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Lean Maintenance at Ghana Gas: Employee Perceptions of Waste and Perceived Operational Outcomes

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Abstract

Lean maintenance seeks to improve asset performance while reducing waste. This study examines employee perceptions of maintenance waste, lean implementation factors and operational outcomes at Ghana National Gas Company Limited (Ghana Gas). A questionnaire survey of 73 employees assessed six waste items, nine implementation factors and five outcome items. Inventory management (M = 1.90) and waiting for maintenance resources (M = 1.95) received the strongest agreement among the waste items. Respondents strongly agreed with improved equipment availability (M = 1.63) and safety (M = 1.49), but disagreed with reduced maintenance costs (M = 4.10). Employee involvement (M = 1.05), supplier integration (M = 1.18), and customer alignment (M = 1.18) were rated very poor; management commitment (M = 1.86) was rated poor. The findings describe an uneven perceived outcome profile and support further investigation of participation, inventory practices and maintenance resource flow. All results are descriptive and perception-based. The study adds energy-sector evidence from sub-Saharan Africa, where empirical work on lean maintenance remains scarce.

Keywords: *Lean Maintenance; Total Productive Maintenance; Maintenance Waste; Critical Success Factors; Energy Sector; Ghana.*

I. INTRODUCTION

- *Maintenance, Lean Thinking and Total Productive Maintenance*

Maintenance has evolved from a reactive, break-fix support function into a strategic determinant of competitiveness in asset-intensive industries. In processing and utility operations it is typically one of the largest controllable components of operating expenditure, and its effectiveness directly conditions plant availability, safety and unit production cost [1], [2]. In midstream gas processing, where a single train outage interrupts supply to downstream power generation and industrial customers, the cost of ineffective maintenance extends well beyond the plant fence.

Lean thinking is one of the most influential responses to this challenge. Originating in the Toyota Production System and popularized by Womack and Jones [3], it rests on five principles: specify value from the customer's standpoint, identify the value stream, make value flow, let the customer pull, and pursue perfection. Applying these principles to maintenance recognizes that maintenance is itself a process with customers (operations), inputs (labour, spares, information) and embedded waste. Lean maintenance therefore aims to deliver the required equipment reliability with the minimum expenditure of maintenance resources, rather than simply to maximize maintenance activity [1]. Smith and Hawkins [4] framed it as a proactive, team-based practice built on planned and reliability-centred work, and Mostafa et al. [5] reviewed lean maintenance tools and proposed a framework linking them to waste in the maintenance process.

Total productive maintenance (TPM), lean maintenance's most established operationalization, was developed in Japan and codified by Nakajima [9]. It combines technical disciplines (planned maintenance, focused improvement, early equipment management) with social ones (autonomous maintenance by operators, education and training, participative problem-solving), involving all employees in the care of equipment. Evidence continues to link lean practices, including TPM, to better operational performance: Panigrahi et al. [10] found them significant predictors across manufacturing firms, consistent with earlier work [6], [7]. Digital

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extensions, including machine-learning-supported decision systems, are broadening the field's technical frontier [8], which renews rather than diminishes the importance of the waste-elimination logic examined here.

➢ *Waste in Maintenance Management*

This study examines six waste categories that formed the waste section of its questionnaire: unproductive maintenance, waiting for maintenance resources, centralized maintenance management, poor inventory management, unnecessary motion and resource under-utilization. They overlap with classical lean concerns such as waiting, inventory, motion and inefficient resource use, although centralized decision-making contributes to delay rather than being a direct equivalent of transportation waste. The categories offer a descriptive framework for interpreting the ratings, not a validated universal waste taxonomy [2].

➢ *Critical Success Factors and Outcomes*

Lean's benefits are not automatic. Implementation outcomes depend less on the tools deployed than on the organizational conditions surrounding them. Recurrent critical success factors (CSFs) include top management commitment, employee involvement and empowerment, supplier and contractor integration, alignment of improvement activity with customer requirements, training, communication, standardization for continuous improvement and the capability to detect abnormalities early [2], [11], [12]. Bhasin and Burcher [13] argue that lean succeeds when adopted as an organizational philosophy rather than a set of tools, a distinction relevant to the participation ratings reported here.

Evidence from developing economies suggests these enablers are where implementations most often falter, with weak leadership commitment, limited technical capacity and cultural resistance recurring as barriers [12], [14]. Assessing TPM in Ethiopian manufacturing, Gelaw et al. [12] identified top management commitment and employee engagement among the decisive success factors. West African evidence points the same way: Eti et al. [15] identified management support, training and operator involvement as prerequisites for TPM in Nigerian manufacturing, and Ayarkwa et al. [16] reported limited awareness, weak top-management support and resistance to change as obstacles to lean construction in Ghana. Tetteh et al. [14] found top management commitment pivotal to Lean 4.0 implementation in Ghanaian pharmaceutical manufacturing and observed that lean adoption did not translate into immediate efficiency or profitability gains, suggesting adaptation lags between technical implementation and economic outcomes.

In the energy sector, Shou et al. [2] showed that structured lean frameworks can improve maintenance operations in oil and gas settings, while cautioning that single-case evidence limits generalization and that sustaining improvements requires systematic organizational routines. Al Kitab et al. [17] reviewed lean management in oil and gas maintenance and found few documented applications, particularly in Iraq. In a later survey at two Iraqi refineries, Al Kitab et al. [18] found that value stream mapping significantly influenced maintenance performance, whereas the other lean principles showed no significant effect. Zeinalnezhad et al. [19] identified and ranked fifteen CSFs for reliability-centred maintenance in oil and gas companies, underlining that organizational preparation precedes technical gains.

Maintenance engineering concerns reliability, downtime, safety, equipment life and cost management [20]. This study evaluates five corresponding perceived outcomes separately.

➢ *Research Gap, Objectives and Contribution*

Sub-Saharan African evidence on lean remains concentrated in construction and manufacturing, and empirical studies of lean maintenance in the sub-region's energy utilities are scarce, leaving practitioners to extrapolate from contexts with materially different institutional and resource conditions. Ghana National Gas Company Limited (Ghana Gas) is a suitable setting: as the operator of the country's gas processing infrastructure, it sits at a critical node in Ghana's energy value chain.

This study pursues three objectives:

- To identify the forms of waste associated with maintenance management at Ghana Gas Company Limited;
- To describe employee ratings of implementation factors associated with lean maintenance; and
- To assess the perceived contributions of lean maintenance management to the organization's operational performance.

This paper contributes an account of maintenance perceptions at a Ghanaian energy organization. It reports waste, implementation factors and outcomes separately, identifies an uneven perceived profile, and adds energy-sector evidence from sub-Saharan Africa.

II. METHODOLOGY

➢ *Research Design*

The study adopted a quantitative, descriptive single-case survey design. Data were collected from employees of Ghana Gas in 2018 through a structured questionnaire.

➢ *Population and Sampling*

The study population comprised employees of Ghana Gas.

A target sample of 100 employees was selected by simple random sampling, and 73 completed questionnaires were analysed.

➢ *Research Instrument*

The questionnaire comprised a demographic section and three research sections: six waste items, nine implementation-factor items and five contribution items. The item labels are given in Tables II–IV.

- *Waste Block (Six Items):*

Waste associated with maintenance management, rated on a five-point Likert scale (1 = strongly agree, 2 = agree, 3 = neutral, 4 = disagree, 5 = strongly disagree);

- *Implementation-Factor Block (Nine Items):*

Organizational performance on critical success factors for effective lean maintenance, rated on a five-point performance scale (1 = very poor, 2 = poor, 3 = average, 4 = good, 5 = excellent);

- *Outcome Block (Five Items):*

Perceived contributions of lean maintenance management to operational performance, rated on the same agreement scale as the waste block.

The questionnaire was administered personally by the researcher after permission had been obtained from the management of the organization.

➢ *Validity and Reliability*

The questionnaire was reviewed by an academic supervisor and pilot-tested with a small number of employees, then revised for clarity. Reliability coefficients were not computed, so items are interpreted individually.

➢ *Data Analysis*

Data were analysed in SPSS version 20 using means, standard deviations and mean-score ranking. Agreement anchors run from 1 = strongly agree to 5 = strongly disagree; performance anchors run from 1 = very poor to 5 = excellent. For consistent interpretation of rounded means, this study applies equal-width bands of 1.00–1.80, 1.81–2.60, 2.61–3.40, 3.41–4.20 and 4.21–5.00. Rankings indicate strength of agreement. The analysis is descriptive. 95% confidence intervals for the means were computed from the recorded means, SDs and n = 73 using the t distribution.

➢ *Ethical Considerations*

Permission was obtained from the organization's management. Participation was voluntary, data collection did not disrupt operations, and the questionnaire did not record respondent identities.

III. RESULTS

➢ *Respondent Profile*

Table 1 reports gender and education for 73 respondents. Males constituted 68.5% and females 31.5%. Educational attainment was 54.8% first degree, 27.4% diploma and 17.8% master's degree. Most respondents (60 of 73) had three or more years of service.

Table 1 Respondent Profile (N = 73)

Characteristic	Category	Frequency	Percent
Gender	Male	50	68.5
	Female	23	31.5
Tenure	1–2 years	13	17.8
	3–4 years	30	41.1
	5 years and above	30	41.1
Education	Diploma	20	27.4
	First degree	40	54.8
	Master's degree	13	17.8

Source: Field Survey. Tenure Percentages are Recomputed from the Recorded Counts (See Section IV-C).

➢ *Waste Associated with Maintenance Management*

Table 2 presents respondents' assessment of the six maintenance waste forms, ranked by mean score (lower means indicating stronger agreement that the waste is present).

Table 2 Maintenance Waste Ratings (n = 73)

Waste Form	Mean	SD	95% CI	Interpretation	Rank
Poor inventory management	1.90	0.414	1.80–2.00	Agree	1st
Waiting for maintenance resources	1.95	0.550	1.82–2.08	Agree	2nd
Centralized maintenance management	2.00	0.289	1.93–2.07	Agree	3rd
Unproductive maintenance	2.16	1.028	1.92–2.40	Agree	4th
Unnecessary motion	2.33	0.944	2.11–2.55	Agree	5th
Under-utilization of resources	4.04	0.200	—	Disagree	6th

Source: Field Survey. 1 = Strongly Agree, 5 = Strongly Disagree; Bands as in Section II-E. CI = 95% Confidence Interval; — = not Computed (See Section IV-C).

Respondents agreed that all five of the higher-ranked waste forms are present: poor inventory management (M = 1.90), waiting for maintenance resources (M = 1.95), centralized maintenance management (M = 2.00), unproductive maintenance (M = 2.16) and unnecessary motion (M = 2.33). They disagreed that resources are under-utilized (M = 4.04), which does not by itself show that resources are adequate. The pattern points to perceived problems in inventory practices, resource flow and decision structure.

Views were more consistent for inventory management (SD = 0.414) and centralized management (SD = 0.289) than for unproductive maintenance (SD = 1.028).

- *Performance on Critical Success Factors for Lean Maintenance*

Table 3 presents respondents' ratings of the organization's performance on nine critical success factors, on the scale 1 = very poor to 5 = excellent. Factors are grouped into people and leadership, process and standards, and external alignment.

Table 3 Critical Success Factor Ratings (N = 73)

Critical Success Factor	Mean	SD	95% CI	Interpretation
People and leadership				
Training of employees	4.45	0.501	4.33–4.57	Excellent
Effective communication between management and employees	3.44	0.564	3.31–3.57	Good
Commitment of management to lean maintenance	1.86	0.631	1.71–2.01	Poor
Involvement of employees in development of standards	1.05	0.283	0.98–1.12	Very poor
Process and standards				
Implementation of measures to eliminate maintenance waste	4.04	0.200	—	Good
Ease of detecting faults	3.90	0.414	3.80–4.00	Good
Development of standards for continuous improvement	2.32	0.705	2.16–2.48	Poor
External alignment				
Involvement of suppliers and contractors in standards	1.18	0.485	1.07–1.29	Very poor
Ability to align customer demands with maintenance activities	1.18	0.385	1.09–1.27	Very poor

Source: Field Survey. 1 = Very Poor, 5 = Excellent; Bands as in Section II-E. CI = 95% Confidence Interval; — = not Computed (See Section IV-C). Customer-Alignment CI Uses the Tabled SD (See Section IV-C).

Ratings varied widely. Training was the highest-rated factor (M = 4.45) and fault detection the highest of the remaining factors (M = 3.90); communication was also rated good (M = 3.44). Employee involvement (M = 1.05), supplier involvement and customer alignment (both M = 1.18) were rated very poor, and management commitment (M = 1.86) and continuous-improvement standards (M = 2.32) were rated poor. Waste-elimination measures were rated good (M = 4.04), but this value is treated cautiously (Section IV-C).

Within the people-related factors the split was sharp: training and communication were rated favorably, while employee involvement and management commitment were rated poorly.

- *Perceived Contributions of Lean Maintenance Management*

Table 4 presents respondents' assessment of five expected contributions of lean maintenance on the agreement scale (lower means indicating stronger agreement).

Table 4 Perceived Contributions of Lean Maintenance (N = 73)

Contribution	Mean	SD	95% CI	Interpretation
Improved personnel and equipment safety	1.49	0.580	1.35–1.63	Strongly agree
Improved equipment availability	1.63	0.565	1.50–1.76	Strongly agree
Extended useful life of equipment	2.22	0.507	2.10–2.34	Agree
Reduced downtime	4.04	0.200	—	Disagree
Reduced cost of maintenance	4.10	0.414	4.00–4.20	Disagree

Source: Field Survey. 1 = Strongly Agree, 5 = Strongly Disagree; Bands as in Section II-E. CI = 95% Confidence Interval; — = not Computed (See Section IV-C).

Respondents strongly agreed that lean maintenance improved personnel and equipment safety (M = 1.49) and equipment availability (M = 1.63), and agreed that it extended equipment life (M = 2.22). They disagreed that it reduced maintenance cost (M = 4.10) or downtime (M = 4.04, treated cautiously; see Section IV-C). Respondents therefore perceived gains in availability, safety and equipment life, but not in maintenance cost.

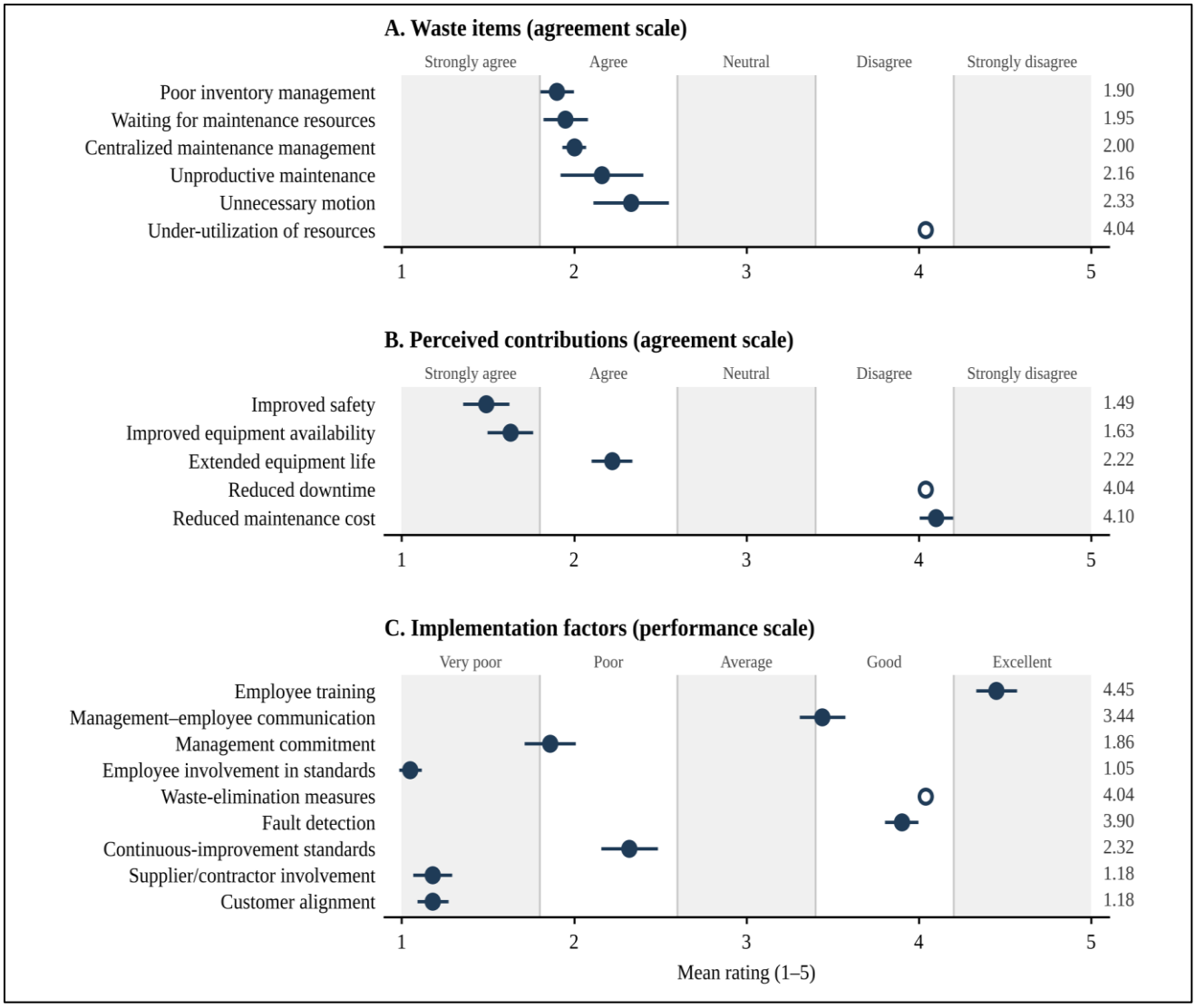


Fig 1 Mean Ratings with 95% Confidence Intervals (n = 73). Panels A and B: 1 = Strongly Agree, 5 = Strongly Disagree; Panel C: 1 = Very Poor, 5 = Excellent. Hollow Markers: Values Treated with Caution, no Interval Shown (See Section IV-C).

➢ *Overview Across Blocks*

Fig. 1 places all 20 items on common axes. Two patterns stand out. Within the implementation factors, ratings are highest for training and technical routines and lowest for employee, supplier and customer involvement. Across blocks, respondents perceived benefits for safety, availability and equipment life while agreeing that inventory, waiting and centralized-decision waste are present and disagreeing that maintenance costs fell. These are descriptive patterns across item blocks; the survey does not test relationships between them.

IV. DISCUSSION

➢ *Uneven Perceived Outcomes*

Respondents agreed with improved availability (M = 1.63), safety (M = 1.49), and equipment life (M = 2.22), but disagreed that maintenance costs had fallen (M = 4.10). This is an uneven perceived outcome profile. Because it rests on perceptions, it does not show that lean implementation caused these outcomes.

Inventory management, resource waits, and centralized decisions are plausible areas for follow-up when perceived asset benefits coexist with no perceived cost reduction. These links remain hypotheses to test against operational records. A mixed profile is not unusual in comparable settings: in two Iraqi refineries, Al Kitab et al. [18] found that value stream mapping significantly influenced maintenance performance while the other lean principles did not, and Tetteh et al. [14] observed that lean adoption in Ghanaian manufacturing did not yield immediate efficiency or profitability gains. Partial or delayed benefits may therefore be a common feature of lean maintenance in developing-economy energy and process settings, rather than a peculiarity of Ghana Gas.

➢ *Organizational Participation and Implementation Factors*

The implementation-factor ratings show favorable training, fault detection, and communication perceptions alongside weak participation, supplier integration, customer alignment, leadership commitment, and continuous-improvement standards. Communication is an organizational and relational factor, rather than inherently technical. This profile suggests priorities for investigation.

The importance of participation and management support is consistent with the literature on maintenance and lean implementation [2], [12], [14]. The survey did not capture which lean tools were implemented or when.

- *Data Verification*

The summary statistics are reported as recorded in the original SPSS output; item-level response distributions are not reported here. Three items share a mean of 4.04 and a standard deviation of 0.200 (resource under-utilization, waste-elimination measures and reduced downtime). This is arithmetically possible, since 70 responses at scale point 4 and 3 at scale point 5 among 73 respondents give exactly these values, but the item-level distributions are not shown here to confirm it. Their confidence intervals are therefore not reported and the items are interpreted cautiously. A standard deviation of 0.414 also recurs for three other items. The customer-alignment standard deviation is taken from the output table (0.385); the value of 0.631 given in the original narrative duplicates that of management commitment and is treated as a transcription error. Tenure percentages are recomputed from the recorded counts (13, 30 and 30 of 73). A good rating for waste-elimination measures alongside agreement that five waste forms are present may reflect formal programmes coexisting with residual waste.

- *Implications*

For Ghana Gas and comparable organisations, the findings suggest reviewing inventory practices, resource waits, employee participation, supplier coordination and improvement standards. Priorities should be confirmed using current maintenance records and employee feedback.

For research, the findings support reporting availability, safety, asset life, downtime and cost perceptions separately. Future studies can test their relationships rather than assume a single outcome construct.

V. CONCLUSION, LIMITATIONS AND FUTURE RESEARCH

This study examined employee perceptions of lean maintenance at Ghana Gas. Inventory management, waiting for resources and centralized decisions received the strongest agreement among waste items. Training was rated excellent; employee involvement, supplier integration and customer alignment were rated very poor; management commitment and improvement standards were rated poor. Respondents agreed with availability, safety and equipment-life improvements but disagreed with maintenance cost reduction. These organizational weaknesses are hypotheses for follow-up.

The study is limited to one organization and 73 respondents, and the survey was conducted in 2018, so the findings may not describe current conditions. Item-level response distributions are not reported, so the summary statistics cannot be independently verified (see Section IV-C). Employee perceptions may reflect common-method and social-desirability biases [21] and are not independently measured operational outcomes.

Future research should collect contemporary employee evidence, compare perceptions with consistently defined maintenance cost, downtime and availability records, and undertake comparative or longitudinal studies across energy utilities. These studies could test the organizational mechanisms suggested by this profile.

DECLARATIONS

- *Funding*

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- *Conflict of Interest*

The author declares no competing interests.

- *Data Availability*

Available upon request.

- *Ethics Statement*

The survey was conducted with permission from the organization's management. Participation was voluntary and no respondent identities were recorded.

- *Author Contributions*

Sole author: Emmanuel O. Ackon. The author conceived the study, collected and analysed the data, and wrote and approved the manuscript.

REFERENCES

[1]. A. H. C. Tsang, "Strategic dimensions of maintenance management," J. Qual. Maint. Eng., vol. 8, no. 1, pp. 7–39, 2002, doi: 10.1108/13552510210420577.

[2]. W. Shou, J. Wang, P. Wu, and X. Wang, "Lean management framework for improving maintenance operation: Development and application in the oil and gas industry," Prod. Plan. Control, vol. 32, no. 7, pp. 585–602, 2021, doi: 10.1080/09537287.2020.1744762.

[3]. J. P. Womack and D. T. Jones, *Lean Thinking: Banish Waste and Create Wealth in Your Corporation*, rev. ed. London, U.K.: Simon & Schuster, 2003.

[4]. R. Smith and B. Hawkins, *Lean Maintenance: Reduce Costs, Improve Quality, and Increase Market Share*. Burlington, MA, USA: Elsevier Butterworth-Heinemann, 2004.

[5]. S. Mostafa, J. Dumrak, and H. Soltan, "Lean maintenance roadmap," Procedia Manuf., vol. 2, pp. 434–444, 2015, doi: 10.1016/j.promfg.2015.07.076.

[6]. R. Shah and P. T. Ward, "Lean manufacturing: Context, practice bundles, and performance," J. Oper. Manag., vol. 21, no. 2, pp. 129–149, 2003, doi: 10.1016/S0272-6963(02)00108-0.

[7]. I. P. S. Ahuja and J. S. Khamba, "Total productive maintenance: Literature review and directions," Int.

J. Qual. Reliab. Manag., vol. 25, no. 7, pp. 709–756, 2008, doi: 10.1108/02656710810890890.
[8]. K. Antosz, M. Jasiulewicz-Kaczmarek, Ł. Paśko, C. Zhang, and S. Wang, "Application of machine learning and rough set theory in lean maintenance decision support system development," Eksploat. Niezawodn. – Maint. Reliab., vol. 23, no. 4, pp. 695–708, 2021, doi: 10.17531/ein.2021.4.12.
[9]. S. Nakajima, *Introduction to TPM: Total Productive Maintenance*. Cambridge, MA, USA: Productivity Press, 1988.
[10]. S. Panigrahi, K. K. Al Ghafri, W. R. Al Alyani, M. W. A. Khan, T. Al Madhagy, and A. Khan, "Lean manufacturing practices for operational and business performance: A PLS-SEM modeling analysis," Int. J. Eng. Bus. Manag., vol. 15, pp. 1–14, 2023, doi: 10.1177/18479790221147864.
[11]. P. Achanga, E. Shehab, R. Roy, and G. Nelder, "Critical success factors for lean implementation within SMEs," J. Manuf. Technol. Manag., vol. 17, no. 4, pp. 460–471, 2006, doi: 10.1108/17410380610662889.
[12]. M. T. Gelaw, D. K. Azene, and E. Berhan, "Assessment of critical success factors, barriers and initiatives of total productive maintenance (TPM) in selected Ethiopian manufacturing industries," J. Qual. Maint. Eng., vol. 30, no. 1, pp. 51–80, 2024, doi: 10.1108/jqme-11-2022-0073.
[13]. S. Bhasin and P. Burcher, "Lean viewed as a philosophy," J. Manuf. Technol. Manag., vol. 17, no. 1, pp. 56–72, 2006, doi: 10.1108/17410380610639506.
[14]. M. G. Tetteh, S. Gupta, M. Kumar, H. Trollman, K. Salonitis, and S. Jagtap, "Pharma 4.0: A deep dive top management commitment to successful Lean 4.0 implementation in Ghanaian pharma manufacturing sector," Heliyon, vol. 10, no. 17, Art. no. e36677, 2024, doi: 10.1016/j.heliyon.2024.e36677.
[15]. M. C. Eti, S. O. T. Ogaji, and S. D. Probert, "Implementing total productive maintenance in Nigerian manufacturing industries," Appl. Energy, vol. 79, no. 4, pp. 385–401, 2004, doi: 10.1016/j.apenergy.2004.01.007.
[16]. J. Ayarkwa, K. Agyekum, E. Adinyira, and D. Osei-Asibey, "Perspectives for the implementation of lean construction in the Ghanaian construction industry," J. Constr. Project Manag. Innov., vol. 2, no. 2, pp. 345–359, 2012.
[17]. M. A. A. H. M. Al Kitab, F. B. I. Al-Nuaimi, M. N. M. Ansari, and T. K. Ibrahim, "Robust lean management model for maintenance in Iraqi oil and gas industry: A review study," J. Mech. Eng. Res. Dev., vol. 44, no. 5, pp. 249–257, 2021.
[18]. M. A. A. H. M. Al Kitab, S. Thiruchelvam, and T. S. Gaaz, "The importance of lean management principles for maintenance in Iraqi refineries," J. Eng. Sci. Technol., vol. 18, no. 6, pp. 3029–3046, 2023.
[19]. M. Zeinalnezhad, A. G. Chofreh, F. A. Goni, and J. J. Klemeš, "Critical success factors of the reliability-centred maintenance implementation in the oil and gas industry," Symmetry, vol. 12, no. 10, Art. no. 1585, 2020, doi: 10.3390/sym12101585.
[20]. R. C. Mishra and K. Pathak, *Maintenance Engineering and Management*, 2nd ed. New Delhi, India: PHI Learning, 2012, ISBN: 9788120345737.
[21]. P. M. Podsakoff, S. B. MacKenzie, J.-Y. Lee, and N. P. Podsakoff, "Common method biases in behavioral research: A critical review of the literature and recommended remedies," J. Appl. Psychol., vol. 88, no. 5, pp. 879–903, 2003, doi: 10.1037/0021-9010.88.5.879.