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The influence of lean manufacturing on firm performance through mediation of supply chain practices

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ABSTRACT

This research study aims to explore and confirm the impact of lean manufacturing practices on specifically the Supply Performance and generally the overall firm performance through the mediating role of supply chain practices among different partner entities associated with accomplishing a combined goal to generate profit, primarily focusing on minimizing wastes and reducing cost so that they can attain improved performance and competitive advantage. This study used a quantitative method to explore and confirm the developed and hypothesized model using a deductive approach. They were examined for the reliability, validity and structural equation modelling for analyzing the Path using Smart PLS 4. The obtained results not only suggested that there is a positive and direct impact of implementing LM Practices on SCRs and SP and SP influenced by improved SCRs among supply chains, but the indirect effect also confirmed the mediation of SCR between Lean practices and the SP, which consequently enhances overall firm performance in SME's sector in Pakistan.

Keywords: *Supply chain management, Lean manufacturing, Inventory control, Inventory management*

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1. Introduction

These days, many of the firms are trying to get a competitive advantage against their peer business rival. Rather than only focusing on firm orientation, a keen focus on supply chain orientation can be an essential approach for the better survival of a firm, as stated by author Vonderembse (2006). Council of Logistics Management launched Supply Chain Management in 2000 as a set of well-managed coordination and tactics over formal business activities inside a particular firm and over businesses associated with the supply chain for increasing long-term enhanced performance for the firms and the Supply chain as a whole.

Markets are becoming full of challenges increasing globally; manufacturing firms depend on operational distinction and improved performance to minimize the cost to lower and deliver higher quality products and services with as short as possible lead times. Firms are facing much pressure to adapt LM principles and methods that are being used extensively to get to the level of desired improvement performance and grab a competitive edge over rivals (Garza-Reyes et al., 2012; Hashmi, 2022; 2023; Baloch & Rashid, 2022). The term “lean” refers to a set of strategies and tools for increasing the efficiency of an organization's goals for gaining a strategic advantage over its business rivals, as stated by Bhasin (2012) and for acquiring a strategic edge over its peer trade rivals confirmed by Belekoukias, Garza-Reyes et al. (2001), Forrester et al. (2010), Sparrow et al. (2015).

Leanness is an approach to manufacturing whose competency is to help a firm to be competitive within the industry by increasing productivity and taking cost-cutting initiatives by killing non or less-value-added steps and wasteful aspects in the process lifecycle (Garza-Reyes et al., 2012). Aljawarneh et al. (2018) reported that lean activity is an operation system aimed at smoothing the creation flow by eliminating waste and expanding the value of practice. Solaimani et al. (2019) stated that to maintain their position worldwide, many associations are serious about adopting and implementing lean practices. Another researcher argued that the primary reason for implementing LM in the supply chains is to stay competitive against the superior rivals operating in the industry and grab the desired competitive edge, which brings the firm to a leading position (Taylor et al., 2006; Hashmi et al., 2020a, b).

LM (LM) was initiated in the Toyota Production System in Japan; several manufacturing firms have extensively used lean principles from many countries in stable industries or sectors. It still needs to be improved to get to a well-executed implementation of LM practices and retain its results investigated by Bhasin et al. (2012). Using lean strategies, several methods and techniques are responsible for improving the overall performance of a firm, as stated by Bhasin et al. (2012). As researched by Rocha-Lona et al. (2013), the most commonly used and fruitful lean practices are just-in-time (JIT), value stream mapping (VSM), automation, total productive maintenance (TPM), and kaizen/continuous improvement (CI).

The technique of JIT emphasizes the term Just-In-Time and focuses on the production of the correct quantity at the right time to avoid warehousing and handling costs reported by Womack et al. (2007). A few tools of LM that are being used frequently by a vast number of firms are one-piece flow, cell manufacturing, pull system, levelled production and JIT purchasing suggested by Liu et al. (2017). Firms can use the TPM technique to promote predictive, preventive and corrective maintenance practices to ensure higher productivity and enhance overall firm performance and can save the cost incurred for buying new and costly machinery and equipment unnecessarily, as argued by Brah et al. (2004).

Another frequently used lean manufacturing technique is Value stream mapping VSM, which carefully analyzes the processes and identifies wastes caused by inefficient, unreliable and incomplete or useless information, tools and equipment throughout the production process of a product

investigated by Abdi et al. (2017). As confirmed by Imai et al. (2012), Continuous improvement CI or Kaizen is among the top lean tools in a lean firm. Firms are frequently using that. It intensively focuses on the elimination of wastes to a minimum extent, which continuously improves the processes whenever it is introduced. It becomes an essential part of the firm to manage the lean initiatives. Many researchers have confirmed that LM approaches like Just-in-time (JIT) purchasing integrated with TPM, VSM, Kaizen or CI, material requirement planning (MRP), and waste handling have shown a significant positive effect on operational excellence in businesses, as stated by Hird et al. (2015).

When the implementation of lean tools such as JIT is done successfully, it was not only found helpful in improving and maintaining operations, finance and strategic course of action, but it also improved quality level and enhanced productivity by reducing stocks researched by Tsenget al. (2015). Motivating and controlling involvement and participation are the two main and essential aspects in any firm for implementing lean tools effectively and efficiently, as reported by Achanga et al. (2006). The two most important aspects for achieving superior firm performance are employee engagement and appropriate implementation of lean practices, confirmed by Dombrowski et al. (2012). The influence of these two is significant, which consequently improves firm performance caused by the adoption and level of implementation of LM practices. This study aims to look more carefully at the influence of transactional SCM gained by implementing LM practices on the relational SCM referred to as SCR and specifically SP generally overall performance of SMEs in the manufacturing industries in Pakistan.

The business environment keeps on changing; therefore, organizations ought to keep changing in order to embrace and adapt to this environment. LM must maintain sincere relationships between key stakeholders, specifically main supplying partners and customers. However, there needs to be more proper attention among different entities inside the supply chain, and the collaboration among business partners is exceptionally researched by Slone et al. (2010). In line with Al-Omari et al. (2020), better overall firm performance results from enhanced and maintained operations performance. Firms can realize their ultimate goals if their operations are being executed perfectly, as reported by Masa et al. (2017). Some researchers, Fredendall et al. (2016), confirmed that enhanced performance of the supply chain is taken into account by the integration of vendors of a business, and vendor management and the firm's growth are interdependent.

Firms that focus on transactions executed to level production and minimize the cost often face an adverse or damaging impact on relations among business partners, as argued by Crum et al. (2011). Moreover, Vanichchinchai et al. (2014) stated that in many developing countries like Thailand, firms thirst to reduce the costs incurred in transactions rather than targeting the goodness of the relationships in contrast to the Supply chains operating in developed states like the United States, which emphasize the worth of relationship development (Li et al., 2006). If the relationship among trade partners is excellent and stable, all executions will be perfectly smooth. On the other hand, if a firm experiences a slight shift in the focus from partnership development to the costs and devalued partnership development, many unseen issues arise regarding the supply chain or supplier's performance, as argued by researcher Vanichchinchai et al. (2014).

Various researchers have investigated how the excellence of operations is achieved by applying lean approaches, as stated by Hajmohammad et al. (2013) and financial performance by Fullerton et al. (2009). However, manufacturing organizations should achieve and maintain their financial and eco-friendly performance to actively participate in the current market (Erdil et al., 2018). Another researcher argued that many past studies have investigated and confirmed the attainment of organizational performance influenced by lean practices (Fullerton et al., 2009).

According to Ghaithan et al. (2021), several companies operating in Pakistan cannot apply the LM practices because they need to learn about the real-time benefits of adopting LM and its effect on the sustainability of the environment. There are a few researches that investigated the application of lean practices in different industries, and those studies are most substantial and essential for the establishment of leanness since every other industry has distinctions and variations in its operations

and the course of action confirmed by Shou et al. (2017). Therefore, based on the above arguments, to strengthen the evidence supporting the positive relation of LM practices on firm performance and the level of implementation, further research is required, particularly in developing countries, that can contribute to past available research works, as stated by Jasti et al. (2014). Moreover, there is a space to dig out more in developing countries like Pakistan to explore the Influence of LM techniques and approaches on a company's overall performance. This research will answer the below-mentioned research question(s):

Q 1. What is the level of implementing lean practices in SMEs operating in the manufacturing industries of Pakistan?
Q 2. What is their contribution to enhancing the overall performance of the firm?

In this way, this study has two primary purposes to investigate. They were the first to find the level of adopting LM approaches by SMEs in Pakistan. After testing the model to test the influence of lean principles on the enhancement of firms (SCR and SP), we must understand and accept that not all practices impact at the same level, and their effects can vary depending on the industries. The underseen study offers substantial academic and practical value. Academically, it contributes to understanding the LM practices encompassing supply chain management. Practically, it helps professionals in Pakistan to understand the level of implementing LM approaches and how they are influencing operational performance, SCR, and SP, especially in the SME sector of Pakistan.

2. Literature Review

2.1 Lean Manufacturing

Krafcik et al. (1988) initially found the concept of leanness in manufacturing, which later on gained recognition through the book "The Machine That Changes the World" written by Womack et al. (2007). Womack and Jones (1997) further suggested that there exist five fundamental rules for implementing lean production within an organization: specification of the value, recognizing its flow, eliminating disturbances in the value stream, enabling the customer-driven value pull and in a quest for continuously finding perfection. The LM enhances production excellence by reducing waste to minimal and non or less-value-adding activities or processes. Its primary goals are to reduce costs and improve quality, as argued by Nordin et al. (2010). As Filipe et al. (2005) suggested, the core of the Lean strategy revolves around orchestrating a comprehensive, organization-wide endeavour focused on enhancing processes and minimizing waste. The objective of LM implementation is to minimize waste (any non-value-adding item) and enhance performance. As LM is widely used as a management tactic, researchers have investigated the real impact of lean practices on enhancing operations, as stated by Ciano et al. (2019).

2.2 Firm Performance

If a firm executes its operations efficiently and effectively, it can enjoy an enhanced overall organizational performance and attain the best output, as argued by researcher Busse et al. (2016). Firms hunt for the initiatives taken collaboratively not only outside the firm with the different entities serving in the supply chain but also internally within the firm. In this way, they can experience enhanced performance in the rapidly changing market, as researched by Rahbari et al. (2019). Nimeh et al. (2018) confirmed that the LM practice of just-in-time purchasing (JIT) technique has proven that it has a noteworthy effect on businesses and has captured much attention from both industry experts and researchers as well. Another researcher, Belekoukias et al. (2014), suggested that Just-in-time, as a tool for managing processes, targets to decrease the cycle time within the manufacturing system and enhance responsiveness in both vendors and customers. This expectation is based on the theme of curtailing waste from inventory, which ultimately enhances the overall performance of firms.

2.3 Just-in-Time

Toyota Motor Corporation introduced the JIT technique for the first in the history of manufacturing systems reported by Kahraman and Yavuz (2012). Therefore, the term JIT can easily be used and replaced by the Toyota Production System and is also famously known as one of the primary approaches in lean production practices (Emiliani et al., 2006). As per the researchers Phogat et al. (2019), it was found that the concept of leanness can reduce extensive inventories of spare parts if implemented in any maintenance department and lowers unneeded maintenance time. Intended or planned reduction of waste in maintenance can be fruitful for organizations, which consequently allows organizations to save money over time.

2.4 Total Productive Maintenance

Within the maintenance field, TPM is a perfect lean approach that allows firms to stay operational and competitive. According to Panneerselvam et al. (2012), it takes time to experience change caused by TPM implementation in both firms and workers. To attain this positive change, TPM relies on some special tools like overall equipment effect (OEE) that tends to keep the equipment maintained and up-to-date to ensure hassle-free production, use of automation for maintenance to experience excellence and timely achievement of tasks and to prevent errors like human error, a few more tools are used for the improvement of production analyzed by researchers Randhawa et al. (2017) and Rocha-Lona et al. (2013). Automation is an LM management technique that promotes quality management and emphasizes empowering workers to identify and correct problems at the source. This is achieved through the implementation of mistake-proofing devices and visual controlling systems, which offer a fully operational workplace, as argued by researchers Romero et al. (2019). Manufacturing and maintenance units must work collaboratively because implementing new pillars in SMEs is sufficient to improve OEE. With the help of TPM, firms can create more robust and better relations between the manufacturing and the maintenance departments.

2.5 Transaction and Supply Chain Relationship

The ability of an organization to set up and maintain long-term trustworthy partnerships with its suppliers is defined by a good supplier relationship (Li, 2006). The tactical relationship of firms with the vendors aids in killing many of the problems firms face, and it also strengthens relations with vendors for the future, as stated by Kroes et al. (2010). Supplier relationship has a vital contribution to the decision-making process in an organization, according to Mitrega et al. (2017). There are two crucial features in the theory of Lean Supply Chain Management: assessing relations with suppliers and ensuring cost translucency in transactions. On the other hand, compared to Lean supply chain management, LM is more implemented in the industries because LSCM faces troubles in execution, investigated by Lamming et al. (1996). In the whole SCM, there is still a meaningful lack regarding the contribution of an executive's awareness (Tortorella et al., 2017; Mollenkopf et al., 2010). To accomplish LM firms should have close relations with their vendors.

2.6 Supply Chain Performance

A few researchers, like UlHameed et al. (2019), suggested that although there is much research in the literature about several supply chain activities, there still needs to be more research regarding the relationship between lean activities and the performance of supply chains. Many scholars have investigated SC performance from different perceptions. Wang et al. (2009) researched about the SC Performance with a keen focus on efficiency that affects the tactics for designing a product. Another researcher investigated and confirmed that SC performance is measured in terms of cost incurred in a transaction, the extent to which a firm is responsive and flexible, and its relations with different entities in the supply chains confirmed by Vanichchinchai et al. (2009).

2.7 SME's Sector of Pakistan

To promote Pakistan, it has designated various industries in many areas across the country. The government of Pakistan formed a regulatory authority for SMEs known as the small-and-medium-sized Enterprises Development Authority (SMEDA), which implies that SMEs' are critical players in developing the industries of a country. A significant portion of about 90% of all the enterprises in Pakistan comprises SMEs. These days, the SME sector is extensively active in almost all big cities across the country. As investigated previously, 3.2 million SMEs are working on regulating SMEDA in Pakistan. Despite that, there are still many things that could be improved in the SMEs' industrial zone of Pakistan. Critical problems to industrial development are inadequate infrastructure, quality assurance issues, a need for more skilled workers, and limited access to capital. To cope with the scarcity of available resources and ecological problems, the Government of Pakistan imposed rules for sustainability to maintain an eco-friendly environment. This resulted in a slower but steady growth in manufacturing production, with a 4.10% increase in April 2018. Data was collected from various small and medium-sized enterprises (SMEs) in the sports, automotive spare parts, garments, cardboard manufacturing, textile, and food industries analyzed by Shahzadi et al. (2013).

2.8 Empirical Review

When evaluating the effectiveness of lean approaches, many researchers have tried to identify and develop a single measure to capture the overall impact of these practices, which is currently known as leanness, investigated by Bayou and De Korvin (2008). In Indonesia, many firms observed a cost reduction and enhanced production after the implementation of the JIT technique, as stated by Hakim et al. (2016). When a firm focuses on creating value for stakeholders and shareholders and continues to fulfil environmental requirements, it can achieve sustainable performance. JIT and TPM are directly proportional to operational performance, which consequently improves organizational performance. Numerous organizations have benefited from implementing LM tools to compete globally and offer real-time competition to rivals, which represents a significant advancement regarding continuous improvement for manufacturing operations, confirmed by Ruzo et al. (2011). Julian et al. (2004) suggested that practitioners pay keen attention to the supplier's role to facilitate a firm to perform excellently. Hence, below are the research hypotheses of this study:

H1. LM is positively and directly associated with SCR.

H2. LM is positively and directly associated with SP.

H3. SCR is positively and directly associated with SP.

H4. LM is positively and indirectly associated with SP through SCR.

3. Methodology

This study has used quantitative research methodology (Rashid et al., 2021; 2023). As our study is based on finding the influence of LM practices on the SP with the mediation of SCR, which consequently will improve overall Firm performance in SME's industry with literature (both academically and industrially), so, we will use correlation design to analyze and assess the relationship between constructs of our study. For this study, we have collected data from professionals serving in the field of supply chain (Rashid & Rasheed, 2023). Our aim was to collect sample responses from managerial-level employees serving in SME's industrial zone operating in Karachi, Pakistan. We collected data from the Supply Chain professionals serving in different SMEs' in Karachi. We aimed to collect 200 sample responses for the study from the supply chain professionals serving as managers and above managers in SME's industrial zones operating in Karachi, Pakistan (Rasheed & Rashid, 2023). We have used the Convenience sampling technique to gather data from the targeted population (Rasheed et al., 2023).

A developed questionnaire was used as a tool for gathering data (Rashid et al., 2022a, b). A quantitative research methodology was used to study how firm performance is influenced by LM practices by establishing and maintaining relations among partners and the SP based on cost, time, quality and flexibility by explicitly focusing on the SME sector in Pakistan. The scale used for measuring the data will be five points (Likert scale) with the help of a questionnaire. We initially shared a developed questionnaire of 55 questions about the relation between the LM and Firm performance based on cost, time, quality and flexibility and how it affects overall firm performance by implementing specific LM tools. For collecting responses, selected individuals were designated as assistant managers to upper management staff from many departments across the company because LM is not a one-dimensional management tool; instead, it is a comprehensive management technique that has vast boundaries expanded from manufacturing unit to other entities associated in the supply chains including the buyer and the vendors as well, suggested by Yang et al. (2011). In data analysis, our study used (Cronbach's alpha) to test the validity and find how reliable or internally consistent the measuring indicators are for this study (Hashmi et al., 2021a, b).

4. Results and Findings

To check the study's validity, convergent validity and discriminant validity measures were used to check the constructs and, after that, proceeded to check the overall model. Convergent Validity is a measure to check the inter-item relationship of the focused constructs. AVE, factor loading, and CR are included in standards for checking the convergent validity consists of AVE, factor loading and CR (Khan et al., 2022; 2023a, b). Anderson et al. (1988) argued that factor loading should statistically exceed a minimum of 0.6 to ensure convergent validity of the focused latent variables. However, an acceptable composite reliability value of greater than 0.70 is preferred, and the value of AVE for focused constructs exceeded the minimum threshold (i.e. 0.50), suggesting that the hypothesized items have more variance in the considered constructs rather than attributing to error in measurement. Table 1 confirms the outcomes of convergent validity. The focused constructs obtained value of AVE is more significant than 0.50, which indicates that convergent validity is established, as presented below in Table 1 (Hashmi et al., 2020; Haque et al., 2021; Das et al., 2021).

Table 1: Construct Reliability and Validity

Constructs	Cronbach's Alpha	AVE	CR (rho_a)
LM	0.937	0.530	0.947
SCR	0.972	0.694	0.974
SP	0.952	0.588	0.955

Note: AVE (Average variance extracted), CR (Composite Reliability)

Source: SmartPLS output

To examine the discriminant validity of a study, it is a primary necessity of study that all considered latent variables should be discriminant or not correlate in theoretical background. In simple words, all the considered pairs of variables should not be highly correlated. All the observed values for correlations among each pair of variables were below 1.0 (Rashid, 2016). Resultantly discriminant validity was established. Another test, most commonly used for checking discriminant validity is the Hetrotrait-Monotrait (HTMT) test given by Henseler et al. (2014); results of the HTMT test are shown below, which indicated normal discriminant validity (Khan et al., 2021). Table 2 illustrates HTMT results for discriminant validity.

Table 2: Discriminant Validity

Constructs	LM	SCR	SP
LM			
SCR	0.752		
SP	0.807	0.862	

Source: SmartPLS output

4.1 Path Analysis

The structural equation modelling (SEM) method was used to test and confirm the overall

model and its fitness using Smart PLS 4 and applied bootstrapping with 5000 resamples, the obtained outcomes are shown below in the table and indicated no issue with any proposed hypothesis in any of the paths considered. Table 3 illustrates path analysis. Bootstrapping results shown below also indicated that the value of the t-value and p-value obtained was also well and lay in the allowed range.

Table 3: Path Analysis

Path	Total Effect	Direct Effect	Indirect Effect	Original Sample	T-Value	P Value
LM → SCR	0.782	0.782	0.425	0.782	31.855	0.000
LM → SP	0.795	0.370		0.370	3.995	0.001
SCR → SP	0.543	0.543		0.543	5.972	0.000

Source: SmartPLS output

4.2 Hypotheses Testing

All considered hypotheses were investigated through the regression analysis, details of which are discussed below:

LM is strongly related to Supply chain CR as its high value of total effect (standardized estimate) is 0.782 with a t-value of 31.885, which is well above the acceptable range, which indicates a strong relation. Hence, H1, "LM is positively and directly associated with SCR", was proved true. Partnerships between businesses require a set of transactional practices, as stated by Bowersox et al. (1999). Kannan et al. (2005) suggested that LM highlighting the transactional connections at the operational level helps make cooperative relations in the supply chain because JIT, TQM and SCM strengthen each other. The obtained value of the total effect of the relation between LM and SP is 0.795 with a t-value of 3.995, which is considered to be a good value. Consequently, it is allowed to keep the H2, which is "LM is positively and directly associated with SP". This happened because LM ensures that products are delivered to the right customer at possibly lowest cost by reducing wastes, more specifically with the help of JIT minimizing holding inventories. The use of JIT purchasing has an impact on the production cost and flexibility of production. Therefore, it is proved that implementing Lean manufacturing enhances Supply Performance in firms. As per the data collected from the employees of the targeted SMEs, almost all of the respondents said that their primary and essential reason to adopt and implement LM practices is to reduce the cost, which helps in improving customer satisfaction, which consequently improves the SP after implementing LM Principles.

H3, which is "SCR is positively and directly associated with SP", was also supported as per the results obtained from the observed data. The values of total effect 0.543 with a t-value of 5.972 and the p-value of $p< 0.005$ allowed us to keep the hypothesis H3 as results also support it. On the other hand, there is also an indirect relationship between LM practices and SP through mediation of SCR" proposed in hypothesis H4 which is "LM is positively and indirectly associated with SP through SCR" was also proved true and kept safely because of the obtained results with total effect 0.795 with indirect effect of 0.425 which demonstrates a type of casual connection of LM approaches and SP through mediation of SCR, and this relation is confirmed by authors Vanichchinchai et al. (2019). Table 4 shows the hypotheses results.

Table 4: Hypotheses Assessment Summary

Hypothesis		Direct Effect	Indirect effect	Remarks
H1	LM is positively and directly associated with SCR.	0.782	-	Supported
H2	LM is positively and directly associated with SP.	0.370	-	Supported
H3	SCR is positively and directly associated with SP.	0.543	-	Supported
H4	LM is positively and indirectly associated with SP through SCR	-	0.425	Supported

Source: SmartPLS output

5. Conclusion

The conducted study presented understandings contributing to the discussion about how much SCRs and SP are influenced by implementing the LM practices in the SME sector of Pakistan, which resultantly enhances firm performance. It was revealed that LM had a positive relation with both SCR

(SCR) and SP (SP), which enhanced firm performance. Results indicated that the direct impact was not as strong as others but it contributed to a significant extent and showed a positive direct relation when exploring about direct impact of LM in the enhancement of SP because it primarily focuses on reducing waste and improving efficiency. Implementation of LM techniques and tools also improved SP indirectly by enabling cooperation and building trust between supply chain partners.

5.1 Discussion

The obtained results are dependable with previously explored and confirmed research works in similar areas, and all the proposed hypotheses were retained and proved true in this study. The discussion of results obtained in testing the proposed hypotheses are as per previously established knowledge and is discussed in below sections:

Proposed hypothesis 1, "LM is positively and directly associated with SCR", responded positively to the concepts associated with and discussed in the literature regarding implementing lean practices. The obtained results supported and allowed us to keep hypothesis 1 safe with a solid direct effect and t-value; we can undoubtedly state that LM practices enhance the relations among the Supply Chain partners. To attain outstanding firm performance and remain competitive among the supply chains, integrating transactional and relational supply chain management is the most essential and appropriate tool. To make the optimal capital, collaboration among supply chains plays a vital role.

The second proposed hypothesis, H2, which is "LM is positively and directly associated with SP", was also supported through the results obtained and also showed relatively close relevancy with the insights available in the literature. It contributed positively to the literature and helped in answering the research questions showing the effectiveness of Firm performance affected by the implementation of lean principles. Tests conducted during analysis showed a good value (0.370) direct effect between the acceptable range and t-value (3.995), which revealed its relevancy with existing literature. LM focuses mainly on timely delivery via an appropriate or shortest possible route and by eliminating waste to reduce costs, which consequently enhances SP.

Our third proposed hypothesis, H3, which is "SCR is positively and directly associated with SP" when going through testing, was also found satisfactory with a good value of direct effect (0.543) and t-value (5.972) and p-value ($p<0.05$) and consistent with literature available in similar areas and also shown relevancy with previously researched works. LM principles often focus on internal processes even though their benefits spread far beyond the factory walls. A significant improvement can be obtained in terms of efficiency and quality in the successful application of lean practices.

The fourth proposed hypothesis, H4, which is "LM is positively and indirectly associated with SP through SCR", also proved its relativity with existing research works and supported. The obtained results of the indirect effect (0.425) were quite enough to prove the indirect and positive relation of LM practices with SP. As LM helps in building strong and trustworthy relations among supply chains, partners can trust each other and work closely, which helps in avoiding problems and improving efficiency.

5.2 Implications

The conducted study mainly focused on and confirmed that as the adoption and implementation of LM practices take place, firms can have enhanced performance by minimizing wastes, shortening lead times, improving inventory handling and enabling production flexibility for cost reduction and customer satisfaction, which consequently improves firms' overall performance. This study will help practitioners to implement LM practices, especially in SMEs' to establish good relations among supply chains and experience a better and enhanced SP, which will result in improved overall firm performance.

The theoretical work presented in this research provided the academicians with a framework that mainly aids SMEs in achieving their organizational goals and improving performance by implementing LM practices. Firms can draw the full benefits in terms of a collaborative partnership among different entities associated with the supply chain through which firms can work on cost-cutting by eliminating or minimizing their wastes, avoiding the long-term handling of inventories so that warehousing costs may be as low as possible, and can have a superior firm performance. It has been observed that SMEs who adopted a lean culture gained a competitive edge.

5.3 Limitations and Recommendations

Besides all the researched and established work there are a number of limitations, like we used convenience sampling is a valuable tool for exploratory research or for studies that are conducted with limited resources in future, random sampling is encouraged to have a better generalizability of the results obtained. To realize more generalizability and draw conclusions from a broader perspective, another study in the services sector of any developing country is further suggested. In this study, we studied the mediation of SCR between the LM practices and the firm overall performance. It is further recommended to study the effect of other mediating variables like Risk Management through which Lean practices can help firms improve risk management, which will consequently aid organizations in avoiding disruptions and improving overall performance. For instance, LM practices can help organizations manage inventory levels better and reduce the risk of stockouts. There should be more work in developing countries because implementing lean principles can improve the firms and the overall country.

References

Abdi, M. R., & Labib, A. (2017). RMS capacity utilization: product family and supply chain. *International Journal of Production Research*, *55*(7), 1930–1956. https://doi.org/10.1080/00207543.2016.1229066

Achanga, P., Shehab, E., Roy, R., & Nelder, G. (2006). Critical success factors for lean implementation within SMEs. *Journal of Manufacturing Technology Management*, *17*(4), 460–471. https://doi.org/10.1108/17410380610662889

Aljawarneh, N. M., Taamneh, M. M., Alhndawi, N., Alomari, K. A. A., & Masa'd, F. (2021). Fog computing-based logistic supply chain management and organizational agility: The mediating role of user satisfaction. *Uncertain Supply Chain Management*, *9*(3), 767–778. https://doi.org/10.5267/j.uscm.2021.4.001

Al-Omari, Z. S., Alomari, K. A. A., & Aljawarneh, N. M. (2020). The role of empowerment in improving internal process, customer satisfaction, learning and growth. *Management Science Letters*, 841–848. https://doi.org/10.5267/j.msl.2019.10.013

Anderson, J.C. and Gerbing, D.W. (1988). Structural equation modeling in practice: a review and recommended two- step approach". *Psychological Bulletin*, *103*(3), 411–423. https://doi.org/10.1037/0033-2909.103.3.411

Baloch, N. & Rashid, A. (2022). Supply Chain Networks, Complexity, and Optimization in Developing Economies: A Systematic Literature Review and Meta-Analysis. *South Asian Journal of Operations and Logistics, 1*(1), 1-13. https://doi.org/10.57044/SAJOL.2022.1.1.2202

Bayou, M. E., & De Korvin, A. (2008). Measuring the leanness of manufacturing systems-a case study of Ford Motor Company and General Motors. *Journal of Engineering and Technology Management*, *25*(4), 287-304. https://doi.org/10.1016/j.jengtecman.2008.10.003

Belekoukias, I., Garza-Reyes, J. A., & Kumar, V. (2014). The impact of lean methods and tools on the operational performance of manufacturing organizations. *International Journal of Production Research*, *52*(18), 5346–5366. https://doi.org/10.1080/00207543.2014.903348

Bhasin, Sanjay. (2012). Performance of Lean in large organizations. *Journal of Manufacturing Systems*, *31*(3), 349–357. https://doi.org/10.1016/j.jmsy.2012.04.002

Bowersox, D. (1999). Lean launch: managing product introduction risk through response-based logistics. *The Journal of Product Innovation Management*, *16*(6), 557–568. https://doi.org/10.1016/s0737-

6782(99)00016-8

Brah, S. A., & Chong, W.-K. (2004). Relationship between total productive maintenance and performance. *International Journal of Production Research*, *42*(12), 2383–2401. https://doi.org/10.1080/00207540410001661418

Busse, C. (2016). Doing well by doing good? The self-interest of buying firms and sustainable supply chain management. *Journal of Supply Chain Management*, *52*(2), 28–47. https://doi.org/10.1111/jscm.12096

Chong, H., White, R. E., & Prybutok, V. (2001). Relationship among organizational support, JIT implementation, and performance. *Industrial Management + Data Systems*, *101*(6), 273–281. https://doi.org/10.1108/eum0000000005576

Ciano, M. P., Pozzi, R., Rossi, T., & Strozzi, F. (2019). How IJPR has addressed 'lean': a literature review using bibliometric tools. *International Journal of Production Research*, *57*(15–16), 5284–5317. https://doi.org/10.1080/00207543.2019.1566667

Cox, A. (1999). Power, value and supply chain management. *Supply Chain Management: An International Journal*, *4*(4), 167–175. https://doi.org/10.1108/13598549910284480

Das, S., Ghani, M., Rashid, A., Rasheed, R., Manthar, S., & Ahmed, S. (2021). How customer satisfaction and loyalty can be affected by employee's perceived emotional competence: The mediating role of rapport. *International Journal of Management, 12*(3), 1268-1277. https://doi.org/10.34218/IJM.12.3.2021.119

Daugherty, P. J. (2011). Review of logistics and supply chain relationship literature and suggested research agenda. *International Journal of Physical Distribution & Logistics Management, 41*(1), 16–31. https://doi.org/10.1108/09600031111101402

Dombrowski, U., Mielke, T., & Schulze, S. (2012). Employee participation in the implementation of lean production systems. In *Enabling Manufacturing Competitiveness and Economic Sustainability* (pp. 428–433). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-23860-4_70

Emiliani, M. L. (2006). Origins of lean management in America: The role of Connecticut businesses. *J. Manag. Hist*, *12*, 167–184. https://doi.org/10.1108/13552520610654069

Erdil, N. O., Aktas, C. B., & Arani, O. M. (2018). Embedding sustainability in lean six sigma efforts. *Journal of Cleaner Production*, *198*, 520–529. https://doi.org/10.1016/j.jclepro.2018.07.048

Filipe, L. L. A. D. B. M. (2005). The relationship between export assistance and performance improvement in Portuguese export ventures: An empirical test of the mediating role of pricing strategy adaptation. *European Journal of Marketing*, *39*, 755–784. https://doi.org/10.1108/03090560510601752

Forrester, P. L., Kazumi Shimizu, U., Soriano-Meier, H., Arturo Garza-Reyes, J., & Fernando Cruz Basso, L. (2010). Lean production, market share and value creation in the agricultural machinery sector in Brazil. *Journal of Manufacturing Technology Management, 21*(7), 853–871. https://doi.org/10.1108/17410381011077955

Fullerton, R. R., & Wempe, W. F. (2009). Lean manufacturing, non-financial performance measures, and financial performance. *International Journal of Operations & Production Management*, *29*(3), 214–240. https://doi.org/10.1108/01443570910938970

Garza-Reyes, J. A., Oraifige, I., Soriano-Meier, H., Forrester, P. L. & Harmanto, D. (2012). The development of a lean park homes production process using process flow and simulation methods". *Journal of Manufacturing Technology Management*, *23*(2), 178–197. https://doi.org/10.1108/17410381211202188

Ghaithan, A., Khan, M., Mohammed, A., & Hadidi, L. (2021). Impact of Industry 4.0 and lean manufacturing on the sustainability performance of plastic and petrochemical organizations in Saudi Arabia. *Sustainability*, *13*(20), 11252. https://doi.org/10.3390/su132011252

Hajmohammad, S., Vachon, S., Klassen, R. D., & Gavronski, I. (2013). Reprint of Lean management and supply management: their role in green practices and performance. *Journal of Cleaner Production*, *56*, 86–93. https://doi.org/10.1016/j.jclepro.2013.06.038

Haque, I., Rashid, A., & Ahmed, S. Z. (2021). The Role of Automobile Sector in Global Business: Case of Pakistan. *Pakistan Journal of International Affairs*, *4*(2), 363-383. https://doi.org/10.52337/pjia.v4i2.195

Hashmi, A. (2022). Factors affecting the supply chain resilience and supply chain performance. *South Asian Journal of Operations and Logistics*, *1*(2), 65-85. https://doi.org/10.57044/SAJOL.2022.1.2.2212

Hashmi, A. R., & Mohd, A. T. (2020). The effect of disruptive factors on inventory control as a mediator and organizational performance in health department of Punjab, Pakistan. *International Journal of Sustainable Development & World Policy*, *9*(2), 122-134. https://doi.org/10.18488/journal.26.2020.92.122.134

Hashmi, A. R., Amirah, N. A., & Yusof, Y. (2020a). Mediating effect of integrated systems on the relationship between supply chain management practices and public healthcare performance: Structural Equation Modeling. *International Journal of Management and Sustainability*, *9*(3), 148-160. https://doi.org/10.18488/journal.11.2020.93.148.160

Hashmi, A. R., Amirah, N. A., & Yusof, Y. (2021b). Organizational performance with disruptive factors and inventory control as a mediator in public healthcare of Punjab, Pakistan. *Management Science Letters, 11*(1), 77-86. https://doi.org/10.5267/j.msl.2020.8.028

Hashmi, A. R., Amirah, N. A., Yusof, Y., & Zaliha, T. N. (2020b). Exploring the dimensions using exploratory factor analysis of disruptive factors and inventory control. *The Economics and Finance Letters*, *7*(2), 247-254. https://doi.org/10.18488/journal.29.2020.72.247.254

Hashmi, A. R., Amirah, N. A., Yusof, Y., & Zaliha, T. N. (2021a). Mediation of inventory control practices in proficiency and organizational performance: State-funded hospital perspective. *Uncertain Supply Chain Management*, *9*(1), 89-98. https://doi.org/10.5267/j.uscm.2020.11.006

Hashmi, R. (2023). Business Performance Through Government Policies, Green Purchasing, and Reverse Logistics: Business Performance and Green Supply Chain Practices. *South Asian Journal of Operations and Logistic*s, *2*(1), 1–10. https://doi.org/10.57044/SAJOL.2023.2.1.2301

Hird, S. M., Sánchez, C., Carstens, B. C., & Brumfield, R. T. (2015). Comparative gut Microbiota of 59 neotropical bird species. *Frontiers in Microbiology*, *6*. https://doi.org/10.3389/fmicb.2015.01403

Imai, M. (2012). *Gemba kaizen: a common sense approach to continuous improvement strategy*. McGraw-Hill Professional.

Irum Shahzadi, S. A., & Chaudhary, K. M. (2013). Drivers of supply chain performance enhancing organizational output: An exploratory study for manufacturing sector. *European Journal of Business and Management*, *5*(14), 53–64. https://www.iiste.org/Journals/index.php/EJBM/article/view/6167

Jasti, N. V. K., & Kodali, R. (2015). Lean production: literature review and trends. *International Journal of Production Research*, *53*(3), 867-885. https://doi.org/10.1080/00207543.2014.937508

Julian, C. C., & O'Cass, A. (2004). The antecedents of export marketing performance: an Australian perspective. *Journal of Asia Pacific Marketing*, *3*(2), 99-113.

Kahraman, C., & Yavuz, M. (Eds.). (2012). *Production Engineering and Management under Fuzziness* (2010th ed.). Springer. https://doi.org/10.1007/978-3-642-12052-7

Kannan, V. (2005). Just in time, total quality management, and supply chain management: understanding their linkages and impact on business performance. *Omega*, *33*(2), 153–162. https://doi.org/10.1016/j.omega.2004.03.012

Khan, S. K., Ahmed, S., & Rashid, A. (2021). Influence of social media on purchase intention and customer loyalty of generation Y with the mediating effect of conviction: a case of Pakistan. *Pakistan Journal of International Affairs*, *4*(2), 526-548. https://doi.org/10.52337/pjia.v4i2.207

Khan, S. K., Rashid. A., Benhamed, A., Rasheed, R., & Huma, Z. (2023b). Effect of leadership styles on employee performance by considering psychological capital as mediator: evidence from airlines industry in emerging economy. *World Journal of Entrepreneurship, Management and Sustainable Development*, *18*(6), 799-818. https://doi.org/10.47556/J.WJEMSD.18.6.2022.7

Khan, S., Rasheed., R., Rashid, A., Abbas, Q., & Mahboob, F. (2022). The Effect of Demographic Characteristics on Job Performance: An Empirical Study from Pakistan. *Journal of Asian Finance, Economics and Business*, *9*(2), 283-294. https://doi.org/10.13106/JAFEB.2022.VOL9.NO2.0283

Khan, S., Rashid, A., Rasheed, R., & Amirah, N. A. (2023a). Designing a knowledge-based system (KBS) to study consumer purchase intention: the impact of digital influencers in Pakistan. *Kybernetes*, *52*(5), 1720-1744. https://doi.org/10.1108/K-06-2021-0497

Krafcik, R. J., Wheeler, D. T., Paciorek, W. J., McGuigan, R., Eckersley, R. T., Johnson, D. L., & Munson, H. T. (1998). Electroluminescent lamp devices and their manufacture (Patent No. 5811930). In *US*

Patent (No. 5811930).

Kroes, J. R., & Ghosh, S. (2010). Outsourcing congruence with competitive priorities: Impact on supply chain and firm performance. *Journal of Operations Management*, *28*(2), 124–143. https://doi.org/10.1016/j.jom.2009.09.004

Lamming, R. (1996). Squaring lean supply with supply chain management. *International Journal of Operations & Production Management*, *16*(2), 183-196. https://doi.org/10.1108/01443579610109910

Li, S., Ragu-Nathan, B., Ragu-Nathan, T. S., & Subba Rao, S. (2006). The impact of supply chain management practices on competitive advantage and organizational performance. *Omega*, *34*(2), 107–124. https://doi.org/10.1016/j.omega.2004.08.002

Liu, C.-C., Niu, Z.-W., Chang, P.-C., & Zhang, B. (2017). Assessment approach to stage of lean transformation cycle based on fuzzy nearness degree and TOPSIS. *International Journal of Production Research*, *55*(23), 7223–7235. https://doi.org/10.1080/00207543.2017.1355124

Masa'd, F., & Aljawarneh, *nader Mohammad. (2020). Administrative creativity and job performance: An Empirical Study at Jadara University. *International Journal of Psychosocial Rehabilitation*, *24*(8), 9574–9584. https://www.psychosocial.com/article/PR280950/25532

Masa'deh, R., Alananzeh, O., Algiatheen, N., Ryati, R., Albayyari, R., & Tarhini, A. (2017). The impact of employee's perception of implementing green supply chain management on hotel's economic and operational performance. *Journal of Hospitality and Tourism Technology*, *8*(3), 395–416. https://doi.org/10.1108/jhtt-02-2017-0011

Mitrega, M., Forkmann, S., Zaefarian, G., & Henneberg, S. C. (2017). Networking capability in supplier relationships and its impact on product innovation and firm performance. *International Journal of Operations & Production Management*, *37*(5), 577–606. https://doi.org/10.1108/ijopm-11-2014-0517

Nimeh, H. A., Abdallah, A., & Sweis, R. (2018). Lean supply chain management practices and performance: Empirical evidence from manufacturing companies. *International Journal of Supply Chain Management*. https://www.semanticscholar.org/paper/e0f67162acc4d2556f0be98e414de616714d9d54

Nordin, N., Deros, B. M., & Wahab, D. A. (2010). *A survey on lean manufacturing implementation in Malaysian automotive industry*. Ijimt.org. http://www.ijimt.org/papers/68-M457.pdf

Phogat, S., & Gupta, A. K. (2019). Expected maintenance waste reduction benefits after implementation of Just in Time (JIT) philosophy in maintenance (a statistical analysis). *Journal of Quality in Maintenance Engineering*, *25*(1), 25–40. https://doi.org/10.1108/jqme-03-2017-0020

Rahbari, A., Nasiri, M. M., Werner, F., Musavi, M., & Jolai, F. (2019). The vehicle routing and scheduling problem with cross-docking for perishable products under uncertainty: Two robust bi-objective models. *Applied Mathematical Modelling*, *70*, 605–625. https://doi.org/10.1016/j.apm.2019.01.047

Randhawa, J. S., & Ahuja, I. S. (2017). 5S – a quality improvement tool for sustainable performance: literature review and directions. *International Journal of Quality & Reliability Management*, *34*(3), 334–361. https://doi.org/10.1108/ijqrm-03-2015-0045

Rasheed, R., & Rashid, R. (2023). Role of service quality factors in word of mouth through student satisfaction. *Kybernetes.* Vol. ahead-of-print No. ahead-of-print. http://dx.doi.org/10.1108/k-01-2023-0119

Rasheed, R., Rashid, A., Amirah, N. A., & Afthanorhan, A. (2023). Quantifying the moderating effect of servant leadership between occupational stress and employee in-role and extra-role performance. *Calitatea*, *24*(195), 60-68. *https://doi.org/10.47750/QAS/24.195.08*

Rashid, A. & Rasheed, R. (2023). Mediation of inventory management in the relationship between knowledge and firm performance, *SAGE Open*, *13*(2), 1-11. https://doi.org/10.1177/21582440231164593

Rashid, A. (2016). Impact of inventory management in downstream chains on customer satisfaction at manufacturing firms. *International Journal of Management, IT and Engineering*, *6*(6), 1-19.

Rashid, A. Rasheed, R., & Amirah, N. A. (2023). Information technology and people involvement in organizational performance through supply chain collaboration. *Journal of Science and Technology Policy Management,* Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/JSTPM-12-2022-0217

Rashid, A., Ali, S. B., Rasheed, R., Amirah, N. A. & Ngah, A. H. (2022a). A paradigm of blockchain and supply chain performance: a mediated model using structural equation modeling. *Kybernetes, Vol. ahead-of-*

print No. ahead-of-print. https://doi.org/10.1108/K-04-2022-0543

Rashid, A., Rasheed, R., & Amirah, N. A., & Afthanorhan, A. (2022b). Disruptive factors and customer satisfaction at chain stores in Karachi, Pakistan. *Journal of Distribution Science, 20*(10), 93-103. https://doi.org/10.15722/jds.20.10.202210.93

Rashid, A., Rasheed, R., Amirah, N. A., Yusof, Y., Khan, S., & Agha, A., A. (2021). A Quantitative Perspective of Systematic Research: Easy and Step-by-Step Initial Guidelines. *Turkish Online Journal of Qualitative Inquiry, 12*(9), 2874-2883. https://www.tojqi.net/index.php/journal/article/view/6159/4387

Rocha-Lona, L., Garza-Reyes, J. A., & Kumar, V. (2013). *Building quality management systems: Selecting the right methods and tools* (1st ed.). CRC Press.

Romero, D., Gaiardelli, P., Powell, D., Wuest, T., & Thürer, M. (2019). Rethinking jidoka systems under automation & learning perspectives in the digital lean manufacturing world. *IFAC-PapersOnLine*, *52*(13), 899–903. https://doi.org/10.1016/j.ifacol.2019.11.309

Ruzo, E., Losada, F., Navarro, A., & Díez, J. A. (2011). Resources and international marketing strategy in export firms: Implications for export performance. *Management Research Review*, *34*(5), 496–518. https://doi.org/10.1108/01409171111128698

Shou, W., Wang, J., Wu, P., Wang, X., & Chong, H. Y. (2017). A cross-sector review on the use of value stream mapping. *International Journal of Production Research*, *55*(13), 3906–3928. https://doi.org/10.1080/00207543.2017.1311031

Slone, R. E., Dittmann, P. J., & Mentzer, J. T. (2010). *The new supply chain agenda: The 5 steps that drive real value*. Harvard Business Review Press.

Solaimani, S., Veen, J. van der, Sobek, D. K., II, Gulyaz, E., & Venugopal, V. (2019). On the application of Lean principles and practices to innovation management: A systematic review. *The TQM Journal*, *31*(6), 1064–1092. https://doi.org/10.1108/tqm-12-2018-0208

Taylor, D. H. (2006). Strategic considerations in the development of lean agri-food supply chains: a case study of the UK pork sector. *Supply Chain Management: An International Journal*, *11*(3), 271–280. https://doi.org/10.1108/13598540610662185

Tortorella, G. L., Miorando, R., & Marodin, G. (2017). Lean supply chain management: Empirical research on practices, contexts and performance. *International Journal of Production Economics*, *193*, 98–112. https://doi.org/10.1016/j.ijpe.2017.07.006

Tseng, P.-H., & Liao, C.-H. (2015). Supply chain integration, information technology, market orientation and firm performance in container shipping firms. *International Journal of Logistics Management*, *26*(1), 82–106. https://doi.org/10.1108/ijlm-09-2012-0088

Ul-Hameed, W., Mohammad, H. B., Shahar, H. B. K., Aljumah, A. I., & Azizan, S. B. (2019). The effect of integration between audit and leadership on supply chain performance: Evidence from UK based supply chain companies. *Uncertain Supply Chain Management*, 311–328. https://doi.org/10.5267/j.uscm.2018.8.001

Vanichchinchai, A. (2014). Supply chain management, supply performance and total quality management: An organizational characteristic analysis. *International Journal of Organizational Analysis*, *22*(2), 126–148. https://doi.org/10.1108/ijoa-08-2011-0500

Vanichchinchai, A., & Igel, B. (2009). Total quality management and supply chain management: similarities and differences. *The TQM Journal*, *21*(3), 249–260. https://doi.org/10.1108/17542730910953022

Vonderembse, M. A., Uppal, M., Huang, S. H., & Dismukes, J. P. (2006). Designing supply chains: Towards theory development. *International Journal of Production Economics*, *100*(2), 223–238. https://doi.org/10.1016/j.ijpe.2004.11.014

Wang, F., Lin, J., & Liu, X. (2010). Three-dimensional model of customer order decoupling point position in mass customization. *International Journal of Production Research*, *48*(13), 3741–3757. https://doi.org/10.1080/00207540902865746

Wang, S., Chang, S., & Wang, R. (2009). Assessment of supplier performance based on product-development strategy by applying multi-granularity linguistic term sets☆. *Omega*, *37*(1), 215–226. https://doi.org/10.1016/j.omega.2006.10.003

Womack, J. P., & Jones, D. T. (1997). Lean thinking—banish waste and create wealth in your corporation. *The*

Journal of the Operational Research Society, *48*(11), 1148–1148. https://doi.org/10.1057/palgrave.jors.2600967

Womack, J. P., Jones, D. T., & Roos, D. (2007). *The machine that changed the world: The story of lean production--Toyota's secret weapon in the global car wars that is now revolutionizing world industry.* Simon and Schuster.

Yang, M. G. (mark), Hong, P., & Modi, S. B. (2011). Impact of lean manufacturing and environmental management on business performance: An empirical study of manufacturing firms. *International Journal of Production Economics*, *129*(2), 251–261. https://doi.org/10.1016/j.ijpe.2010.10.017