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-RESEARCH ARTICLE-

DOES LEAN IMPLEMENTATION HELP IMPROVE BALANCED SCORECARD OF ISO 9001 CERTIFIED COMPANIES? EVIDENCE IN THAILAND LISTED COMPANY

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─Abstract─

Implementing an ISO 9001-compliant QMS necessitated addressing investor expectations, often known as the influence of stakeholders on an organization. Investors were required to assess the readiness of the company's resources, which might have a bearing on the output's quality and consistency. Due to the importance of complying with the QMS, which required ISO 9001 at a minimum, and lean implementation, which was an accepted standard, by modern businesses, the purpose of this study was to investigate the relationship between lean implementation and the balanced scorecard of companies in S-Curve sectors, Thailand's future industry.

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Multiple regression analysis was performed to determine that the sampled S-curve organizations with QMS, ISO 9001 certification, and lean implementation passed three statistically significant components: Perfection, Value Stream Mapping, and Flow influencing Firm Performance. This study's findings would be helpful for firms seeking information to develop ISO 9001, Ministry of Industry, and Securities Exchange competencies in organizational administration. Additionally, investors may utilize this information to make decisions.

Keywords: Lean Implement, ISO 9001, S-Curve, Balanced Scorecard

1. INTRODUCTION

Implementing Quality Management System (QMS), as ISO 9001 includes investor expectations, defined as the influence of the organization's stakeholders. It was expected that investors would determine resource readiness, which could affect the product's quality and consistency. The increased ownership and larger return expectations put pressure on the management to provide bigger returns for the investment and encourage additional investment. Suppose the organization was unable to give the return. In that case, investors might withdraw their funds, and the organization would undoubtedly perish Wolniak (2019) particularly in the modern-day when businesses struggle to maintain firm performance and survive the crisis (Veena & Prabhushankar, 2019). Therefore, the process that could build more performance and flexibility became more important (Kuiper, Lee, van Ham, & Does, 2022) in the face of a constantly changing business environment and the COVID-19 pandemic. It was full of competitive pressure for the better, faster, and less expensive things that could impact Firm Performance (Joensuu-Salo, Sorama, Viljamaa, & Varamäki, 2018).

According to the Balanced Scorecard (BSC), developed by Robert Kaplan and David Norton, which indicated non-monetary and monetary performance, studies on firm performance typically centred on objective and subjective perceptions of the research issues (Barrozo, 2020). This was natural according to the measurement of firm performance based on the Balanced Scorecard (BSC), which indicated non-monetary and monetary performance. This was consistent with Malcolm Baldrige's Measuring and Improving Organizational Performance under the Excellence Framework guideline. According to the guideline, the four components of outcome indication were 1) finances, 2) customers, 3) internal processes, and 4) learning and development (Barrozo, 2020; Joensuu-Salo et al., 2018). This method was typically associated with QMS and Supply Chain Management (Astrini, 2021; Vanichchinchai, 2022; Vetchagool, Augustyn, & Tayles, 2021)

The upward and radiating trend of organizations adopting Lean Implementation (Saengchai & Jermsittiparsert, 2019) was congruent with the fundamental concept of being certified in quality standards related to industrial organizations, such as ISO 9001:2015, which served as a standard and could be expanded for further development. The tenth clause—improvement, specified importance concerning specification and

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selection of opportunity for advancement and other work to satisfy customer needs and enhance their satisfaction—specifies the importance of specifying and selecting options for improvement and other work (9001, 2015). The improvement notion was associated with lean administration (Ditkaew, Chankong, Polprasert, & Jermsittiparsert, 2021; Kuiper et al., 2022; Taouab & Issor, 2019; Vanichchinchai, 2022). Though lean manufacturing focused on cost-reduction, productivity improvement, and quality improvement, it was inspired by the Toyota Product System. This system emphasized waste management and the evolution of the lean process, which emphasized high production flexibility to accommodate prevailing conditions, shorter turnaround time, and cost reduction. Currently, lean processes such as Just in Time (JIT) (Ditkaew et al., 2021) link Value definition, Value Stream Mapping, Flow, Pull/Just in time, and Perfection (Németh, 2017). Although obtaining the ISO 9001 standard was considered an effort to construct a moral image of the company, which altered investors' expectations and built a higher return (Yue, Yeung, Chung, & Tong, 2018)) compared to before the certification (Kiryanto, Kartika, & Zaenudin, 2022).

In contrast, the firm performance of companies with QMS was affected by little more than half, indicating a lack of QMS's reliability on firm performance. In addition, there was academic disagreement on the fact that QMS was only a partial facilitator and supporter of Supply Chain Relationships (SCR) and did not cover the complete lean implementation (Astrini, 2021). There was also a statistically significant distinction between ISO 9001-certified firms with cost management or production action and those without (Vetchagool et al., 2021).

The issues mentioned above prompted the research objective to investigate the S-curve group. It was a major mechanism and future for Thailand's economy. It was something the government was promoting to attract more investment in automobiles, smart electronics, affluent, medical and wellness tourism, agriculture and biotechnology, food, robotics for industry, logistics and aviation, biofuels and biochemical, digital, medical services, defense, and education development (Chairat, 2021). This study examined the relationship between lean management and business performance as measured by a balanced scorecard using a sample of ISO 9001-certified Thai listed companies with lean management. This study's findings would be valuable for organizations needing information to establish their own Lean & ISO 9001, Ministry of Industry, and Securities Exchange administrative systems. Additionally, investors may utilize this information to make decisions.

2. LITERATURE REVIEW

2.1 Firm Performance and Balanced Scorecard (BSC)

Better performance was pursued because of a focus on competitive advantage and sustainability (Saengchai & Jermsittiparsert, 2019). Taouab & Issor (2019) suggested an operational success that included continuity, efficiency, security, and survival in a

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competitive setting. In a strategic management study, the firm performance served as the dependent variable (Barrozo, 2020). Taouab & Issor (2019) and Barrozo (2020) highlighted measuring of performance that might be done in a variety of ways, depending on the academician's purpose and viewpoint, under the Balanced Scorecard (BSC) guideline published by Robert Kaplan and David Norton in 1990. This notion elaborated on the successful implementation of a company's vision and strategy. According to Taouab & Issor (2019), Barrozo (2020), and Joensuu-Salo et al. (2018), it consists of 1) finances, 2) customers, 3) internal processes, and 4) learning and growth.

Malcolm Bridge cited Excellence Framework as a guide for Measuring and Improving Organizational Performance (Taouab & Issor, 2019) in four aspects of result (Baldrige Performance Excellence Program, 2015) such as finance, which consisted of (9001) having continuously-increasing total income and profit, (2) satisfactory operational cost-cutting, (3) satisfactory investment return, and (4) Meeting the financial goal. The second aspect was customer, which included (9001) increasing market share and constant influx of new customers, (2) customer relations management, customer loyalty, and continuous repeat business, (3) attention to customer feedback and continuous improvement, and (4) continuous improvement of customer satisfaction. The third internal process consisted of (9001) research, design, and development of new products and services; (2) reduction of operation time and error minimization; (3) application of information technology for an internal management system; and (4) quick and high-quality access to management-required data. The learning and development aspect included: (9001) the promotion of staff performance and participation in effective management; (2) the consideration of staff feedback; (3) the survey and improvement of staff satisfaction; and (4) the use of data for studying the problem, as well as its solution, performance evaluation, and inspection (Bailey, 2015; Joensuu-Salo et al., 2018).

2.2 Lean Manufacturing

Lean is frequently used in various interdisciplinary domains, and its meaning can be interpreted in many diverse ways by academics who come from different intellectual backgrounds and have a wide range of ideas, objectives, opinions, and suggestions (Psomas & Antony, 2019). In the context of production, "lean" refers to the removal of waste (Psomas & Antony, 2019).Most researchers have highlighted lean as a way to minimize or eliminate waste. Hardcopf, Liu, and Shah (2021) described lean as an approach for maximizing client value by removing waste by applying process and human design elements. This was known as the "lean delivery strategy." Some definitions focus on minimizing buffering costs (Browning, 2021), removing waste from a product's value stream (Hopp & Spearman, 2021), and identifying waste and removing it from the supply chain value streams (Cocca, Marciano, Alberti, & Schiavini, 2019).

Another way to define lean is in terms of its benefits or implementation motives (Bertagnolli, 2018). Hardcopf et al. (2021) explained lean as an approach with the primary objectives of increasing the efficiency of operations, identifying both value and waste, acquiring knowledge, and establishing a culture of continuous improvement to

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promote sustainability in process operations and business management. These objectives are all designed to boost the efficiency of lean. Therefore, reducing rework, which inherently uses more materials and energy than necessary, will aid in increasing employee awareness of the need for sustainable practices (Kaswan & Rathi, 2020). Other studies have defined lean based on the philosophical foundations of lean methodologies. Lean, for instance, is defined as a production method that focuses on the people involved (Sinha & Matharu, 2019).

In addition, Toyota's production philosophy is complemented by lean manufacturing techniques (Browning, 2021). In addition, lean is a multi-dimensional strategy with favorable effects on operations and competitive performance. This strategy includes minimal waste output (JIT), continuous and uninterrupted flow (cellular layout), well-maintained equipment (TPM), a well-established quality system (TQM), and a well-trained and empowered labor force (HRM) (Lacerda, Xambre, & Alvelos, 2016). Despite this, Browning (2021) discovered that many researchers do not agree on a single precise definition of lean. Ultimately, these arguments led to the formation of the lean definition. Even though it is deficient in various areas, it has provided scholars with the opportunity to investigate and seek a superior lean ideology. As a result, lean can be viewed as a strategy with the primary objective of reaping benefits from lean tools by eliminating waste, generating knowledge, and fostering a culture of teamwork. In contrast, knowledge about the benefits of a slimmer physique has been actively distributed for almost three decades (Lermen, Echeveste, Peralta, Sonego, & Marcon, 2018).

According to Panwar, Jain, Rathore, Nepal, and Lyons (2018), lean methodologies show a favorable correlation with the four dimensions of operational performance, namely quality, lead time performance, flexibility performance, and cost performance. According to Shrafat and Ismail (2019), lean is a successful method for enhancing operations performance by improving quality and minimizing inventory, delivery, productivity, and cost. Additionally, lean has been demonstrated to reduce waste. Negrão et al. (2020) studied the various implementation patterns of lean practices and operational performance. They discovered that high adopters of lean practices performed better in lead time, inventory, and turnover, but not in quality and on-time delivery. Lean manufacturing is also recognized as an efficient technique for enhancing business performance. This can be achieved by boosting a company's profitability (Panwar et al., 2018), sales (Teixeira et al., 2021), social performance (Negrão et al., 2020), and green supply chain performance (Wong, Wong, & Boon-itt, 2018). The researchers discovered a positive relationship between lean strategies and environmental management. Psomas and Antony (2019) conducted thorough literature research on how the implementation of lean influences the performance of business organizations to enhance it.

2.3 Lean Manufacturing and Implementation

Lean manufacturing and implementation were viewed as a collection of modern manufacturing synergistic management techniques that originated in the automotive

sector under the name "Toyota Product System" and evolved into the Just in Time Production System (Engelseth, Pujawan, & Ushada, 2018), leaning increased efficiency and agility by eliminating waste and focusing on non-value-added tasks via supply chain management that prioritized value addition and customer delivery readiness (Basheer, Siam, Awn, & Hassan, 2019). This was essential for establishing a relationship with the supply chain and enhancing performance, which was related to the introduction of lean manufacturing (Ditkaew et al., 2021) and the application of integrated operation (Saengchai & Jermsittiparsert, 2019).

The Just In Time principle, which evolved from lean manufacturing, stressed production flexibility and a JIT system with a small inventory, fewer workers, and less space (Veena & Prabhushankar, 2019). The following elements and indicators may serve as indications of lean implementation inside the company: 1) Value Definition (X1) that could be stated by (9001) manufacturing process that adds value (2) customer service satisfaction (3) continual product development (Kaufmann, 2020; Németh, 2017; Veena & Prabhushankar, 2019) 2) Value Stream Mapping (VSM: X2) that might be indicated by (9001) a flexible practice and structure that would not limit the operation's rapid pace. (2) emphasis on human capital for effective management (3) continual product quality improvement (Kosasih, Sriwana, Sari, & Doaly, 2019) 3) Flow (X3) that may be illustrated by (9001) a continuous sequence of work stages (2) operational support in manufacturing (Basheer et al., 2019; Kosasih et al., 2019; Németh, 2017) 3) Pull/ Just in time (X4), which might be represented by (9001) adequate production to meet the needs of the customers. (2) timely manufacturing to meet the needs of the customer (3) Rapid reaction to alterations in customer demands (Basheer et al., 2019; Kosasih et al., 2019; Salunkhe & Shinge, 2018; Veena & Prabhushankar, 2019) 5) Perfection (X5), which may be demonstrated by (9001) Appropriate production area management (2) Effective process with little mistake (3) Customer-satisfying product design (Adreeva et al., 2021; Németh, 2017).

2.4 ISO9001 and Lean Implementation

As a result of the expansion of globalization, businesses are increasingly embracing management standards produced and published by the International Organization for Standardization (9001) to ensure that they can meet the needs of their customers (Cai & Jun, 2018). ISO has developed more than 22,500 International Standards, with ISO 9001 being one of the organization's most well-known standards due to its certification of over one million organizations in over 170 countries (Demir, Budur, Omer, & Heshmati, 2021). The ISO publication states the requirements for a quality management system. It advocates implementing a process-based strategy incorporating the PDCA (Plan-Do-Check-Act) cycle and risk-based thinking to achieve the desired outcomes and guarantee customer satisfaction. Risk-based thinking and the PDCA cycle enable an organization to determine the proper level of planning and control, and risk-based thinking enables continual improvement (Demir et al., 2021). According to the ISO publication, during each phase of the PDCA cycle, the organization must carry out the following tasks: Plan

- Define the objectives and processes of the QMS, as well as the resources required to achieve the desired results under the client's specifications and the organization's policies, and identify the risks and opportunities. Do - Put the plans into action. Check: Keep an eye on the processes and compare the outcomes to the scheduled activities' policies, goals, and requirements. - Act: Develop new activities to boost the QMS's effectiveness and, consequently, the organization's performance.

Each PDCA cycle phase corresponds to a subset of the ISO 9001 standard's requirements. The organization is obliged to create, execute, and maintain the QMS following the set of quality management principles outlined in the ISO publication, which has the potential to result in a plethora of benefits for the organization (Cai & Jun, 2018). Internal uses include cost savings, fewer errors, fewer complaints, quality improvement of products or services, reduced personnel issues and enhanced efficiency, documentation, and employees' clear understanding of their assigned tasks. External benefits include increasing revenue and market share, the development of client connections, enhanced customer satisfaction, an enhanced reputation, and acquiring a competitive edge (Bravi, Santos, Pagano, & Murmura, 2020).

The benefits can often be divided into two categories: internal and external. Internal advantages include the following: According to ISO 9001, the potential benefits of implementing a quality management system (QMS) include, but are not limited to the following: the ability to consistently provide products and services that meet customer and applicable statutory and regulatory requirements; the facilitation of opportunities to enhance customer satisfaction; the addressing of risks and opportunities associated with its context and objectives; and the ability to demonstrate conformance to specified QMS requirements (Cai & Jun, 2018). Under the ISO 9001 standard, implementing a QMS is considered a strategic decision for every organization. According to the research, an organization must be competitive (Sachin & Rajesh, 2022). However, the ISO 9001 standard only lists the requirements that the QMS must meet; it does not mention how they must be met (Sá et al., 2022). By removing waste and producing value, Lean methods and technologies can substantially contribute to the pursuit of excellence in quality management (Siltori et al., 2021). These enhancements can be accomplished by eliminating waste and producing value.

Historically, quality demand was used to measure competitiveness. Therefore, businesses must develop new strategies and methods for managing quality and delivery time. Studies comparing fundamental QMS like ISO 9001 to Lean Manufacturing (Adreeva et al., 2021; Veena & Prabhushankar, 2019) found that QMS influenced Firm Supply Performance. In addition, there was a statistically significant connection between Supply Chain Management Practices and business success (Basheer et al., 2019). The clause "10. Improvement" of the ISO 9001 standard, which could be expanded to other development, outlined the significance of identifying and selecting opportunities for improvement and other work to meet customer needs and improve their satisfaction and defined (a) improvement of product and service to meet customer needs and

expectations, (b) remedy, prevention, and minimization of undesirable effect, and (c) improvement of the efficiency and performance of the QMS. Key directives were key to correction, Corrective Action, Continuous Improvement, Breakthrough Change, Innovation, and reorganization (9001, 2015). Typically, the improvement notion was associated with Lean Manufacturing (Adreeva et al., 2021; Ditkaew et al., 2021; Kuiper et al., 2022; Taouab & Issor, 2019; Vanichchinchai, 2022). Nonetheless, Carvalho, Sá, Marques, Santos, and Pereira (2022) discovered that operation and support provided by Quality Management System ISO 9001 and the development of Lean Manufacturing were crucial.

Implementation of lean manufacturing had a significant impact on manufacturing, strategic cost management, and competitive advantage through production planning and control, new product development, machinery and equipment, labor management, and supplier relationships (Ditkaew et al., 2021). QMS was a sponsor and facilitator for Supply Chain Relationship (SCR) (Vanichchinchai, 2022). The research conducted by Vetchagool et al. (2021) revealed a statistically significant difference between ISO 9001-certified firms with and without production and cost management techniques. Astrini (2021) discovered that QMS affects business performance.

2.5 Lean implementation and Firm Performance

Lean manufacturing was one of the excellence ideals that affected the sustainability of a business (Bailey, 2015). The association between manufacturing industry performance and various problem-solving development strategies was discovered. Thus, development became a performance and efficiency enhancer that might give the organization a competitive advantage (Saengchai & Jermsittiparsert, 2019). According to the BSC, which approach may be measured in monetary and non-monetary terms as a result of implementing the firm's vision and strategy? (Taouab & Issor, 2019).

It was discovered that Lean Manufacturing with Lean Implementation positively impacted the BSC (Stevanovic, 2018). Navarro-García, Arenas-Gaitán, and Rondán-Cataluña (2014) found a contradiction in VSM, an element in lean implementation that highlighted waste but did not dispose of it. The flow was discovered to have limits in businesses that lacked a comprehensive flow procedure. Fernández-Mesa and Alegre (2015) found that the evaluation of lean manufacturing guidelines in terms of quality improvement is typically centered on reducing setup time and cell production and determining the relationship between lean manufacturing and monetary and non-monetary indicators. In this instance, the technique did not represent lean manufacturing. Consequently, a hypothesis can be formulated below.

Hypothesis: *Lean Manufacturing was related to BSC*

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3. RESEARCH FRAMEWORK

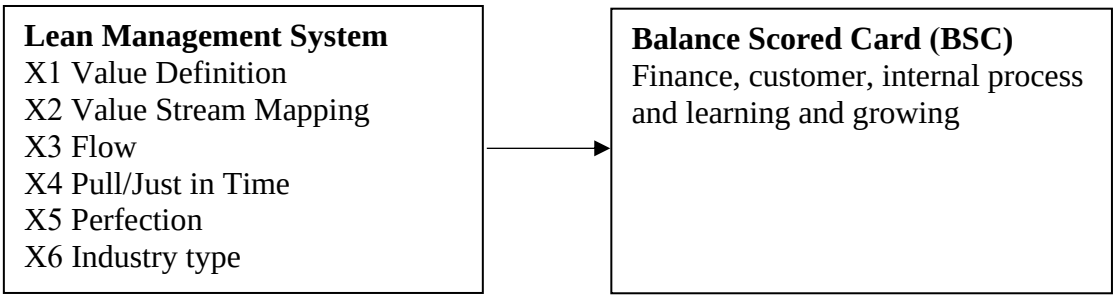

Figure 1. Research Framework

4. RESEARCH METHOD

Cross-sectional and quantitative research design was used to conduct this study. The population in this study were 271 ISO 9001-certified S-curve companies working in Thailand. Out of this, 103 companies were selected through cluster sampling, as sample size >10% precision levels where the confidence level is 95% for sampling a small population (Singh & Masuku, 2014). The questionnaires were used as data collection tool. The construct of the lean management system was measured using six dimensions, i.e. i) Value Definition, ii) Value Stream Mapping, iii) Flow, iv) Pull/Just in Time, v) Perfection, vi) Industry type (Kaufmann, 2020; Kosasih et al., 2019; Németh, 2017; Veena & Prabhushankar, 2019). Similarly, the construct of BSC was measured from the multi-dimensional scales, i.e., financial performance, non-financial performance, customer perspective, internal business process perspective, and learning & growth perspective, adopted from a prior study (Kotane & Kuzmina-Merlino, 2011). The tool used in this study was a 5-point Likert-scale survey form on Google Form, the link to which was emailed to the respondents (Nayak & Narayan, 2019) All scales used in the study have Cronbach's alpha coefficient of 0.70. Thus the reliability of each scale is established. Then, the respondents collected data after 60 days to select complete information (Sauermann & Roach, 2013). The SPSS version 22 was used to analyze descriptive statistics, Pearson Correlation Analysis and the Multiple Regression Model. Variables were set up based on the research scope.

5. RESULT

The results of descriptive statistics related to lean implementation and BSC are shown below.

Table 2 shows the relationship between lean management and BSC of ISO 9001-certified companies, along with control variables like industry type. Most variables had a correlation coefficient between 0.026 and 0.526. Multicollinearity Variance Inflation Factor (VIF) was between 1.216 and 1.432, less than 10, which caused no Multicollinearity problem (Hair, Ortinau, & Harrison, 2010)

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Table 1. Descriptive Statistic

Variable	**Mean**	**SD**	**Rating**	**Ranking**
X_1 Value Definition	4.31	0.44	Highest	1
X_2 Value Stream Mapping	4.17	0.52	High	4
X_3 Flow	4.13	0.51	High	5
X_4 Pull/Just in Time	4.23	0.55	Highest	2
X_5 Perfection	4.18	0.45	High	3
Y (BSC)	**4.20**	**0.31**	High	**-**

According to Table 1 Lean management, overall, the lean management was done through indicators like value definition (X1) (Mean = 4.31, SD = 0.44) followed by Pull/Just in Time (X4) (Mean = 4.23, SD = 0.55) that had the highest rating. On the other hand, Perfection (X5) (Mean = 4.18, SD = 0.45), Value Stream Mapping (X2) (Mean = 4. 17, SD = 0.52) and flow (X3) (Mean = 4.13, SD = 0.51) had high rating. The BSC (Mean = 4.20, SD = 0.31) had high rating.

The result of the multiple regression analysis to test the influence of lean management on BSC by Pearson Correlation Analysis is shown in Table 2.

Table 2. Pearson Correlation Analysis Result

ตัวแปร	**X_1**	**X_2**	**X_3**	**X_4**	**X_5**	**X_6**	**Y**
X_1		.234*	.203*	.275**	.242*	-.330**	.254**
X_2			.304**	.026	.416**	-.368**	.398**
X_3				.304**	.411**	-.172	.436**
X_4					.285**	-.199*	.301**
X_5						-.245*	.526**
X_6							-.145
VIF(F)	1.216	1.432	1.362	1.299	1.425	1.275	

Table 3, Model 2 showed a relationship between lean management and BSC. It was found that all independent variables had positive effects on the BSC and could predict up to 38.6% (R Square = 0.386). Regarding statistical significance and coefficient, Perfection (B = .223), Value Stream Mapping (B = .133), and Flow (B = .115) were shown to have an effect. At the same time, the relationship between Pull/ Just in time, Value Definition, and S-Curve industry type could not be conclusively proven.

6. DISCUSSION & CONCLUSION

This study's primary objective was to analyze the extent of lean management in the manufacturing processes of ISO 9001-certified firms and examine the relationship between lean management and BSC in Thailand's S-curve-listed companies. It was discovered that 103 S-curve sampled enterprises had a high level of lean implementation.

Value Definition, Pull/Just in time, Perfection, Value Stream Mapping, and Flow were the most significant variables. This is consistent with Basheer et al. (2019); Ditkaew et al. (2021) concluded that the lean manufacturing idea was similar to an international-standard tool used to increase firm efficiency, decrease waste, and focus more on non-value-added operations, and lean the companies.

Table 3 Multiple Regression Analysis between Lean Management and BSC of ISO 9001-Certified Companies

Model	B	t-value
Constant	1.630	.000
X_1 Value Definition	.059	.394
X_2 Value Stream Mapping	.133	.024*
X_3 Flow	.115	.046*
X_4 Pull/Just in Time	.075	.153
X_5 Perfection	.223	.001**
X_6 Type of S-Curve industry	.063	.266
R Square		0.386
Adjusted R Square		0.348
F-Value		10.056**
* significance level of 0.05 ** significance level of 0.01		

Discovery of statistically significant positive effects of lean management and BSC, such as ideal operations such as efficient, error-free operations. Németh (2017) cited adequate operations as the basis for superior performance and competitiveness. Veena and Prabhushankar (2019) noted that implementing the ISO 9001 standard and learning was to close the gap or overcome constraints to tackle problems more effectively. It was necessary to integrate the operation with a focus on customer needs, enhance innovation and staff capability that would lead to a reduction in result variation and waste, and ultimately process improvement. According to the ISO 19001 standard, Adreeva et al. (2021) identified the connection between QMS and lean implementation as positive organizational process development and improvement tool.

Value Stream Mapping revealed that a variable with a statistically significant influence on lean management and BSC, a flexible organizational structure and practice that did not impede the rapid process, reliance on personnel power for effective leadership, and constant product quality development would be beneficial. Similarly, Saengchai and Jermsittiparsert (2019) and Saengchai and Jermsittiparsert (2019) discovered that lean implementation would result in such adaptability. Veena and Prabhushankar (2019) also found that lean management might be combined with QSM to enhance value-added customer response. Kosasih et al. (2019) discussed waste detection and waste reduction.

Regarding flow, another variable with statistically significant influence on lean management and BSC, it could be concluded that it comprises operations involving a continuous chain of work steps, operational support in manufacturing, and appropriate, systematic process distance and dispersion. Basheer et al. (2019); (Saengchai & Jermsittiparsert, 2019)

Despite the favorable benefit, there was insufficient evidence to indicate a relationship between Pull/Just in time, sufficient output for customer demands, production on time for customer needs, and rapid responsiveness to changes in customer orders. The likelihood that Joensuu-Salo et al. (2018),(Pamornmast, Sriyakul, & Termsittiparsert, 2019) concluded that attempts to develop competence, particularly in SMEs, affected company performance and included both monetary and non-monetary components. On the other hand, the more recent S-Curve group Chairat (2021) was born when lean implementation was already a conventional practice that could be followed from the beginning. (Németh, 2017).

Classification as an S-Curve industry and lack of statistical significance for the observed difference between ISO 9001-certified QMS operation and lean implementation, together with an encouragement to invest and anticipation of future growth. It would take some time to implement, consistent with Chairat (2021); (Poompruk, 2021).

REFERENCE

9001, I. S. I. (2015). Quality Management Systems Requirements: Reference number ISO 9001:2015(E). Retrieved from https://www.iso.org/standard/62085.html

Adreeva, T., Shvidenko, D., Popova, L., Krupoderova, M., Grimashevich, O., & Cherkashnev, R. (2021). Development of Lean Manufacturing in Quality Management System. *Calitatea, 22*(181), 71-75. Retrieved from https://www.proquest.com/openview/150223788e34bca8dc242a80554c66e1

Astrini, N. (2021). ISO 9001 and performance: a method review. *Total Quality Management & Business Excellence, 32*(1-2), 5-32. doi:https://doi.org/10.1080/14783363.2018.1524293

Bailey, D. (2015). The metrology of organizational performance: How baldrige standards have become the common language for organizational excellence around the world. *Retrieved November, 17*, 2015. Retrieved from http://academico.une.org/Documents/The%20metrology%20of%20organizational%20performance%20(3rd%20place).pdf

Barrozo, E. (2020). Strategic Management System for Competitive Business Performance: A Literature Review. *The ASTR Research Journal, 4*(1), 1-23. Retrieved from https://www.researchgate.net/profile/Edgar-Barrozo/publication/349311415

Basheer, M., Siam, M., Awn, A., & Hassan, S. (2019). Exploring the role of TQM and supply chain practices for firm supply performance in the presence of information technology capabilities and supply chain technology adoption: A

case of textile firms in Pakistan. *Uncertain Supply Chain Management, 7*(2), 275-288. doi:http://dx.doi.org/10.5267/j.uscm.2018.9.001

Bertagnolli, F. (2018). *Lean management*: Springer.

Bravi, L., Santos, G., Pagano, A., & Murmura, F. (2020). Environmental management system according to ISO 14001:2015 as a driver to sustainable development. *Corporate Social Responsibility and Environmental Management, 27*(6), 2599-2614. doi:https://doi.org/10.1002/csr.1985

Browning, T. R., & de Treville, S. (2021). A lean view of lean. *Journal of Operations Management, 67*(5), 640-652.

Cai, S., & Jun, M. (2018). A qualitative study of the internalization of ISO 9000 standards: The linkages among firms' motivations, internalization processes, and performance. *International Journal of Production Economics, 196*, 248-260. doi:https://doi.org/10.1016/j.ijpe.2017.12.001

Carvalho, M., Sá, J. C., Marques, P. A., Santos, G., & Pereira, A. M. (2022). Development of a conceptual model integrating management systems and the Shingo Model towards operational excellence. *Total Quality Management & Business Excellence*, 1-24. doi:https://doi.org/10.1080/14783363.2022.2060810

Chairat, K. (2021). Concept of S-Curve at the Macro and Micro Level Case Study of the New S-Curve: Aviation and Logistics Industrial. *RMUTK Journal of Liberal Arts, 3*(1), 99-111. Retrieved from https://so02.tci-thaijo.org/index.php/larts-journal/article/view/249269

Cocca, P., Marciano, F., Alberti, M., & Schiavini, D. (2019). Leanness measurement methods in manufacturing organisations: a systematic review. *International Journal of Production Research, 57*(15-16), 5103-5118. doi:https://doi.org/10.1080/00207543.2018.1521016

Demir, A., Budur, T., Omer, H. M., & Heshmati, A. (2021). Links between knowledge management and organisational sustainability: does the ISO 9001 certification have an effect? *Knowledge Management Research & Practice*, 1-14. doi:https://doi.org/10.1080/14778238.2020.1860663

Ditkaew, K., Chankong, W., Polprasert, P., & Jermsittiparsert, K. (2021). Lean Manufacturing Implementation on Strategic Cost Management of Medical Devices Industrial. *PSYCHOLOGY AND EDUCATION, 58*(4), 1553-6939. Retrieved from https://research.kpru.ac.th/research2/pages/filere/1632968211.pdf

Engelseth, P., Pujawan, I. N., & Ushada, M. (2018). Continuous Handling of Uncertainty in Food Chains: Using the House of Risk Model in Ecosystems. *Proceedings in Food System Dynamics*, 363-373. doi:https://doi.org/10.18461/pfsd.2018.1829

Fernández-Mesa, A., & Alegre, J. (2015). Entrepreneurial orientation and export intensity: Examining the interplay of organizational learning and innovation. *International Business Review, 24*(1), 148-156. doi:https://doi.org/10.1016/j.ibusrev.2014.07.004

Hair, J. F., Ortinau, D. J., & Harrison, D. E. (2010). *Essentials of marketing research* (Vol. 2): McGraw-Hill/Irwin New York, NY.

Hopp, W. J., & Spearman, M. S. (2021). The lenses of lean: Visioning the science and practice of efficiency. *Journal of Operations Management, 67*(5), 610-626. doi:https://doi.org/10.1002/joom.1115

Joensuu-Salo, S., Sorama, K., Viljamaa, A., & Varamäki, E. (2018). Firm Performance among Internationalized SMEs: The Interplay of Market Orientation, Marketing Capability and Digitalization. *Administrative Sciences, 8*(3), 31. doi:https://doi.org/10.3390/admsci8030031

Kaswan, M. S., & Rathi, R. (2020). Green Lean Six Sigma for sustainable development: Integration and framework. *Environmental Impact Assessment Review, 83*, 106396. doi:https://doi.org/10.1016/j.eiar.2020.106396

Kaufmann, G. (2020). *Aligning Lean and Value-based Management*: Springer.

Kiryanto, K., Kartika, I., & Zaenudin, Z. (2022). Stock price reaction on ISO 9001 certification announcement: evidence from Indonesia. *International Journal of Quality & Reliability Management, 39*(2), 612-629. doi:https://doi.org/10.1108/IJQRM-04-2020-0127

Kosasih, W., Sriwana, I. K., Sari, E., & Doaly, C. O. (2019). *Applying value stream mapping tools and kanban system for waste identification and reduction (case study: a basic chemical company)*. Paper presented at the IOP Conference Series: Materials Science and Engineering.

Kotane, I., & Kuzmina-Merlino, I. (2011). Non-financial indicators for evaluation of business activity. *European integration studies*(5), 213-219. doi:https://doi.org/10.5755/j01.eis.0.5.1099

Kuiper, A., Lee, R. H., van Ham, V. J. J., & Does, R. J. M. M. (2022). A reconsideration of Lean Six Sigma in healthcare after the COVID-19 crisis. *International Journal of Lean Six Sigma, 13*(1), 101-117. doi:https://doi.org/10.1108/IJLSS-01-2021-0013

Lacerda, A. P., Xambre, A. R., & Alvelos, H. M. (2016). Applying Value Stream Mapping to eliminate waste: a case study of an original equipment manufacturer for the automotive industry. *International Journal of Production Research, 54*(6), 1708-1720. doi:https://doi.org/10.1080/00207543.2015.1055349

Lermen, F. H., Echeveste, M. E., Peralta, C. B., Sonego, M., & Marcon, A. (2018). A framework for selecting lean practices in sustainable product development: The case study of a Brazilian agroindustry. *Journal of Cleaner Production, 191*, 261-272. doi:https://doi.org/10.1016/j.jclepro.2018.04.185

Navarro-García, A., Arenas-Gaitán, J., & Rondán-Cataluña, F. J. (2014). External environment and the moderating role of export market orientation. *Journal of Business Research, 67*(5), 740-745. doi:https://doi.org/10.1016/j.jbusres.2013.11.037

Nayak, M., & Narayan, K. (2019). Strengths and weaknesses of online surveys. *Technology, 6*(7), 0837-2405053138. Retrieved from https://www.researchgate.net/profile/Mudavath-Nayak/publication/333207786

Negrão, L. L. L., Lopes de Sousa Jabbour, A. B., Latan, H., Godinho Filho, M., Chiappetta Jabbour, C. J., & Ganga, G. M. D. (2020). Lean manufacturing and

business performance: testing the S-curve theory. *Production Planning & Control*, *31*(10), 771-785. doi:https://doi.org/10.1080/09537287.2019.1683775

Németh, G. (2017). In search of non conventional organizations: in fact, what we are looking for? *Taylor, 9*(1), 15-23. Retrieved from http://www.iskolakultura.hu/index.php/taylor/article/view/13070

Pamornmast, C., Sriyakul, T., & Termsittiparsert, K. (2019). Can Lean Manufacturing and 4.0 Industry Enhance the Financial Performance of Pharmaceutical Industries of Thailand? Mediating Role of Waste Reduction Behavior. *Systematic Reviews in Pharmacy, 10*(2). Retrieved from https://web.s.ebscohost.com/abstract?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl

Panwar, A., Jain, R., Rathore, A. P. S., Nepal, B., & Lyons, A. C. (2018). The impact of lean practices on operational performance – an empirical investigation of Indian process industries. *Production Planning & Control, 29*(2), 158-169. doi:https://doi.org/10.1080/09537287.2017.1397788

Poompruk, C., & Erbim, N. (2021). Marketing Equilibrium in The New S-Curve in Thailand Affected by the Digital Transformation. *RMUTT Global Business and Economics Review*, *16*(2), 185-198. Retrieved from https://so03.tci-thaijo.org/index.php/RMUTT-Gber/article/view/249471

Psomas, E., & Antony, J. (2019). Research gaps in Lean manufacturing: a systematic literature review. *International Journal of Quality & Reliability Management, 36*(5), 815-839. doi:https://doi.org/10.1108/IJQRM-12-2017-0260

Sá, J. C., Vaz, S., Carvalho, O., Lima, V., Morgado, L., Fonseca, L., . . . Santos, G. (2022). A model of integration ISO 9001 with Lean six sigma and main benefits achieved. *Total Quality Management & Business Excellence, 33*(1-2), 218-242. doi:https://doi.org/10.1080/14783363.2020.1829969

Sachin, N., & Rajesh, R. (2022). An empirical study of supply chain sustainability with financial performances of Indian firms. *Environment, Development and Sustainability*, *24*(5), 6577-6601. doi:https://doi.org/10.1007/s10668-021-01717-1

Saengchai, S., & Jermsittiparsert, K. (2019). The mediating role of supplier network, the moderating role of flexible resources in the relationship between lean manufacturing practices and the organizational performance. *Humanities and Social Sciences Reviews*, *7*(3), 720-727. Retrieved from https://d1wqtxts1xzle7.cloudfront.net/70424885/1126-libre.pdf?1632869331

Salunkhe, R., & Shinge, A. (2018). Value Stream Mapping to Reduce Lead Time and Improve Throughput Time in a Manufacturing Organization: A Review. *IUP Journal of Operations Management*, *17*(3), 42-52. Retrieved from https://www.proquest.com/openview/40a3cbea3ab48d379a9c6ccc1cea6062

Sauermann, H., & Roach, M. (2013). Increasing web survey response rates in innovation research: An experimental study of static and dynamic contact design features. *Research Policy, 42*(1), 273-286. doi:https://doi.org/10.1016/j.respol.2012.05.003

Shrafat, F. D., & Ismail, M. (2019). Structural equation modeling of lean manufacturing practices in a developing country context. *Journal of Manufacturing Technology Management, 30*(1), 122-145. doi:https://doi.org/10.1108/JMTM-08-2017-0159

Siltori, P. F. S., Simon Rampasso, I., Martins, V. W. B., Anholon, R., Silva, D., & Souza Pinto, J. (2021). Analysis of ISO 9001 certification benefits in Brazilian companies. *Total Quality Management & Business Excellence, 32*(13-14), 1614-1632. doi:https://doi.org/10.1080/14783363.2020.1756246

Singh, A. S., & Masuku, M. B. (2014). Sampling techniques & determination of sample size in applied statistics research: An overview. *International Journal of Economics, Commerce and Management, 2*(11), 1-22. Retrieved from https://d1wqtxts1xzle7.cloudfront.net/65225177/21131

Sinha, N., & Matharu, M. (2019). A comprehensive insight into Lean management: Literature review and trends. *Journal of Industrial Engineering and Management, 12*(2), 302-317. doi:http://dx.doi.org/10.3926/jiem.2885

Stevanovic, T., & Cecevic, N.B. (2018). Balanced Scorecard and LEAN Business Concept. *Series: Economics and Organization, 15*(2), 149–163.

Taouab, O., & Issor, Z. (2019). Firm performance: Definition and measurement models. *European Scientific Journal, 15*(1), 93-106. Retrieved from https://d1wqtxts1xzle7.cloudfront.net/58353550/6

Teixeira, P., Sá, J. C., Silva, F. J. G., Ferreira, L. P., Santos, G., & Fontoura, P. (2021). Connecting lean and green with sustainability towards a conceptual model. *Journal of Cleaner Production, 322*, 129047. doi:https://doi.org/10.1016/j.jclepro.2021.129047

Vanichchinchai, A. (2022). Investigating the impacts of ISO 9001 certification on lean manufacturing and supply chain relationship: an empirical analysis. *International Journal of Lean Six Sigma, 13*(1), 232-252. doi:https://doi.org/10.1108/IJLSS-10-2020-0164

Veena, T., & Prabhushankar, G. (2019). A literature review on lean, Six Sigma and ISO 9001: 2015 in manufacturing industry to improve process performance. *International Journal of Business and Systems Research, 13*(2), 162-180. Retrieved from https://d1wqtxts1xzle7.cloudfront.net/60639878/

Vetchagool, W., Augustyn, M. M., & Tayles, M. (2021). ISO 9000, activity based costing and organizational performance. *Total Quality Management & Business Excellence, 32*(3-4), 265-288. doi:https://doi.org/10.1080/14783363.2018.1549938

Wolniak, R. (2019). Context of the organization in ISO 9001: 2015. *Zeszyty Naukowe. Organizacja i Zarządzanie/Politechnika Śląska*. doi:http://dx.doi.org/10.29119/1641-3466.2019.133.10

Wong, C. W. Y., Wong, C. Y., & Boon-itt, S. (2018). How Does Sustainable Development of Supply Chains Make Firms Lean, Green and Profitable? A Resource Orchestration Perspective. *Business Strategy and the Environment, 27*(3), 375-388. doi:https://doi.org/10.1002/bse.2004

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Yue, H.-Y., Yeung, S. M. C., Chung, K. H. K., & Tong, C.-L. (2018). Investors' expectation on rate of return and moral image of companies. *Corporate Ownership & Control*, *15*(2), 99-115. Retrieved from https://pdfs.semanticscholar.org/6d38/ee39d95045979c45a67c10738247d3c1337e.pdf