 E info@phmausa.com U www.phmausa.com

APPENDIX 'G'

PHMA North Chairman Support Letter 2013

PAKISTAN HOSIERY MANUFACTURERS & EXPORTERS ASSOCIATION
(Government approved sole representative body of Knitted goods & Apparel Manufacturers)

Ref: PHMA/ 06.34/24
Date: March 11, 2013

To: **Members of PHMA**
North Zone

Subject: **Doctoral Research Study on knitwear and Hosiery Industry of Pakistan**

Respected Members;

We have received a research study request from College of Electrical and Mechanical Engineering, National University of Sciences and Technology (NUS), Islamabad, recommending, Mr Tahir Iqbal, a PhD Research scholar from the Department of Engineering Management. Mr Tahir Iqbal is pursuing his PhD thesis in "**Analysis of Implementation of Lean and Agile Manufacturing Practices in Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan**". The scholar wishes to conduct a field survey of knitwear and Hosiery export industry of Pakistan. The Gentleman will contact you for filling of research study questionnaire.

I shall be grateful if you could spare some of your valuable time to fill the research study questionnaire so that Mr Tahir Iqbal can accomplish his research objectives.

Mr Tahir Iqbal will insure his commitment to research ethics and data confidentiality of the participating units. He will also share the information based on the analysis with participating units for business improvement.

Thanking you for your cooperation.

Your's sincerely,

Adil Butt

Chairman PHMA(NZ)
Date: 11 March 2013

ZONAL OFFICE:
P.H.M.A. HOUSE: 33-D, New Muslim Town, Lahore-Pakistan.
Tel: +92-42-35833868, 35830694 Fax: +92-42-35832213
E-mail: phmalhr@gmail.com

APPENDIX 'H'

GIZ - NAVTTC – Course Attendance Certificate

Pakistan Readymade Garments Technical Training Institute

A Project of

Ministry of Textile Industry, Government of Pakistan and Pakistan Readymade Garments Manufacturers & Exporters Association

CERTIFICATE OF ATTENDANCE

THIS IS TO CERTIFY THAT

Tahir Iqbal

NUST – (Ph.D. Candidate)

has attended the

GIZ-NAVTTC

DACUM- Developing a Curriculum Session

From

March 19 to 24, 2013

AT

PRGTTI - Lahore, Pakistan

SIGNED BY: KAMRAN YOUSAF SANDHU
PROJECT DIRECTOR/PRINCIPAL

SIGNED BY: SAJID SALEEM MINHAS
CHAIRMAN (CENTRAL) PRGMEA

Sessions Organized in partnership with

PRGMEA

Certificate number# 01

Issue date 25th March, 2013

Address:71-L, Gulberg-III, Tel: 042-99230756-57

APPENDIX 'I'

PRGMEA North Chairman Support Letter 2013

PRGMEA

Recognised by Govt. Of Pakistan

Tel : (052) 4597128
Fax : (052) 4592683
E-mail:
prgmea_sialkot@yahoo.com

PAKISTAN READYMADE GARMENTS MANUFACTURERS & EXPORTERS ASSOCIATION

Sub-Office: Oberoi Building, Paris Road, Sialkot-Pakistan

Ref:PS/732/PHd./13 March 25, 2013

To: All Members,
PRGMEA North Zone.

Subject: **Doctoral Research Study on Readymade Garments Industry of Pakistan**

Respected Members;

We have received a research study request from College of Electrical and Mechanical Engineering, National University of Sciences and Technology (NUS), Islamabad, recommending, Mr. Tahir Iqbal, a PhD Research scholar from the Department of Engineering Management. Mr. Tahir Iqbal is pursuing his PhD thesis in **"Analysis of Implementation of Lean and Agile Manufacturing Practices in Apparel (Readymade Garments, Knitwear and Hosiery) Export Industry of Pakistan"**. The scholar wishes to conduct a field survey of Readymade Garments export industry of Pakistan. The Gentleman will contact you for filling of research study questionnaire.

I shall be grateful if you could spare some of your valuable time to fill the research study questionnaire so that Mr Tahir Iqbal can accomplish his research objectives.

Mr. Tahir Iqbal will insure his commitment to research ethics and data confidentiality of the participating units. He will also share the information based on the analysis with PRGMEA and the participating units for business improvement of the Industry as a whole.

Thanking you for your cooperation.

Your's sincerely,

Mir Muhammad Farooq Meyer
Chairman (NZ)

PAKISTAN READYMADE GARMENTS MANUFACTURERS & EXPORTERS ASSOCIATION SIALKOT

Head Office : Shaheen View Building, 19-A, Block VI, P.E.C.H.S. Shahrah-e-Faisal, Karachi-29, Pakistan
Tel : 453 3327, 453 5394 Fax : (92 21) 453 9669
Zonal Office : PRGMEA House, 343-A, New Bhabrra, Main Ferozpur Road, Lahore Pakistan
Tel : 042 35852946, 35851277 Fax : 042 35858231

APPENDIX "J"

DESCRIPTIVE STATISTICS

Variable Code	N	Mean	SD	Skewness	Kurtosis	Min	Max	Range
TMC1	248	5.21	0.78	0.086	0.249	3	7	4
TMC2	248	5.31	0.75	0.188	0.093	3	7	4
TMC3	248	5.23	0.79	-0.084	0.498	3	7	4
TMC4	248	5.31	0.80	-0.064	0.319	3	7	4
TMC5	248	5.23	0.83	-0.111	0.998	2	7	5
IS1	248	5.58	0.80	-0.011	0.045	3	7	4
IS2	248	5.58	0.76	-0.080	0.280	3	7	4
IS3	248	5.60	0.76	0.001	0.217	3	7	4
IS4	248	5.55	0.80	-0.007	0.254	3	7	4
ET1	248	5.54	0.83	-0.099	0.116	3	7	4
ET2	248	3.57	1.70	0.083	*-1.387*	1	6	5
ET3	248	5.52	0.82	-0.174	0.141	3	7	4
ET4	248	5.52	0.81	-0.056	0.193	3	7	4
ET5	248	5.52	0.79	-0.055	0.324	3	7	4
ET6	248	5.50	0.77	-0.066	0.457	3	7	4
CT1	248	5.54	0.87	0.079	-0.343	3	7	4
CT2	248	5.52	0.83	0.054	-0.145	3	7	4
CT3	248	5.54	0.86	0.107	-0.281	3	7	4
CT4	248	5.55	0.85	0.065	-0.253	3	7	4
SVP1	248	5.38	0.77	-0.125	0.647	3	7	4
SVP2	248	5.37	0.79	-0.266	0.585	3	7	4
SVP3	248	5.36	0.78	-0.043	0.344	3	7	4
SVP4	248	5.38	0.79	-0.124	0.516	3	7	4
PE1	248	5.37	0.72	0.179	0.235	3	7	4
PE2	248	5.35	0.69	0.263	0.446	3	7	4
PE3	248	5.36	0.73	0.202	0.192	3	7	4
PE4	248	5.36	0.75	0.242	0.149	3	7	4
RWC1	248	5.14	0.77	0.561	0.548	3	7	4
RWC2	248	5.11	0.74	0.303	0.556	3	7	4

RWC3	248	5.10	0.74	0.445	0.499	3	7	4
RWC4	248	5.11	0.79	0.516	0.614	3	7	4
RWC5	248	5.15	0.82	0.522	0.391	3	7	4
RWS1	248	5.08	0.92	0.155	0.182	3	7	4
RWS2	248	5.08	0.89	-0.012	0.449	3	7	4
RWS3	248	5.08	0.90	0.142	0.329	3	7	4
RWS4	248	5.13	0.92	0.043	0.090	3	7	4
RWS5	248	5.13	0.92	0.153	0.314	3	7	4
PD1	248	5.18	0.69	0.516	0.579	4	7	3
PD2	248	5.16	0.72	0.490	0.395	4	7	3
PD3	248	5.18	0.71	0.530	0.463	4	7	3
PD4	248	5.16	0.72	0.423	0.265	4	7	3
PD5	248	5.18	0.72	0.506	0.392	4	7	3
SPC1	248	5.10	0.65	0.445	0.746	4	7	3
SPC2	248	5.12	0.63	0.302	0.479	4	7	3
SPC3	248	5.14	0.67	0.338	0.355	4	7	3
CI1	248	5.10	0.67	0.537	0.828	4	7	3
CI2	248	5.12	0.67	0.431	0.557	4	7	3
CI3	248	5.09	0.65	0.349	0.480	4	7	3
LSR1	248	5.46	0.88	-0.181	-0.240	3	7	4
LSR2	248	5.48	0.87	-0.175	-0.142	3	7	4
LSR3	248	5.45	0.86	-0.136	-0.135	3	7	4
STR1	248	5.46	0.84	-0.207	-0.038	3	7	4
STR2	248	5.56	0.87	-0.345	-0.079	3	7	4
STR3	248	5.51	0.87	-0.277	-0.139	3	7	4
PPS1	248	5.41	0.86	-0.051	0.057	3	7	4
PPS2	248	5.44	0.83	-0.195	0.249	3	7	4
PPS3	248	5.46	0.83	-0.218	0.224	3	7	4
PPS4	248	5.48	0.86	-0.170	0.091	3	7	4
JS1	248	5.48	0.80	-0.159	0.000	3	7	4
JS2	248	5.54	0.81	-0.284	0.049	3	7	4
JS3	248	5.48	0.80	-0.240	-0.011	3	7	4

CP1	248	5.06	0.83	0.276	0.934	3	7	4
CP2	248	5.09	0.86	0.251	0.703	3	7	4
CP3	248	5.07	0.83	0.166	0.920	3	7	4
CP4	248	5.06	0.81	0.033	0.877	3	7	4
CP5	248	5.08	0.83	0.066	0.645	3	7	4
CP6	248	5.07	0.82	0.090	0.672	3	7	4
CP7	248	5.09	0.81	0.103	0.928	3	7	4
KM1	248	5.14	0.77	-0.241	0.953	3	7	4
KM2	248	5.06	0.73	-0.407	0.902	3	7	4
KM3	248	5.11	0.77	-0.243	0.882	3	7	4
KM4	248	5.07	0.77	-0.232	0.714	3	7	4
KM5	248	5.07	0.73	-0.421	0.928	3	7	4
AMT1	248	4.96	0.78	-0.037	0.428	3	7	4
AMT2	248	4.97	0.79	-0.004	0.39	3	7	4
AMT3	248	4.95	0.78	-0.031	0.464	3	7	4
AMT4	248	4.94	0.79	-0.055	0.226	3	7	4
AMT5	248	4.96	0.77	-0.048	0.534	3	7	4
Cost	248	5.21	0.99	0.138	-0.539	3	7	4
Speed	248	5.30	0.94	0.158	-0.508	3	7	4
Reliability	248	5.21	0.85	-0.016	-0.219	3	7	4
Quality	248	5.13	0.91	0.063	-0.156	3	7	4
Variety	248	5.34	0.92	-0.004	-0.342	3	7	4
Volume	248	5.21	0.96	0.035	-0.295	2	7	5
MP1	248	4.77	1.13	-0.008	-0.425	2	7	5
MP2	248	4.86	1.15	-0.13	-0.504	2	7	5
MP3	248	4.85	1.17	-0.011	-0.645	2	7	5
FP1	248	4.85	1.12	-0.236	-0.393	2	7	5
FP2	248	4.95	1.08	-0.414	0.083	2	7	5
FP3	248	4.92	1.09	-0.309	-0.231	2	7	5
IT1	248	5.21	0.84	-0.13	-0.042	3	7	4

IT2	248	5.21	0.82	-0.132	-0.581	3	7	4
IT3	248	5.23	0.82	-0.136	0.151	3	7	4
IT4	248	5.20	0.85	-0.027	-0.008	3	7	4
IT5	248	5.30	0.90	0.092	-0.188	3	7	4
IT6	248	5.28	0.86	-0.065	-0.14	3	7	4
IT7	248	5.21	0.84	-0.177	0.052	3	7	4
CPr1	248	5.23	0.89	-0.529	0.346	2	7	5
CPr2	248	5.25	0.85	-0.85	1.308	2	7	5
CPr3	248	5.21	0.88	-0.522	0.446	2	7	5
MD1	248	4.79	1.09	-0.091	-0.251	2	7	5
MD2	248	4.77	1.11	-0.104	-0.271	2	7	5
MD3	248	4.73	1.07	0.007	-0.216	2	7	5
TD1	248	4.80	1.08	-0.295	0.055	2	7	5
TD2	248	4.83	1.07	-0.261	-0.18	2	7	5
TD3	248	4.81	1.05	-0.213	-0.098	2	7	5

APPENDIX 'K'

First Order Factor Measurement Model Results (Standardized Factor Loadings and t-Values)

CONSTRUCTS AND ITEMS		STANDARDIZED FACTOR LOADING	t-VALUE
1. INDEPENDENT VARIABLES CONSTRUCTS			
a. Top Management Commitment (TMC)			
TMC1	Top Managers anticipate change in business/market and make plans to respond	0.806	a
TMC2	Top Managers promote the use of quality tools & techniques in manufacturing processes	0.765	15.332
TMC3	Top Managers have received adequate training on quality tools & techniques	0.856	14.675
TMC4	Top Managers provides adequate resources for product and process quality improvement	0.792	13.42
TMC5	Top Managers are held accountable for achieving quality, innovation and improvement targets	0.798	13.542
b. Information System (IS)			
IS1	Information on productivity is readily available to employees	0.788	a
IS2	Feedback on strategic and economic information is provided to employees	0.837	13.882
IS3	Generic operational data is shared with suppliers to improve supplies	0.864	14.317
IS4	Frequent contact and communication is maintained with suppliers and customers	0.748	12.191
c. Empowered Teams (ET)			
ET1	Production scheduling is handled by empowered teams	0.896	a
ET2	Suppliers certification and training are handled by empowered teams*	*	
ET3	Labour scheduling/job assignment is handled by empowered teams	0.871	18.784
ET4	Independent decision-making done by empowered teams is encouraged in the firm	0.788	15.727
ET5	Performance reviews are handled by empowered teams	0.808	16.327
ET6	Empowered working teams operate together with suppliers and customers	0.79	15.676
d. Strategic Vision and Planning (SVP)			
SVP1	The management follows a formal strategic planning process resulting in written mission, long-term goals and implementation strategies	0.841	a
SVP2	Plant management is included in the strategic planning process	0.81	15.254
SVP3	Top management regularly reviews and updates long-range strategic plans	0.873	17.152
SVP4	Formal and well-defined strategy is implemented in the plant	0.902	17.988
e. Cross Training (CT)			
CT1	Employees receive different training to be capable to perform multiple tasks	0.897	a
CT2	Shop floor employees are rotated regularly among different jobs	0.886	20.471
CT3	Employees are rewarded for learning new skills & techniques	0.862	19.283
CT4	Employees are evaluated on continual professional development criteria	0.896	20.949
f. Plant Environment (PE)			

PE1	Plant and equipment is in a high state of readiness for production at all times	0.871	a
PE2	Emphasis is placed on putting all tools and fixtures at their place after use	0.784	14.336
PE3	Pride is felt in keeping plant neat and clean	0.877	16.725
PE4	Maintenance department train machine operators to perform routine preventive maintenance	0.773	14.033
g. Relationship with Customers (RWC)			
RWC1	Close contact with customers is maintained	0.835	a
RWC2	Results of customer satisfaction surveys are shared with all employees	0.908	16.869
RWC3	Opportunities for employee–customer interactive sessions are created	0.808	14.745
RWC4	A systematic process exist to translate customer requirements into new/improved products/services	0.827	14.06
RWC5	Customer service employees are empowered to resolve customers' complaints quickly	0.795	13.487
h. Relationship with Suppliers (RWS)			
RWS1	Strives to establish long-term relationships with suppliers based on quality, price and reliability	0.843	a
RWS2	Suppliers are actively involved in new product development process	0.869	17.215
RWS3	Collaborates with key suppliers to improve their quality of supplies in the long-term	0.892	18.445
RWS4	Quality and reliability is priority one in selecting suppliers	0.856	16.777
RWS5	Firm relies on a few high quality and reliable suppliers	0.831	16.323
i. Product Design (PD)			
PD1	There is considerable involvement of production and quality assurance people in the early design of products	0.844	a
PD2	Manufacturing engineers are involved to a great extent in new product design and development	0.823	15.454
PD3	Employees are involved to a great extent (teams or consultants) for introducing new products or making product changes	0.832	15.799
PD4	Composite teams are made from major functions (marketing, manufacturing, etc.) to introduce new products*	0.873	16.958
PD5	Customer requirements are thoroughly analyzed/reviewed in the new product design process	0.796	14.66
j. Process Management Using Statistical Process Control (SPC)			
SPC1	A large number of the processes on the shop floor are controlled through statistical process control techniques	0.905	a
SPC2	Statistical techniques are extensively used to reduce variance in processes/supplies	0.925	21.073
SPC3	SPC charts are used to determine manufacturing processes capabilities	0.838	18.08
k. Continuous Improvement (CI)			
CI1	Quality improvement is the responsibility of every employee in the firm	0.858	a
CI2	Continuous improvement of quality is stressed in all work processes throughout the firm	0.897	17.265
CI3	All employees analyze their work to look for ways and means of improvement	0.852	16.431
l. Lot Size Reduction (LSR)			
LSR1	Small lot sizes are used in the firm	0.767	a
LSR2	Small lot sizes are used in master schedule	0.883	13.401
LSR3	Aggressively working to lower lot sizes in plant	0.845	13.232
m. Set-Up Time Reduction (STR)			
STR1	Aggressively working to reduce set-up times in the firm	0.8	a
STR2	Workers carryout practices to reduce set-up time	0.873	14.128

STR3	Low equipment set-up time is assured in the firm	0.841	13.876
n. Pull Production System (Kanban) (PPS)			
PPS1	Pull system for production control is used	0.764	a
PPS2	Production is pulled by the delivery of finished goods	0.804	20.754
PPS3	Production at current work station is pulled by the current demand of the next work station	0.935	15.697
PPS4	Kanban squares, containers of signals for production control are used	0.913	15.476
o. JIT Scheduling (JS)			
JS1	Production schedule is met each day	0.862	a
JS2	There is time in the schedule for machine breakdowns or production stoppages	0.936	19.343
JS3	Production schedule is designed to allow time for catching up due to production stoppages for quality problems	0.859	17.572
p. Change Proficiency (CP)			
CP1	Capabilities necessary to sense, perceive and anticipate market changes exist	0.827	a
CP2	Production processes are flexible in terms of product models and configurations	0.893	21.767
CP3	Immediately reacts to incorporate changes into manufacturing processes and systems	0.894	17.879
CP4	Appropriate technology capabilities exist to quickly respond to changes in customer demand	0.868	17.041
CP5	Strategic vision is used to emphasize the need for flexibility and agility to respond to market changes	0.866	16.803
CP6	The firm has the capabilities to deliver products to customers in time and quickly respond to changes in delivery requirements	0.858	16.535
CP7	Firm can quickly get new products to market	0.806	16.641
q. Knowledge Management (KM)			
KM1	Employees are encouraged to learn from work experiences and share innovative ideas with each other's and management	0.81	a
KM2	Teams are prepared to constantly assess, apply and update knowledge of work	0.849	14.997
KM3	Databases containing organizational information are easily accessible to respective employees	0.851	15.048
KM4	Firm information system allow extensive dissemination of work knowledge throughout the organization	0.759	12.884
KM5	Employees are encouraged to share technical and work information	0.791	13.61
r. Advance Manufacturing Technology (AMT)			
AMT1	Firm uses Computer Aided Design (CAD)	0.754	a
AMT2	Firm uses Computer Aided Manufacturing (CAM)	0.645	13.924
AMT3	Firm uses Flexible Manufacturing Systems (FMS)	0.891	11.961
AMT4	Firm uses Robotics in production system	0.734	12.14
AMT5	Firm uses Rapid Prototyping for product development and design validation	0.872	11.703
2. DEPENDENT VARIABLES CONSTRUCTS			
a. Operational Performance			
Cost	Firm unit cost of manufacturing is lower than major competitors	0.788	a
Quality	Firm product quality (conformance to specification) is better than major competitors	0.806	13.636
Reliability	Firm on-time delivery performance is better than major competitors	0.805	14.836
Speed	Firm delivery speed to the customer is better than major competitors	0.848	14.396
Variety	Firm has more flexibility to change product (variety) mix as compare to major competitors	0.795	13.413

Volume	Firm has more flexibility to change product (volume) mix as compare to major competitors	0.783	13.174
b. Market Performance			
MP1	Sales growth (volume) performance of the firm for the last three years	0.891	a
MP2	Market share growth performance of the firm for the last three years	0.891	17.484
MP3	Sales performance of the firm for the last three years	0.801	15.486
c. Financial Performance			
FP1	Return on Asset (ROA) performance of the firm for the last three years	0.824	a
FP2	Return on Investment (ROI) performance of the firm for the last three years	0.807	12.475
FP3	Profitability performance of the firm for the last three years	0.797	12.398
3. CONTEXTUAL VARIABLES CONSTRUCTS			
a. Information Technology (IT)			
IT1	Firm has direct computer-to-computer links with key suppliers	0.853	a
IT2	Firm has direct computer-to-computer links with key customers	0.815	18.697
IT3	Inter-organizational coordination is achieved using electronic links	0.838	16.374
IT4	Firm uses information technology-enabled orders processing	0.802	15.336
IT5	Firm has electronic mailing capabilities with key suppliers and customers	0.877	17.965
IT6	Firm uses electronic transfer of purchase orders, invoices, and funds etc.	0.811	15.619
IT7	Firm uses advanced information systems to track and expedite shipments	0.849	16.786
b. Competitive Pressures (CPr)			
CPr1	Competitive pressure in Apparel (Readymade Garments, knitwear and Hosiery) export industry is extremely high	0.824	a
CPr2	Competitive moves in market are rapid and deliberate, with short time for companies to react	0.883	14.665
CPr3	Much attention is paid to main competitors	0.81	13.911
c. Market Dynamics (MD)			
MD1	Customers' product preferences change very quickly	0.805	a
MD2	Customers tend to look for new products all the time	0.787	12.409
MD3	Demand for products and services is sought from new customers	0.85	12.838
d. Technological Dynamics (TD)			
TD1	Technological changes provide big opportunities in Apparel (Readymade Garments, knitwear and Hosiery) Export Industry	0.801	a
TD2	A large number of new product ideas have been made possible through technological breakthroughs in Apparel Export (Readymade Garments, knitwear and Hosiery) Industry	0.792	12.015
TD3	Major technological developments are taking place in Apparel (Readymade Garments, knitwear and Hosiery) Export Industry	0.821	12.187
"*Items excluded from the analysis" " All t-values are significant at $p < 0.01$."			

APPENDIX 'L'

List of Publications

(a) **Conference Papers**

(1) Iqbal, T., Rana, A., Khan, N., Shahzad N. Q. (2011) Analysis of Factors Affecting the Customer Satisfaction Level of Public Sector in Developing Countries: An Empirical Study of Automotive Repair Service Quality in Pakistan. Paper presented at the Global Conference on Innovations in Management, 21-22 July 2011 London, United Kingdom.

(b) **Journal Papers**

(1) Iqbal, T., Khan, B. A., Talib, N., & Khan, N. (2012), TQM and Organization Performance: Mediation and Moderation Effects. (ISSN NO 1097-8135) Life Science Journal 9(4) pp. 1571-1582.

(2) Iqbal, T., Khan, N., (2012). Export Performance A Vital Indicator for Measuring Industry Competitiveness: Evidence from Pakistan Textile and Clothing Industry (ISSN NO 1097-8135) Life Science Journal 9(4) pp. 3816-3822.

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