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The Effect of Lean Manufacturing Practices on Social Sustainability Performance: Empirical Evidence from Manufacturing Firms in Tanzania

Lena Amoni Lyama[1], Gladness Ladislaus Salema[2], Gerald Zachary Paga Tinali[3]

Abstract

This paper examines the effect of lean manufacturing practices, namely, Total Productive Maintenance (TPM) and Continuous Improvement (CI), on the social sustainability performance of Tanzanian manufacturing firms. Using a self-administered structured questionnaire, the study conducted a cross-sectional research design, collecting data from 236 manufacturing firms in Dar es Salaam, Arusha, Mwanza, and Morogoro regions of Tanzania Mainland. A key respondent from each firm was either a director, manager, or any informant suggested by the management with knowledge and experience in lean manufacturing implementation. The study employed Structural Equation Modelling (SEM) data analysis technique to test and verify the hypothesized relationship of the study variables. The findings reveal that total productive maintenance and continuous improvement significantly and positively affect social sustainability performance.

The findings suggest that successful and practical implementations of total productive maintenance and continuous improvement can enhance the social performance of manufacturing firms in Tanzania. The findings provide practitioners with an understanding of the contribution of TPM and CI to social performance. The management of manufacturing firms should consider a practical implementation of total productive maintenance and continuous improvement, and pay attention to improving CI as an essential resource in the shop flow that can improve performance and enhance the achievement of competitive marketing environments. Furthermore, the study contributes to the theoretical understanding of a broader firm's performance, from financial or operational to social performance, using the firm's internal resources.

Key Terms: Total Productive Maintenance; Continuous Improvement; Manufacturing Firms; Social Sustainability Performance

Introduction

Sustainability issues have gained importance in developed and developing nations as an essential approach to achieving sustainable development. Sustainability is the capacity to satisfy the present generation without endangering those of future generations to satisfy their economic, environmental, and social needs. Among the aspects that are vital for a firm's success and growth is social sustainability (Díaz-Reza et al., 2024). Although there is significant growth of concern

[1] Mzumbe University, Morogoro, Tanzania
Email:lyama.lena@gmail.com
[2] University of Dar es Salaam Business School, Tanzania
[3] University of Dar es Salaam Business School, Tanzania

for social sustainability due to stakeholder's awareness of the impact of manufacturing activities, the social issues remain scant and unattended (Mani & Gunasekaran, 2018). The existing studies on lean manufacturing practices mainly focused on the economic and environmental performance of manufacturing firms, and very few studies examined the social sustainability performance dimension (Díaz-Reza et al., 2024; Henao et al., 2019; Samadhiya & Agrawal, 2023). Furthermore, the influence of lean manufacturing practices, such as total productive maintenance and continuous improvement, on social sustainability performance remains underexplored, particularly in developing countries like Tanzania, where issues related to employees' well-being, health, and safety are critical. The attention for manufacturing firms to improve social sustainability performance alongside economic and environmental performance improvement is increasing, leaving social performance with fewer studies (Henao & Sarache, 2023). According to Milanesi et al.(2020), the social performance of industries, including manufacturing, was forgotten in theory and practice. Human capital is becoming an important asset, and employee engagement, safety, and well-being are under consideration in manufacturing operations. From a conventional manufacturing system driven by operational and financial performance to manufacturing practices considering sustainability demand, including social performance prioritizing human capital in operations, manufacturing activities have evolved (Dubey et al., 2016; Sajan et al., 2017).

Studies show that manufacturing industries play a pivotal role in influencing the economic development of the nation. For example, African nations view manufacturing as the engine of economic growth (Moyo & Jeke, 2019; Opoku & Yan, 2019).). Especially in Tanzania, the industrial sector is still essential in raising economic development (Lugina et al., 2022). With an increase of 0.385% over the 2022 GDP, the manufacturing sector in Tanzania accounted for 8.385% of the nation's GDP in 2023, according to the Tanzania Investment Report of 2023. The manufacturing sector has kept developing; its yearly growth rates from 4.5% in 2020 to 5.1% in 2021 have increased, and in manufacturing, the percentage of all jobs likewise changed from 7.4% to 7.8% over the same period. Food goods, plastic and rubber, chemical, basic metal, and non-metallic mineral products comprise most subsectors in manufacturing; these categories relate to output growth, export growth, product innovation, and product diversity (Wangwe et al., 2014). Manufacturing sectors, despite their importance in national development, encounter numerous social challenges. These include unsafe working conditions, a workforce lacking necessary skills, limited access to education for employees, and poor working environments that diminish employee morale, ultimately leading to a shortage of workers (Díaz-Reza et al., 2024). To overcome the social challenges, manufacturing firms are adopting different manufacturing practices that can enhance social performance in both the long and short terms. Total productive maintenance and continuous improvement are among the lean manufacturing practices that manufacturing firms adopt to improve organizational performance. The adoption and implementation of LMPs are revealed globally (Henao et al., 2019; Kafuku, 2019; Maware, 2021). These LMPs are found to be advantageous not only from economic and environmental perspectives but also because their waste reduction principle revealed benefits in social performance.

The literature indicates that lean manufacturing practices substantially enhance firm sustainability performance. Nonetheless, there exists a paucity of research connecting lean manufacturing practices with social sustainability performance in comparison to economic and environmental

performance (Bhattacharya et al., 2019; Ciannella & Santos, 2021; Henao et al., 2019). Specifically, the effect of total productive maintenance and continuous improvement as lean manufacturing practices on social sustainability performance remains underexplored (Samadhiya et al., 2023). Furthermore, in emerging economies such as Tanzania, there is a lack of research linking total productive maintenance (TPM) and continuous improvement (CI) to social performance. For example, research by Kafuku (2019), Sinkamba and Mgwatu (2024), and Mapunda (2019) investigates the adoption and implementation of lean manufacturing practices, including TPM and CI in Tanzania, but does not provide insight into the extent to which LMPs influence manufacturing firm performance. This study aims to close the knowledge gap by investigating the effects of lean manufacturing practices, namely total productive maintenance and continuous improvement, on the social sustainability performance of Tanzanian manufacturing firms.

Theoretical Perspective and Hypotheses Development

This research is based on the resource-based perspective (RBV) theory established by Penrose (1959). This theory elucidates how the internal resources of a firm might impact its performance. The Resource-Based View (RBV) theory posits that a firm's competitive advantage can be attained and sustained through its internal resources, including both tangible assets and intangible resources such as skills, operations, characteristics, motives, attitudes, information, and knowledge (Barney, 1991; Samadhiya & Agrawal, 2023). Resources are deemed strategic and effective if they possess value, rarity, non-substitutability, and difficulty of imitation. Valuable resources possess the ability to formulate and execute strategies that enhance efficiency and effectiveness, but rarity denotes the incapacity of other companies to acquire these resources when needed (Miles, 2012). Prior research has examined the Resource-Based View (RBV) theory in evaluating the relationship between lean manufacturing methods or sustainable practices and organizational performance, including works by Samadhiya and Agrawal (2023), Abobakr et al. (2022), and Silva et al. (2019). Lean manufacturing practices are regarded as a strategic organizational asset that is challenging to replicate due to their inherent connection to distinctive historical contexts, causal ambiguity, and social intricacies (Silva et al., 2019). Consequently, lean manufacturing practices, namely total productive maintenance and continuous improvement, are seen as internal shop flow resources in manufacturing companies, where the adoption of these lean manufacturing practices improves social sustainability performance and is detailed herewith.

Lean Manufacturing Practices and Social Sustainability Performance

The sustainability performance of manufacturing firms is critical for the long-term growth and success of manufacturing industries, taking into account economic, environmental, and social performance aspects. According to the literature, social sustainability receives minimal attention when compared to economic and environmental performance despite its importance in boosting employee well-being (Milanesi et al., 2020; Henao et al., 2021; Chavez et al., 2022). Manufacturing firms have improved working conditions by incorporating social sustainability measures (Morales-García et al., 2021). Social sustainability is all about employee well-being. Manufacturing enterprises may underperform in a competitive climate due to dissatisfied employees who are excessively stressed by unsafe working conditions. Employee and community health and safety are the most important metrics for assessing social sustainability performance. Developed and developing nations adopt lean manufacturing practices to improve organizational performance(Abobakr et al., 2022; Kafuku, 2019; Maware, 2021). Literature has shown that lean

manufacturing practice is a technical and social practice that minimizes all non-value-added activities in production processes (Bortolotti et al., 2015; Genç, 2021; Lizarelli et al., 2022). Technical lean manufacturing practices include just-in-time (JIT), statistical process control (SPC), value stream mapping (VSM), the Kanban system, and total productive maintenance (Genç, 2021; Lizarelli et al., 2022). Meanwhile, Social lean manufacturing practices include practices that reflect the behavioural and human aspects of the organization, such as continuous improvement (kaizen), customer and supplier involvement, a commitment of management and employees, as well as training (Lizarelli et al., 2022).

Lean manufacturing practices have been proven to improve employee satisfaction, motivation, and encourage accountability. This study examines two lean manufacturing practices, Total Productive Maintenance (TPM) and Continuous Improvement (CI), as they are recognized as the most effective practices for enhancing organizational performance (Thekkoote, 2022). Previous researches indicate that Total Productive Maintenance (TPM) facilitates the adoption of other lean manufacturing practices, such as Just-In-Time (JIT) and Total Quality Management (TQM), by improving production efficiency through the reduction of inventory and cycle time, which is achieved by preventing unexpected equipment stoppages and breakdowns (Agustiady & Cudney, 2018; Khalfallah & Lakhal, 2021). For instance, Khalfallah and Lakhal (2021) argued that organizations succeed in implementing JIT when equipment is highly available and effective. On the other hand, continuous improvement focuses on the endless improvement of products and production processes. Additionally, TPM and CI/kaizen are among the lean manufacturing practices implemented in Tanzania (Kafuku, 2019). The hypotheses development process below explains the relationship between the selected lean, namely Total Productive Maintenance(TPM) and Continuous Improvement(CI), on social sustainability performance.

On one hand, Total Productive Maintenance (TPM) is a lean manufacturing practice aimed at eliminating unforeseen failures and equipment shutdowns in the manufacturing process, striving for zero accidents, breakdowns, and defects (Khalfallah & Lakhal, 2021). TPM plays a vital role in controlling any unexpected interruption to the flow of the production process through an autonomous and preventive maintenance system (Silva et al., 2019). Implementing total productive maintenance avoids generations of waste caused by inefficient machines and process variation. Machine failure prevention frees operators from physical injuries and increases motivation and commitment to the assigned duties (Díaz-Reza et al., 2024). TPM practices improve the well-being of employees because the expected machine failures are identified before they occur. Morales-García et al. (2021) argued that TPM activities, including cleaning and monitoring machines and performing preventive maintenance, maintain optimal facility conditions and mitigate accidents, thereby enhancing operator safety. Given the preceding arguments that social sustainability performance can be achieved through an effective machine maintenance system, the effect of Total Productive Maintenance (TPM) on social sustainability performance is thus hypothesized as follows;

H1: Total Productive Maintenance has a positive effect on the Social Sustainability Performance of manufacturing firms.

On the other hand, Continuous improvement is revealed as a lean strategy that emphasizes permanent and incremental improvement programs to achieve long-term advantages for

organizations in a continuous effort (Silva et al., 2019). Other scholars referred to continuous improvement as kaizen systems (Silva et al., 2019; Díaz-Reza et al., 2024; Nguyen, 2019), which involve all employees in the company's decision-making and foster a collaborative culture and shared responsibilities among employees. Continuous improvement or kaizen strategy is an essential philosophy in manufacturing firms, as it sustains other lean manufacturing practices such as TPM, JIT, and TQM (Díaz-Reza et al., 2024). Díaz-Reza et al. (2024) emphasized that continuous improvement facilitates TPM by maximizing equipment efficiency and reducing downtime. Continuous improvement improves the employee's working environment, which tends to improve the social sustainability of firms, such as reducing the stress of workers and improving health and safety (Díaz-Reza et al., 2024; Nigatu, 2022). Similarly, Stimec and Grima (2019) argued that the successful implementation of continuous improvement in manufacturing firms reduces employee's stress levels and enhances motivation. Studies revealed that continuous improvement raised the satisfaction level of employees and the overall performance of companies. Given the foregoing reviewed literature, the effect of continuous improvement on the social sustainability performance of manufacturing firms is hypothesized as:

H2: Continuous improvement has a positive effect on the social sustainability performance of manufacturing firms.

The Conceptual Framework of the Study

The study's conceptual framework is based on the theoretical foundation of the research and the reviewed empirical literature. Figure 1 illustrates the conceptual framework that delineates the causal relationship between total productive maintenance and continuous improvement, regarded as independent variables, and social sustainability performance, classified as the dependent variable.

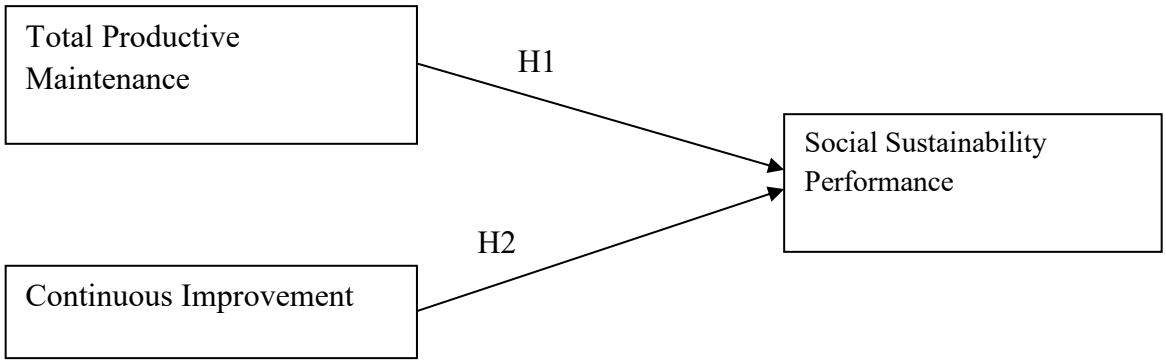

Figure 1: Conceptual Framework
Source: *Researcher Construction based on the Literature Review*

Study Methods and Materials

This research utilized a quantitative methodology to investigate the effect of lean manufacturing practices, namely Total Productive Maintenance (TPM) and Continuous Improvement (CI), on social sustainability performance of manufacturing firms in Tanzania. Data were collected through a cross-sectional survey utilizing self-administered structured questionnaires from 236 out of 329 sampled manufacturing firms across four regions of Tanzania Mainland: Dar es Salaam, Morogoro, Arusha, and Mwanza. The selected regions account for over 50% of the 1864

manufacturing firms employing more than ten individuals (NBS, 2018). Proportionate sampling distribution was considered to determine the sample size from the selected regions, whereby manufacturing firms were randomly selected through a fishbowl simple random sampling method. The key respondents from the chosen firm included directors, managers, and other individuals possessing experience in lean manufacturing practices and sustainability concerns. Research indicates that lean manufacturing practices, including Total Productive Maintenance and Continuous Improvement, apply to both large and small to medium-sized enterprises (Matt & Rauch, 2013). Prior to the main data collection process, a structured questionnaire was developed to gather demographic information about respondents and manufacturing firms, as well as to measure the study variables. The indicators for total productive maintenance, continuous improvement, and social sustainability performance are adapted from the research studies of Bortolotti et al. (2015), Awad et al. (2022), Nguyen et al. (2018), Abdul-Rashid et al. (2017), and Afum et al. (2021), respectively. The adapted items (indicators) are considered as reflective measurement, in that the items represent the effect of an underlying construct. The five-point Likert scale was utilized to capture respondent's opinions and perceptions on measured items effectively. The questionnaire content underwent validation by experts in operations management, including both academicians and practitioners, to ensure question clarity and confirm that the developed items accurately reflect the intended variables for measurement. A pilot study was conducted to evaluate the relevance of the questions and the respondent's understanding of the developed items. This process guarantees the quality of the questionnaire and the reliability of the data (Bhattacherjee, 2012).

The data for the main study were cleaned by assessing missing values, outliers, normality, and suspicious response patterns prior to further analysis, as recommended by Hair et al. (2022) to ensure data quality. The causal relationship was analyzed through Partial Least Squares Structural Equation Modeling (PLS-SEM), confirming the hypothesized relationship. The study utilized PLS-SEM due to its effectiveness in delivering high predictive accuracy for the model, supported by established causal explanations (Hair et al., 2017). The Smart PLS 4 software was utilized to conduct PLS-SEM analyses for the evaluation of both measurement and structural models. The measurement model entails evaluating the reliability and validity of measurements. Likewise, the structural model assesses the relationship between independent constructs, including total productive maintenance and continuous improvement, with social sustainability performance as the dependent construct.

Research Findings

Demographic characteristics.

The descriptive results for the demographic characteristics of 236 study respondents are presented in Table 1. The characteristics encompass, initially, the essential respondent details, including their occupation and the department to which they are affiliated. Secondly, the characteristics of manufacturing firms encompass aspects such as type of ownership, the age of the firm (measured by duration of their operational existence), and the firm size (measured by the number of employees).

Table 1: Respondent's Demographic Characteristics

Characteristics Variable	Category	Frequency	Percentages
Occupation of the respondent	Directors	30	12.7
	Managers	116	49.2
	Supervisors	73	30.9
	Others	17	7.2
Respondent's Department	Production	125	53.0
	Engineering	42	17.8
	Marketing/sales	26	11.0
	Accounting and finance	23	9.7
	Human resource	20	8.5
Firm's ownership	Public	17	7.2
	Private	219	92.8
Time a firm has been in operations (Firm Age)	< 1 year	2	.8
	1-5 years	58	24.6
	6-10 years	72	30.5
	> 10 years	104	44.1
Number of employees in the firm (Firm size)	10-49 employees	74	31.4
	49-99 employees	52	22.0
	≥ 100 employees	110	46.8
Total number of respondents			236

Source: Research Data (2023)

From Table 1, the results show that out of 236 respondents, 61.9% were respondents from highly managerial positions, including directors and managers, while 38.1% were from lower managerial positions, including supervisors and others. The results imply that the information obtained comes from informants who have experience and knowledge of social sustainability improvement and lean manufacturing practices implementation. Meanwhile, about 53% of respondents were from the production department, 17.8% were from the engineering department, and the remaining 29.2% were from other departments such as marketing, accounting, finance, and human resources. The higher response from operations and engineering departments indicates that LMPs such as TPM and CI are among the production strategies affecting social sustainability performance. Likewise, the results show that out of 236 manufacturing firms involved in this study, 92.8% were privately owned, while 7.2% were public-owned firms. The high response of private manufacturing indicates that private investors dominate the ownership of manufacturing in Tanzania compared to public investment. The findings are in line with Myamba and Nguni (2023).

Furthermore, Table 1 indicates that the majority of participating firms are mature, about 44.1% ofmanufacturing firms, which were in operation for more than 10 years, while 30.5% were middle-aged, being in operation for more than 5 to 10 years, and 25.4% were newly formed or start-up firms with not more than five years of operations. The findings suggest that the participating firms had considerable experience in social sustainability enhancement through LMPs implementation. The large, medium, and small-sized manufacturing firms participate, whereby 46.6% of responding firms engaged 100 or more employees, 22% engaged 49 but less

than 100, and 31.4% engaged 10 to 49 employees, respectively (see Table 1). In general, the demographic characteristics give an assurance on the relevance of findings regarding the size of manufacturing firms that may implement lean manufacturing practices (Matt & Rauch, 2013), and that the obtained information comes from informants with knowledge and experience on sustainability performance and lean manufacturing practices implemented by manufacturing firms.

Measurement Model Assessment

The assessment of the measurement model's quality involved a thorough examination of reliability and validity tests. Hair et al. (2022) suggested evaluating the reliability of the measurement model through factor loadings for construct reliability and composite reliability, which assesses internal consistency reliability. Additionally, it is advisable to assess the validity of a measurement model by utilizing the average variance extracted (AVE) to determine convergent validity and the Heterotrait-monotrait ratio (HTMT) for discriminant validity (Hair et al., 2022; Henseler et al., 2015). Table 2 presents the indicator reliability results, indicating that all indicators exhibit a loading exceeding 0.708, following the recommendations of Hair et al. (2022). However, the CI_3 and CI_5 indicators fall short of this threshold, with loadings below 0.708. These indicators were retained due to their significant contributions to internal consistency reliability and convergent validity (Hulland, 1999). The arrangement of equipment and machinery at the workplace (TPM_3) exhibited a loading value of 0.559, which is also below the threshold criteria, and it was subsequently removed, as this action enhances both internal consistency reliability and convergent validity (Hair et al., 2022). The majority of loading factors indicate that over 50% of the variations in indicators are accounted for by the corresponding construct (refer to Table 2 below). Furthermore, the study findings indicate that the composite reliability values for all constructs exceed 0.7 (refer to Table 2 below), demonstrating that the measurement model has attained a higher level of internal consistency.

Table 2: Reliability and Convergent Validity Results

Indicators	Indicator Loading	CR (rho_a)	AVE
Total Productive Maintenance		0.784	0.600
TPM_1: Operators in our firm are involved in cleaning machines before and after operations	0.795		
TPM_2: Operators in our firm monitor the performance of machines that they operate	0.760		
TPM_4: Operators in our firm can treat preliminary abnormal operations of machines	0.749		
TPM_5: We have a prepared maintenance schedule to be done before failure occurs (preventive maintenance)	0.794		
Continuous Improvement		0.776	0.517
CI_1: Our firm continuously looks for better ways of doing jobs	0.734		
CI_2: All employees in our firm have a role in the quality of the product produced	0.749		
CI_3: The management of the firm supports the initiatives made to improve the product and process	0.693		

CI_4: Employees in our firm are empowered through self-directed teams	0.745		
CI_5: In our firm, there is a continuous analysis of the production process to identify sources of waste	0.671		
Social Sustainability Performance		0.838	0.595
SOCSP _1: Our firm managed to improve the safety of employees	0.776		
SOCSP _2: Our firm managed to improve the relationship with the community and stakeholders	0.774		
SOCSP_3: The morale of working of our employees is increased	0.729		
SOCSP _4: The living quality of our surrounding community is improved	0.749		
SOCSP _5: Our firm managed to improve the customer satisfaction level	0.826		

Source: *Research Data (2023)*

The evaluation of convergent and discriminant validity was also conducted to examine the quality of measurements. The convergent validity was assessed using AVE, while the discriminant validity was assessed using HTMT. Hair et al. (2022) state that the acceptable AVE value for convergent validity is 0.5 and above. Results in Table 2 above show that all variables had AVE values above 0.5, indicating the existence of convergent validity. As indicated in Table 3 below, the discriminant validity displays the maximum HTMT value of 0.77, below the recommended threshold of < 0.85 (Henseler et al., 2015). The findings indicate that the variables/constructs of the structural model of the study are conceptually distinct. This study used the HTMT measure rather than Fornell-Larcker and cross-loading, as recommended by researchers that HTMT is the best approach in assessing discriminant validity (Hair et al., 2022; Henseler et al., 2015).

Table 3: Discriminant Validity (HTMT Results)

Variable/Construct	TPM	CI	SOCSP
TPM			
CI	0.290		
SOCSP	0.482	0.758	

Source: Research Data (2023)

Assessment of the Structural Model

Collinearity check

The collinearity assessment evaluates the correlation of independent variables in the structural model. The process of collinearity assessment is based on suggestions provided by Hair et al. (2022), where the variance inflation factor (VIF) of each of the independent variables in the model is examined. The cutoff point of the VIF value suggested by researchers is ≤ 3.3 for the structural model to be free from the multicollinearity problem (Hair et al., 2017; Kock, 2015). This study's obtained VIF values of the structural model are below 3.3 (see Table 4), suggesting collinearity has no substantial effect on the estimated model.

Model explanatory power, effect size, and significance of the relationship

The model's explanatory power is primarily measured using the coefficient of determination (R^2). The coefficient of determination (R^2) indicates the degree of variance of the dependent variable, as explained by the independent variable (Hair et al., 2022). The obtained R^2 of the current study model is 0.452 (Table 4). The results imply that 45.2% of the variation in the social sustainability performance of manufacturing firms in Tanzania is explained by independent variables, namely total productive maintenance and continuous improvement. The obtained R^2 value is considered moderate (Hair et al., 2022). Other factors explain the remaining 54.8%. The extent to which the independent variable affects the dependent variable was also determined by evaluating the model's effect size (f^2) results. Table 4 herein displays the f^2 value of 0.117 and 0.541 for TPM and CI, respectively. Following the guideline of 0.02, 0.15, and 0.35 representing small, medium, and large effect sizes as suggested by Cohen (1988), the obtained f^2 of 0.117 for TPM, which is above 0.02 and below 0.15 and the f^2 value of 0.541 is above 0.35 then the effect of change in R^2 when total productive maintenance is removed from the model is small while removing continuous improvement leads to large effect size.

Table 4: Hypotheses Testing Results

Hyp	Relationship	Path coefficient	Std. error	t-value	p-value	95% Confidence interval	VIF	f^2
H1	TPM -> SOCSP	0.261	0.053	4.000*	0.000	[0.156;0.372]	1.06	0.117
H2	CI -> SOCSP	0.560	0.065	10.583*	0.000	[0.477;0.653]	1.06	0.541
	R^2	0.452						
	Q^2	0.428						

Source: Research Data (2023)
*Note: * indicates that p<0.001*

Additionally, the results in Table 4 show that total productive maintenance ($\beta = 0.261$; $t = 4.000$; $p < 0.001$) and continuous improvement ($\beta = 0.560$; $t = 10.583$; $p < 0.001$) significantly and positively affect the social sustainability performance of manufacturing firms. The significance is further evidenced by bootstrapping confidence intervals [0.156;0.372] and [0.477;0.653], which do not include zero for total productive maintenance and continuous improvement, respectively. Hence, hypotheses H1 and H2 were supported at $p<0.001$.

Model's Predictive Power

In addition to the model explanatory power (in-sample prediction) evaluation, Shmueli et al. (2019) suggested the importance of assessing the model's predictive power to conclude the capability of a study model to predict new observations. The model is considered to have predictive power when the $Q^2>0$ (Becker et al., 2023; Hair et al., 2022; Shmueli et al., 2019). Q^2 value is determined using Stone-Geisser's Q^2 technique developed by Geisser (1974) and Stone (1974). Using the SmartPLS 4 tool, data were executed and calculated in PLSpredict. The obtained Q^2 for the endogenous variable was 0.428, greater than 0, suggesting the model's predictive relevance. Also, all endogenous indicators' Q^2predict was greater than zero, justifying that the predictive power of the PLS analysis for the items outperforms the most naïve benchmark (Shmueli et al., 2019). However, the comparison of PLS-SEM Root Mean Square Error (RMSE) with the Linear Model (LM) RMSE results revealed that the majority of the items yield small

prediction errors (the highlighted PLS SEM values); see Table 5. The results indicate medium predictive power in the study model (Becker et al., 2023; Shmueli et al., 2019).

Table 5: PLSpredict results

Endogenous Indicators	Q²predict	PLS-SEM_RMSE	LM_RMSE
SOCSP_1	0.293	0.494	0.502
SOCSP_2	0.194	0.533	0.531
SOCSP_3	0.209	0.599	0.602
SOCSP_4	0.163	0.531	0.54
SOCSP_5	0.365	0.429	0.417

Source: Research Data (2023)

Importance-Performance Map

The importance-performance map analysis (IPMA) was further conducted to evaluate the performance of TPM and CI as independent variables in predicting social sustainability performance. IPMA results show that TPM and CI had importance values of 0.261 and 0.560, respectively, with the performance levels of 83.616% for TPM and 82.932% for CI. Figure 2 shows that continuous improvement is the most important lean practice in influencing social sustainability compared to total productive maintenance. The importance value of 0.555 for CI implies that a one-unit increase in continuous improvement will increase the performance of social sustainability by the same value of 0.560 (*Ceteris paribus*) from 82.932% to 83.492%. This implies that management of manufacturing firms should pay much attention to continuous improvement to increase the social sustainability performance of their firms. At the same time, resources for TPM should be retrained based on Ringle and Sarstedt's (2016) and Wyród-Wróbel and Biesok's (2017) suggestions.

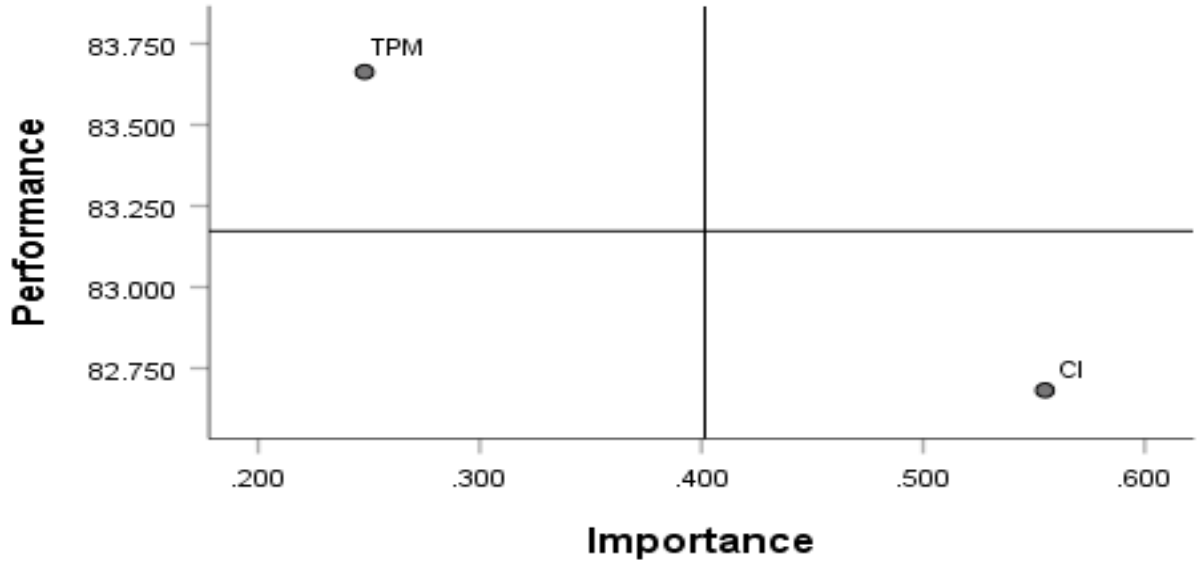

Figure 2: Importance-Performance Map of Social Sustainability Performance Construct

Furthermore, the IPMA analysis was extended to an indicator level to obtain a more specific area for improvement. Figure 3 shows that CI_1 should be given priority for improvement in order to improve the social sustainability performance of manufacturing firms in Tanzania. A one-unit increase in CI_1's performance increases the performance of social sustainability by CI_1's importance value, which is 0.188 (*ceteris paribus*). The priority for improvement should be followed by CI_4, CI_2, CI_5, and CI_3 as second to fifth priority, which have important values of 0.169, 0.155, 0.134, and 0.130, respectively.

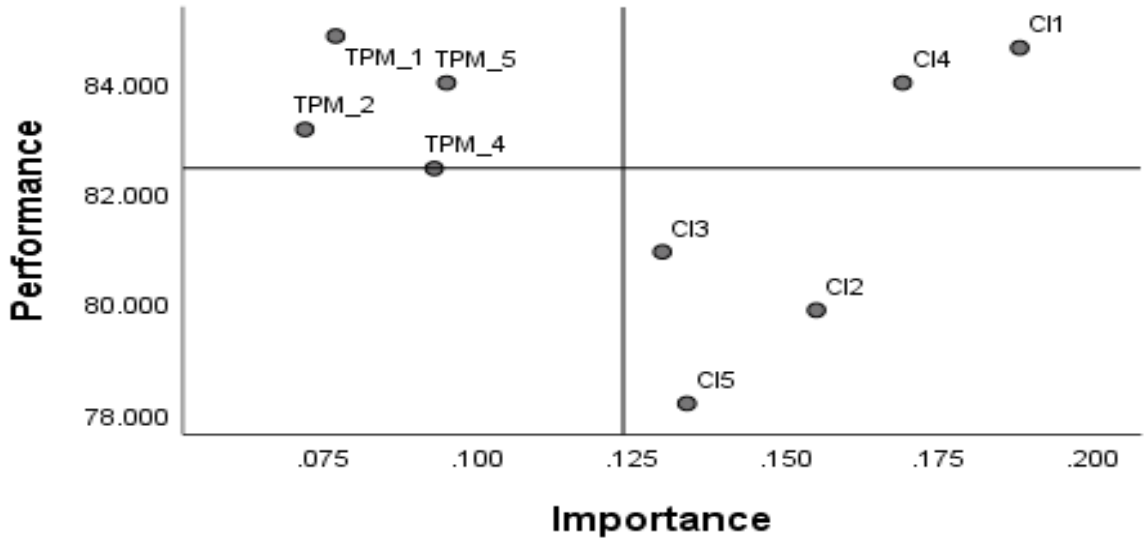

Figure 3: IPMA at the indicator level on SOCSP as a target construct

Discussion of Findings

The study examined the effect of lean manufacturing practices, namely total productive maintenance and continuous improvement, on social sustainability performance in Tanzanian manufacturing firms. Two hypotheses were developed to address the objective of the study. The findings supported hypothesis (H1) and confirmed that, "*there is a significant and positive effect of total productive maintenance on the social sustainability performance of manufacturing firms".* The verified reliable and valid measures of TPM in this study include an autonomous maintenance system where operators are involved in cleaning the machine before and after operations, the ability of operators to monitor the performance of machines, the operator's ability to treat preliminary abnormal operations of machines, and the availability of a preventive maintenance schedule. These findings align with previous scholars, including Samadhiya and Agrawal (2023) and Morales-García et al. (2021). According to Samadhiya and Agrawal (2023), a healthier and safer working environment, good employee relationships, and customer satisfaction are influenced by successful TPM implementation. At the same time, Morales-García et al. (2021) concluded in their study that social sustainability in the Mexican maquiladora industry can be attained through the appropriate use of machines and maintenance systems.

Moreover, Chavez et al. (2022) found a positive relationship between internal lean practices measured in machine maintenance aspects and the social sustainability performance of manufacturing companies in Chile. It was further noted that proper implementations of TPM

lower unexpected breakdowns of machines that might harm operators, production of defective output, and unplanned downtime that might cause delivery delays and poor quality of products to customers (Agustiady & Cudney, 2018). The successful implementation of total productive maintenance prevents machine failures that lead to unsafe working environments and unexpected waste (solid and air pollution) generation due to machine linkages and breakdowns. The results further support H2, which asserts that "*continuous improvement has a significant and positive effect on social sustainability of manufacturing firms"*. Continuous improvement (kaizen) assists manufacturing companies in minimizing waste, including solid, water, and air pollution, thus safeguarding the health and safety of employees, customers, and the broader community. This study aligns with Sajan et al. (2017), who assert that lean manufacturing strategies, such as continuous improvement (kaizen), positively impact the social sustainability performance of SMEs in India. Additional research corroborating the substantial and favourable impact of CI on social performance metrics encompasses Stimec and Grima (2019), Nigatu (2022), and Díaz-Reza et al. (2024). Furthermore, the empirical results for H1 and H2 support the resource-based theory (RBV) that the capabilities of internal resources, such as lean manufacturing practices, which are considered a shop flow strategic resource, specifically TPM and CI, can enhance the firm's performance. The effective execution of TPM and CI in Tanzanian manufacturing has demonstrated social sustainability. Hence, the overall results corroborate prior findings.

Theoretical Implications

The findings of this study are more important and relevant in the body of knowledge as the study provides a deeper understanding of the significant and positive contribution of TPM and CI as lean manufacturing practices on social sustainability performance, which were inadequately covered by previous studies. As Henao et al. (2021) recommended, more studies are needed to assess the benefits of lean manufacturing practices for social sustainability. Most of the previous studies focused on the influence of lean manufacturing on operational performance, economic performance, and environmental sustainability, and few studies were conducted on social sustainability performance (Henao & Sarache, 2023; Maware & Adetunji, 2019). The current study evidenced that total productive maintenance and continuous improvement affect not only economic or environmental performance but also their implementations provide a long-term social benefit in manufacturing firms, which is regarded as social sustainability performance.

Conclusion and Recommendations for Future Research

This study examined the contribution of specific lean manufacturing practices, namely total productive maintenance and continuous improvement, to the social sustainability performance of manufacturing firms. The successful implementation of total productive maintenance and continuous improvement makes employees within the firms, especially operators on the shop floor, perform their duties with peace of mind and work without stress, resulting in satisfaction with a safe working environment. Achieving social sustainability should be considered a challenge for manufacturing in order to improve the production process. Because of these, this study concludes that total productive maintenance and continuous improvement are essential in explaining the variations in social sustainability performance in manufacturing firms. The greater explanatory power results from a decrease in operator's accidents caused by unexpected failure, as TPM emphasizes failure prevention. Also, the practices emphasize employee's empowerment and a continuous system of improving the production processes, increasing employee's empowerment, customer satisfaction, and community relationships, ultimately leading to firm's

social performance. Despite these contributions, the study has certain limitations that future research could address. First, the study examined the direct effect of TPM and CI on social sustainability; future research could include other lean manufacturing practices in the model, such as supplier and customer relationships or other internal practices, to increase the variance explained by social sustainability. Second, the study concentrated on the manufacturing sector; the same framework should be tested in the service industry setting. Finally, future research could use a case study to investigate in depth how TPM and CI affect specific types of manufacturing.

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