# Optimization of Mechanical Companies Production Performance through the Operations Management Models: Moderating Role of Technology Capability

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**ABSTRACT**

The research aim to test the optimization of production performance through operations management models of mechanical companies. Moderating effect of technology capabilities also tested. Cross sectional quantitative data was collected from the 450 mechanical company's employees employing convenient sampling technique. Both of the descriptive and inferential statistics were conducted using SPSS and Smart PLS respectively. The results shown that all operations management models have positive and significant impact on the production performance of mechanical companies. From the direct effects, ERP has more effect on production performance which is showing the critical importance of integrated information systems in improving production planning, resource coordination, and real-time decision-making. While six sigma and JIT also has positive significant impact on production performance. Balance scorecard also significantly contributed to increase the production performance. Moderating effect results also confirmed that technology capability positively strengthens the relationship between operation management models and production performance. Study with significant finding highlighted the significance of combining managerial practices with technological readiness to achieve superior mechanical company's performance. The research theoretically also contributed to operations management literature through demonstrating that production performance is enhanced through the integrated adoption of lean, quality, strategic, and digital management systems. From the practical aspect, research also suggested that mechanical organizations should invest in digital transformation, quality improvement programs, and technological capability development to sustain long-term operational competitiveness.



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## 1. Introduction

Production performance is being recognized as a fundamental driver for the competitiveness and sustainability of the organizations (Fullerton & McWatters, 2001). It reflects the firm's ability to transform the inputs, such as labor, materials, capital, and technology into high-quality outputs in an efficient and cost-effective manner (Ahmad et al., 2025). Due to globalization, production performance not only determines the operational success but it also increases the strategic survival (Fransisca et al., 2025). High production performance also enable to the companies in reducing operational wastage, optimizing resource utilization, and enhance delivery reliability (Fransisca et al., 2025). Equally, effective production performance also strengthens cost leadership and differentiation strategies which improves the company's market share (Y. Zhang et al., 2022). Furthermore, other study also suggested that companies with the higher level of operational production performance tend to demonstrate stronger financial outcomes, customer satisfaction, and long-term growth potential (Zhang et al., 2023). On the other hand, production performance also significantly contributed towards the national productivity, export competitiveness, and industrial development

(Zhang et al., 2023). Based on the importance of production performance, understanding the drivers of production performance remains a central concern in operations and supply chain management research.

For increase the production performance of the companies, companies adopted significantly various structured operational management models which are being designed to improve the companies' operational efficiency and quality. From the various influential operational models, Just in Time (JIT), Six Sigma, Balanced Scorecard (BSC), and Enterprise Resource Planning (ERP). JIT, originally developed within the Toyota Motor Corporation production system, emphasizes waste elimination, continuous improvement, reduced inventory, and synchronized production flows (Helo & Hao, 2022; Jackson et al., 2024; Lu & Shen, 2021; Salah et al., 2023). From the above factors, JIT helps to reduce the cost because it allows to the companies in reducing the cost because it helps to analyze that produce goods only when it is needed (Lara et al., 2022). Further, empirical study demonstrated that JIT implementation significantly improves productivity, reduces work-in-process inventory, and enhances delivery reliability (García-Cutrín & Rodríguez-García, 2024). Lean-oriented practices embedded in JIT systems have been found to reduce waste and improve process flow efficiency across mechanical sectors (Ahmed et al., 2023; Rashid et al., 2025). Six Sigma focuses on minimizing process variability and defects through data-driven quality control techniques, following the structured DMAIC methodology (Ahmed et al., 2023). This approach improves process capability, reduces rework, and enhances product consistency. On the other hand, Six Sigma initiatives are also are associated with measurable improvements in quality control, cost reduction, and operational stability (Gomaa, 2026). Organizations implementing Six Sigma report enhanced defect management, improved process capability, and stronger customer satisfaction outcomes (Utama & Abirfatin, 2023).

Furthermore, the BSC, provides a multinational framework that integrates financial support, and learning perspectives in aligning operational activities along with strategic objectives (Kaufmann, 2024). Other study also suggested that (Zainab et al., 2017) balance scorecard also significantly contributed towards increasing the performance through strengthening strategic control and aligning operational metrics with organizational goals (Chehimi & Naro, 2024; Hristov et al., 2024). Research indicates that firms utilizing BSC frameworks achieve better internal coordination and performance measurement effectiveness (Hristov et al., 2024). Equally, ERP system is being widely implemented through the organizations using the various platform namely SAP, integrate cross-functional processes into unified information systems that improve coordination, planning accuracy, and decision-making efficiency (Chinta, 2022). In addition to prior studies, ERP system also helps create improvement in inventory turnover, supply chain integration, and production scheduling efficiency (Abobakr et al., 2023). These prior studies highlighted that operations management models are important to increase the production performance. Therefore, study focused on testing the influence of operational management models on the production performance of mechanical industry.

Operational management models improves the effectiveness when these are properly integrated with the latest technology (Salah et al., 2023). For instance, technology capability is being an important factor in enhancing the effectiveness of operations management models (Salah et al., 2023). Technology capability refers to a firm’s ability to acquire, integrate, deploy, and leverage technological resources to support organizational processes (Quesado et al., 2022). Technology capability consisted of IT infrastructure quality, system integration capacity, and data analysis capability (Lee et al., 2023). According to the Resource-Based View technology capability constitutes a strategic asset that can create sustainable competitive advantage when effectively combined with managerial practices (Hsiao, 2024). It is also further evidenced from the literature (Othman et al., 2015) that companies with the strong technology infrastructure achieve higher performance gains from the operational innovations compared to firms with limited digital resources (Nasution et al., 2026). Therefore, technology capability strengthens the operational impact of management systems and enhances production performance. In this regard, study tested the moderating effect of technology capability among operation management models and production performance.

Despite the significant literature on examining the direct effect of operational management models on production performance, still various gaps are existed. Firstly, prior studies were mainly focused on the direct effect of single operational management model on the production performance with limited a limited attention on combined operational management model on production performance. Secondly, the empirical study also evidenced that prior studies have inconsistent findings (Mehmood et al., 2023; Trivedi et al., 2025; Wahjudi & Palit, 2024). These inconsistent findings indicate that direct relationships alone may not fully explain performance variations across firms. These findings emphasized that further study needs to be tested with the moderating effect to clear the relationship. With this gaps, moderating role of technology capability remains underexplored, particularly in studies integrating multiple operations management models simultaneously (Saraswat et al., 2025). Although research acknowledges that IT capability enhances organizational performance (Saraswat et al., 2025), limited empirical work systematically investigates how technological competence strengthens the impact of operational management models on the production performance (Asgharian et al., 2025; Trivedi et al., 2025).

Most of the studies on the technology capability has tested the direct effect on production performance with a limited attention with moderating effect (Hanaysha & Alzoubi, 2022; Kamble et al., 2023). On the other hand, prior studies have been also conducted on other sectors with a limited attention on the mechanical industry (Mehmood et al., 2023; Trivedi et al., 2025; Wahjudi & Palit, 2024). Therefore, addressing these theoretical and empirical gaps by examining both direct and moderating relationships contributes to a more comprehensive understanding of how operations management models and technology capability jointly enhance production performance in Mechanical firms. The study objective is to explore the optimization of production performance of Mechanical companies through the operations management models. Moderating influence of technology capability also tested. Study with this objective was further segregated into four chapters.

## 2. Literature Review

### 2.1 Just in Time and Production Performance

Just is time (JIT) is an integral production management model which is being focused on the waste elimination through producing goods only when it is need and is required as per quantity (García-Cutrín & Rodríguez-García, 2024). This concept was being originally developed in the Toyota motor corporation production system under the lean manufacturing principals (Fullerton & McWatters, 2001). JIT emphasizes continuous flow, reduced inventory levels, shorter lead times, and close supplier coordination (Siddiqui, 2022). This is reason, it is further emphasized that JIT enhances operational discipline and efficiency by minimizing non-value-adding activities. Production performance, as the dependent variable, includes indicators such as cost efficiency, quality consistency, delivery reliability, and flexibility (Azad, 2025). Theoretically, JIT improves production performance through waste reduction and process synchronization, which reduces variability and enhances workflow stability (Lara et al., 2022). By lowering inventory carrying costs and reducing overproduction, firms improve cost structures and operational responsiveness (Pratiwi et al., 2023). From the empirical perspective, it is found that JIT is significantly increases the productivity and reduces cycle time (Azad, 2025). Other study also emphasized that JIT also lead to improve the production of the companies without compromising the quality through reducing the (Azad, 2025). Lastly, Pratiwi et al. (2023) study also found that JIT significantly increases the production performance. They also suggested that further research could be explored with other variable that could increase the predictive power of the model and these prior studies emphasized that JIT is integral factor to improve production performance. Therefore, the empirical literature consistently validates the significant impact of JIT on production performance and hence hypothesis is,

H1: Just in Time significantly improves the production performance of Mechanical companies.

### 2.2 Six Sigma and Production Performance

Six sigma is an integral operation management model which aimed is to minimize the defects and process variation using different statistical controls (Ahmed et al., 2023). It helps to find out the near zero defects through limiting the variable to 3.4 defects per million opportunities (Achibat et al., 2023). Other researchers also emphasized that it helps to increase the production quality through ensuring systematic problem solving (Achibat et al., 2023). Authors also supported the findings that Six sigma increases the process reliability, data-driven decision-making, and operational discipline (Utama & Abirfatin, 2023). The theoretical foundation of Six Sigma is rooted in Total Quality Management and continuous improvement philosophy (Gomaa, 2025). By reducing rework and improving process capability, firms experience improved throughput and reduced operational costs (Gomaa, 2025). Empirically, it has been also found that Six Sigma significantly increase the production performance. For instance, research indicates that Six Sigma implementation significantly improves productivity and operational effectiveness (Gomaa, 2025). Daniyan et al. (Daniyan et al., 2022) further also demonstrated that Six Sigma practices positively affect operational performance through structured quality management. Equally, further empirical study also found that Six Sigma strengthens competitive positioning and process innovation which increases significantly production performance (Huang et al., 2023). These consistent findings support the hypothesis that Six Sigma significantly enhances production performance and hence hypothesis is.

H2: Six Sigma significantly improves the production performance of Mechanical companies**.**

### 2.3 Balanced Scorecard and Production Performance

Balance scorecard is an integral strategic performance operational management model which integrate financial and non-financial performance indicators (Quesado et al., 2022). This model was consisted of four perspectives, financial, customer, internal processes, and learning and growth (Quezada et al., 2022). Literature supported that BSC enhances strategic alignment and performance monitoring across organizational functions (Mio et al., 2022) that could leads to improve the production performance. Other study also enforced that production performance is being improved when the company's internal process is being measured systematically and is being aligned from the strategic objectives. From the operational management model perspective, performance measurement systems improve decision-making quality and operational transparency (Haekal, 2023). Consequently, BSC supports productivity improvement and operational excellences which leads to improve the production performance (Quesado et al., 2022). On the other hand, Tagkouta et al. (Tagkouta et al., 2023) found that larger manufacturing companies using BSC reported enhanced performance measurement effectiveness. Additionally, empirical evidence suggests that BSC strengthens coordination between departments and enhances productivity (HAMID, 2022). It is also highlighting in the literature that BSC improves innovation capability and operational performance (Priliska et al., 2023). Collectively, these findings validate the positive relationship between Balanced Scorecard implementation and production performance and accordingly hypothesis is,

H3: Balanced Scorecard significantly improves the production performance of Mechanical companies.

### 2.4 Enterprise Resource Planning (ERP) and Production Performance

Enterprise resource planning (ERP) is an operational management model which is being integrated through an effective software platform which unify the business process across finance, production, procurement, and supply chain management (Chopra et al., 2022). ERP solutions were popularized globally by firms such as SAP and Oracle Corporation, enabling centralized databases and real-time information sharing (Chinta, 2022). It is also enforced that ERP significantly increase the coordination, data accuracy, and operational integration (Abobakr et al., 2023) which leads to improve the production performance. Production performance depends significantly on information flow efficiency, production planning accuracy, and inventory control (Abobakr et al., 2024). Other study also suggested that ERP systems serve as strategic resources that enhance operational capabilities (Velaga, 2022). Previous study findings also supported with the most latest study where they indicate that ERP adoption leads to improved inventory turnover and cost efficiency to improve the production performance (Cebekhulu & Ozor, 2022). Furthermore, empirical findings show that ERP-integrated firms outperform non-adopters in operational metrics (Tuli & Kaluvakuri, 2022). Other study also suggested that ERP enhances productivity and operational responsiveness (Shish & Shafa, 2023). These studies collectively support the significant relationship between ERP systems and production performance and accordingly hypothesis is,

H4: Enterprise Resource Planning significantly improves the production performance of Mechanical companies.

### 2.5 Moderating Role of Technology Capability

The studies on the operational management models and production performance are not consistent which is emphasizing to conduct research in other perspective (Mehmood et al., 2023; Wahjudi & Palit, 2024). These inconsistent findings indicate that direct relationships alone may not fully explain performance variations across firms. These findings emphasized that further study needs to be tested with the moderating effect to clear the relationship. With this gaps, moderating role of technology capability remains underexplored, particularly in studies integrating multiple operations management models simultaneously (Saraswat et al., 2025; Trivedi et al., 2025). The technology capability is being referred to the firm's ability to acquire a best resources and to reconfigure technological resources to support operational and strategic objectives (Tao et al., 2022). It is being consisted of IT infrastructure, digital integration, technical skills of employees, innovation competence, and the ability to leverage advanced systems for process improvement (Andrade-Rojas et al., 2024). The technology capability according to Resource based View (RBV) represents is an intangible resource that strengthens firm competitiveness (Andrade-Rojas et al., 2024). Similarly, Dynamic Capability Theory suggests that organizations with strong technological competence are better able to adapt to environmental changes and maximize the benefits of management innovations (Dewi et al., 2023).

Literature supported that effectiveness of JIT, SIX Sigma, Balanced Scorecard, and ERP systems largely depends on the firm's technological readiness because the companies with the advanced IT systems and skilled personnel can better synchronize production flows, analyze quality data, monitor strategic indicators, and integrate enterprise information systems (Tao et al., 2022) which leads to improve the company's performance. Companies with the limited focused on the technology capability, the implementations of these management practices may face resistance, inefficiencies, or underutilization (Andrade-Rojas et al., 2024). This is the reason, the technology capability is not being a direct performance indicator but it is also an important factor to strengthens mechanism that enhances the impact of operational practices on production performance (Kamble et al., 2023). Similarly, Jum'a & Bushnaq (Jum'a & Bushnaq, 2024) reported that technological infrastructure enhances the effectiveness of Six sigma on operational outcomes. On the other hand, ERP also helps to increase the firm's ability where found that companies with the stronger IT system improves the companies ERP system which give the greater operational benefits compared to firms with limited technological resources (Jum'a & Bushnaq, 2024).

Jum'a & Bushnaq (Jum'a & Bushnaq, 2024) study also found that technological capabiliyt strengthens ERP by improving coordination and information visibility. Moreover, studies on digital transformation confirm that technological competence enhances ERP and operational flexibility (Akram et al., 2022) which leads to improves the production performance. Other study also found that companies with the stronger technology infrastructure is being experienced a stronger digital infrastructure experience increases the companies Six Sigma and JIT practice (Lara et al., 2022; T. Zhang et al., 2022) to increase production performance. Furthermore, Akram et al. (Akram et al., 2022) study also found that technology readiness significantly increase the production improvement when the JIT is improvement. On other hand, technology capability also improves the efficiency of balance scorecard through enabling the real time data monitoring, automation, and better performance measurement of production processes which leads to improve the performance. other empirical study also shown that companies which are using the digital system along with the effective BSC then companies achieve better process efficiency and product quality because technology strengthens internal process (Saihi et al., 2025). Similarly, digital capability enhances learning and growth by improving employee skills and innovation, which leads to better production outcomes (Saihi et al., 2025). These prior studies indicated that technology capability is expected to positively moderate the relationship between operational management models and production performance in Mechanical companies and accordingly hypothesis are,

H5: Technology capability positively moderates the relationship between Just in Time and production performance.

H6: Technology capability positively moderates the relationship between Six Sigma and production performance.

H7: Technology capability positively moderates the relationship between Balanced Scorecard and production performance.

H8: Technology capability positively moderates the relationship between Enterprise Resource Planning and production performance.

## 3. Theoretical Framework Development

Research framework is being formulated based on two theories namely Resource-Based View (RBV) and Dynamic Capability Theory (DCT). RBV theory is being proposed by Barney (Barney, 1991) suggests that firm performance depends on the effective utilization of valuable, rare, inimitable, and non-substitutable resources. On other the other hand, DCT which is being developed from the Porter (Porter, 1991) where he explain that how firms achieve long-term competitiveness through integrating, reconfiguring, and renewing internal and external competencies in response to environmental changes. Based on above theories the relation among operational management models and production performance are conceptually supported with moderating effect of technology capability which was being unexplored in the prior literature. The above variables are predicted in Figure.1

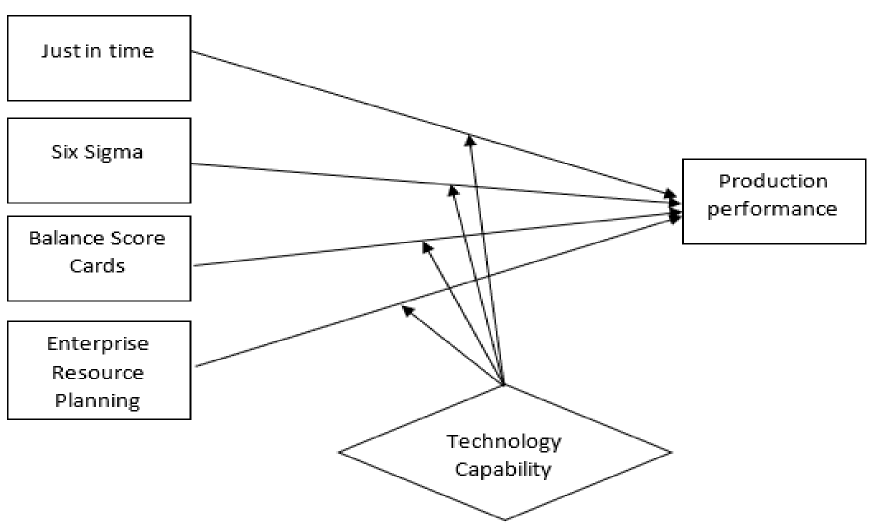


**Figure 1:** Research Framework

## 4. Research Methodology

The study objective is to explore the optimization of production performance of Mechanical companies through the operations management models. Moderating influence of technology capability also tested. For this purpose, researchers adopted the quantitative research approach where numerical data through the survey instrument. Research used the quantitative research approach because it has the ability to test hypotheses, generalize findings to a larger population, and provide reliable and replicable results, which is particularly important in management and Mechanical research (Attneave & Arnoult, 1956). On the other hand, research used the cross-sectional research design, where data is being collected on a single point to examine the study relationship. This research design was being used because this is a cost effective, and is being suitable for analyzing the relationship between variables without requiring long-term data collection. In addition, the researchers selected an explanatory research approach to explore causal relationships among study variables. The explanatory research is being effective because it goes helps to identifying the underlying mechanisms of relationships and supporting theory testing in empirical studies (He et al., 2019). In this regards the researchers has been selected the quantitative, cross sectional and explanatory research approach for the current study.

### 4.1 Research Instrument

The study research instrument adapted from prior studies. For instance, balance scorecard was measured using two dimensions namely innovation and learning perspective, and internal business process perspective. Each of dimension was measured from 3 items of (Albuhisi & Abdallah, 2018). Just in time comprised from 8 items (Agyabeng-Mensah et al., 2021). Six sigma comprised from 5 items (Sahoo & Upadhyay, 2025). Enterprise resource planning comprised from 7 items. Technology capability comprised from 11 items of (Cruz-Torres et al., 2021). Lastly production performance measured from four dimensions quality, flexibility, delivery and cost. From these dimensions quality measured from 6 items, flexibility measured from 3 items, delivery measured from 3 items and cost measured from 2 items (Anumala, 2021). Each of the item measured on five point likert scale.

### 4.2 Sampling Techniques

Study population is being consisted of employees who are working in mechanical companies because these employees are directly involved in operational processes, technology utilization, and production activities, making them suitable respondents. Furthermore, researchers employed the convenient sampling technique for selecting the sample of the study because this sampling has ability to provided more effective practicality, accessibility, and efficiency in reaching respondents who were available and willing to participate in the research (Golzar et al., 2022). On the other hand, this sampling technique is being in the organizations when the sample size is not known and probability sampling is being not effective because of the time, organizational access, and resource limitations (Etikan et al., 2016). Using the convenient sampling technique, 550 questionnaires were distributed among the mechanical company's employees where 450 responses were returned, because the questionnaire was distributed through the online, therefore all 450 responses were effective for the study analysis. The sample size of 450 is considered appropriate for Partial Least Squares Structural Equation Modeling (PLS-SEM) analysis because PLS-SEM is suitable for complex models, smaller to medium sample sizes, and predictive research objectives (Hair et al., 2017). In this regards, PLS-SEM along with the sample is being justified through the proper structural relationship among the study variables.

## 5. Data Analysis and Results

### 5.1 Demographic Analysis

This section shown the demographic characteristics of mechanical companies where data was collected from 450 employees. The demographic characteristics results shown that majority of the respondents are belongs to male (69.3%), which reflects the typical workforce composition in Mechanical industries, while females accounted for 30.7% of the sample. From the age perspective, majority of respondents comes under the age of 30-39 years (39.1%), while under the age of 40-49 years are (26.9%), which is suggesting that the respondents were primarily mid-career professionals with substantial industry exposure. While, the educational background shown majority of the respondents have bachelor's degree (49.1%), while 26.2% possessed a master's degree, which is indicating a relatively well-qualified workforce capable of understanding structured operations management models. Concerning job positions, a significant proportion worked at the operational level (37.1%), followed by supervisory and middle management roles, which ensures that responses were obtained from employees directly involved in production-related activities. Lastly, majority of respondents are being belonged to the production departments (38.7%), followed by quality control and supply chain units, which strengthens the relevance and reliability of the data for examining production performance in Mechanical companies. Demographic results are in Table.1.

**Table 1:** Demographic Analysis

| Demographic Variable | Category | Frequency (N) | Percentage (%) |
|---|---|---|---|
| Gender | Male | 312 | 69.3% |
| | Female | 138 | 30.7% |
| Age Group | 20–29 years | 98 | 21.8% |
| | 30–39 years | 176 | 39.1% |
| | 40–49 years | 121 | 26.9% |
| | 50 years and above | 55 | 12.2% |
| Education Level | Diploma | 84 | 18.7% |
| | Bachelor's Degree | 221 | 49.1% |
| | Master's Degree | 118 | 26.2% |
| | PhD/Other Professional | 27 | 6.0% |
| Job Position | Operational Staff | 167 | 37.1% |
| | Supervisory Level | 121 | 26.9% |
| | Middle Management | 96 | 21.3% |
| | Senior Management | 66 | 14.7% |
| Work Experience | Less than 5 years | 103 | 22.9% |
| | 5–10 years | 158 | 35.1% |
| | 11–15 years | 112 | 24.9% |
| | More than 15 years | 77 | 17.1% |
| Department | Production | 174 | 38.7% |
| | Quality Control | 83 | 18.4% |
| | Supply Chain/Logistics | 72 | 16.0% |
| | IT/Technical | 61 | 13.6% |
| | Administration/Finance | 60 | 13.3% |

### 5.2 Convergent Validity

Partial Least Squares (PLS)-Structural Equation Modeling (SEM) technique was employed to test the study objective. For this purpose, Smart PLS 4 was used, where two models, namely measurement and structural, were used. In the measurement model, convergent and discriminant validity were tested. Convergent validity refers to the extent to which multiple indicators of a construct share a high proportion of common variance, reflecting the main underlying concept. Convergent validity is being using through using the factor loadings, Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE) (Hair et al., 2017). From these factors, factor loading is being strengthen the association within each observed indicator and its latent construct, with a greater value of 0.5 is acceptable in the exploratory research (Hair Jr et al., 2017). On the other hand, Cronbach's alpha is used to evaluate the internal consistency reliability of a construct, and an acceptable value is greater than 0.70 (Hair et al., 2017). While composite reliability is being considered more appropriate in the PLS-SEM because it does not assume equality indicators loadings where each value should be greater than 0.70 which demonstrated the adequate reliability (Fornell & Larcker, 1981). Additionally, AVE measures the amount of variance captured by a construct relative to measurement error, and a value of 0.50 or higher indicates that the construct explains at least half of the variance of its indicators, thereby confirming adequate convergent validity (Fornell & Larcker, 1981). Above result is depicted in Table.2 and in Figure 2.

**Table 2:** Convergent Validity

| Construct | Items | Cronbach Alpha | Composite Reliability | AVE |
|---|---|---|---|---|
| Innovation & Learning Perspective | ILP | 0.846 | 0.907 | 0.765 |
| Internal Business Process | IBP | 0.821 | 0.894 | 0.738 |
| Just in Time | JIT | 0.912 | 0.928 | 0.617 |
| Six Sigma | SS | 0.873 | 0.908 | 0.664 |
| ERP | ERP1 | 0.901 | 0.921 | 0.626 |
| Technology Capability | TC | 0.934 | 0.942 | 0.596 |
| Quality | Q | 0.903 | 0.925 | 0.673 |
| Flexibility | FLX | 0.802 | 0.883 | 0.716 |
| Delivery | DEL | 0.811 | 0.889 | 0.728 |
| Cost | CST | 0.742 | 0.886 | 0.795 |

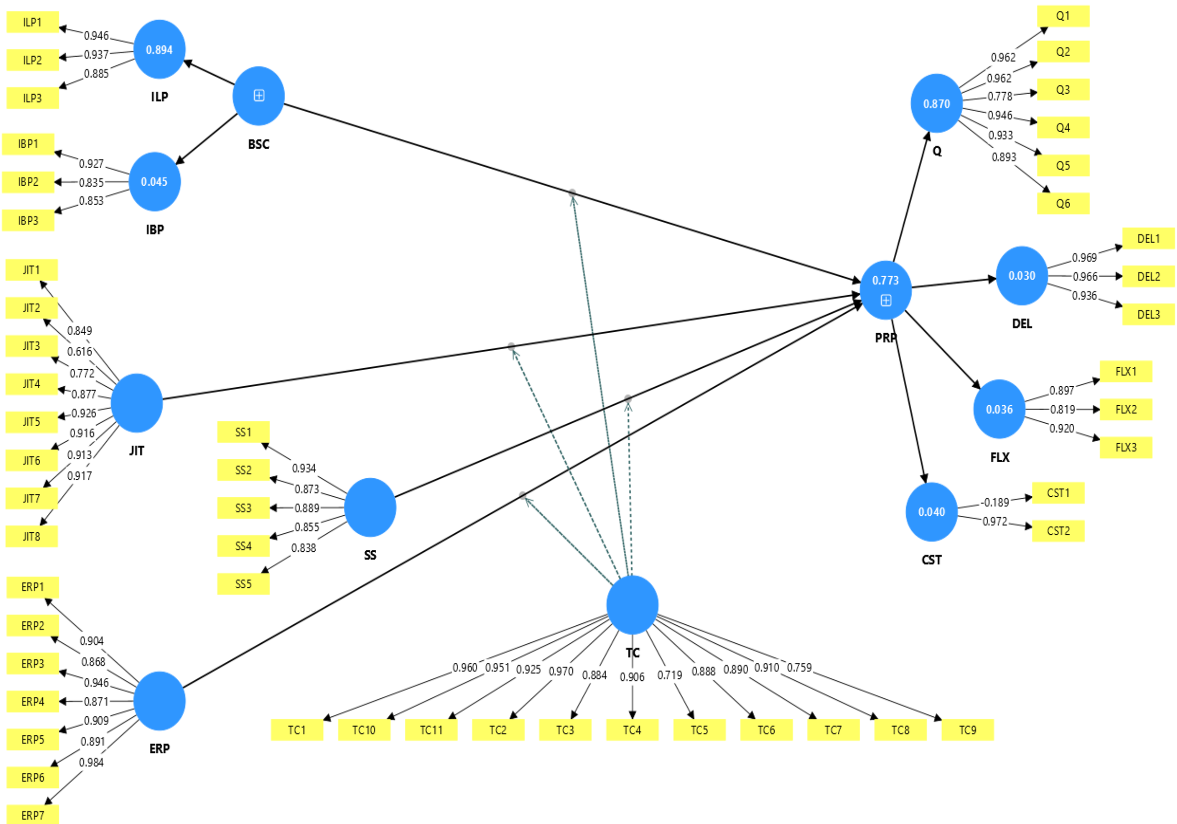


**Figure 2:** Measurement Model

### 5.3 Discriminant Validity

Discriminant validity is considered to the extent to which shown that the construct is truly distinct from each other construct in a model (Hair et al., 2017). One of the most widely used methods is to assess the discriminant validity of the construct is the Fornell and Larcker which is being proposed by Fornell and Larcker (1981). As per these criteria, discriminant validity is established when the square root of the AVE of each construct is greater than its highest correlation with any other construct in the model. This means that a construct should share more variance with its own indicators than with other constructs. Table.3 results shown that each diagonal value is greater than from below values.

**Table 3:** Discriminant Validity

| Construct | ILP | IBP | JIT | SS | ERP | TC | QLT | FLX | DEL | CST |
|---|---|---|---|---|---|---|---|---|---|---|
| ILP | 0.875 | | | | | | | | | |
| IBP | 0.621 | 0.859 | | | | | | | | |
| JIT | 0.583 | 0.645 | 0.785 | | | | | | | |
| SS | 0.556 | 0.612 | 0.667 | 0.815 | | | | | | |
| ERP | 0.601 | 0.634 | 0.689 | 0.658 | 0.791 | | | | | |
| TC | 0.648 | 0.671 | 0.702 | 0.695 | 0.721 | 0.772 | | | | |
| QLT | 0.577 | 0.601 | 0.644 | 0.659 | 0.682 | 0.713 | 0.820 | | | |
| FLX | 0.534 | 0.566 | 0.612 | 0.623 | 0.645 | 0.668 | 0.701 | 0.846 | | |
| DEL | 0.521 | 0.554 | 0.598 | 0.611 | 0.633 | 0.659 | 0.689 | 0.712 | 0.853 | |
| CST | 0.498 | 0.523 | 0.567 | 0.578 | 0.601 | 0.625 | 0.656 | 0.634 | 0.667 | 0.892 |

### 5.4 Structural Model Results

Next process after measurement model is to test the research hypothesis. The research results shown that Just in Time (JIT) has positive and significant ($\beta = 0.214$, $p = 0.000$) effect on the production performance. In the same vein, Six Sigma practices also show a significant positive ($\beta = 0.238$, $p = 0.000$) effect on production performance which is showing that quality management initiatives play an important role in mechanical environments. Further, balance scorecard (BSC) also has positive significant (β = 0.167, p = 0.000) on production performance which is indicating that strategic performance measurement systems contribute to operational improvement in Mechanical firms. In addition, enterprise resource planning (ERP) also has significant impact (β = 0.291, p = 0.000) on the production performance which is showing the importance of integrated information systems in modern mechanical operations. Further moderating effect of technology capability is also significant for all interaction effects, including JIT (β = 0.126, p = 0.001), six sigma (β = 0.141, p = 0.001), balanced scorecard (β = 0.118, p = 0.002), and ERP (β = 0.153, p = 0.000). This research confirmed that mechanical companies along with the technology capabilities are more likely to obtain greater performance benefits from operational management models, as advanced technological infrastructure supports better implementation, data processing, and process integration. Above result is predicted in Table.4.

**Table 4:** Hypothesis Results

| Relationship | Beta (β) | Std. Error | t-value | p-value | Decision |
|---|---|---|---|---|---|
| JIT → PP | 0.214 | 0.048 | 4.458 | 0.000 | Supported |
| SS → PP | 0.238 | 0.051 | 4.667 | 0.000 | Supported |
| BSC → PP | 0.167 | 0.046 | 3.630 | 0.000 | Supported |
| ERP → PP | 0.291 | 0.053 | 5.491 | 0.000 | Supported |
| JIT × TC → PP | 0.126 | 0.039 | 3.231 | 0.001 | Supported |
| SS × TC → PP | 0.141 | 0.041 | 3.439 | 0.001 | Supported |
| BSC × TC → PP | 0.118 | 0.037 | 3.189 | 0.002 | Supported |
| ERP × TC → PP | 0.153 | 0.042 | 3.643 | 0.000 | Supported |

**Note:** JIT = Just in Time, SS = Six Sigma, BSC = Balanced Scorecard, ERP = Enterprise Resource Planning, TC = Technology Capability, PP = Production Performance

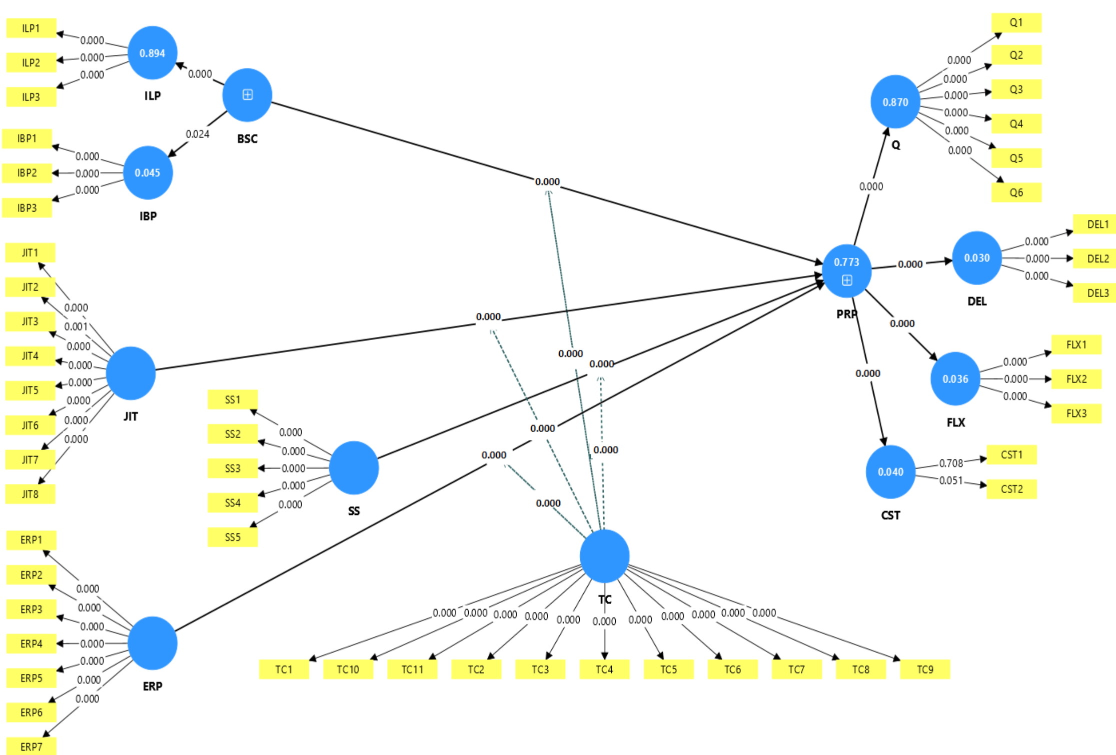


**Figure 3:** Structural Model

## 6. Discussion

The study objective is to explore the optimization of production performance of Mechanical companies through the operations management models. Moderating influence of technology capability also tested. The study results demonstrated that Just in Time (JIT) positively and significantly improve the mechanical company's production performance. These results shown that lean production principles like as waste minimizations, pull based production, and strong supplier relationships increase the company's operational efficiency which is leading to improve the production performance. It is increased the JIT enable to the companies in reducing the extra inventory, shorten lead times, and improve responsiveness to customer demand which increases the production performance. The outcome is supported with the empirical studies which is showing that JIT implementation improves operational flexibility, cost efficiency, and product quality in Mechanical settings (Nugraha et al., 2022; Vidan & Fiedler, 2023). These prior studies highlighted that lean systems positively influence Mechanical performance when supported by effective coordination and workforce involvement. In this regards, mechanical companies should be strengthening the supplier partnerships which increase the production planning accuracy, and provide continuous training to employees to maximize the benefits of JIT practices which leads to improve the production performance.

Further results highlighted that six sigma operation management model also significantly increase the performance which is highlighting the significance of quality management initiatives in Mechanical environments. As the six sigma is being focused on reducing the process variation, eliminating defects, and enhancing the production consistency through a proper structured and data-driven methodology. In this regards, mechanical companies are effectively applying the systematic tools in the firms which is identifying the root causes of inefficiencies and implement corrective actions to optimize production processes. Because the improve quality in the product is being leads to reduced rework, lower operational costs, and enhanced customer satisfaction, which collectively strengthen production performance. The results is supported with the prior studies which confirms the positive relationship between Six Sigma implementation and operational excellence (Ahmed et al., 2023; Mittal et al., 2023). These previous studies authors also argued that Six Sigma raises a culture of continuous improvement and evidence-based decision-making, which is critical for Mechanical competitiveness. In supporting to prior studies and current research findings it is suggesting that mechanical companies should invest in employee certification programs, develop cross-functional quality teams, and integrate Six Sigma tools into routine production activities to achieve sustainable performance gains which in turn could lead to achieve competitive advantage.

Further empirical study results shown that BSC also increase the mechanical company's production performance which is suggesting that BSC enhance operational effectiveness. This is showing that mechanical companies have good BSC system which is enabling to the companies to translate strategic objectives into measurable performance indicators across financial, customer, internal process, and learning and growth perspectives. Because the linking operational activities with long-term strategic goals, the BSC improves coordination, accountability, and transparency within Mechanical organizations. Companies with this multidimensional approach ensures that production performance is not assessed solely on financial outcomes but also on process efficiency, innovation capability, and workforce development. Kaplan and Norton (Kaplan & Norton, 1996) and Ruhiyat et al. (Ruhiyat et al., 2025) found the same results where they demonstrated that organizations adopting comprehensive performance measurement frameworks achieve superior strategic alignment and operational improvements. Subsequent empirical research further confirms that BSC enhances decision-making quality and production monitoring systems which significantly increase the performance. These prior studies emphasized that mechanical companies should implies the need to adopt integrated performance dashboards, align departmental targets with corporate strategy, and continuously evaluate production metrics beyond traditional cost-based measures that could lead to improve the production capacity of mechanical to meet the demand of the market.

From the above directs effects, ERP also significantly increase the mechanical companies mechanical production performance which is emphasizing the crucial role of integrated information system in the modern Mechanical operations. These results highlighting that mechanical companies have stronger ERP system which is facilitating the real time data sharing across departments, including procurement, production, inventory management, finance, and distribution, and this integration is supporting to improve the planning accuracy, reduces information silos, and enhances coordination among functional units. This coordination is leading to improve the resource allocation, improve demand forecasting, and streamline production scheduling. The results is supporting the view with previous studies where it is highlighting that ERP adoption significantly improves operational efficiency and organizational performance (Al-Assaf et al., 2025; Talo & Emanuel, 2025). These prior studies are highlighting that ERP systems enhance productivity through improving information transparency and supporting evidence-based managerial decisions. Accordingly, mechanical firms should be prioritize an effective digital transformation initiative which ensure proper system customization to match operational needs, and provide continuous user training to maximize ERP effectiveness and avoid implementation challenges that leads to improve the production performance.

On the other hand, operations management models (JIT, Six Sigma, Balanced Scorecard, and ERP), and production performance relationship is significantly moderated with the technology capability. This result is supporting the view that technology capability is not being supporting with the resources but it also functions as a strategic enabler that amplifies the effectiveness of operational systems. These findings highlighting that mechanical firms with the stronger technological infrastructure like as integrated information systems, real-time data analytics, automation tools, and skilled IT personnel is being facilitating smoother implementation of lean practices, quality management techniques, and enterprise systems. Companies with the stronger technology foundation are being better able to process the larger volumes of production data, monitor performance indicators accurately, and coordinate complex operational activities. This finding is consistent with the RBV and DCT theories which argue that technological capability enhances the value and effectiveness of organizational practices (Quesado et al., 2022). Various previous studies have also found the technology capability as moderating variable (Mukhtar et al., 2025; Saihi et al., 2025), which is strengthening the moderating effect of technology capability as a moderating effect. Hence, these moderating effect results indicated that technology capability is an important factor to improve operation management models to improve production performance because companies with the weaker technology capability are not potentially taken benefits from the operations management models to improve the production performance of mechanical companies. Previous studies have also emphasized that IT capability enhances the performance impact of management practices by improving alignment between technology and business processes. In this regard, for the mechanical firms seeking sustained production performance, it is essential to invest in digital transformation initiatives, upgrade technological infrastructure, and develop employees' technical competencies. Therefore, strengthening technology capability will not only improve the direct effectiveness of operational practices but it will creates the synergistic benefits that significantly elevate overall production performance.

### 6.1 Theoretical Implications

The study results has various theoretical contributions with the specific objective to explore the optimization of production performance of Mechanical companies through the operations management models. Moderating influence of technology capability also tested. Firstly, the research contributed in the context of operations management through empirically validating the integrated model on the production performance within a single comprehensive structural model. As prior studies were mainly concentrated on independently, this research contributed through demonstrated their simultaneous and complementary effects on Mechanical performance. Therefore, this study extending on how multiple operational system collectively influence production performance. Secondly, this research contributed with the RBV theory through confirming that operational management model function as strategic resources that enhance firm-level performance when effectively implemented. Study results with the stronger ERP direct effect contributed to information through reinforcing the argument that integrated digital systems create sustainable competitive advantages through improved coordination and information transparency which is being aligned with the RBV theory, where is emphasized that valuable and rare organizational resources drive superior performance.

Thirdly, study also contributed with the dynamic capability theory through empirically validating the moderating effect of technology capability. The research indicated that technological capability strengthens the relationship between operational practices and production performance, which is highlighted that companies not only adopt the management practice but they should also develop a complementary technology capability for maximizing the benefits. This finding contributed to the theoretical extension of dynamic capability arguments through demonstrating that technological readiness increases the performance impact of operational excellence initiatives in Mechanical contexts. Lastly, the research also contributed methodologically through integrating operations management models along with the moderating of technological capability in the mechanical companies which is offering a more holistic theoretical framework for explaining production performance. This integrated approach contributed to bridging the gap between traditional operations management theories and contemporary digital transformation literature.

### 6.2 Practical Implications

Practically, the research offers various important managerial implications. Firstly, the study results contributed various managerial practices through demonstrating that mechanical companies should not only rely on the single operational tool but companies should adopt a combination of JIT, Six Sigma, BSC, and ERP systems to achieve superior production performance. Therefore, it is encouraged to the managers to implement a stronger operation management model through reducing waste management and improving quality management to reduce the defects which could increases the production performance. Secondly, the stronger direct effect of ERP contributed a significant practical understanding through highlighting the central role of digital integration in modern Mechanical operations. Therefore, managers should be properly prioritize effective ERP implementations to ensure the production performance.

Continuous information flow across procurement, production, and distribution units. This study contributed through emphasizing that digital infrastructure is not optional but essential for improving operational efficiency and decision-making accuracy. Thirdly, the study with the significant moderating role of technology capability contributed to managerial strategy by demonstrating that the effectiveness of operational practices depends heavily on technological readiness. Mechanical firms with weak technological infrastructure may not fully benefit from advanced operational models. Therefore, this study contributed by suggesting that managers invest in upgrading IT systems, enhancing automation, and developing employees' digital competencies to strengthen technological capability. Lastly, the research also contributed various policy and strategic planning through providing evidence that technology capability is being acts as a performance amp in the mechanical companies. Managers should align operational improvement initiatives with digital transformation strategies to create synergistic benefits. Therefore, companies should integrate a proper data analytics tool to support the successful implementation of operational excellence models and sustain long-term production performance.

## 7. Conclusion

The study objective is to explore the optimization of production performance of Mechanical companies through the operations management models. Moderating influence of technology capability also tested. The results shown that all operational management models have positive and significant impact on the production performance. From the direct effects, ERP has more effect on production performance which is showing the critical importance of integrated information systems in improving production planning, resource coordination, and real-time decision-making. While six sigma and JIT also has positive significant impact on production performance. Balance scorecard also significantly contributed to increase the production performance. Moderating effect results also confirmed that technology capability positively strengthens the relationship between operation management models and production performance. Study with significant finding highlighted the significance of combining managerial practices with technological readiness to achieve superior mechanical performance. From the practical aspect, research also suggested that mechanical organizations should invest in digital transformation, quality improvement programs, and technological capability development to sustain long-term operational competitiveness.

Study with the significant findings still has various limitations that which needs to be addressed in future study. Firstly, study only focused on mechanical companies while ignored other manufacturing companies. Future research could be explored on whole manufacturing companies to know the changes in results. Secondly, study focused only on moderating effects while ignored the mediating effects which ignored the effective predictive power of the study. Therefore, future research could be explored with the mediating effect which could increase the predictive power of the model. Lastly, study focused on cross sectional research where data collected at one time while there is also a longitudinal research design where data collected in different time frames. Therefore, future research could be explored on longitudinal research design to know the variation in results.

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