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Lean Manufacturing and Sustainable Performance with a Moderation of Organizational Culture

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ABSTRACT

This study explores the contribution of lean practices in a manufacturing firm in Karachi towards sustainable performance while considering organizational culture as a moderator. Lean approaches benefit firms' social, environmental, and financial aspects, influencing their endurable performance. Manufacturing firms nowadays globally are focused on lean implementation. A structured questionnaire was distributed among employees of the Small and Medium Enterprises in Karachi that fit in the category and belonged to the manufacturing enterprises. A sample of 200 respondents was analyzed using the partial least squares technique (PLS-SEM). The results indicate that Human resource practices, Supplier relationships, and organizational culture significantly affect sustainable performance; furthermore, organizational culture moderated the supplier relationships' impact on sustainable performance. Thesis outcomes contribute to the analysis of the study, broadening the writings on lean manufacturing and sustainable performance with a Moderation of Organizational Culture. The finding of the thesis possibly will be used as a motivation for firms in Karachi to implement Lean approaches as companies that adopt Lean practices globally have the result of improving firms' endurable performance through lean manufacturing approaches.

Keywords: *Lean manufacturing, SME, Karachi, Performance, Sustainable, PLS-SEM*

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1. Introduction

Manufacturing industries are producing goods on an immense scale because the demand for goods and services is increasing daily. On the other hand, competition is getting tough because of technological adoption; technological innovation requires time to compete with rivals and overcome increasing customer demand/awareness demands. So industries go for technological boom and strategies to produce and supply a large number of goods, to sustain in the market with a competitive advantage, and sustainable performances ultimately resource consumption and waste everywhere the planet goes up. As far as the stakeholders and regulative agencies are concerned, they pressure manufacturing firms to be more sustainable due to the warnings about global warming and social issues. Stakeholders instruct that companies are environmentally and socially accountable, and firms have become attentive to playing their strategic part in sustainable performance as a competitive advantage. In addition, numerous studies have proposed that embracing lean manufacturing can improve firms' environmental, social, and financial performance.

Illustrating lean can be an operational activity that improves competitive functions such as quality, flexibility, expenditure, and delivery within organizations (Bhuiyan & Baghel, 2005; Khanchanapong et al., 2014; Hallgren & Olhager, 2009; De Toni & Tonchia, 1996). "A method designed to lower the costs in production to minimize scrap" can be stated as lean manufacturing. Lean manufacturing is "a corporate strategy and methodology that enriches process performance with the outcome of enhanced customer fulfilment and improves bottom-line results" (Snee, 2010). Researchers have revealed that lean manufacturing invariably enriches the operational performance of firms. Therefore, from other techniques, lean manufacturing is adopted. Lean manufacturing is recognized with declines in customer lead time, cycle time, and costs while improving the quality of operations and products along with these factors (Khanchanapong et al., 2014; Hajmohammad et al., 2013). Research scholars have tried to search out the most practical lean manufacturing approaches. Lean practices are categorized into leading areas, 1) manufacturing planning and control, 2) process and equipment, 3) human resources, 4) product design, 5) customer relationships, and 6) supplier relationships. These areas fit well in various industries, as shown in previous studies.

Implementing Lean principles remains a mechanism that creates aggressive factors as organizations take strategic actions to stay beneficial when the economy worsens. However, like other headway programs, Lean executions have not been achieved universally in their applications because of various variables that will influence the implementation of such initiatives (Abu et al., 2021). The low achieving sufficient or enduring Lean adoption remains a management concern of institutions being incompetent to capitalize on the advantages of Lean (Barclay et al., 2022). Lean manufacturing is an approach to creating a "world-class production system. “By creating world-class systems for enhanced adequate operational capacity by lean manufacturing, organizations are better able to compete globally (Alkhoraif et al., 2019). In this study, we tend to explore how manufacturing companies will gain sustainable performance in primary areas. Particularly manufacturing planning and control, process and equipment, human resources practices, product design, customer relationships, supplier relationships, and the way organizational culture will enhance the sustainable performance of companies (Kafuku, 2019).

Prasad et al. (2020) identified lean manufacturing methods as a way to create lasting value for any business, thus implying that lean manufacturing methods are a way for manufacturers to sustain their organizations. Corporate culture is considered the primary motive for the failure of executing programs/systems to modify the organizational structure. Studies have proposed that like the instruments, procedures, and change techniques may be present, failure appears if the institution's culture remains identical (Dorval et al., 2019). Therefore, organizational values usually focus on

assessing and measuring organizational culture. However, an essential fact of cultural studies is the role of an organization towards its primary matters and principles of management in diverting or developing the execution of organizational decisions and creations belongs to reengineering, total quality management, adaptable manufacturing technologies, enterprise resource planning (ERP) systems (Taherimashhadi & Ribas, 2018; Rashid & Rasheed, 2022). So, in this study, organizational culture is evaluated as a moderator to analyze the impact of organizational culture on lean manufacturing execution, ultimately, a company's sustainable performance.

Lean manufacturing has been investigated by several studies, the relationships between across-the-board lean manufacturing towards environmental and financial performance. However, these studies suffer from limits. First, to explore how lean approaches can affect the endurable performance of businesses in terms of social, economic, and environmental characteristics to compete in the existing competitive and international market. By adopting lean approaches to balance their social, economic, and environmental performance, manufacturing companies need to understand the lean approaches that thoroughly impact all three sustainability factors and not just cover one part. In the second exploration, most earlier studies have experimented with the impact of general lean approaches on organization performance. Although lean implementation approaches vary in different areas of a business, research of these lean practices and firms' sustainable performance provide the connection between them and a clear sight of the approaches that best influence firms' sustainable performance. Finally, the organization's culture is another factor that can affect the outcomes of lean implementation or can resist lean practice implementation. So, this hypothesis study investigates the effect of lean manufacturing approaches on sustainable performance and how organizational culture can assist or resist adapting lean practices.

1.1. Research Questions

The following research questions were formulated:

RQ1: Do processes and equipment affect sustainable performance?

RQ2: Does manufacturing planning affect sustainable performance?

RQ3: Do human resource practices affect sustainable performance?

RQ4: Do supplier relationships affect sustainable performance?

RQ5: Does customer relationship affect sustainable performance?

RQ6: Does product design affect sustainable performance?

RQ7: Does organizational culture moderates the relationship between manufacturing planning and control, process and equipment, human resources practices, customer relationship, product design, and supplier relationship on sustainable performance?

2. Literature Review

2.1. Empirical Reviews

The first section of this chapter explores literature. It suggests why it is essential to separate lean implementation as a development from the organizational initiatives traditionally associated with it as a transformation process. To provide a forum for competitive edge demonstrating the lean production model's long-term impact. The paper develops a visionary approach (established on the operating view of the firm) illustrating the operational activities that strengthen sustainable competitive advantage. Ohno (1988) reported his book on the Toyota Production System (TPS). A Toyota discovered the concept of lean approaches in the 1950s Japanese automotive company, which was

documented as Toyota Production System (TPS) (Nordin et al., 2010). It might be like the 'lean' guides caused by the broader society beyond Japan after the Second World War. It is a reaction to the mass-production approach rehearsed in most American and European organizations (Herzog & Tonchia, 2014). The objective of TPS was to lessen the process, manufacturing, and operational cost and to boost productivity by eliminating wastes or non-added value else exercises. In the 1980s, the lean approaches implementations and manufacturing performance among western firms due to increasing Japanese imports showed penetration interest (Nordin et al., 2010; Alam, 2022; Asif, 2022). Ohno (1988) cited that the solution proposed by Toyota to change reconstruction of the corporate and shortly delivered thanks to the introduction of an alternative production approach revealed that is Toyota Production System (TPS) that geared toward straight offensive any waste within the production process. Besides, the Just in time (JIT) perspective was refined within the framework of this latest production system and formed explicitly out of Japanese trade's requirement to survive the post-war international demand.

2.1.1. Lean manufacturing and sustainable performance

Lean practice implementation has been associated with an intensively researched topic. Many authors agree that a standard definition of the lean manufacturing concept is lacking. For example, shah and ward (2007) suggest as an abstract definition that "lean production is an associate integrated socio-technical method whose central objective is to stop waste by at the same time decreasing or minimizing customer, supplier, and inner variability." however, as authors check with it as a system, others distinguish it as a principle: "leanness could be a perspective supposed to considerably lower down expenditure and cycle time throughout the worth supply chain of firms, whereas continued to enable product performance" (Comm & Mathaisel, 2000; Uddin, 2022; Ayaz, 2022). Considered as a strategy: "lean consideration could be a business procedure that seeks at providing a replacement manner of unique activities over the way to organize human activities to produce additional advantages to society and value to people whereas eliminating waste" (Ndaita et al., 2015).

Lean approaches cannot be inapplicable to the reflection of waste. The under part of the Lean approach is eliminating waste, which is any action that may not produce any value to the ultimate product (Pavnaskar et al., 2003). The customer does not volunteer to purchase it, so the firm's drive should be to stop it (Karlsson & Ahlström, 1996). However, it is not as straightforward, and most organizations struggle to recognize the waste (Ghosh, 2012). In Italy, Panizzolo (1998) questioned the number of businesses operating in global markets on lean approaches developed by the author to explore the extent. As a result, the lean production measure was embraced, and findings were that the mostly adopted programmers' existed on the internal procedures. At the same time, the external relationships (supplier and customer) were revealed to be more challenging. Staudacher and Tantardini (2008) also questioned each Lean and non-Lean implementer in Italy on the strategic goals and developments over time. They found that those with lean practices implementation for an extended period stated much vaster improvements.

Lean Manufacturing Practices are usually supported by the empirical evidence that it enhances the company's sustainable performance (Sanchez & Perez, 2001). Regardless, like several improvement agendas, Lean practices executions have not succeeded globally in their application and measure completely diverse variables that will influence a Lean implementation (Worley & Doolen, 2006). Furthermore, Achanga et al. (2006) acknowledge that integrated with an absence of standardized instruments at intervals, organizations of study, and live of value-adding abilities like Lean, the execution of Lean practices harbours tremendous difficulties. Some past studies have exposed that Lean implementation is at its immaturity in some countries or sectors. For example, Eswaramoorthi et al. (2011) surveyed Lean practices in Indian machine makers and concluded they were still on the newbie level of Lean commission. Similarly stated, Nordin et al. (2010), that automotive industries, measured Lean approaches implementation by adapting the dimensions from (Shah & Ward, 2003) and completed that practically all of the respondent's companies stood in the transformation toward Lean manufacturing exercise Italy (Panizzolo, 1998; Ayaz, 2022; Anwar, 2022).

2.1.2. Manufacturing planning and control and sustainable performance

Manufacturing enterprises account for a large quantity of resource consumption and scrap generation everywhere (Abdullah et al., 2016). Stakeholders and regulatory agencies pressure manufacturing corporations to be more sustainable because of the warnings concerning global warming and social issues (Zailani et al., 2015). Firms that follow sustainability as an execution goal for manufacturing operations need immediate changes to the manufacturing planning and control system (MPC). Lean practices have been preferred to boost performance because such systems contain all critical activities used for planning and controlling manufacturing within a company's functions (Silver et al., 1998). Studies include waste made within the materials requirement planning (MRP) process by adding a "Bill-Of-Waste." the objective is not to reduce waste but to spot the waste created. At the functional (short-term) level, the standing of the manufacturing operation system changes the whole time. Therefore, the skillfulness and precision of the MPC system in adjusting to the changing production circumstances are critical (Melnyk et al., 2001). However, the truth for most manufacturers is that it is challenging to predict work-in-process (WIP) inventory and resource standing accurately. Therefore, the system is frequently disrupted by quick jobs, and production breakdowns occur as unplanned activities, changeover, and set-up times (Strandhagen et al., 2017; Amjad, 2022).

2.1.3. Process and equipment and sustainable performance

Sustainability has been the foremost priority of intense discussions because of the essential role of production workouts in value addition to national economies and their environmental consequences (Camioto et al., 2014; Hunaid et al., 2021). Evaluating every aspect of sustainability as a particular variable presents a practical problem once assessing the international sustainability of a company in different directions, just in case variables mature in several directions. For example, suppose that in a business, there is an excessive loss of work generated by a severe problem in a piece of equipment/ accidents suffered by machine operators leading to loss of operating hours. The industrial engineering department proposes that increasing the cycle time by decreasing the machine speed would eliminate operator casualties nearly to the lowest level. In sustainability, this solution first enhances the social attribute of the firm because the number of casualties is significantly lowered. Secondly, it declines the economic side because the production expenditure increases (cycle time turns high). So as this matter is concerned, the company's overall sustainability improves, worsens, or remains unchanged. This query cannot be responded to without a single action that blends the three aspects of sustainability. In 1999, several leading businesses decided to be more sustainable businesses. They adopted numerous initiatives and shifts to enhance the social and environmental performance of their facilities, processes, and products in Europe, the United States, and Japan (Fiksel et al., 1999; Rasheed, 2022).

2.1.4. Human resource practices and sustainable performance

Human resource management (HRM) refers to the practices used to govern individuals and teams performing the job for the organization. These approaches are used to build connections between external stakeholders and organizations. HRM is to improve organizational performance and sustainability. The input of HRM to the competitive edge has been a prevailing theme in the literature (Pfeffer, 1995; Boxall & Purcell, 2003). These indicate human resources' capacity to influence aspects of managerial consequences, particularly individual and organizational abilities, which construct value addition to organizational performance. HRM exercises have been shown to elevate organizational performance by developing individual capabilities such as knowledge, skills, and abilities (Daniels, 2003) as well as manners and mindsets (Schuler & Jackson, 1997). HR practices in studies contribute to the development of odd cultures and organizational capabilities, such as the way innovation and learning management take place inside organizations. Certain Human resources practices such as good selection, training and development, and performance evaluation can enhance employee productivity and performance, so people declare the required capabilities to further organizational goals. HRM approaches can also create a favourable psychological arrangement between the employee and the employer. Ultimately, this can enhance loyalty, trust, organizational engagement, and a sense of righteousness (Coyle-Shapiro, 2002; Baloch & Rashid, 2022; Shaheen, 2022).

2.1.5. Product design and sustainable performance

Bruce and Bessant (2002) state that designs are, in the broader sense, the vision and planning of artificial notions and transforming things. Product design is the exercise that converts a set of product requirements into a specification of a material's geometry and properties (Ulrich &Pearson, 1998). These researchers illustrate that product design is part of the more expansive product development exercise. These are the overall process of concept generation, product, strategy, organization, and marketing project design, implementation, and evaluation of a new product to illustrate the role of design in the product expansion process (Belliveau et al., 2004). Furthermore, provide substantial proof that good design can be related to organizational performance (Hertenstein et al., 2005). Efficient and effective designs may lean market share or create new market segments. Investment in product design has usually tied to a firm's dominant performance (Gemser & Leenders, 2001; Bloch, 1995; Ulrich & Pearson, 1998). Studies suggested that the relationship is not absolute but counts on industry development and design approaches to a particular scope. A company that sponsors design and materializes the proper skills to acquire efficient designs may have sounder results than others that do not retain such skills. The study claims that intervening factors partially mediate the relationship between design investment and firm performance from the resource-based perspective (Gemser & Leenders, 2001; Victory et al., 2022).

2.1.6. Customer relationship and sustainable performance

Marketing relationship aims to build longer, mutually good relations with key parties across the supply chain. Embracing customer association promotion enables companies to create close economic and social relations with key customers and focus on realistic, profitable customers. This marketing vision represents a replacement direction for the modern business perspective. That is to seek further competitive edge under stress changes in business surroundings, including sustainability prerequisites. This idea depends on the distinction that the principal driver of business profitability is the essence of the company's customer (Kotler & Keller, 2003), and considerably of the company's market worth and competitive edge comes from intangible investments across the supply chain. Whereas traditionally, firms retain the most well-liked to seduce frequently more fresh customers, this vision drives the policy of customer retention and constructing customer devotion. Firms have acknowledged that the expenditure on customer retention is lower than that on reaching newer customers. Devoted customers are inclined to buy more additional products from the selected company. They admire each and are worth social delivery and transferring benefits between the company and customers. Devoted customers are frequently ready to spend even at exceptional prices. The sustainability consideration of customer association dealing includes the chance to make a faithful customer base operating more increased satisfaction, including products and services in favour of environment-friendly, and consequently the social worth and reputation of having intended consumer behaviour (Antonides & Raaij, 1996). Organizations may target devoted customers and entertain them as fellows for more activities related to sustainability conditions.

2.1.7. Supplier relationship and sustainable performance

Supplier relationship management (SRM) has become an essential business method due to the inflated off-shoring and outsourcing of administrative processes and production. It can considerably impact achieving sustainability goals (Ashby et al., 2012; Ali, 2022). SRM can be viewed as a practice of influencing supplier behaviour and impacting the sustainability practices of the organization by working with suppliers in activities like improving operational functions in warehouses, reducing packaging, using more cost-effective transport, and taking on environmental and social programs requiring all these from suppliers' end (Carter & Rogers, 2008). In current years, it has evolved more noticeably that organization should develop their sustainability measures far away from intra-organizational executions. These organizations must commit their actions across the supply chain (Sajjad, 2015). In some cases, suppliers are found to be operating businesses unethically. Focal organizations are sometimes held liable for their supplier's actions. These focal organizations then face pressure from stakeholders to examine the sustainability problems within their supply chain networks (Boström et al., 2015). Ağan et al. (2016) explored that around 60% of parts or services are acquired

from suppliers. In a comprehensive view, sustainable supplier connections have been recognized as a core of institution competitiveness (Nagati & Rebolledo, 2013; Esfahbodi et al., 2016). Therefore, it's impossible for an organization nowadays to be sustainable without considering suppliers for sustainable performance (Esfahbodi et al., 2016; Muzammil, 2022).

2.1.8 Organizational culture and sustainable performance

According to Schein (1985), organizational culture is abstracted as "the approach of primary thoughts and beliefs that a group has developed, learned, or designed while it retains to deal with its internal integration and outward transformation concerns. That has behaved so well to be gauged correct, and from their perspective, it repositioned to new members as the correct way of sensing, judging and handling regarding those concerns" (Schein, 1985). Similarly, an organization's culture could be individuals' or teams' collective methods, standards, beliefs, principles, and patterns (Zakari et al., 2013). For example, a work procedure based on practice represents corporate culture as "the mindsets or set of conducts observed in perceptions of approaches shared by team players in certain ways that administer motivation or settle the concerns discovered in the track of a team task" (Nguyen & Watanabe, 2017). As discussed earlier, studies hold determined organizational culture's importance in sustainable organizational execution. Developing research studies in organizational culture have concentrated on the functions of cultural attributes. The outcomes indicate that every cultural trait positively affects overall firm performance, sales growth, and asset return (Yilmaz & Ergun, 2008; Basit, 2022).

2.2 Underpinning and Supporting Theories/Models

This section will explore the multiple theories/models to demonstrate an understanding of theories/models and concepts appropriate to this study.

2.2.1. Integrating lean management with DMAIC/DMADV

DMAIC is examined as Define, Measure, Analyze, Improve, and control. DMADV is examined as Define, Measure, Analyze, Design, and Verify/Validate. These are two distinct techniques for the refinement of the procedure. Lean practice intends to recognize and stop waste in the complete process. DMAIC/DMADV is utilized to spot and terminate variation in a process. The DMAIC process in a Lean Management system can be clarified and described. The first step is to define the problem for the selected Project and define the problem. The second step is to measure data about process performance as a process map for recording activities. The third step is to analyze the problem's suspected root cause(s) and verify. The fourth step is to improve the process by taking measures to reduce flaws and divergence caused by source cause(s) and execute selected measures. Finally, the last step is to control the procedure to confirm sustained enhanced performance.

The DMADV Process can be clarified and explained as follows: The foremost step is to define the concern for the selected Project and define the problem; the second step is to measure crucial quality attributes related to the process and product; the third step is to analyze to form design, it is alternatives, and evaluate to determine the most suitable design; fourth step is to design test and optimize the design and prepare for design validation; and the last step is to validate the design outcome fulfils and design input that is requirements, implement the process, and ultimately hand it over to the process owners. DMAIC is a process refinement instrument used to revise an existing process that does not deliver the expected performance. DMADV outlines an organized strategy for defining, designing, and implementing a new process where no process presently lives. Although both have identical attributes, virtually all Lean concepts integrated well with these tools, having two distinct visions of identifying and stopping waste versus identifying and stopping variation.

2.2.2 Theory of constraints integrating lean management

The theory of Constraints carries the general objective of achieving profit maximization, which is accomplished by increasing the production rate of processes and operations in a system. Attaining maximization of Profit by increasing Throughput (rate of production or speed of process) can be

obtained by being more efficient in the company's resource management (Saleh et al., 2019). Therefore, it is required to focus on the constraint because its elimination offers a greater return to resource management and operation; the constraint can be defined as the weakest connection in the Process (Slack et al., 2016).

Goldratt (1990) shaped five steps to reduce or remove the constraint: The foremost step is to determine the constraint: specify a physical process step, origin, and corporate policy that restricts the operation's production pace. The second step leads to controlling the constraint to determine how to do all potential ways to use the constraint to its utmost capacity. Involve Six Sigma, Lean, or other methodology upgrading methods where suitable. The third step leads to the above decision: the constraint should be adjusted to support and deferred to all other activities to ensure it operates at peak effectiveness. The last step is to promote the constraint. Suppose the performance of a system is still not at a satisfactory level; time to consider investments in the constraint to improve or eliminate. For example, it refers to expenses for technology adoption, or personal development may be required to eliminate/reduce the constraint. The last step is to repeat the cycle; this theory is about continuous improvement. When the recent constraint is shattered or dismissed, return to the following constraint in the system/process. Such improvements prepare the organization to grow to be a Lean management institute. Even if Lean and TOC (theory of constraint) illustrate two procedures to process modification, they are highly interconnected. Therefore, managing constraints establishes an atmosphere where the participants can understand their procedure deeply. Figure 1 illustrates the research framework of this study.

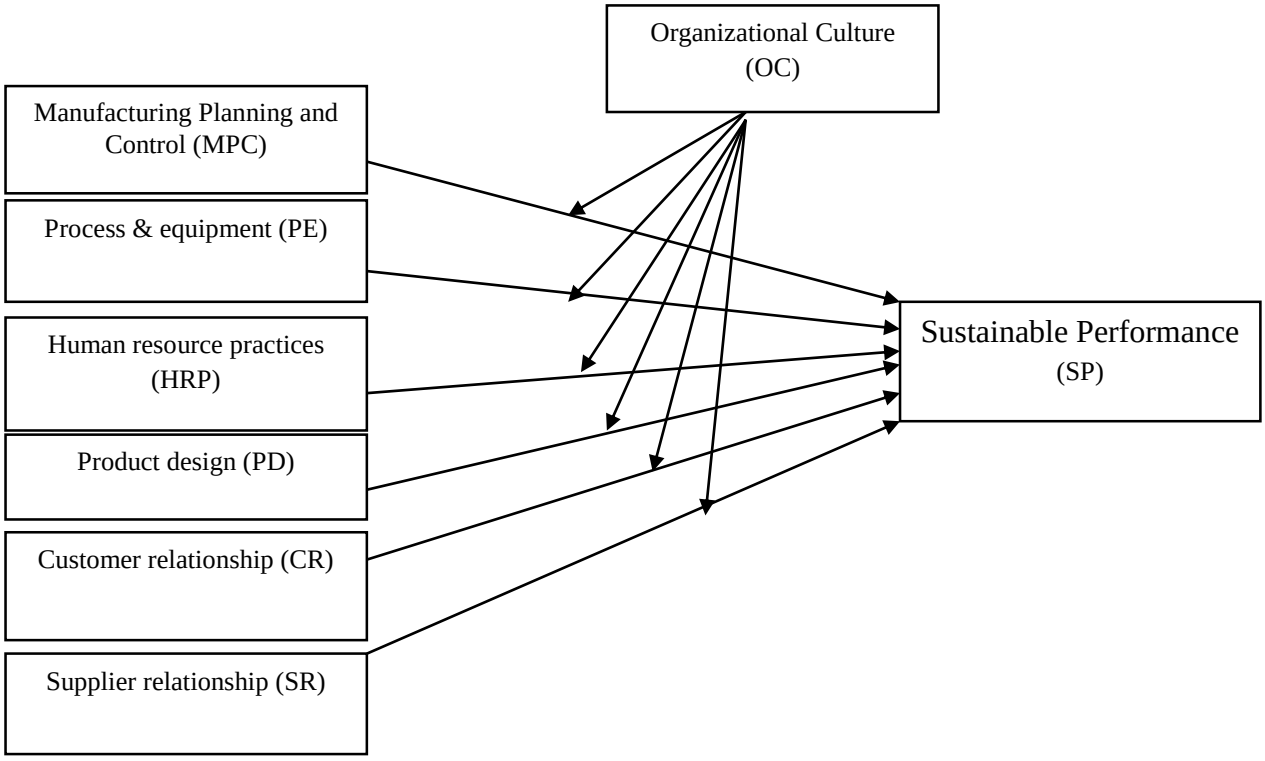

Figure 1: Research framework

2.3. Hypotheses

The following hypotheses are developed from the framework of this research to test the effect of lean manufacturing practices on sustainable performance,

H1: There is a significant effect of manufacturing planning and control on sustainable

performance

H2: There is a significant effect of process and equipment on sustainable performance

H3: There is a significant effect of human resource practices on sustainable performance

H4: There is a significant effect of product design on sustainable performance

H5: There is a significant effect of customer relationships on sustainable performance

H6: There is a significant effect of supplier relationships on sustainable performance

H7: There is a significant effect of organizational culture on sustainable performance that moderates

H7a: There is a significant moderating effect of organizational culture on process & equipment and sustainable performance,

H7b: There is a significant moderating effect of organizational culture planning on control and sustainable performance,

H7c: There is a significant moderating effect of organizational culture on human resources practices and sustainable performance,

H7d: There is a significant moderating effect of organizational culture on product design and sustainable performance,

H7e: There is a significant moderating effect of organizational culture on supplier relationships and sustainable performance, and

H7f: There is a significant moderating effect of organizational culture on customer relationships and sustainable performance

3. Research Methodology

The explanatory research approach is used in this research as it is closely connected to hypothesis testing using deductive reasoning (Alrazehi et al., 2021; Das et al., 2021). "The deductive approach is used to develop hypotheses to test variables based on existent theory and leads to research design to test the hypothesis based on theories" (Wilson, 2014; Hashmi & Mohd, 2020; Hashmi et al., 2020a, b). Deductive reasoning is described using hypotheses derived from the theories. In other words, deductive reasoning is discussed by findings from statements or debates to provide proof. The deduction procedure initiates with a typical pattern "tested in opposition to statements, the procedure for induction initiates with statements and seeks to discover a pattern" (Babbie, 2010). The deductive technique proposes some advantages, the "potential to demonstrate connections and directions among concepts and variables, the potential to estimate concepts quantitatively, and the potential to take an overall view of research conclusions to a particular level. So, this study's deductive research approach leads to quantitative research.

3.1. Research Design

This study used the quantitative approach to conclude from empirical evidence. Its reasoning can be defined in the positivist pattern to test statements (Hashmi et al., 2021a; b; Rashid et al., 2020; Rashid et al., 2021). The quantitative research approach relies on drawing empirical evidence from a large population by data collection. Further, the quantitative approach measures the objectives via actions and opinions to streamline representing the data rather than interpreting it. Rashid et al. (2021)

argued that "explanatory study assists in determining the reasonableness of the happening of a distinct phenomenon." This study usually describes a casual problem and is appropriate to the quantitative approach. This approach authorizes a fresh understanding to develop, build, or test a hypothesis. The quantitative approach used in illustrative research aims to identify issues and key variables in a specific situation.

3.2. Sampling Design

Sampling design is the roadmap for the researcher; the next step of defining the target population is how to select a sample size that can represent the population, what sampling techniques are more suitable for the targeted population and the collection of data from the sample size. A population represents all entities or persons a researcher expects to understand. In most cases, assessing the entire population is not feasible or possible; sampling is used to select a proportion from the population for study to measure the characteristics of that population based on sampling (Rashid et al., 2021). The targeted population for this study is small and medium enterprises (SMEs), and samples from the population are used to draw and represent a conclusion. The general question has been there to draw a sample size from the population in academic writings. However, deciding the suitable sample size is always challenging for investigators as the statistical methods and processes are broadly sensitive and need to be carefully selected the sample size (Rashid et al., 2021). Inferior is the sample size of 50, poor is 100, reasonable is 200, good is 300, excellent is 500, and more than excellent is 1000, which is a rule of thumb recommended for determining an adequate sample size (Rashid et al., 2021). Further, explained that a sample size of a minimum of 200 samples is needed for small and medium enterprises study. Furthermore, to decide the proportions of utilized items in factor analysis, a minimum of five times or a maximum of ten times indicators form a sample size (Rashid et al., 2021).

The targeted population for this research is SMEs, "Lean manufacturing and sustainable performance with a Moderation of Organizational Culture," a sampling approach is used as the likelihood of each unit selected is not confirmed or unidentified. The sampling approach of non-probability selection is divided into convenience, quota, judgment, and snowball (Rashid et al., 2021). The sampling approach from non-probability was selected as convenience sampling for this study, where the data gathering is voluntarily available at the researcher's comfort. This method assists researchers in getting responses cost-effectively but is usually condemned for finite selection due to the lack of equality in the target population (Rashid et al., 2021).

3.3. Instrument of Data Collection

Quantitative studies are based on primary and secondary data. This study needs primary data, the type of data collection one has explicitly collected for one's projects. In contrast, secondary data are the type of data collection that pre-exits data collected for research projects or commercial purposes (Rashid et al., 2019). The main distinction between these two primary and secondary data is that 'new' data while the other is 'used' data in previous studies or available on demand (Maylor & Blackmon, 2005). Data was acquired using structured questionnaires or observation to collect primary data from individuals, used in quantitative research methods, collected data transformed into numerical data. Enterprise researchers often direct to quantitative data collection as survey research. The data range from opinions, statements, mindsets, behavior, and lifestyles on individuals with general background information on their demographic attributes (Hair et al., 2007). Hair et al. (2007) explained a set of questions to measure as a questionnaire used by respondents to record answers (primary data). Primary data was collected by designing questionnaires with a prearranged frame consisting of questions and scales. However, Lee and Lings (2008), "the research will also be less than satisfactory without a sound tool, this will mean that study data will never be of high quality, and of course. Further, urged that the span of the questionnaire is likely the fundamental factor in impacting people's response to your questionnaire."

3.4. Procedure of Data Collection

The targeted population of SME firms in Pakistan to implement lean practices from this study's sampling frame. The data were gathered from the executives who directly participate in the manufacturing process, as they have direct participation in the process related to manufacturing. Therefore, they have facts and knowledge of their enterprises' lean implementation. On behalf of that, they can answer the essence of this study. The participants were selected from different corporate departments, as this study is a multidimensional approach that progressively moves from operations to other business functions. Structured questions were distributed to collect the primary data using convince sampling, as discussed in the above section (Rashid & Amirah, 2017).

3.5. Statistical Technique

Descriptive statistics used in this research to present the collected data in a summarized manner refers to dealing with collecting, arranging, summarizing, and expressing quantitative data is the type of statistics. Central tendency mode, mean, and median are the measures of descriptive statistics. The inferences for research on the population are based on the observations made on the data collected through sampling. Statistics deals with the procedures and techniques by which inferential statistics offer a pathway for testing the significance of results acquired by collected data. It thus uses likelihood, the chance of an event occurring. Analysis of Variance, Covariance, Correlation Analysis, and Multiple regressions used to generate inferences based on collected data (Rashid, 2016). For the study, unprocessed raw data must be processed using computers. Because manual procedures for evaluating and calculating appropriate statistics have become increasingly tiresome or unthinkable in this technological world, the software for this research, SPSS and Smart PLS, contains multiple considerable common statistical approaches.

4. Results and Findings

The data collected is based on this research study methodology. Data obtained from respondents were analyzed through statistical tools and procedures to test whether the sampling results matched the previous theories and literature. The sampling data of 200 respondents is explained in a descriptive profile using SPPS software. The model must be validated before hypothesis testing to check the data's reliability and validity. R-Square represents model representation by variables present corresponding to this study; later in the chapter, hypotheses testing was carried out using SmartPLS-4 (PLS-SME); later, a summary of hypotheses shows which hypotheses are accepted or not.

4.1 Demographic Profiles

In the first section of results and findings, descriptive profiles of respondents are described in table 1 for the sample size of 200 respondents; this provides the frequency and percentage of respondents. Gender is divided into two groups, male and female, Demographic items of male respondents are 159 (79.5%), and female respondents are 41 (20.5%). Age is divided into four groups. Demographic items of age groups are 20 to 30, 31 to 40, 41 to 50, and 51 to 60 Years are 60 (30%), 95 (47.5%), 31 (15.5%), and 14 (7%), respectively. The level of education is classified into four groups. Demographic items of the level of education are Matric, Intermediate, Graduate, Postgraduate 2 (2%), 59 (24.5%), 110 (55%), and 39 (19.5%), respectively. Finally, experience is divided into four groups, Demographic items of experience are 0 to 5, 6 to 10, 11 to 15 years, and 16 Years and above are 46(23%), 73(36.5%), 45(22.5%) and 36(18%) respectively.

Table 1: Respondent's demographic profile

Demographic Items	Frequency	Percentile %
	Gender	
Male	159	79.5
Female	41	20.5
Total	200	100
	Age	
20-30 Years	60	30.0
31-40 Years	95	47.5

41-50 Years	31	15.5
51-60 Years	14	7.0
Total	200	100
Education		
Matric	2	1.0
Intermediate	49	24.5
Graduate	110	55.0
Postgraduate	39	19.5
Total	200	100
Experience		
0-5 Years	46	23.0
6-10 Years	73	36.5
11-15 years	45	22.5
16 Years and above	36	18.0
Total	200	100

4.2 Validation of Model

In the second section of results and findings, the data were analyzed on SmartPLS-4 for confirmatory factor analysis. SEM software for a partial least square (PLS) is Smart PLS, which enables the path modeling methodology with a two-step data analysis approach (Sarstedt & Cheah, 2019). Reliability and validity are the measures used to confirm factors analysis for items loading on latent variable and construct. If sufficient reliability and validity exist, then the quality of research works exists with the outcome of accurate results.

4.2.1. Construct reliability and convergent validity

Acceptable reliability for construct specifies if Cronbach's Alpha (α) and composite reliability (CR) are more significant than 0.7 for established scales to construct reliability (Ghozali, 2014). Convergent validity exists when the average variance extracted (AVE) cutoff point is more significant than 0.5 of items by their respective constructs (He & Li, 2011; Khan et al., 2022a, b). Table 2 represents that the threshold for Cronbach's Alpha (α) and composite reliability (CR) is more than 0.70 for all latent variables exceeding the cutoff point, so there is sufficient construct reliably; this indicates that all items represent variables very well. The AVE of all latent variables is higher than 0.5, which indicates sufficient construct validity; all latent variables have a good base over the individual item. All the values are more significant than the cut point weights, fulfilling the assumptions for the test.

Table 2: Construct reliability and convergent validity

Latent variables	NO. of items	Cronbach's Alpha α	CR	AVE
Manufacturing Planning and Control (MPC)	05	0.869	0.905	0.657
Process & Equipment (PE)	05	0.897	0.924	0.710
Human Resource Practices (HRP)	05	0.890	0.919	0.696
Product Design (PD)	04	0.891	0.923	0.752
Customer Relationship (CR)	04	0.847	0.890	0.672
Supplier Relationship (SR)	05	0.864	0.900	0.644
Organizational Culture (OC)	05	0.905	0.930	0.728
Sustainable Performance (SP)	05	0.870	0.906	0.659

4.2.2. Discriminant validity

The squared value of AVE (average variance extracted) of any latent variable (the diagonal value shown in table 3) exceeds the associated values under diagonal values, indicating Discriminant validity (Ghozali, 2014). By using SmartPLS-4 results in table 3 Fornell-Larcker Criterion, the Squared value of AVE (Average Variance Extracted) values exceed their respective column values indicating Discriminant validity exists. For appropriate Discriminant validity, Fornell and Larcker (1981) specified that "for each latent variable's squared value of AVE to be greater than its correlation with

each construct." Therefore, all the diagonal values are more significant than the cut point for respective column values, fulfilling the test assumptions (Agha et al., 2021; Haque et al., 2021; Khan et al., 2021; Khan et al., 2022c).

Table 3: Discriminant validity

	CR	HRP	MPC	OC	PD	PE	SP	SR
CR	0.820							
HRP	0.324	0.834						
MPC	0.342	0.636	0.811					
OC	0.338	0.560	0.622	0.853				
PD	0.247	0.397	0.417	0.464	0.867			
PE	0.314	0.592	0.652	0.548	0.410	0.843		
SP	0.353	0.656	0.629	0.736	0.400	0.588	0.812	
SR	0.160	0.218	0.181	0.292	0.245	0.158	0.288	0.802

4.2.3 Adjusted R square

R squared and Adjusted R squared values are shown in Table 4. If the values of R-Squares are 0.75, then the model is substantial, 0.50, then the model is moderate, and 0.25, then the model is weak (Hair et al., 2017). As the model has multiple independent variables, adjusted R-square indicates that independent variables represent 66% of the model and 34% represented by other variables not taken in this model.

Table 4: R square and adjusted R square

	R-square	R-square adjusted
SP	0.682	0.660

4.3. Hypotheses Testing

The developed hypotheses for this study were tested in SEM on t values, beta values, p-values, and the hypotheses direction (Hair et al., 2019). PLS bootstrapping can provide more precise estimates of moderator effects by reporting an error that attenuates corresponded relationships and improves the confirmation of theories (Chin et al., 2003). In table 5, hypotheses results showed, and only three Independent variables that significantly impact dependent variables are supported. 1) Significant impact of human resource practices (HRP) on Sustainable Performance (SP) with a path coefficient of 0.274 and p-value of 0.000. 2) Significant effect of Supplier relationship (SR) on Sustainable Performance (SP) with path coefficient of 0.084 and p-value of 0.037. 3) Significant effect of Organizational culture (OC) on Sustainable Performance (SP) with a path coefficient of 0.407 and p-value of 0.000. All other hypotheses not supported that there is no significant effect of Manufacturing Planning and Control (MPC), process and equipment (PE), Customer relationship (CR), and Product design (PD) on Sustainable Performance (SP).

Table 5: Hypotheses testing

Hypothesis	Relationships	Path Coefficients (β)	*p*-value	Decisions
H1	MPC -> SP	0.108	0.080	Not Supported
H2	PE -> SP	0.140	0.060	Not Supported
H3	HRP -> SP	0.274	0.000***	Supported
H4	PD -> SP	-0.047	0.172	Not Supported
H5	CR -> SP	0.018	0.344	Not Supported
H6	SR -> SP	0.084	0.037*	Supported
H7	OC -> SP	0.407	0.000***	Supported
H7a	OC x PE --> SP	0.083	0.138	Not Supported
H7b	OC x MPC--> SP	0.038	0.334	Not Supported
H7c	OC x HRP --> SP	-0.014	0.432	Not Supported
H7d	OC x SR --> SP	-0.148	0.005**	Supported
H7e	OC x CR --> SP	0.015	0.400	Not Supported
H7f	OC x PD --> SP	-0.052	0.216	Not Supported

** p < 0.05, ** p < 0.01, ***p < 0.001*

Table 6 shows the moderation impact of organizational culture on manufacturing planning and

control (MPC), process and equipment (PE), human resources practices (HRP), product design (PD), supplier relationship(SR), and customer relationship (CR) to Sustainable Performance (SP). Organizational culture's moderation development significantly impacts supplier relationship (SR) on Sustainable Performance (SP) with a path coefficient of -0.148 and p-value of 0.005. All other Moderation effects are not supported. There is no significant effect of Organizational culture (OC) that moderates Manufacturing planning and control (MPC), process and equipment (PE), human resources practices (HRP), customer relationship (CR), and product design (PD) on Sustainable Performance (SP).

4.4. Hypotheses Assessment Summary

Table 4.6 shows the summary of hypotheses statement and decision, either supported or not supported.

Table 6: Hypotheses summary

Hypothesis	Relationships Statement	Decisions
H1	There is a significant effect of manufacturing planning and control on sustainable performance	Not Supported
H2	There is a significant effect of process and equipment on sustainable performance	Not Supported
H3	There is a significant effect of human resource practices on Sustainable Performance	Supported
H4	There is a significant effect of product design on sustainable performance	Not Supported
H5	There is a significant effect of customer relationship on sustainable performance	Not Supported
H6	There is a significant effect of supplier relationship on sustainable performance	Supported
H7	There is a significant effect of organizational culture on sustainable performance	Supported
H7a	There is a significant moderating effect of organizational culture on process and equipment and sustainable performance	Not Supported
H7b	There is a significant moderating effect of organizational culture on planning and control and sustainable performance	Not Supported
H7c	There is a significant moderating effect of organizational culture on human resources practices and sustainable performance	Not Supported
H7d	There is a significant moderating effect of organizational culture on supplier relationship and sustainable performance	Supported
H7e	There is a significant moderating effect of organizational culture on customer relationship and sustainable performance	Not Supported
H7f	There is a significant moderating effect of organizational culture on product design and sustainable performance	Not Supported

5.1. Conclusion

Lean approaches in manufacturing firms have been drawing interest across the world. Many companies have used them as a positive feature to improve performance and gain a competitive advantage. This study aimed to discover the moderation development of the relationship between lean manufacturing approaches for manufacturing firms in Karachi, Pakistan, on sustainable performance. This research study suggests that firms with human resource practices, managing supplier relationships, and organizational culture positively and significantly influence sustainable performance. In addition, the moderation development of organizational culture established by supplier relationships influences sustainable performance.

5.2. Discussion

The study was conducted under the quantitative research method to explore the significant effect of lean practices with the moderation of organization culture on the sustainable performance of firms. This study used connivance sampling with 200 respondents and constrained time and expertise. A study explored how manufacturing companies will gain sustainable performance in six primary areas. Particularly manufacturing planning and control, process and equipment, human resources, product design, supplier relationships, customer relationships, and how organizational culture will enhance the sustainable performance of companies. A non-significant result of the study may be based on previous findings; the lacking of achieving an adequate or enduring Lean adoption remains a management problem of organizations being incapable of capitalizing on the benefits of Lean (Karim & Arif-Uz-

Zaman, 2013).

The research purpose is to find whether the hypothesis is supported or not. Even if data differs from expected, recording accurate results and concluding based on collected information still holds informative results. These non-significant results can be affected by a change in methods, low statistical power, different population, etc. Results differ along different cultures or another demographic gender, ethnicity, etc.

5.2.1. Manufacturing planning and control over sustainable performance

Lean practices for firms are chosen to advance performance because such systems possess all fundamental activities of a company's operations used for planning and controlling manufacturing (Silver et al., 1998). However, a study conducted based on respondents did not support the hypotheses of the significant influence of Manufacturing Planning and Control on a firm's sustainable performance. The limitation and recommendations for this research will be explored in a later section.

5.2.2. process and equipment over sustainable performance

Several leading countries decided to be more endurable companies and embraced many initiatives to enhance the environmental and social performance of their facilities, processes, and products (Fiksel et al., 1999). However, a study based on respondents did not support the hypotheses of the significant effect of process and equipment on sustainable performance. The limitation and recommendations for this research will be explored in a later section.

5.2.3. Human resource practices over sustainable performance

Human resource practices include advancing the performance of an organization by training and developing personal capabilities, for example, skills, understanding, and capabilities (Daniels, 2003), over and above manners, and mindsets (Schuler & Jackson, 1997). Human resource practices positively impact sustainable performance, supported in this study by testing path coefficient and significant level. With better HRM practices, the firm can build the capabilities of its employees to enhance firm performance.

5.2.4. Product design over sustainable performance

Efficient and effective product designs may lean market share or develop new segments. Acquisition in product design has usually tied to a firm's across-the-board performance (Gemser & Leenders, 2001). A study conducted based on respondents did not support the hypotheses of the significant effect of Product design on sustainable performance. The limitation and recommendations for this research will be explored in a later section.

5.2.5. Customer relationship over sustainable performance

The sustainability consideration of customer relationship dealing contains the possibility to make a dedicated customer base employing higher satisfaction, including products and services environment-friendly, and therefore the consumer behavior by social value and reputation of having conscious environment (Antonides & Raaij, 1996). A study based on respondents did not support the hypotheses of the significant effect of a customer relationship on sustainable performance. The limitation and recommendations for this research will be explored in a later section.

5.2.6. Supplier relationship over sustainable performance

Supplier relationship management (SRM) can be considered as an approach to influencing the behavior of suppliers and influencing sustainability practices by working with suppliers in activities like improving operational functions of the organization in warehouses, reducing packaging, using more cost-effective transport, and taking on environmental and social programs requiring all these from supplier’s end (Carter & Rogers, 2008). Supplier relationship positively impacts sustainable performance, supported in this study by testing path coefficient and significant level. With improved

supplier relationships, the firm can build a competitive advantage with more cost-effective functions, inventory, and warehousing controls to enhance performance.

5.2.7. Organizational culture that moderates lean practices over sustainable performance

"The attitudes of behaviors observed in perceptions of approaches communicated by team players in particular pathways that assist resolution to resolve the problems faced in the track of a team task" (Nguyen & Watanabe, 2017). This study's supported the hypothesis that organizational culture influences sustainable performance by testing path coefficient and significant level. Developing organizational culture enhances firm performance with effective team working and successful lean practices implementation.

Moderation effect of organization culture over Manufacturing planning and control, process and equipment, human resources practices, product design, supplier relationship, and customer relationship analyzed on Sustainable Performance in this study. Only supplier relationship with moderating impact of organizational culture towards firm's sustainable performance supported in the study with a negative path coefficient. As this hypothesis tested was not related to the findings present in the previous study due to geographical change or research methodological approach used in this approach. The limitation and recommendations for this research will be explored in a later section.

5.3. Implications

This study explores the positive effect of implementing lean practices on human resources practice, supplier relationships, and organizational culture towards sustainable performance. The findings can be helpful in exploring the literature for further studies. This study has discussed lean manufacturing practices incorporated in manufacturing control plans, process and equipment, human resource practices, customer relationships, supplier relationships, and organizational culture toward sustainable performance in firms from previous studies. Furthermore, the theory and literature discussed are helpful for readers to understand lean practices, organizational culture, and sustainable performance. Theories explored in this study are Relational Coordination and Lean Manufacturing Systems, Incorporating Lean Management theories with DMAIC and DMADV, and Theory of Constraints Incorporating Lean Management.

This study can be helpful in manufacturing firms (HR managers, Supplier relationship management) regarding lean practice implementation in Pakistan. Lean manufacturing is a hot topic, and organizations are focused on this. However, as this research seeks to provide how effective and positive lean implementation is in Karachi, Pakistan, this study has limitations in getting more generalized results. Future recommendations and limitations will be discussed in the coming sections. This study provides in-depth knowledge for stakeholders of the company, how previous study and this study relates lean manufacturing to the sustainable performance of the company. As per respondents of this study, the positive attributes of human resource practice, supplier relationships, and organizational culture enhance the firm's performance in Karachi. Moreover, lean implementation can create competitive advantages for the firm to enhance their productivity along with better customer satisfaction and ultimate objective their profitability.

5.4. Limitations

This research study on lean practices in manufacturing firms with moderation effect of organizational culture has several limitations. Each study has its limitation considering sample size/techniques, methodological approach, item selections concerning latent variables, geographical and cultural attributes, etc. Non-significant hypotheses not supported by the study may have happened. Due to sampling technique, procedures, sample size, appropriate questions (items) and characteristics of sample data collected from the population, and so forth, failed to choose that might correctly gauge the positive approach. Not supported hypothesis is a limitation of study parameters. However, human resource practices, supplier relationships, and organizational culture significantly positively affect lean practices in a manufacturing firm in Karachi, Pakistan confirming sustainable performance. First, this

study is conducted under time constraints, has to be completed within provided deadlines, is based on self-funding, and no external sources are incorporated. This study leads to how much stronger self-expertise a researcher holds. Further limitations to this study are related to sampling and geographical constraints limited to Karachi, Pakistan. The first limitation of time constraint leads to sample size and sampling technique, which can affect the results related to hypotheses developed in this study, as one of the critical elements of research is sample have to be an accurate representation of the population. Last but not least sampling approach used in this study is conventional sampling, by incorporating an adequate sampling approach for more generalized results to meet the construct of the study. Research studies with constrained sample size or sampling technique may not truly represent population or theory generalization as data reliability is concerned with capturing accurate population representation from the sample.

5.5. Recommendations

As firms now a day are focusing on lean practices to build competitive advantage to achieve sustainable performance and growth. Future research can be established in a specific industry for the targeted population to meet the research objective, for lean implementation in firms against performance, barriers to lean practices implementation. The study may include moderation and mediation effects over lean practices toward sustainable performance. Lean manufacturing approaches of firms' associations towards sustainable performance may differ depending on the initiative in which lean manufacturing approaches firms operate. Pakistan has not adopted lean very well as the other world does. But companies are showing interest; studies like this and future studies related to lean practices and performance of firms will explore areas for firms to better understand the effectiveness of lean implementations. This study is based on conventional sampling and future studies by targeting a population with longitudinal research study. Better sampling techniques like Stratified sampling or systematic sampling against the targeted population of specific firms will lead to the generalization of results while exploring new demographic and geographical sectors. Likewise, the range of this thesis was the lean practice and the sustainable performance of firms considering organizational culture as moderators. Even hypotheses are not supported to explore the area of research; investigating the factors that restrain the successful implementation of process industries would be of interest to researchers. In addition, further research could be related to the economic effects of broader lean practices implementation in the process industry. As the process industry is leading in the global economies, any slight variation or revision in the production process can have a crucial effect on the real economy and the growth rates.

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