

Impact of Lean Manufacturing Practices on Sustainable Firm Performance: An Empirical Study Moderated by Lean Culture

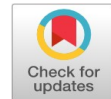
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Abstract: The main objective of this empirical study is to investigate the impact of lean manufacturing practices (total quality management and just in time) on firm's sustainability performance in leather export industry of Pakistan, moderated by the lean culture of the firm. Also, we measure the level of moderation created by lean culture in lean system to achieve the sustainability in firm performance. Study used the empirical research study by adopting quantitative research methodology to collect the required data to gain results on set objectives and research questions. Data collected through the various level of executives, managers and supervisors of the leather export industry of Pakistan. A 240 final sample utilized in data processing to check the stated research questions and objectives. Stratified random sampling technique used to analyses the data and from each stratum, a random sample selected from each stratum. This study finding are in accordance with the prior studies of literature which shows the significant impact of lean manufacturing on firm's sustainability performance. Results shows the firms main focused on process efficiency and enhancing productivity by eliminating wastes at each level, firms used this approach as competitive advantage having highly focus on preferences required by customer, which is usually, "quality product, low cost, maximum variety with efficient delivery". This study also provides the insightful managerial implications and future directions in the fields of lean sustainability.

Keywords: Lean manufacturing, Total quality management, Just-in-time, Lean culture, Triple bottom line, Sustainability, Sustainable performance, Economic performance, Social performance, Environmental performance

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INTRODUCTION

In the current dynamic business environment, manufacturing organizations seek for competitive advantage; specifically, in the form of sustainability with ultimate business vision is to satisfy the customers and multiple stakeholders along with maximizing the firm's profits (Abualfarraa et al., 2020; Cherrafi et al., 2016; Ganapathy et al., 2014; Wang et al., 2015). As a result, organizations are concentrating on implementing various sustainable business practices in order to establish a viable manufacturing system that optimizes available industrial resources and enhances the sustainability performance of the firm (Benkarim & Imbeau, 2021; Despeisse et al., 2012). Literature shows that various manufacturing tools, techniques and methodologies were proposed, tested and developed with only aims to enhance the manufacturing capability of the firm while reducing the waste and increasing the firm's economic performance. Few manufacturing practices which includes kaizen, total quality management, total productive maintenance, poka-yoke, 5S, setup time reduction, kanban, just-in time, takt time, value stream mapping and lot size reduction; have the significant manufacturing impact on firm's performance. Although the incremental effects that these manufacturing bundles have on businesses' profits and performance, many businesses still struggle to maintain their existence in the competitive marketplace (Hines et al., 2004; Lim et al., 2022). The problem for many firms is that these suggested manufacturing solutions, despite promising short-term economic gains, sometimes flop as long term sustainable firms performance (Bateman, 2005; Maware & Parsley, 2023; Mellado & Lou, 2020; Thomas et al., 2012). Therefore, there is a need to proposed and developed the viable model for firms which have sustainable impact, ultimately leads towards fit manufacturing.

Lean manufacturing is process oriented tool which mainly aims to reduce wastes in the system while enhancing productivity of the firm. Lean Manufacturing Practices (LMP) emerged as the competitive manufacturing tool, organizations use and incorporate to gain competitive advantage (Inman et al., 2011; Lima et al., 2023; Paranitharan

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et al., 2017). Lean manufacturing appeared as 21st century manufacturing paradigm having significant impact on firm’s sustainability performance (Abualfaraa et al., 2020; Godinho Filho & Barco, 2015; Shah & Ward, 2007). Few firms have not get long term benefits from lean bundles which requires to plough such organizational system, culture and employee’s mindset that positively welcome and nurture lean manufacturing bundles. Previous studies rarely give the significant attentions to the combined role of lean practices with other aspects, like; lean culture to check the collective impact on firm’s sustainability performance. While implementing the lean manufacturing practices to achieve the sustainability performance, lean culture supposed to be the most critical factor to fully implement the lean approach. Its implementation and execution will lead firm towards success or failure (Benkarim & Imbeau, 2021).

Empirical study conducted on leather export industry of Pakistan to test the proposed model. Leather export industry have the significant impact in the economies of Pakistan as it is the second largest export oriented sector in manufacturing domain, while third in the overall exports of Pakistan (Pakistan Tanners Association: Annual Report, 2022). For this, it acts as the engine of the Pakistan’s economic growth and provide the social stability impact by creating the employment opportunities over 1 million (approx.) people directly or indirectly (Pakistan Tanners Association:Annual Report, 2018). As per the Pakistan Tanners Association, leather industry of Pakistan contributes the 5.4% share in the country’s GDP (Gross Domestic Product) (Pakistan Tanners Association: Annual Report, 2021). This sector put up 953.707 million US\$ (approx.) in the Pakistan’s export in 2021-22 and showing the incremental growth of 14.51% as compare to the last financial year’s export, even with the economic downturns due to COVID-19 pandemic (Pakistan Tanners Association: Annual Report, 2022). Figure 1 shows the exports figures of leather, leather apparel & clothing, leather gloves, leather footwear and other leather products. Figure shows that 6.32% value in US Dollars increases in leather exports of Pakistan with respect to last financial year.

COMMODITIES	UNIT	JULY-SEPT 2021		JULY-SEPT 2022		% CHANGE	
		QTY	VALUE	QTY	VALUE	QTY	VALUE
LEATHER	'000' SQM	3,709	44,399	3,359	45,153	-9.44%	1.70%
	AUP/Sq.M		11.97		13.44		12.29%
LEATHER APPAREL & CLOTHING	'000' DOZ	447	80,487	472	80,724	5.59%	0.29%
	AUP/Pcs		15.01		14.25		-5.02%
LEATHER GLOVES	'000' DOZ	3,041	69,372	2,543	74,393	-16.38%	7.24%
	AUP/Pair		1.90		2.44		28.24%
LEATHER FOOTWEAR	'000' Pairs	1,875	32,185	2,684	41,417	43.15%	28.68%
	AUP/Pair		17.17		15.43		-10.10%
OTHER LEATHER MANUFACTURES	'000' KGS		4,568		3,929		-13.99%
	AUP/Kg						
TOTAL :			231,011		245,616		6.32%

Figure 1: Exports of Leather and Leather Products from Pakistan (Source: Pakistan bureau of statistics, VALUE = US Dollars in Thousands 21-10-2022)

Previous literature focusing LMP and firm’s sustainability performance have two limitations: First, although LMP have significant impact on operational performance and financial performance of the firms but comparatively less consideration is given in literature that how much impact does LMP have on firm’s sustainability performance or triple bottom line (economic, social and environmental performance). Literature shows that how LMP enhance the productivity of the firm by reducing different kind of wastes and improve firms operational performance (Agyabeng-Mensah et al., 2020; Cua et al., 2001; Shah & Ward, 2007; Yang et al., 2011), which ultimately reduce operational cost to enhance the firms economic performance. But there is some uncertainty that how LMP equally contributes to social sustainability and environmental performance of the firms. Second, literature shows that lean manufacturing mostly empirically tests to check the firm’s financial performance and operational performance but none of them studied the impact of lean manufacturing on firm’s sustainability performance, specifically in the leather export industry of Pakistan. For this, further investigation is needed specifically to the following research questions:

- How much impact does total quality management and just in time on firm's sustainability performance in the leather export industry of Pakistan?
- How and what level of lean culture, moderated the relationship of total quality management, just in time, and firm's sustainability performance in the leather export industry of Pakistan?

Therefore, the main objective of this empirical study to investigate the impact of lean manufacturing practices (total quality management and just in time) on firm's sustainability performance, moderated by the lean culture of the firm. This paper has five sections. Section 2 comprehensively explains the theoretical grounds through literature review, section 3 have the research methodologies, section 4 have the results of the analysis, section 5 have the discussions on empirical observations and section 6 have the implications and future recommendations.

LITERATURE REVIEW

Lean

A book named as "The Machine that Changed the World", spread the lean manufacturing paradigm developed by the Toyota Motors. There are various definitions, explanations and characteristics of Lean Manufacturing (LM) (Dahlgaard & Dahlgaard-Park, 2006; Mellado & Lou, 2020). As the lean manufacturing paradigm and its related theories are still evolving, there is no universal definition yet. Overall, core objective of Lean Manufacturing Practices (LMP) is to produce quality product with low possible operational cost, with minimum lead time and with least possible amount of waste. Lean management defined by (Shah & Ward, 2007) is a combined socio-technical integrated system with the core aim to minimize the internal waste of the firm (production's waste) and external waste linked to supply chain and customer. Many research studies show that by only focusing the "hard" and operational practices (i.e., kanban, value stream mapping and lot size reduction) are not sufficient for firm's long term sustainability performance (Bateman, 2005; Mellado & Lou, 2020). "Soft" core practices related to people (employees, customers and society) and relations with them considered as equal importance as hard core practices. Few researchers conclude that successful lean firms put more efforts and comprehensively invest in soft core practices as compare to hard one (Bortolotti, Danese, et al., 2015; Maware & Parsley, 2023). Many researchers having same lens also concluded the lean management system as inter-related set of soft and hard core practices. For example, researcher grouped ten different lean manufacturing dimensions into four domains, which are; supplier, process, customer and control and human factors and this study mainly investigate the mediating effect of lean manufacturing on industry 4.0 (Kamble et al., 2020). We conceptualized hard core and most technical lean practices in our research, which includes Total Quality Management (TQM) and Just in Time (JIT). TQM practices are technical one which comprises of those improvement initiatives that are essential to sustain and continuous improvement in the product quality along with meeting and surpassing the customers' expectations (Abualfaraa et al., 2020; Cua et al., 2001). TQM contains the total quality management program, processing capability management and continuous improvements advantages as the tool to gradually enhance the product quality with respect to set quality standards (Lobo Mesquita et al., 2022; Shah & Ward, 2007). JIT are also the technical program and practices for gradually minimizing the manufacturing related waste which includes scrap and excessive inventory and having such initiatives such as lot size reductions, waste of motion, total cycle time reduction, inventory waste, bottleneck removal, processing waste, process reengineering and quick changeover, which ultimately leads the firm towards good housekeeping aspect (Shah & Ward, 2007). As per the customer's point of view, for example, any action or activity for which customers are not agreeable to pay are called as waste activity (Benkarim & Imbeau, 2021; Chen et al., 2010; Chaiyakot et al., 2022). For this, it is very important for firm to create such organizational culture in which every employee proactively willing to welcome such lean initiatives to produce quality product with minimum possible cost by eliminating waste.

Lean Manufacturing and Performance

As per the literature, lean manufacturing practices is the socio-technical initiatives that have several management and manufacturing tools, techniques and principles which assist firms to produce quality product as per the customers' expectations by eliminating the process waste at each possible level. Lean manufacturing initiatives have the core objectives to identify waste, minimize it, deal with its possible root causes; for such benefits, many firms successfully adopt the lean manufacturing paradigm (Abualfaraa et al., 2020; Panizzolo et al., 2012). Various studies have shown the evidential findings that lean manufacturing practices have significant impact on firm operations

performance or financial performance or firm marketing performance. Both service sector and manufacturing sector get benefits of this quality initiative paradigm.

Theoretical foundation of this paper based on Theory of Systems, which refers to that manufacturing system which have interdependence and interrelated components, working in such a way to achieve operational efficiency and productivity. When we explore the lean manufacturing system in the theory of systems perspective, then it may lead us to that system which have interrelated and interconnectedness set of activities within the firm, having unified objective to achieve the manufacturing excellence by best possible use of their available resource with minimum wastages (Mellado & Lou, 2020). Key aspects of systems theory applying in lean system are; system optimization, continuous improvement, communication and feedback, flow and pull systems and value stream mapping. Firms can improve their process and operations, minimize waste by identify and manage it, enhance the systems productivity, and deliver the best possible value to customer (Benkarim & Imbeau, 2021). Lean manufacturing focuses the whole system in a way to identify and resolve the root cause of problems occurred, enhance systems efficiency and gain sustainable results.

Lean Manufacturing and Sustainability

The idea of sustainability gain focus when firms performance collectively considered as economic performance (profits & market share) along with the social performance (employee, customers and public) and environmental performance consequences of the advancing and developmental activities. Sustainability is defined as the firm's growth that fulfill the expectations of the present without damaging or compromising on the future generations to fulfill their expectation and needs (Brundtland, 1987). Other research explains the business sustainability as the firm's incremental increase in productivity by consuming minimum resources without compromising on quality of the product or services, its competitiveness, or profitability of the firm while assisting gradually to protect the environment (Lima et al., 2023; Sajan et al., 2017). Moreover, Seliger et al., (2011) explains the sustainable operations or sustainable product in the manufacturing context as, "those products or process that consumes less energy and natural resources and have less environmental and social impact and fulfill the core main to satisfy present needs without damaging and compromising on the future generation's needs. By focusing and collaboration with stakeholders, manufacturing firms continually trying to improve their product quality and operational performance with the help of their feedbacks (Mellado & Lou, 2020; Russo & Tencati, 2009). Literature shows that many studies have evidences which shows the lean manufacturing practices are one of those which lead firms towards achieving sustainability performance (Alves & Alves, 2015; Azevedo et al., 2012; Belhadi et al., 2018; Kainuma & Tawara, 2006; King & Lenox, 2001; Mollenkopf et al., 2010; Piercy & Rich, 2015; Rothenberg et al., 2001; Sajan et al., 2017). Firms adopting lean manufacturing enhance their attentions to responsiveness to firms economic issues, social as well as environmental issues to gain the competitive advantage, which is sustainable manufacturing (Vithayasrichareon et al., 2012; Yusup et al., 2015). The main theme of lean manufacturing to minimize the all forms of waste which are actually the non-value added activities, to make the operational process more productive. Zero defect or zero waste objective of the firms intended to best use of their available resources in a way that our process used optimum energy, raw material, space and time to produce the customer requirements (Florida, 1996). Waste and defects reduction in the form rework, repair or scrap minimizing the cost of operations, enhance the operational productivity and hence overall profits in the form of return on investment increases (Yang et al., 2011). Achieving sustainable manufacturing also focused on minimizing to adopt those operational process which can cause the hazardous to the environment and sustainability also make efforts to reduce such pollutants which have impact on environment (Benkarim & Imbeau, 2021; Demeter & Matyusz, 2011). Researchers says environmental benefits as the complimentary impact creating by the firm and such environmental performance can enhance by just focusing on the used materials, processes, energy and the proper management of waste and hazardous pollutants (Martínez-Jurado & Moyano-Fuentes, 2014). Literature shows that lean manufacturing has built in intentions to respect for people (employees, customers, stake holders and community) and having the positive reputation in the community is the strategy setting techniques adopted by the lean driven firms (Piercy & Rich, 2015). Lean manufacturing practices strive to empower their employees to go for lean, which ultimately enhance the workers job satisfaction and build up a pride on one's work. Lean and sustainability have the common target to continuously enhance the working conditions of their employees within the firm's operational processes (Piercy & Rich, 2015). Lean driven organizations have highest level of worker's

health and safety protocols by adopting work standardizations, visual management, sign boards and precautions and through employee training (Mousavi et al., 2020). Literature review findings elaborate that lean manufacturing practices have the significant contributions towards the different domains of firm's sustainability performance.

RESEARCH MODEL AND PROPOSED HYPOTHESES

This section has the details about the target population, sampling, instruments of the survey, data collection methods and related analysis.

Total Quality Management (TQM)

TQM have the customer centric approach which continuously enhance the firms process and quality of product to fulfill the ever changing requirements and meet their expectations (Anderson et al., 1994). Such manufacturing techniques provide the competitive advantage to beat their competitors in the form of product quality, efficient delivery and sustain positive reputation in the marketplace (Inman et al., 2011; Narasimhan et al., 2006; Talib et al., 2013). Literature shows that TQM build the strong lean foundations while achieving the sustainable performance Sharp et al., (1999). TQM always ready to response the flexible productions as this lean technique is the customer focused. TQM provide the lean firms the competitive advantage due to its competitiveness capabilities (Abualfaraa et al., 2020; Bortolotti, Danese, et al., 2015; Cua et al., 2006; Putra & Suef, 2018) by achieving operational excellence (Ali, et al., 2010; Grandzol & Gershon, 1998; Zu et al., 2008). TQM works as the significant contributor in terms of customer satisfaction and conformance of the product quality (Forza & Filippini, 1998; Qureshi et al., 2023; Talib et al., 2013). Research study shows that the TQM significantly impact the quality and sustainability performance of the lean firms through various quality improvement initiatives (Curkovic et al., n.d.). The above literature review and comprehensive discussion leads us to hypothesis 1:

H1: Total quality management have significant impact on sustainable firm performance.

Just-in-time (JIT)

JIT considered as one the most important lean bundles while implanting lean production system to achieve firm's performance (Shah & Ward, 2007). JIT considered as inventory management techniques used by the films in which raw material received by the supplier only when it required by the firm for operations. The main target of this technique to achieve less inventory holdings and minimizing the inventory holding expenditures. JIT concepts shows agility in the form of best possible inventory management within the firm. JIT concept gradually improves the firm's stocks through lot size reduction approach (Flynn et al., 1995), increase the efficiency of supply chain process by delivery reliability (Bortolotti, Danese, et al., 2015; Danese et al., 2012). Firms also used JIT to minimizing the buffer inventory by using the lot size reductions (Flynn et al., 1995), pull production technique (Shah & Ward, 2007), set-up time reduction which leads shortened cycle time (Cua et al., 2001; Shah & Ward, 2007), minimizing the non-value added activities throughout the operational (Claycomb et al., 1999) and supply chain process and enhance the firm's capability to meet master schedule timelines continuously (Zelbst et al., 2010). Moreover, literature shows the significant impact of JIT and firms competitiveness and also studies found which shows the aggregate JIT have complementarity impact on firm's performance to achieve the lean production system (Furlan et al., 2011). The above literature review discussion leads us to hypothesis 02:

H2: Just-in-time have significant impact on sustainable firm performance.

Lean Culture

Lean culture is very essential factor that collectively form the ways that how takes are being done in the firm and its affected by the overall management system of that firm (Trivellas & Dargenidou, 2009). Lean culture motivates and involves all employees of the firm to proactively engage in continuous quality improvement system of the firm and make collective effort to achieve optimum use of the resources with less wastes. In lean culture environment, employees from all the levels jointly make organizational plans to eliminate waste from the operational systems and produce the best possible quality products with minimizing the doubts of any type of defects. Overall organizational culture shows the personality, reputation and image of the firm, build the norms and values within the firm (Dahlgaard & Dahlgaard-Park, 2006). Organizational culture always penetrates into employee's mind in the way of feeling, perceiving and thinking while doing their routine work, because it is evolving pattern that

employees learn while problem solving and then these learnt pattern shared with subordinates to solve the same problem with best possible way (Bortolotti, Boscari, et al., 2015).

Literature shows that companies adopting lean culture while implementing the lean manufacturing practices works more effectively and gains sustainable results as compare to those who are not properly adopting lean culture, results lean practices not fully implemented in operational processes. Previous empirical studies conclude the lean implantation failures due to one of the reason of not adopting lean culture in the firm (Bortolotti, Boscari, et al., 2015; Mann, 2014). For this, it is expected that lean culture have some moderations towards implementing lean manufacturing practices to achieve sustainable firm’s performance. Comprehensive discussion leads us to hypothesis 3, 4, and 5:

H3: Lean culture have significant impact on sustainable firm performance.

H4: Lean culture moderates the relationship between total quality management and sustainable firm performance.

H5: Lean culture moderates the relationship between just-in-time and sustainable firm performance.

Research Model

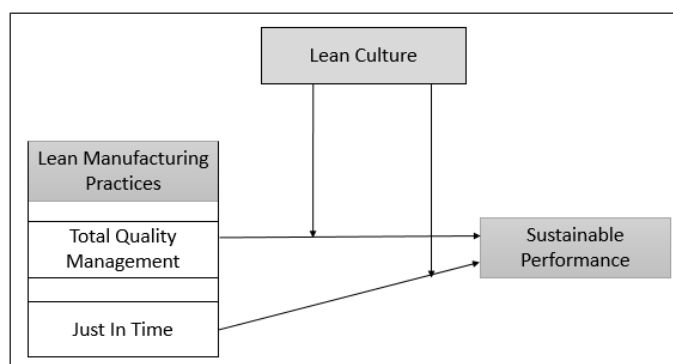


Figure 2: Research Model

RESEARCH METHODOLOGY

This empirical study used the quantitative research method technique to attain the set objective and get the answer against the research questions. Sample perspectives also very important while measuring the level of implantation of lean manufacturing practices on firm’s sustainable performance, moderated by lean culture; thus quantitative research method is appropriate to analyses this study. As per the above discussion and literature review inspires current empirical study to a research framework as shown in figure 2, which shows graphical representation to the proposed hypothesis. As per figure 2, research framework explains the independent constructs (lean manufacturing practices with two sub-variables as; total quality management and just in time), which hypothesized have the significant impact on dependent variable (sustainable firm performance), predicted by the independent variables. Furthermore, lean culture of the firm hypothesized to have moderating effect on firm’s sustainable firm performance. The research sample includes the various level of executives, managers and supervisors of the leather export industry of Pakistan. Current study utilizes the stratified random sampling technique to reach out to the target population to collect the sample data and from each stratum, a random sample selected as this technique make the data collection easy to target the sample (Etikan, 2017).

Stratified random sampling method is beneficial to collect the diversified perspectives from various backgrounds of the target population to collect comprehensive view on lean manufacturing system. This study used the questionnaire technique that adapted from the literature and past studies, and it is circulated to target population sample after measuring its items, validating the items and screened through the panel of expert and specialized professionals in the field of lean manufacturing. Feedback received from the expert’s panel incorporated in questionnaire to make survey items more understandable and easy to responds. After excluding the missing values questionnaire, a total of 240 complete responses were used to analyses the final results.

The quantifications of the lean manufacturing practices were gauged by using two dimension: total quality

management and just in time. All dimensions measured by adapting the dimensional items presented in the previous studies. Five point Likert scale used to collect the responses, ranging as “1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree” and respondents were asked to give their perceptual level of agreement or disagreement against the stated items of main dimensions. Moreover, current study used the Partial Least Squares Structural Equation Modeling method (PLS-SEM) used to analyses the data with the assistance of Smart-PLS software and key statistical analyses performed. The main justification of utilizing PLS-SEM technique to provide the important outputs and it also process multiple variables at once and also proceed the complex framework within one go. Its reliability and validity test made this approach more recommended one, also previous literature supports their utilization in business research (Hair et al., 2019). Furthermore, current empirical research provided the comprehensive examination of two important types of models, which are; structural model and measurement model. Model which used to test and analyses the proposed hypothesized called as research model, and measurement model used to validate the overall research model and also perform the validity analysis through convergent and discriminant validities.

RESULTS

Results of present study analyzed and presented through PLS-SEM (Partial Least Squares) program that most literature suggested as recommendations to performed analysis, as this program provide us the essential aspects of the research statistics, which provide the researcher a clear picture of research as an evidence to discuss findings (Sarstedt et al., 2016). Moreover, this technique used to analyses the moderation effect of lean culture between lean manufacturing and sustainable firm performance, as this technique provide us the comprehensive picture to accept or reject the propped hypothesis. Processing the data analysis through PLS-SEM provide the handy support to manage and calculate the complex analysis having the different level of constructs, dimensions and items (Hair Jr. et al., 2017). This program also provides the multiple options to perform analysis, like; bootstrapping option to backing and supporting the stated research objectives. Two major types of model, which are name as measurement model and structural model explained in later sections having the statistical details of current research.

Measurement Model Assessment

For model measurement, some initial requirements should be fulfilled to perform the analysis, which is validation of indicators, validation of scale, convergent validities and discriminant validities, which guide us towards capabilities of relevant variables to measurements. Total correlations, Cronbach's alpha and CR (composite reliability) give us the details related to scale validity (Hair et al., 2019). For this, main tests suggested in literature performed through PLS-SEM and these test also suggested and recommended by many researchers (Hair Jr. et al., 2017). For example, indicators factors loadings against the variables showing the capability of that variable to actually gauge the target objectives. When Cronbach's alpha exceeds 0.7, composite reliability exceeds 0.7 and cumulative correlation exceeds 0.3 then we called the scale as reliable (Hair et al., 2019). Table 1 below shows the statistical figures, confirming the scale reliability of this study as per Hair et al., (2019). In this study, common method bias (CMB) also measured by adopting and analyzing the Variance Inflation Factor (VIF) and also used the Harmon's one factor test to measure the data are related constructs. If VIF values less than 3.3, then data set is not problematic to proceed further (Hair et al., 2014; Kock, 2015). In current study, VIF values shows the acceptable statistics as values lies in between 1.24 to 2.984 and hence, common method bias has not any threats to validity and reliability of the research findings. Relevant indicators are also tested by checking their reliability analysis, mainly used in the literature having the main analysis, such as; Cronbach's Alpha, AVE (Average Variance Extracted) and CR (Composite Reliability). Variables reliability also explains the essential aspects of the research model which is called as internal consistency. To perform this test to check internal consistency, PLS-SEM perform the AVE (Average Variance Extracted) and CR (Composite Reliability) to measure the reliability issues. Output files shown in Table 1 provide us the statistical measures which is mostly have satisfactory level and fulfill the minimum cut offs criteria. For example, convergent validity calculated through AVE and CR both, results show the acceptable outputs statistics for the measurement model (Hair et al., 2014). Statistical findings of AVE and CR shows the acceptable ranges of constructs as both have meet the minimum cutoff criteria, which are > 0.50 for AVE and > 0.60 for CR (Fornell & Larcker, 2014).

As per the measurement model results, all proposed assumptions are accepted as constructs have acceptable

validity as well as reliability. Fornell and Larcker criterion used to analyses and verify the discriminant validity of the data. As per Fornell and Larcker, (2014), discriminant validity is confirmed if AVE square root surpasses and have more value than inter-construct correlation between the latent variables. Square root value of AVE has the more value than the inter construct correlations, as value given bold at top of each column, shown in Table 2. Hence, discriminant validity of the data test and verified, this lead us to the nomological validity which is well established after the discriminant validity verification. Measurement model shown in figure 3.

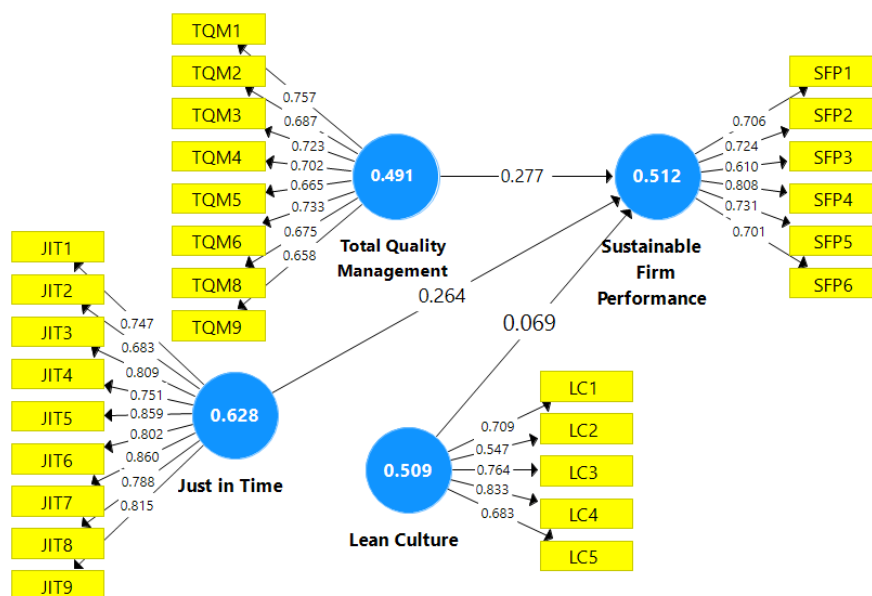


Figure 3: Measurement Model

Table 1: Validity, Reliability and VIF

Constructs	Items	Loadings	VIF	Cronbach's Alpha	Composite Reliability Average	Variance Extracted (AVE)
Just in Time	JIT1	0.747	2.185	0.925	0.938	0.628
	JIT2	0.683	1.629			
	JIT3	0.809	2.984			
	JIT4	0.751	2.068			
	JIT5	0.859	2.452			
	JIT6	0.802	2.769			
	JIT7	0.86	2.318			
	JIT8	0.788	2.475			
	JIT9	0.815	2.467			
Lean Culture	LC1	0.709	1.706	0.761	0.836	0.509
	LC2	0.547	1.245			
	LC3	0.764	1.819			
	LC4	0.833	1.637			
	LC5	0.683	1.266			
Sustainable Firm Performance	SFP1	0.706	1.587	0.811	0.862	0.512
	SFP2	0.724	1.763			
	SFP3	0.61	1.512			
	SFP4	0.808	2.004			
	SFP5	0.731	1.587			
	SFP6	0.701	1.527			
Total Quality Management	TQM1	0.757	1.996	0.853	0.885	0.501
	TQM2	0.687	1.592			
	TQM3	0.723	1.766			
	TQM4	0.702	1.626			
	TQM5	0.665	1.569			
	TQM6	0.733	1.846			
	TQM8	0.675	1.723			
	TQM8	0.675	1.723			
	TQM9	0.658	1.538			

Table 2: Discriminant Validity (Fornell-Larcker Criterion)

	JIT	LC	SFP	TQM
Just in Time	0.792			
Lean Culture	0.533	0.714		
Sustainable Firm Performance	0.392	0.306	0.716	
Total Quality Management	0.33	0.344	0.388	0.701

This empirical study also checks the discriminant validity by adopting HTMT test which explains the assessment of discriminant validity and Heterotrait monotrait ratio of correlations. Discriminant validity established if the HTMT test value is smaller than 1, according to (Henseler et al., 2015). Table 3 shows the value of HTMT and statistical figures shows that HTMT achieved the good threshold of (0.90) to confirm the discriminant validity.

Table 3: HTMT

	JIT	LC	SFP	TQM
Just in Time				
Lean Culture	0.598			
Sustainable Firm Performance	0.437	0.356		
Total Quality Management	0.360	0.394	0.441	

Next step of this empirical study analysis to test the structural model by using PLS-SEM and this model test is performed to confirm the research hypothesis. Structural model testing always suggested and recommended by the literature to verify and confirm the described hypothesis. Table 4 showed that stated research hypothesis are accepted, as structural model shows goodness of the research model. Total quality management have positive and significant impact on the sustainable firm’s performance having the values as, $\beta = 0.277, t = 5.589, p < 0.01$, which leads to acceptance of H1. Just-in-time have positive and significant impact on the sustainable firm’s performance having the values as, $\beta = 0.264, t = 7.854, p < 0.001$, which leads to acceptance of H2. Lean culture have positive and significant impact on the sustainable firm’s performance having the values as, $\beta = 0.069, t = 1.995, p < 0.001$, which leads to acceptance of H3. Figure 4 shows the structural model assessment of this research.

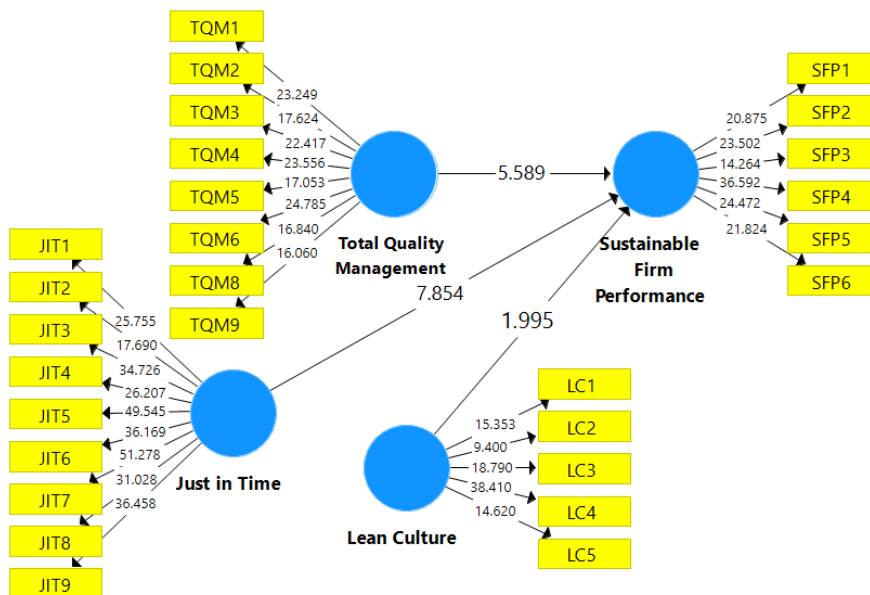


Figure 4: Structural Model Assessment

Table 4: Direct Hypotheses Testing

	Beta	SD	t Stats	p Values	Decision
Just in Time -> Sustainable Firm Performance	0.264	0.034	7.854	0.000	Significant
Lean Culture -> Sustainable Firm Performance	0.069	0.035	1.995	0.023	Significant
Total Quality Management -> Sustainable Firm Performance	0.277	0.050	5.589	0.000	Significant

Figure 5 shows the moderation model assessment and Table 5 shows the moderation statistics. Results confirmed that lean culture significantly moderates between the total quality management and sustainable firm performance, having the values as, $\beta = 0.236$, $t = 1.960$, $p = 0.025$, which leads to acceptance of H4. Results also confirmed that lean culture significantly moderates between the just-in-time and sustainable firm performance, having the values as, $\beta = 0.108$, $t = 2.469$, $p = 0.007$, which leads to acceptance of H5.

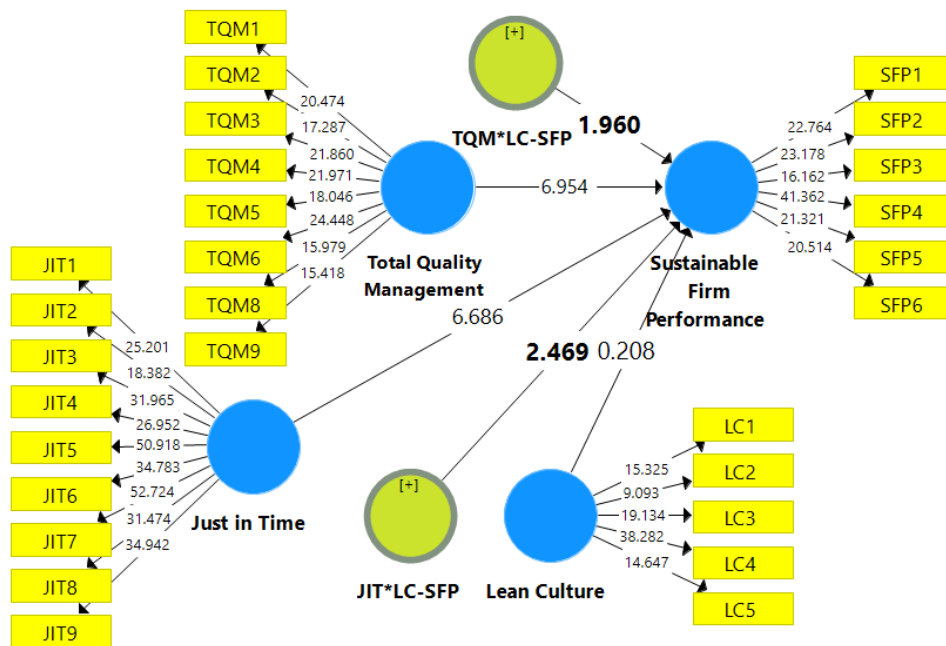


Figure 5: Moderation model

Table 5: Moderation Hypotheses Testing

	Beta	SD	t Statistics	p Values	Decision
JIT*LC -> Sustainable Firm Performance	0.108	0.044	2.469	0.007	Moderation
TQM*LC -> Sustainable Firm Performance	0.236	0.120	1.960	0.025	Moderation

SUMMARY AND DISCUSSION

Although considerable research and attention given in literature review related to lean and sustainability, e.g., (Agyabeng-Mensah et al., 2020, 2021; Kamble et al., 2020; Yang et al., 2011), but the mostly research are not able gauge the relationship of lean on triple bottom line (TBL), collectively on economic performance, social performance and environmental performance (Abualfarra et al., 2020; Martínez-Jurado & Moyano-Fuentes, 2014; Paranitharan et al., 2017). Mixed type of results and variations in findings concludes that lean sustainability research still have much potential to discover and more empirical studies required to fill this missing gap to measure the collective impact of lean on triple bottom line. Inspired by this research gap, and main focus on lean sustainability research, this empirical study analyses that what level of impact creates by lean manufacturing practices on sustainability firm’s performance and how this particular research contributes to gauge the triple bottom line performance, which are; economic, social and environmental performance. So, in modern competitive environment, most researcher considered lean manufacturing system as the firm’s competitive advantage in the

market place (Abualfaraa et al., 2020; Agyabeng-Mensah et al., 2020; Bellisario & Pavlov, 2018). This study empirically checks if the lean culture as moderation can perform positive function for firm to achieve the triple bottom line collectively. Getting the logical answer to identified research and established research question, this study can statistically clarify whether lean culture was the missing link to get collective results while implementing lean system. In the presence of extensive literature, this study considered the lean management system as the integrated socio-technical system having various alignments and coordination's within the firm (Shah & Ward, 2007). This study verifies the literature that lean management system has set of both hard core practices, like; total quality management and just-in-time but soft core practices are also very essential to implement this system, like; lean culture, plays a soft core role in this empirical study (Abualfaraa et al., 2020).

Challenges to completely implement the manufacturing improvement techniques, like; lean manufacturing practices have the tough experiment for many firm who aims to achieve sustainability, as growing firm thought such process improvement initiatives as competitive advantage of the firm as well. Having the productive benefits of lean manufacturing implementation as firms minimize the waste, eliminate non value added activities to produce quality product but firms get the short term benefits usually and lacking the long term advantages. Most firms also feel very difficult to implement it fully to gain long term benefits, e.g., (Abualfaraa et al., 2020; Bortolotti, Danese, et al., 2015; Paranitharan et al., 2017; Yusup et al., 2015). For this, current research makes an effort to analyses the level of lean manufacturing implementation to gain the sustainable results in leather export industry of Pakistan. For this, sustainable business profits through economic view point studied along with the social and environmental impact. Finding shows that total quality management have positive and significant impact on sustainable firm performance. It shows that firms implanting the total quality management have fully focused on customer needs and deliver desirable product by involving the engineers, production managers and quality supervisors to plan, process and deliver the best possible product with minimum waste, which lead firm to achieve economic sustainability. Firms utilized the composite teams to thoroughly get the customers demand through marketing team, then planning and production team make such lean management system in which firm tried to eliminate the possible waste, also produce quality product so that less repair or rework happened. As one of the quality gurus said that "quality is free", which means that if company invest in planning, processing and delivering the product under lean system then they maximum tried to focus on achieving the total quality aspect, means achieving quality in all the activities and processes. In lean system, all processing controlled by statistical processing techniques and through quality charts, which help the process engineers to identify and eliminate waste to gradually improve the system.

Results also shows the significant impact of just-in-time on sustainable firm performance. Firms implementing lean system have aim to reduce the stocks and saves inventory cost. Companies make plans to order the inventory when it demanded by the process units. Master schedule of the firms break down into daily based schedules, in which inventory demanded by one station can initiate the demand for supply the materials. It saves the companies handling cost and process floor not occupied with extra materials, ultimately flow of things get smoothened. But, lean implantation is not achieved with the involvement of each employees of the firm, so lean culture within manufacturing system gains important when we implement such improvement initiatives. That's why, lean culture shown as the moderated and results also confirm that lean culture moderated in between the total quality management and sustainable firm's performance, also; just-in-time have impact on sustainable firm performance moderated by lean culture. Firms, while implementing lean culture, first trained their employees about lean, its systems and its importance. Top management must also get involved in this process to train the employees and also set the criteria, standards and benchmark for each process. Lean culture enhanced when firms attached it with some kind of rewards to achieve the lean process. All level of employees gets involved, motivate as team, showing dedication to eliminate all possible waste after continuously identifying the wastes. Firms set targets related to lean system must be properly defined and communicated to each employee so that every employee feel involved and motivate enough to perform as key quality player to improve the overall system.

Firms also tried to gain sustainability in social and environmental aspects along with achieving economic stability, as all three aspects are equally important towards achieving the sustainability as a whole for firm. Lean culture having lean system aimed to protect the employees right as well as the wellbeing of the society. Firms implementing lean, tried to adopt such manufacturing system in which less wastages produced in the form of solid, liquid and gaseous waste, so that environment less effected by the firm's operations. Every lean management firm have goal, mission and vision to gradually reduce the three types of waste, so that surrounding environment get

less polluted. When we talk about the leather industry, typically in Pakistan, mostly firm used traditional methods to preserve the leather, which includes hazardous chemicals as well. Lean firms tried updated their preservation system in which less hazardous chemicals used so that environment less effect by the manufacturing operations. Firms empower their employees, get involved in decision making, feel them motivated, get them rewards are also leading firms towards achieving internal social sustainability of the firm. On the other hand, firms doing charity projects for the development of societies considered as external social performance of the firm.

Hence, current study findings are in accordance with the prior studies provided in literature which shows the significant impact of lean manufacturing on firm's sustainability performance and this could be more effective implementation of lean when lean culture in the firm indulge in a way that every employee involved to achieve the collective organizational goal. As, now a days and later on, firm's main focused towards process efficiency and enhancing productivity by eliminating wastes at each level, firms used this approach as competitive advantage having highly focus on preferences required by customer, which is usually, "quality product, low cost, maximum variety with efficient delivery".

MANAGERIAL IMPLICATION AND FUTURE DIRECTIONS

From the managerial perspectives, this empirical study provides the insightful details for practitioners and managers with the comprehensive set of guidelines to fully implement the lean management system to achieve the sustainability. Guidelines have the details with the importance of hard core practices, which are; total quality management and just-in-time, and equal importance with soft core practices, which are; lean culture involving internal public to achieve lean implementation properly. Managers have the comprehensive package in the form of lean system which have focus on cleaner production system by eliminating processing wastes, also have equal respect to protect environment by releasing less pollutants and same attention given to social aspects in the form of human rights, employee rights and community rights. Hard core practices (total quality management and juts-in-time) along with softcore practices (lean culture) can build firm confidence to guarantee the environmental performance and social performance, parallel with economic performance of the firm. Secondly, this study strongly suggests the lean culture implementation as its importance already discussed previously. It is necessary to develop and implement lean culture within firm before implement the lean management system. Thirdly, this research suggests managers to continuously identify and eliminate processing wastes along with non-value added activities, as these wastes also recommended to manage in the previous literature as well. Empower the firm's employee and create the lean culture mindset so that everyone knows their critical role to achieve the sustainable culture in the firm.

This empirical research has some limitations as its just focus on leather export industry of Pakistan, so its scope is limited to leather sector. Moreover, small sample of 240 respondents used which make it difficult to generalize its applicability on other sectors as well. Future studies can use this framework to explore other sector in developing countries to strengthen the theory. Also, this study carried out in limited time for which specific responses received, so it is recommended the longitudinal impacts on other industries as well to gain more clarity on lean sustainability paradigm. This study used lean culture as moderator to check the lean sustainability link. Future studies may use other aspects as moderator or mediator to explore future evidences in this area.

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