



(REVIEW ARTICLE)



From concept to capacity: Aligning product design, process selection and facility layout through operations strategy and emerging technologies

Jhon Kenneth A. Uban *, Rashida Abdulrashid-Mangorsi and Rasmiah Macabalang-Mama

Department of Agribusiness Management, College of Agriculture, Mindanao State University-Main Campus, Marawi City, 9700, Philippines.

World Journal of Advanced Research and Reviews, 2026, 30(02), 1791-1797

Publication history: Received on 12 March 2026; revised on 16 May 2026; accepted on 19 May 2026

Article DOI: <https://doi.org/10.30574/wjarr.2026.30.2.1430>

Abstract

This literature review examines the alignment of product design, process selection, and facility layout within the framework of operations strategy, emphasizing the role of emerging technologies in enhancing organizational capacity. Drawing from international, national (Philippines), and regional (Mindanao) studies, the paper highlights how firms transition from conceptual product development to operational execution. Findings reveal that strategic alignment significantly improves productivity, flexibility, and competitiveness, while emerging technologies such as artificial intelligence, automation, and digital systems act as key enablers. However, in developing contexts like the Philippines, structural constraints among micro, small, and medium enterprises (MSMEs) are particularly limiting full integration. Existing literature also shows a persistent gap between globally recognized operations strategies and the realities faced by Philippine and Mindanao-based enterprises, where limited infrastructure, restricted technological access, and weak institutional support hinder operational alignment. This review is significant because it contextualizes operations strategy within Mindanao and Philippine MSMEs, emphasizing the need for localized and adaptive approaches that can improve competitiveness and sustainable growth.

Keywords: Operations strategy; Product design; Process selection; Facility layout; Emerging technologies; MSMEs; Philippines

1. Introduction

Operations management has evolved into a strategic function that integrates product design, process selection, and facility layout to achieve organizational efficiency and competitiveness. Product design defines the features and value proposition of goods and services, while process selection determines how these products are created. Facility layout, in turn, ensures that resources and workflows are organized to support efficient production. These elements are interdependent and must be aligned through a coherent operations strategy to ensure optimal performance. According to Slack et al. (2019), the effectiveness of operations management lies in how well these decisions are integrated to support both market requirements and internal capabilities. Globally, firms that successfully align these components are better positioned to respond to market changes, reduce costs, and improve quality.

The emergence of advanced technologies has further transformed operations strategy. Technologies such as automation, artificial intelligence, and digital modeling enable firms to optimize production systems and facility layouts dynamically. Pérez-Gosende et al. (2021) emphasize that facility layout planning is a critical strategic decision due to its direct impact on productivity and cost efficiency. However, despite these global advancements, developing economies like the Philippines face significant challenges in adopting integrated operations systems. The dominance of MSMEs, limited access to capital, and infrastructural constraints hinder the implementation of advanced technologies (Aldaba,

* Corresponding author: Jhon Kenneth A. Uban

2018). These challenges are even more pronounced in regions such as Mindanao, where enterprises operate within resource-limited environments.

Although numerous international studies discuss operations alignment and technological integration, limited literature specifically examines how these strategies can be adapted to the realities of Philippine and Mindanao-based MSMEs. Most existing studies focus on large corporations and highly industrialized economies, creating a research gap regarding localized operational strategies suitable for resource-constrained enterprises. This review addresses that gap by synthesizing global, national, and regional perspectives to evaluate how operations strategy can support sustainable growth among Philippine MSMEs. The study is important because it highlights the operational realities of Mindanao enterprises and identifies opportunities for policy intervention, institutional support, and adaptive technology adoption.

2. Methodology

This study employed a systematic literature review approach to examine the alignment of product design, process selection, and facility layout within the context of operations strategy and emerging technologies.

A total of 52 academic and institutional sources were reviewed. Relevant materials were gathered from databases including Google Scholar, ScienceDirect, ResearchGate, SpringerLink, and institutional publications from Philippine agencies such as the Department of Trade and Industry (DTI), Philippine Statistics Authority (PSA), Department of Science and Technology (DOST), and Mindanao Development Authority (MinDA).

The search process used keywords and keyword combinations such as "operations strategy," "product design," "process selection," "facility layout," "capacity planning," "digital transformation," "Industry 4.0," "MSMEs in the Philippines," "Mindanao enterprises," and "technology adoption." These keywords were selected to capture both international and localized studies relevant to the research objectives.

The inclusion criteria required that publications:

- Were published between 2010 and 2026,
- Discussed operations management concepts related to product design, process selection, facility layout, or capacity planning,
- Addressed technology integration or operational efficiency, and
- Provided insights relevant to international, philippine, or mindanao contexts.

Sources were excluded if they:

- Lacked academic or institutional credibility,
- Focused on unrelated business functions,
- Contained outdated operational frameworks with limited relevance to current technologies, or
- Duplicated findings already represented in other reviewed studies.

The screening procedure involved three stages. First, titles and abstracts were examined to determine relevance to operations strategy and operational integration. Second, full-text screening was conducted to assess the applicability of each source to the study objectives. Third, the selected studies were categorized according to international, national, and regional perspectives to facilitate comparative analysis.

A thematic analysis was then conducted to synthesize findings from the selected literature. Recurring themes such as operational alignment, MSME constraints, technology adoption, infrastructure limitations, institutional support, and digital transformation were identified and grouped into broader analytical categories. Contradictions, research gaps, and contextual differences between developed and developing economies were also analyzed to strengthen the critical synthesis of the review.

3. Reviews of Related Literature

3.1. International Reviews

3.1.1. *Design–Process Interdependency and Operational Complexity*

Global literature consistently underscores that product design is a critical determinant of operational complexity and long-term efficiency. Product characteristics such as customization level, structural complexity, material requirements, and technological sophistication directly influence the type of production process required. Highly customized products often require flexible manufacturing systems and skilled labor, while standardized products are more compatible with repetitive and high-volume production systems.

However, contradictions exist within the literature regarding the balance between flexibility and efficiency. Studies from developed economies argue that high customization supported by automation can improve both responsiveness and profitability, while other studies suggest that excessive customization increases operational complexity and production costs. These differing perspectives indicate that the effectiveness of customization depends heavily on technological capability and organizational resources.

The concept of “design for manufacturability” further demonstrates the importance of aligning design and process decisions. Failure to integrate these considerations can lead to production delays, quality issues, and excessive operational costs. Despite strong international evidence supporting integrated design systems, existing studies largely focus on highly industrialized economies and multinational firms. This creates a research gap regarding how design–process alignment can be implemented in resource-constrained MSMEs, particularly in developing countries.

3.1.2. *Process–Layout Fit as a Determinant of Flow Efficiency*

The alignment between process selection and facility layout is widely recognized as a critical factor in achieving efficient workflow and minimizing operational waste. Product-oriented layouts are commonly associated with mass production systems, while process-oriented layouts support customized and low-volume production.

International studies emphasize that advanced simulation tools and metaheuristic approaches can significantly improve facility layout efficiency. However, some literature critiques the heavy reliance on technologically advanced models, arguing that these approaches are often impractical for enterprises with limited resources. This contradiction highlights the unequal applicability of global operational models between developed and developing economies.

In developed contexts, firms increasingly adopt flexible layouts and cellular manufacturing systems to respond to changing market demands. In contrast, enterprises in developing countries often operate in constrained spaces and informal production environments, limiting their ability to implement optimized layouts. This difference suggests that operations strategies must be adapted according to economic and infrastructural conditions.

3.1.3. *Strategic Role of Capacity Planning in Operations Alignment*

Capacity planning serves as a critical link connecting product design, process selection, and facility layout within the operations strategy framework. International literature consistently identifies capacity alignment as essential for balancing demand responsiveness and operational efficiency.

Despite broad agreement regarding its importance, studies differ on the most effective capacity strategies. Some researchers advocate lean and low-capacity systems to reduce waste and operating costs, while others emphasize excess or flexible capacity to improve resilience during disruptions and demand fluctuations. The COVID-19 pandemic further intensified discussions regarding operational resilience and supply chain flexibility.

These debates reveal a major limitation in the literature: there is limited consensus regarding how developing economies with resource limitations can realistically implement advanced capacity planning models. This gap is particularly relevant for Philippine MSMEs that operate with constrained capital and infrastructure.

3.1.4. *Digital Transformation and Real-Time Decision Systems*

Emerging technologies such as artificial intelligence, automation, digital twins, and machine learning have transformed modern operations management. These technologies improve decision-making, optimize layouts, and enhance production efficiency through real-time monitoring and predictive analytics.

However, existing studies reveal unequal technological readiness across countries and industries. Developed economies generally benefit from strong digital infrastructure and skilled labor, allowing firms to fully integrate digital systems into operations strategy. In contrast, enterprises in developing contexts often experience barriers related to cost, technical expertise, and infrastructure.

This disparity exposes a major research limitation in the global literature. Many studies assume the availability of stable digital infrastructure and organizational readiness, conditions that are not consistently present in developing regions such as Mindanao. Consequently, there is a need for localized studies that examine adaptive and low-cost technological integration strategies suitable for MSMEs.

3.1.5. Structural Influence of MSMEs on Operational Decisions

The Philippine business environment is dominated by MSMEs, significantly shaping how operations strategies are implemented. Due to limited financial and technological resources, many enterprises adopt fragmented approaches to product design, process selection, and facility layout.

Unlike multinational corporations that rely on structured operations systems, Philippine MSMEs often prioritize affordability and immediate market survival. This operational reality creates a major contrast between developed and developing contexts. While firms in advanced economies focus on automation and optimization, many Philippine enterprises continue to depend on labor-intensive and adaptive practices.

Existing local studies consistently identify financial limitations, inadequate infrastructure, and restricted technological access as barriers to integration. However, much of the literature focuses primarily on identifying constraints rather than proposing operational models specifically tailored for MSMEs. This represents an important research gap within Philippine operations management studies.

3.2. Informality and Adaptive Practices in Operations Management

Informality remains a defining feature of many Philippine enterprises. Businesses frequently rely on experience-based decision-making rather than formal planning systems.

Although informal operations provide flexibility, they often create inefficiencies in workflow, inconsistent production quality, and difficulty in scaling operations. Some studies argue that informality demonstrates entrepreneurial adaptability, while others view it as a barrier to long-term competitiveness and industrial modernization.

These differing interpretations highlight the complexity of balancing flexibility and standardization in developing economies. More localized studies are needed to determine how enterprises can gradually transition from informal systems toward more structured operational practices while maintaining adaptability.

3.2.1. Human Capital and Technology Adoption

Philippine enterprises continue to rely heavily on labor-intensive operations due to lower labor costs and limited access to automation technologies. Human capital serves as both a strength and a substitute for technological capability.

However, literature suggests that dependence on labor-intensive systems limits productivity and international competitiveness. While some studies emphasize workforce development as the key to operational improvement, others argue that technological upgrading is necessary for long-term sustainability.

This contradiction indicates that operations strategy in the Philippine context should combine workforce development with gradual and affordable technological integration rather than relying exclusively on either labor or automation.

3.2.2. Policy-Driven Transformation and Industrial Upgrading

Government initiatives such as the DTI Inclusive Innovation Industrial Strategy and the BOI Industry 4.0 Roadmap aim to improve operational capability and technological adoption among MSMEs.

Although these initiatives provide opportunities for modernization, studies indicate that implementation gaps remain significant. Many enterprises lack awareness, accessibility, or technical capacity to fully benefit from government programs.

This limitation suggests that policy interventions alone are insufficient without strong institutional coordination, localized implementation strategies, and continuous capacity-building support.

3.3. Regional Reviews (Mindanao, Philippines)

3.3.1. Resource-Based Production Systems and Local Innovation

In Mindanao, operations systems are strongly influenced by local resources, agricultural production, and community-based enterprises. Product design and production processes are frequently shaped by material availability and traditional production practices.

While this creates unique products and localized innovation, it also limits scalability and standardization. Existing studies emphasize that innovation in Mindanao is often necessity-driven rather than technology-driven. Compared with highly industrialized regions, enterprises in Mindanao adopt incremental rather than transformative operational improvements.

This demonstrates a significant gap between global operational models and the realities faced by Mindanao enterprises.

3.3.2. Constraints of Infrastructure on Operational Efficiency

Infrastructure limitations remain among the most significant barriers affecting operations systems in Mindanao. Transportation challenges, unstable utilities, and limited digital connectivity increase production costs and reduce operational efficiency.

Compared with developed economies where operations systems benefit from advanced logistics infrastructure, enterprises in Mindanao often design operations around infrastructural limitations rather than operational optimization. This contrast highlights the importance of context-specific operations strategies.

3.3.3. Community-Based Production and Informal Layout Systems

Many enterprises in Mindanao operate within community-based production systems where economic activities are integrated into daily social life.

These informal operational structures strengthen collaboration and accessibility but frequently limit scalability and productivity. Existing literature provides limited guidance regarding how community-based production systems can gradually transition toward more efficient and semi-formal operational frameworks while preserving local identity and social cohesion.

3.3.4. Role of Institutional Support in Capacity Development

Institutional support through programs such as the DTI Shared Service Facilities Project plays a significant role in improving operational capabilities in Mindanao.

Studies indicate that access to equipment, training, and technical assistance can improve production efficiency and competitiveness. However, barriers such as uneven program accessibility, inconsistent implementation, and limited long-term monitoring reduce the effectiveness of these initiatives.

This suggests that stronger collaboration among government agencies, local industries, and academic institutions is necessary to support sustainable operational development in the region.

4. Results and Discussion

The synthesis of international, national, and regional literature reveals that the alignment of product design, process selection, and facility layout is not merely a technical requirement but a strategic imperative for achieving operational efficiency and long-term competitiveness. Organizations that successfully integrate these components within a coherent operations strategy are generally more capable of improving productivity, reducing operational costs, and responding effectively to changing market conditions.

However, the literature also reveals important contradictions between developed and developing contexts. In developed economies, operational alignment is often supported by advanced technologies, stable infrastructure, and highly structured management systems. Firms can implement digital modeling, automation, predictive analytics, and

optimized layouts to enhance operational efficiency. In contrast, enterprises in the Philippines and Mindanao frequently operate under financial, infrastructural, and technological limitations that restrict full integration.

A recurring issue identified across the literature is the mismatch between globally recognized operations frameworks and the operational realities of MSMEs in developing regions. While international studies promote highly automated and technology-driven systems, local enterprises often depend on adaptive and labor-intensive practices due to limited capital and technical capability. This indicates that the direct application of global operational models may not always be feasible in developing economies.

The review also identifies several research gaps within existing literature. Most international studies focus on large corporations and industrialized economies, with limited attention given to localized operations strategies suitable for MSMEs. Similarly, many Philippine studies emphasize operational constraints but provide limited discussion on practical and context-specific frameworks for improving alignment. Research specific to Mindanao remains limited, particularly regarding adaptive technology adoption, sustainable operational integration, and infrastructure-sensitive facility planning.

Another major finding is the continued importance of institutional support in bridging operational gaps. Government initiatives, shared service facilities, and workforce development programs provide opportunities for operational improvement, especially for MSMEs. However, the effectiveness of these programs depends on accessibility, implementation quality, and alignment with local enterprise needs.

The findings also carry important policy and industry implications. Policymakers should prioritize infrastructure development, affordable digital integration programs, and long-term workforce training initiatives tailored for MSMEs. Industry stakeholders should adopt phased and adaptive operational strategies that gradually integrate technology while considering financial and infrastructural limitations. Academic institutions can further contribute by conducting localized research and extension programs that support practical operational innovation in Mindanao and other developing regions.

The findings suggest that operations strategy must be approached as a flexible and context-sensitive system rather than a rigid universal framework. Sustainable operational alignment requires balancing technological advancement with local realities, institutional support, and adaptive management practices.

5. Conclusion

This study highlights the critical importance of aligning product design, process selection, and facility layout within a coherent operations strategy to achieve sustainable competitiveness. The literature review demonstrates that operational alignment significantly influences productivity, efficiency, flexibility, and long-term organizational performance.

International studies consistently show that firms benefiting from integrated operations systems achieve stronger responsiveness, reduced inefficiencies, and improved decision-making through the use of advanced technologies and strategic planning. However, the review also reveals a significant gap between the operational realities of developed economies and those of developing regions such as the Philippines and Mindanao.

For Philippine MSMEs, operational integration remains constrained by limited financial resources, inadequate infrastructure, restricted access to technology, and insufficient technical expertise. Many enterprises continue to rely on fragmented and adaptive operational practices rather than fully integrated systems. Despite these limitations, the literature suggests that gradual technological adoption, workforce development, and institutional support can improve operational alignment over time.

The study further emphasizes that Mindanao requires context-specific operations strategies that recognize the region's infrastructural conditions, resource-based industries, and community-oriented production systems. Existing global operations models cannot simply be transferred without adaptation because local enterprises operate under different economic and technological realities.

This review addresses an important research gap by synthesizing international, national, and regional perspectives to examine how operations strategy can be adapted for Philippine and Mindanao-based MSMEs. The study contributes to the literature by emphasizing the need for localized and flexible operational frameworks rather than one-size-fits-all models.

The findings also have significant policy and industry implications. Government agencies should strengthen infrastructure investment, digital connectivity, MSME financing programs, and operational training initiatives to support enterprise modernization. Industry stakeholders should pursue phased and affordable operational improvements that balance technological integration with local resource limitations. Academic institutions should continue conducting localized operations management research to support evidence-based policy and industry development.

The study concludes that achieving alignment among product design, process selection, and facility layout is not only essential for operational efficiency but also for sustainable growth and resilience. For Philippine and Mindanao enterprises, adaptive and context-sensitive operations strategies represent the most practical pathway toward long-term competitiveness in an increasingly globalized and technology-driven environment.

Compliance with ethical standards

Acknowledgments

The author sincerely expresses heartfelt gratitude to my beloved parents for their endless love, sacrifices, support, and encouragement throughout this journey. Deep appreciation is also extended to my professors and instructors for their guidance, knowledge, patience, and inspiration that greatly contributed to the completion of this article review. Lastly, sincere thanks are given to my friends for their encouragement, understanding, and constant support during the preparation of this work.

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

- [1] Aldaba, R. M. (2018). *The Philippine manufacturing industry roadmap*. Philippine Institute for Development Studies.
- [2] Ballada, W., & Ballada, S. (2020). *Operations management in Philippine enterprises*. DomDane Publishers.
- [3] Board of Investments (BOI). (2021). *Industry 4.0 roadmap for the Philippines*. DTI.
- [4] Department of Agriculture (DA). (2022). *Mindanao agri-industrial development report*. Government of the Philippines.
- [5] Department of Science and Technology (DOST). (2022). *Innovation in Philippine MSMEs*. DOST.
- [6] Department of Trade and Industry (DTI). (2023). *MSME statistics and programs*. Government of the Philippines.
- [7] Habito, C. F., & Briones, R. M. (2020). *Philippine agriculture and rural development*. PIDS.
- [8] Krajewski, L. J., Malhotra, M. K., & Ritzman, L. P. (2019). *Operations management*. Pearson.
- [9] Lee, D. (2026). Facility layout optimization using AI. *Journal of Computational Design and Engineering*.
- [10] Mindanao Development Authority (MinDA). (2021). *Mindanao industry profile*. Government of the Philippines.
- [11] Navarro, A. M., & Medalla, E. M. (2019). SME participation in global value chains. PIDS.
- [12] Pérez-Gosende, P., Mula, J., & Díaz-Madroñero, M. (2021). Facility layout planning review. *International Journal of Production Research*.
- [13] Philippine Statistics Authority (PSA). (2022). *Annual survey of Philippine business and industry*.
- [14] Slack, N., Brandon-Jones, A., & Johnston, R. (2019). *Operations management*. Pearson.