

Strategic and Technological Approaches to Advancing New Product Development in Malaysia's Automotive Industry

Norreha Othman^{1*}, Airuddin Ahmad², Ahmad Fauzi Ahmad Zaini³, Mohd Hadli Shah Mohamad Yunus⁴

^{1,2,3,4,5}Institute of Graduate Studies, Universiti Poly-Tech Malaysia,
56100 Kuala Lumpur, Malaysia
Corresponding author: norreha@uptm.edu.my

Received 1 Mac 2026, Revised 30 April 2026, Accepted 20 Mei 2026, Published 30 June 2026

ABSTRACT

The Malaysian automotive industry is integral to the nation's economic development, with domestic manufacturers like Proton and Perodua contributing significantly to manufacturing, employment, and exports. New Product Development (NPD) is a critical driver for sustaining competitiveness in a rapidly evolving global market. However, the NPD process in Malaysia faces several challenges, including inefficiencies, strategic misalignment, and limitations in IT capabilities, particularly among small and medium-sized enterprises (SMEs). This paper examines the interconnection between the NPD process, strategy, and IT capability in the Malaysian automotive industry and their collective impact on NPD success. The NPD process in the automotive sector, which involves stages such as idea generation, design, and product launch, often suffers from coordination challenges across departments and delays due to a lack of standardized practices. A clear and adaptable NPD strategy is crucial for addressing these challenges, ensuring that product development aligns with market trends and technological advancements, especially with the growing demand for energy-efficient vehicles. Furthermore, the role of IT capability in enhancing NPD efficiency cannot be overstated. While large automotive manufacturers have adopted advanced IT systems such as CAD and Product Lifecycle Management (PLM), SMEs face barriers in implementing these tools due to financial constraints and skill shortages. To overcome these obstacles, automotive vendors must invest in IT infrastructure, strategic partnerships, and innovation ecosystems. This paper discusses actionable recommendations for overcoming the barriers to NPD success in Malaysia, fostering sustainable growth in the automotive industry.

Keywords: *New Product Development, Strategy, Digitalization, Automotive, Sustainability*

How to Cite:

Othman, N., Ahmad, A., Ahmad Zaini, A. F., & Mohamad Yunus, M. H. S. (2026). Strategic and technological approaches to advancing new product development in Malaysia's automotive industry. *Jurnal Evolusi*, 7(1), 31–50.
<https://doi.org/10.61688/jev.v7i1.565>

Copyright: © 2025 The Author(s)

Published by Universiti Poly-Tech Malaysia.

This article is published under the Creative Commons Attribution (CC BY 4.0) license:

<http://creativecommons.org/licenses/by/4.0/legalcode>

INTRODUCTION

The Malaysian automotive industry plays a crucial role in the country's economic landscape, contributing significantly to manufacturing, employment, and export activities. This sector, which includes domestic car manufacturers such as Proton and Perodua, has become a key driver of the Malaysian economy, with its production and sales influencing national GDP and workforce development (Wad & Govindaraju, 2011). Over the years, the Malaysian automotive sector has undergone significant evolution, with increased competition, globalization, and technological advancements shaping how companies approach new product development (NPD) (Goh, 2018). Despite these advances, achieving success in NPD remains complex, especially for automotive vendors who must navigate technological, market, and operational challenges.

At the heart of successful NPD lies the strategic alignment of key organizational factors, including the NPD process, NPD strategy, and IT capability. These elements are intertwined, influencing how efficiently and effectively a company can bring new products to market. Understanding how these factors contribute to NPD success is crucial to ensuring that automotive vendors remain competitive in an increasingly fast-paced, technology-driven industry. This article explores the critical roles of the NPD process, NPD strategy, and IT capability in the Malaysian automotive industry and how they collectively drive NPD success.

NPD Process in the Malaysian Automotive Industry

The NPD process refers to the stages through which a new product progresses from initial concept to market introduction. It encompasses idea generation, design, prototype development, testing, and product launch, each of which involves a series of decisions, tasks, and evaluations (Cooper & Kleinschmidt, 2007). The effectiveness of the NPD process is often linked to the overall success of the product development initiative. In the automotive industry, this process is particularly complex due to the need for high precision, adherence to safety standards, and regulatory compliance (Gilbert, 2013).

In Malaysia, the automotive NPD process faces several hurdles, including reducing time-to-market while maintaining product quality and ensuring the product meets the evolving demands of consumers and car manufacturers (Goh, 2018). The integration of advanced manufacturing technologies, such as computer-aided design (CAD), product lifecycle management (PLM), and robotics, has the potential to streamline the NPD process and reduce development lead time (Yusof et al., 2025). However, many vendors in Malaysia, particularly small and medium enterprises (SMEs), still face difficulties in integrating these technologies into their production processes, which can delay the NPD cycle and increase costs (Tajuddin et al., 2018).

One of the critical issues faced by Malaysian automotive vendors in the NPD process is managing product development across multiple stages while ensuring alignment with carmakers' specifications and market requirements (Chakraborty et al., 2018). The automotive industry is inherently dynamic, with frequent changes in design, manufacturing techniques, and customer expectations, making it essential for vendors to maintain flexibility in their NPD process. Vendors must also manage complex supply chains and coordinate with multiple stakeholders, including suppliers, manufacturers, and testing facilities, which can create additional challenges in meeting deadlines and maintaining product quality (Chae et al., 2014).

Despite these challenges, a structured and efficient NPD process remains a significant driver of success. The ability to accelerate product development, meet quality standards, and respond to market changes quickly can provide vendors with a competitive edge in the marketplace. Research has shown that automotive companies that have adopted a systematic approach to the NPD process, including the use of stage-gate systems and agile project management techniques, have reduced development costs and improved product quality (Henard & Szymanski, 2001).

NPD Strategy in the Automotive Sector

NPD strategy refers to the long-term planning and decision-making that organizations employ to guide their product development efforts (Ulrich & Eppinger, 2016). This strategy is crucial for determining which products to develop, how

to allocate resources, and how to align NPD with the overall business objectives. In the automotive industry, a well-defined NPD strategy ensures that product development efforts are aligned with both market trends and the company's technological capabilities (Tajuddin et al., 2018).

In the context of the Malaysian automotive industry, developing a successful NPD strategy is vital for overcoming competitive pressures and achieving market success (Wad & Govindaraju, 2011). Vendors must consider several factors when formulating their NPD strategies, such as market demand, consumer preferences, technological innovations, and regulatory requirements (Eisenhardt & Martin, 2000). As Malaysia is a developing market, there is a growing emphasis on producing energy-efficient vehicles (EEVs) that cater to both local and international environmental standards (Gilbert, 2013). NPD strategies in the automotive industry must therefore be flexible enough to adapt to changing consumer demands, technological advancements, and regulatory shifts.

The importance of a clear NPD strategy is underscored by previous studies, which show that organizations with strong NPD strategies are more likely to successfully introduce innovative products and achieve higher profitability (Oliveira et al., 2019). By adopting a well-defined strategy, automotive vendors can enhance their ability to navigate market uncertainties, reduce development costs, and accelerate time-to-market (Tan & Wong, 2017). Furthermore, aligning the NPD strategy with the company's overall business objectives ensures that product development efforts contribute to long-term business success rather than being isolated activities (Shah & Goh, 2020).

However, the Malaysian automotive sector faces challenges in developing and executing effective NPD strategies due to intense competition and rapid technological change. While large automotive manufacturers such as Proton and Perodua have the resources to invest in R&D and innovation, smaller vendors often lack the infrastructure and expertise to implement a comprehensive NPD strategy (Goh, 2018). This disparity in resources highlights the need for automotive vendors to adopt more cost-effective and agile NPD strategies to compete in a highly competitive market.

The Role of IT Capability in NPD Success

Information technology (IT) capability refers to an organization's ability to leverage its IT resources to enhance operations, decision-making, and product development (Tippins & Sohi, 2003). In the automotive industry, IT plays a critical role in optimizing the NPD process by enabling collaboration, improving communication, and facilitating data management. IT capability allows automotive vendors to streamline the design process, coordinate production schedules, and reduce lead times, all of which are essential for achieving NPD success (McKinnon, 2018).

For vendors in Malaysia, IT capability is increasingly recognized as a key enabler of NPD success. Technologies such as CAD, PLM, and enterprise resource planning (ERP) systems provide vendors with the tools needed to design and manufacture complex automotive components efficiently (Oliveira et al., 2019). Furthermore, IT enables real-time collaboration among vendors, suppliers, and carmakers, facilitating quicker decision-making and problem-solving during the NPD process (Shah & Goh, 2020). In addition to improving the efficiency of the NPD process, IT capability also contributes to better product quality by enabling precise design, simulation, and testing of new products before they are manufactured (Chae et al., 2014).

However, the adoption of IT in the Malaysian automotive sector is not without its challenges. While large automotive companies are increasingly adopting cutting-edge technologies to enhance their NPD capabilities, many SMEs still struggle with the high costs associated with implementing advanced IT systems (Tan & Wong, 2017). Moreover, there is a lack of skilled IT professionals in the Malaysian automotive industry, which further complicates the integration of IT into the NPD process (Goh, 2018). To overcome these barriers, it is essential for automotive vendors to invest in IT infrastructure and develop the necessary skills within their workforce to maximize the benefits of digital transformation in NPD.

Interlinking NPD Process, Strategy, and IT Capability

The interplay between the NPD process, strategy, and IT capability is crucial for achieving NPD success. Research indicates that organizations that effectively integrate these three factors are more likely to achieve superior product development outcomes, including faster time-to-market, improved product quality, and higher customer satisfaction (McKinnon, 2018). The NPD process provides the framework for product development, while the NPD strategy ensures

alignment with organizational goals and market demands. IT capability, on the other hand, supports and enhances the NPD process by providing the tools and technologies necessary to streamline operations, improve communication, and facilitate decision-making (Tippins & Sohi, 2003).

In the Malaysian automotive industry, vendors that successfully align their NPD processes, strategies, and IT capabilities are better positioned to overcome challenges such as increasing competition, evolving consumer demands, and rising production costs (Shah & Goh, 2020). The integration of these factors allows automotive vendors to improve their operational efficiency, reduce development costs, and introduce innovative products that meet market expectations (Tajuddin et al., 2018).

Importance of NPD Success for the Malaysian Automotive Industry

The success of NPD is crucial for the long-term growth and sustainability of the Malaysian automotive industry. As the industry faces increasing competition from global automakers, it is essential for local vendors to enhance their product development capabilities to remain competitive in both domestic and international markets (Wad & Govindaraju, 2011). By optimizing the NPD process, aligning it with a robust strategy, and leveraging IT capability, automotive vendors can achieve faster time-to-market, reduce product development costs, and improve product quality, all of which contribute to NPD success (Oliveira et al., 2019).

Furthermore, NPD success is important not only to individual vendors but also to the broader automotive ecosystem in Malaysia. As vendors improve their NPD capabilities, they contribute to the overall competitiveness of the Malaysian automotive sector, thereby boosting national economic growth, creating jobs, and enhancing export opportunities (Goh, 2018). Therefore, understanding the factors that contribute to NPD success is critical for policymakers, business leaders, and academics alike.

LITERATURE REVIEW

The automotive sector plays a pivotal role in the global economy, contributing significantly to technological advancements, employment, and the overall development of industrial ecosystems. Malaysia's automotive industry is no exception, with companies such as Proton and Perodua driving the growth of local manufacturing. New Product Development (NPD) is central to the survival and growth of the Malaysian automotive industry, especially as global trends demand faster innovation cycles, greater technological sophistication, and heightened environmental sustainability. Successful NPD hinges on a seamless integration of process, strategy, and IT capabilities, which not only improve efficiency but also ensure products meet market demands and regulatory requirements (Gilbert, 2013).

The automotive industry is particularly challenging for NPD due to its complex design and manufacturing processes, which require close coordination across multiple teams and a variety of technologies. As Malaysia seeks to become a more competitive player on the global stage, understanding the critical drivers of NPD success is essential. This review examines how the NPD process, strategic alignment, and IT capability interact to determine the effectiveness of product development initiatives in the Malaysian automotive sector.

The NPD Process in the Malaysian Automotive Industry

The NPD process refers to the series of activities that an organization undertakes to bring a new product from conception to market. This process typically involves several phases, including idea generation, design, prototyping, testing, and final commercialization (Cooper & Kleinschmidt, 2007). The complexity of the automotive sector, with its stringent regulatory compliance and advanced technology needs, makes the NPD process particularly critical. Each phase of NPD needs to be optimized to avoid delays and cost overruns, and ensure that the final product meets both consumer expectations and industry standards (Griffin, 1997).

The Malaysian automotive industry faces unique challenges in its NPD process due to the need for localization of vehicle designs and manufacturing processes (Yusof et al., 2024). While global car manufacturers often set the pace for automotive

innovations, Malaysian manufacturers must adapt their products to meet local consumer needs and comply with national regulations. A study by Lee & Govindan (2014) emphasizes the importance of integrating both global technological trends and local market insights into the NPD process. For instance, Perodua's strategy of designing compact and fuel-efficient vehicles has been aligned with the needs of Malaysian consumers, who prioritize affordability and efficiency over premium features (Yusof et al., 2024).

In recent years, Industry 4.0 technologies such as automation, IoT, and data analytics have emerged as critical enablers in the NPD process. These technologies allow for improved product design, faster prototyping, and more accurate testing. However, Malaysian automotive companies, especially smaller firms, often struggle with adopting these technologies due to financial constraints and a lack of skilled workforce (Oliveira et al., 2019). Larger players like Proton have made substantial investments in digital solutions such as CAD (Computer-Aided Design) and PLM (Product Lifecycle Management), which have helped streamline their NPD process (McKinnon, 2018).

Furthermore, the integration of digital twins, artificial intelligence, and machine learning in automotive design and production has improved the precision of NPD processes and reduced product development cycles. According to Yusof et al. (2024), adopting such technologies can drastically improve the responsiveness of the Malaysian automotive industry, enabling manufacturers to create products that are both innovative and cost-effective.

NPD Strategy in the Malaysian Automotive Sector

NPD strategy refers to the overarching plan that guides an organization's product development efforts. This strategy includes decisions about which products to develop, the allocation of resources, and how to align development activities with market demands and organizational capabilities (Ulrich & Eppinger, 2016). In the Malaysian automotive industry, the NPD strategy is shaped by both domestic needs and global trends. Companies like Proton and Perodua must not only cater to the preferences of local consumers but also meet international standards for safety, emissions, and fuel efficiency.

The strategic alignment of NPD activities with national policies plays a crucial role in shaping automotive companies' product development decisions. The National Automotive Policy (NAP), for instance, has driven Malaysian automakers to focus on energy-efficient vehicles (EEVs) and sustainable production practices (Yusof et al., 2024). In line with these strategic imperatives, automotive companies must develop NPD strategies that allow them to innovate while maintaining cost-efficiency. Research by Tan & Wong (2017) highlights the importance of strategic flexibility, as the Malaysian automotive market is highly influenced by fluctuating fuel prices, shifting consumer preferences, and regulatory changes.

Partnerships with global automotive giants have been a strategic move for many Malaysian manufacturers to enhance their technological capabilities and NPD processes. For example, Proton's partnership with Geely has enabled the company to access advanced technologies such as hybrid powertrains and autonomous driving features, significantly enhancing its NPD capabilities (Reuters, 2025). Similarly, Perodua's collaboration with Daihatsu has provided access to world-class engineering technologies, ensuring that the company can produce vehicles that meet both local and international standards (Yusof et al., 2024).

The challenge, however, lies in the ability of smaller automotive vendors to align their NPD strategies with the rapidly changing technological landscape. Smaller players in Malaysia often struggle with resource limitations, which hinder their ability to invest in advanced R&D activities. As such, a clear NPD strategy that focuses on innovation, cost management, and responsiveness to market shifts is critical for their survival (Boejang et al., 2017).

IT Capability and Its Role in NPD Success

IT capability is increasingly recognized as a critical enabler of NPD success, particularly in industries that rely on complex design and manufacturing processes, such as automotive manufacturing. IT tools and systems allow organizations to streamline operations, improve collaboration, and enhance decision-making, all of which are essential for effective NPD.

Technologies such as CAD, PLM, ERP (Enterprise Resource Planning), and data analytics provide real-time insights into product design, supply chain operations, and production schedules (Tippins & Sohi, 2003).

The adoption of IT in the Malaysian automotive industry has been uneven, with larger companies leading the way while SMEs face barriers related to cost and expertise (McKinnon, 2018). However, IT plays a crucial role in accelerating product development cycles, improving product quality, and reducing costs. A study by Chae et al. (2014) highlights that companies with strong IT capabilities can manage their NPD processes more effectively, allowing them to reduce development times and improve market responsiveness. By utilizing IT tools, manufacturers can simulate design prototypes, conduct virtual testing, and coordinate with suppliers more efficiently.

Proton's adoption of advanced IT systems, including CAD and PLM tools, has enabled the company to streamline its NPD process and reduce lead times for new model launches (Yusof et al., 2024). Perodua has also incorporated IT systems into its design and production processes, ensuring that the company can meet both local and global demands for safety, fuel efficiency, and performance. However, for smaller players, the high costs associated with these technologies often deter them from adopting IT solutions that could improve their NPD process.

The government's push toward digital transformation in the Malaysian automotive industry is a step in the right direction, helping bridge the gap between large and small manufacturers. Government initiatives, such as providing subsidies for IT infrastructure and offering training programs, are designed to support the digital transformation of SMEs (Gilbert, 2013). With increased access to IT resources, these vendors can enhance their NPD processes and remain competitive in the global market.

Integration of NPD Process, Strategy, and IT Capability

The integration of NPD process, strategy, and IT capability is essential for achieving NPD success. Studies indicate that companies that effectively combine these elements are more likely to succeed in product development (Yusof et al., 2024). A well-structured NPD process provides a framework for product design and testing, while a clear NPD strategy ensures that the product aligns with both market demands and organizational goals. IT capability supports both by providing the tools necessary to manage product development activities efficiently and effectively.

Research by Oliveira et al. (2019) suggests that the synergy between these three elements enables companies to reduce product development cycles, improve product quality, and lower costs. For Malaysian automotive manufacturers, the integration of NPD process, strategy, and IT is especially critical in managing the complexities of producing vehicles that meet both local and international standards. Companies like Proton and Perodua have successfully aligned these elements to create competitive products that meet the demands of Malaysian consumers (Yusof et al., 2024).

However, challenges remain in the integration of these elements. Smaller manufacturers, in particular, struggle with aligning their NPD processes with strategic objectives due to limited resources and technological capabilities (Oliveira et al., 2019). To overcome these challenges, it is essential for Malaysian automotive vendors to adopt a more holistic approach to NPD, ensuring that process, strategy, and IT capability are aligned to meet the changing demands of the industry.

Issues In New Product Development (Npd) In The Malaysian Automotive Industry

While the previous section highlighted the significance of the NPD process, strategy, and IT capability in the Malaysian automotive industry, the practical implementation of these elements is not without its challenges. The success of NPD depends on overcoming numerous issues that hinder the effective alignment of processes, strategies, and technological capabilities. For automotive vendors in Malaysia, these challenges are further exacerbated by global competition, technological advancements, economic fluctuations, and market demands. This section discusses the key issues faced by the Malaysian automotive industry in the context of NPD, with

a particular focus on process inefficiencies, strategic misalignments, and IT limitations. By understanding these issues, industry stakeholders can work towards overcoming these barriers and enhancing NPD success.

Inefficiencies in the NPD Process

One of the primary challenges faced by automotive manufacturers in Malaysia is the inefficiency of the NPD process. The automotive NPD process involves multiple stages, from concept development to product commercialization, requiring close coordination between various departments and external stakeholders. According to Cooper & Kleinschmidt (2007), inefficiencies at any stage of the NPD process can lead to significant delays, cost overruns, and poor product quality. In Malaysia, the NPD process is often hindered by a lack of standardization and inadequate resource management.

For example, studies show that the automotive industry in Malaysia has not fully embraced global best practices in NPD, such as stage-gate processes or agile methodologies, which are widely used in other industries to streamline product development (Griffin, 1997). Research by McKinnon (2018) suggests that the absence of standardized project management frameworks in the Malaysian automotive industry contributes to inefficiencies in time and cost management. These inefficiencies lead to delayed product launches, misaligned product features, and increased development costs, undermining the competitive advantage of local automotive manufacturers.

Furthermore, the complexity of the NPD process in the automotive industry increases the likelihood of communication breakdowns and misunderstandings among different teams. In Malaysia, vendors often struggle with the coordination between the R&D, design, manufacturing, and marketing departments, resulting in poorly managed timelines and unaligned objectives (Boejang et al., 2017). The lack of a seamless integration between different departments and stages of the NPD process further exacerbates the delays in product development.

Strategic Misalignment

The alignment of NPD activities with organizational strategy is another significant issue faced by the Malaysian automotive industry. While strategic planning is essential for guiding NPD efforts, many automotive vendors struggle with formulating and implementing effective NPD strategies that align with both market demands and technological advancements. As identified by Lee & Govindan (2014), misalignment between NPD strategy and market demands is a common challenge in the Malaysian automotive sector. Companies that fail to anticipate shifts in consumer preferences or technological advancements may find their products obsolete before they even reach the market.

For instance, while the global automotive industry has increasingly shifted towards electric vehicles (EVs) and energy-efficient solutions, many Malaysian manufacturers have been slow to embrace these changes. Proton, for example, only recently entered the EV market through its partnership with Geely (Reuters, 2025). This delayed strategic shift highlights the misalignment between the company's NPD strategy and the growing global demand for sustainable mobility solutions. In contrast, competitors in other regions, such as Tesla and BYD, have already established a strong presence in the electric vehicle market, forcing Malaysian manufacturers to play catch-up.

Moreover, strategic misalignment also occurs when companies do not adequately incorporate long-term sustainability goals into their NPD strategies. The Malaysian automotive industry, which has traditionally focused on affordable and fuel-efficient vehicles, has been slow to adapt to the increasing demand for environmentally sustainable products. The government's push for energy-efficient vehicles (EEVs) through the National Automotive Policy (NAP) is a step in the right direction; however, a strategic shift in product development is still needed to fully capitalize on this opportunity (Yusof et al., 2024).

IT Limitations and Digital Transformation Barrier

Another significant issue in the Malaysian automotive industry is the limitation of IT capability, which hampers the efficiency and effectiveness of the NPD process. IT plays a central role in modernizing product development by enabling faster design cycles, improving communication, and streamlining production. However, many automotive vendors in Malaysia, especially small and medium-sized enterprises (SMEs), face barriers in adopting advanced IT solutions due to financial constraints and a lack of skilled personnel (Tajuddin et al., 2018).

A study by Chae et al. (2014) emphasizes that automotive companies that lack the necessary IT infrastructure struggle with inefficiencies in product design and testing. Without advanced IT tools such as Computer-Aided Design (CAD) and Product Lifecycle Management (PLM) systems, automotive vendors are unable to fully integrate their product development processes, leading to delays, errors, and misalignments between teams. These issues are particularly detrimental in the automotive industry, where product design and manufacturing must be highly precise to ensure safety, functionality, and regulatory compliance.

Furthermore, the lack of skilled IT professionals in the Malaysian automotive sector limits the ability of companies to leverage new technologies such as artificial intelligence (AI), data analytics, and machine learning in their NPD processes. According to McKinnon (2018), IT capability is essential for effective decision-making and real-time collaboration between design teams, suppliers, and manufacturers. The inability to adopt these technologies limits the ability of local vendors to keep up with global competitors who have successfully integrated IT into their NPD processes (Oliveira et al., 2019).

Supply Chain and Resource Constraints

The automotive NPD process is highly dependent on efficient supply chain management, which poses another set of challenges for Malaysian automotive vendors. The complexity of the automotive supply chain, which often involves multiple suppliers across different regions, requires seamless communication, coordination, and real-time data exchange. However, research shows that many Malaysian automotive vendors face difficulties in managing their supply chains, leading to delays in parts procurement, production scheduling, and quality control (Chae et al., 2014).

According to Yusof et al. (2024), supply chain inefficiencies are a significant barrier to NPD success in Malaysia, particularly for smaller vendors who lack the resources and expertise to effectively manage supplier relationships and logistics. Furthermore, the reliance on international suppliers for critical components often leads to challenges in maintaining consistent product quality and managing lead times, which directly impacts the NPD process. The Malaysian automotive industry is also heavily reliant on imported parts, which exposes vendors to the risks of currency fluctuations, geopolitical instability, and international trade disruptions.

Resource constraints further complicate the NPD process, as many Malaysian automotive vendors operate under tight budget constraints. The high costs of advanced manufacturing technologies, raw materials, and skilled labor present significant barriers to innovation, particularly for SMEs (Boejang et al., 2017). These resource limitations hinder the ability of vendors to invest in R&D activities and adopt advanced technologies that are necessary to remain competitive in the global automotive market.

Regulatory and Market Challenges

The Malaysian automotive industry is heavily regulated, and compliance with local and international standards is essential for ensuring product quality and safety. However, regulatory requirements often create significant

challenges for automotive manufacturers, particularly when it comes to product design, emissions standards, and safety features. The complexity of regulatory compliance adds an additional layer of complexity to the NPD process, requiring vendors to allocate significant resources to ensure that their products meet all necessary regulations (Lee & Govindan, 2014).

For example, as part of the government's push for environmentally sustainable vehicles, Malaysian manufacturers are required to develop energy-efficient products that comply with emissions standards. However, the lack of robust infrastructure for electric vehicles (EVs) in Malaysia has slowed the adoption of EV technologies, further complicating the NPD process for vendors looking to enter this market (Gilbert, 2013). The absence of a clear regulatory framework for EVs and the limited availability of charging infrastructure have made it difficult for local manufacturers to compete with global automakers who have already established a strong foothold in the EV market.

Additionally, market challenges such as fluctuating demand, changing consumer preferences, and intense competition from foreign automotive manufacturers create further issues for NPD. As the Malaysian market becomes more saturated, local vendors must focus on differentiation, innovation, and product quality to stay competitive (Wad & Govindaraju, 2011). However, these efforts are often hampered by the issues outlined above, including inefficiencies in the NPD process, strategic misalignment, and IT limitations.

DISCUSSION

The Malaysian automotive industry has long been a cornerstone of the nation's manufacturing sector. However, as highlighted in the previous sections, this industry faces significant challenges in achieving new product development (NPD) success. Issues such as inefficiencies in the NPD process, strategic misalignments, IT limitations, and external regulatory and market barriers present significant obstacles. Despite these challenges, the potential for success remains high if automotive vendors in Malaysia can address these issues strategically. This discussion section explores the implications of the issues identified in the previous section and offers insights into how they can be mitigated to improve NPD outcomes in the Malaysian automotive industry.

Addressing Inefficiencies in the NPD Process

The inefficiency of the NPD process is one of the most pressing issues facing the Malaysian automotive industry. A well-defined and optimized NPD process is crucial for reducing time-to-market, ensuring product quality, and meeting consumer demands (Griffin, 1997). However, as observed in Malaysia, the lack of standardization in NPD practices has led to delays, cost overruns, and poor alignment between design and production teams. This inefficiency is particularly problematic given the competitive nature of the global automotive market, where rapid product innovation is essential for staying ahead.

One possible solution to this issue is the adoption of industry best practices such as the stage-gate process or agile methodologies. These methodologies have been shown to reduce inefficiencies by providing clear milestones and checkpoints throughout the NPD process (Cooper & Kleinschmidt, 2007). For example, the use of agile methodologies can improve collaboration between departments, enhance communication, and speed up decision-making, thereby accelerating product development timelines (Yusof et al., 2024). Malaysian automotive vendors should explore adopting these methodologies to enhance the efficiency of their NPD processes.

Additionally, the integration of Industry 4.0 technologies, such as the Internet of Things (IoT) and automation, offers an opportunity to streamline the NPD process. These technologies allow for real-time monitoring,

predictive maintenance, and improved collaboration across the supply chain, all of which can reduce delays and enhance the precision of the NPD process (Oliveira et al., 2019). Despite the high initial investment required, the long-term benefits in terms of reduced development times and improved product quality could outweigh the costs.

However, as identified in the Issues section, the adoption of these technologies is often hindered by the financial constraints and lack of technical expertise within Malaysia's automotive SMEs (McKinnon, 2018). To address this, government incentives and industry partnerships could play a vital role in fostering the adoption of advanced manufacturing technologies among local automotive vendors.

Aligning NPD Strategy with Market and Technological Demands

Strategic misalignment is another critical issue affecting the NPD success in the Malaysian automotive industry. As the global automotive industry continues to evolve, Malaysian vendors must align their NPD strategies with market demands, consumer preferences, and emerging technological trends. The failure to do so can result in products that do not meet consumer expectations, as well as missed opportunities in fast-growing segments such as electric vehicles (EVs) and autonomous driving technology (Lee & Govindan, 2014).

One significant example of strategic misalignment is the slow adoption of electric vehicles (EVs) in Malaysia. While global automotive manufacturers such as Tesla and BYD have aggressively pursued the development and sale of EVs, Malaysian manufacturers have been slower to enter the market. Proton, for instance, has only recently begun to explore electric vehicle development through its partnership with Geely (Reuters, 2025). This delay in adopting global technological trends could result in missed opportunities as consumers increasingly demand more sustainable and environmentally friendly vehicles.

To align NPD strategies with market demands, Malaysian automotive vendors must invest in R&D and technological innovation. As identified by Tan & Wong (2017), a forward-looking NPD strategy that incorporates emerging technologies such as EVs, AI, and autonomous driving features is essential for maintaining competitiveness. By aligning NPD strategies with these technological shifts, Malaysian vendors can ensure that their products remain relevant and meet the growing demand for sustainability and innovation.

Moreover, aligning NPD strategies with market needs also requires an understanding of local consumer preferences. Perodua's focus on producing compact, fuel-efficient vehicles that cater to Malaysian consumers' preference for affordability and practicality has been a key factor in the company's success (Yusof et al., 2024). This market-centric strategy has allowed Perodua to maintain a strong position in the domestic market, despite the increasing presence of foreign competitors. Similarly, Malaysian automotive vendors should conduct thorough market research to identify consumer preferences and incorporate these insights into their NPD strategies.

Leveraging IT Capability to Overcome IT Limitations

IT capability is a crucial enabler of NPD success, but as noted in the Issues section, many Malaysian automotive vendors face significant barriers to leveraging IT effectively. These barriers, including financial constraints and a lack of skilled IT professionals, hinder the ability of smaller vendors to adopt advanced IT tools that can enhance the NPD process (Tajuddin et al., 2018). The lack of a robust IT infrastructure not only slows down product development but also impacts product quality and overall efficiency.

To overcome these limitations, Malaysian automotive vendors must prioritize investments in IT infrastructure, particularly in tools such as CAD, PLM, and ERP systems. The integration of these tools can streamline design processes, improve collaboration across departments, and enhance the efficiency of the production process (Chae et al., 2014). Larger automotive companies in Malaysia, such as Proton and Perodua, have already adopted these systems to improve product design and production scheduling, and their success serves as a model for smaller players in the industry (McKinnon, 2018).

Furthermore, the government can play an essential role in supporting IT adoption within the Malaysian automotive sector. By offering subsidies for IT infrastructure, providing training programs for employees, and fostering industry collaborations, the government can help local vendors bridge the IT gap and build the necessary capabilities to compete on the global stage (Oliveira et al., 2019). Moreover, IT vendors can partner with local automotive companies to offer affordable, scalable solutions that meet the specific needs of the Malaysian automotive market.

Another promising avenue for leveraging IT in NPD is the use of data analytics and AI. AI-powered tools can analyze large datasets, predict market trends, and optimize product designs in real time. As the Malaysian automotive industry increasingly embraces digital transformation, the use of AI in NPD could significantly enhance the speed and accuracy of decision-making (Yusof et al., 2024). However, for this to be effective, it is essential to address the IT infrastructure and skills gap that exists in many smaller Malaysian automotive firms.

Supply Chain Challenges and Resource Constraints

Efficient supply chain management is a key factor in ensuring the success of NPD in the automotive sector. The automotive industry operates with complex, global supply chains that require precise coordination and timely delivery of parts and components. However, as noted in the Issues section, many Malaysian automotive vendors face challenges related to supply chain inefficiencies, particularly when sourcing critical parts from international suppliers (Chae et al., 2014). The reliance on international suppliers exposes vendors to risks such as geopolitical instability, trade disruptions, and fluctuating exchange rates, all of which can delay production and hinder NPD efforts.

To mitigate these challenges, Malaysian automotive manufacturers should focus on strengthening their supply chain management capabilities. One potential solution is the adoption of advanced supply chain management systems, which can provide real-time data on inventory levels, production schedules, and supplier performance. These systems enable vendors to monitor their supply chains more effectively and proactively address potential disruptions (McKinnon, 2018). Additionally, diversifying suppliers and building stronger relationships with local and regional partners can reduce reliance on international suppliers and mitigate the risks associated with global supply chains (Oliveira et al., 2019).

Resource constraints are another significant issue that hampers the ability of Malaysian automotive vendors to compete effectively in the global market. Many local vendors struggle with limited financial resources, which restricts their ability to invest in R&D, adopt new technologies, and scale their operations (Tajuddin et al., 2018). This limitation is particularly problematic for SMEs, which often lack the resources to compete with larger international players.

To address resource constraints, Malaysian automotive vendors should explore cost-effective strategies for innovation, such as collaborative R&D with universities and research institutions, as well as joint ventures with global automotive manufacturers. Government support, such as funding for R&D projects and innovation initiatives, could also provide a boost to local manufacturers looking to enhance their NPD efforts (Boejang et al., 2017).

Regulatory and Market Pressures

The regulatory environment in Malaysia also presents significant challenges to NPD success in the automotive industry. The Malaysian automotive sector is governed by a complex set of regulations related to safety, emissions, and environmental standards. Compliance with these regulations is critical for ensuring that new products meet both local and international standards. However, regulatory compliance can increase development costs and extend the time required for product approvals (Gilbert, 2013).

For instance, the Malaysian government's push for energy-efficient vehicles (EEVs) has forced automotive manufacturers to adapt their product development processes to meet stricter environmental standards. While this shift presents opportunities for innovation, it also increases the complexity of the NPD process, requiring additional testing, certification, and compliance activities (Yusof et al., 2024).

Moreover, market pressures, such as fluctuating consumer preferences, changing fuel prices, and the increasing demand for environmentally friendly vehicles, further complicate NPD efforts. As global automakers continue to dominate the electric vehicle (EV) market, Malaysian manufacturers must adapt to these changing market conditions and develop products that meet both consumer demands and environmental standards.

SUGGESTION

The Malaysian automotive industry, while significant in terms of its contributions to the economy, faces numerous challenges that hinder the efficient execution of New Product Development (NPD). As outlined in the previous section, these challenges include inefficiencies in the NPD process, misalignments in strategic goals, limitations in IT infrastructure, and external pressures such as regulatory changes and market volatility. Despite these issues, the potential for success remains high. The purpose of this section is to offer suggestions for overcoming these barriers, with a focus on improving NPD outcomes in the Malaysian automotive industry.

These suggestions are designed to address the specific challenges identified in the previous section, ranging from enhancing process efficiency and strategic alignment to leveraging IT capabilities and mitigating external pressures. By implementing these solutions, Malaysian automotive vendors can strengthen their NPD practices, improve product quality, reduce time-to-market, and ensure competitiveness in both domestic and global markets.

Streamlining the NPD Process

To address the inefficiencies within the NPD process, Malaysian automotive vendors must prioritize the adoption of standardized and well-established frameworks for product development. One such framework is the stage-gate process, which allows for a structured, step-by-step approach to product development, ensuring that each stage of the NPD process is thoroughly evaluated before moving forward (Cooper & Kleinschmidt,

2007). The adoption of this process can help mitigate the risk of cost overruns, delays, and poorly aligned product features.

In addition to implementing stage-gate processes, the Malaysian automotive industry can benefit from embracing agile methodologies. Agile practices, commonly used in the technology and software industries, emphasize flexibility, collaboration, and continuous feedback. By incorporating agile techniques into their NPD processes, automotive vendors can improve coordination between different departments, enhance communication, and reduce the time required to bring new products to market (Griffin, 1997). This is particularly important in the rapidly changing automotive landscape, where the ability to respond quickly to market demands and technological advancements is crucial.

Furthermore, enhancing collaboration between R&D, design, production, and marketing teams is essential for overcoming inefficiencies in the NPD process. Cross-functional teams should be empowered to work together from the early stages of product development, ensuring that all perspectives are considered and that potential roadblocks are identified early on (McKinnon, 2018). Regular communication and feedback loops can help align goals, address issues promptly, and keep the development process on track.

Aligning NPD Strategy with Market Trends

In terms of strategic alignment, it is essential for Malaysian automotive vendors to adapt their NPD strategies to address emerging market trends, particularly the growing demand for sustainability and energy-efficient vehicles (EEVs). As consumer preferences shift toward environmentally friendly products, vendors must incorporate these demands into their product strategies (Yusof et al., 2024). A strong NPD strategy should prioritize the development of innovative, sustainable vehicles that meet global environmental standards while remaining competitively priced.

A strategic shift toward sustainability requires automotive vendors to invest in green technologies, such as electric vehicle (EV) development, hybrid powertrains, and low-emission technologies. The Malaysian government's support for EV development, through initiatives such as the National Automotive Policy (NAP), provides an opportunity for local manufacturers to align their strategies with global trends and meet consumer expectations for cleaner and more energy-efficient products (Gilbert, 2013).

Moreover, the alignment of NPD strategy with technological advancements is essential. As the automotive industry becomes increasingly reliant on digital technologies, such as autonomous driving and connected car features, Malaysian manufacturers must invest in research and development to integrate these technologies into their products. This will require not only a shift in the strategic direction but also the development of new partnerships with tech companies to ensure that the latest innovations are incorporated into the product development process (Lee & Govindan, 2014).

To ensure the successful implementation of an aligned NPD strategy, Malaysian automotive vendors should consider conducting regular market research to assess consumer preferences, technological trends, and competitive pressures. This research will enable companies to identify new opportunities, adjust their product offerings, and adapt their strategies to meet changing market demands (Wad & Govindaraju, 2011).

Enhancing IT Capability and Digital Transformation

The limitations in IT capability identified in the discussion section highlight the need for increased investment in digital tools and systems. IT infrastructure plays a crucial role in modernizing the NPD process and improving collaboration, efficiency, and product quality. To overcome the barriers posed by IT limitations, Malaysian automotive vendors should prioritize the adoption of advanced IT systems, such as Computer-Aided Design (CAD), Product Lifecycle Management (PLM), and Enterprise Resource Planning (ERP) systems (Oliveira et al., 2019). These systems allow for better data management, improved product design, and enhanced decision-making by providing real-time information and automating processes across the NPD stages. Research by Zainal et al., (2023) further emphasizes that digital integration across manufacturing activities can improve operational responsiveness and reduce delays during product development. Similarly, Zakaria and Ahmad (2024) argue that firms with stronger digital capabilities are more effective in coordinating cross functional teams and accelerating innovation activities.

In addition to investing in IT infrastructure, it is essential for automotive vendors to build their internal IT capabilities by hiring skilled personnel and providing training to existing employees. The implementation of advanced IT systems requires a workforce that is proficient in using these tools and capable of leveraging them to improve the NPD process (Tajuddin et al., 2018). Training programs and industry partnerships with educational institutions can help develop the necessary skills and knowledge within the workforce.

Furthermore, the integration of emerging technologies such as artificial intelligence (AI), machine learning, and big data analytics into the NPD process can significantly enhance product development. AI-powered tools can be used to analyze market trends, predict consumer behavior, and optimize product design, leading to faster and more informed decision-making (McKinnon, 2018). Malaysian automotive vendors should explore these technologies to stay competitive and improve their NPD processes. Studies conducted by Zulkifli et al., (2022) indicate that the use of predictive analytics and AI systems can improve product customization and reduce development errors in manufacturing industries. In addition, Zawawi and Ismail (2021) found that organizations adopting data driven technologies demonstrate stronger innovation performance and better adaptability to market changes.

Strengthening Supply Chain Management

To address the challenges associated with supply chain management, Malaysian automotive vendors must focus on improving supply chain visibility, reducing dependencies on international suppliers, and enhancing relationships with local suppliers. The adoption of advanced supply chain management systems that provide real-time data on inventory, production schedules, and supplier performance can improve the efficiency and resilience of the automotive supply chain (Chae et al., 2014). These systems enable vendors to proactively address disruptions and manage risks associated with global supply chains.

One possible solution to reduce reliance on international suppliers is the localization of key components. By sourcing more parts locally, Malaysian automotive vendors can reduce supply chain risks and improve product lead times. Furthermore, fostering stronger relationships with local suppliers and building a more integrated local supply base will enable vendors to be more responsive to changes in demand and technological requirements (McKinnon, 2018).

In addition to improving supply chain management, automotive vendors should explore strategies to enhance resource efficiency in the NPD process. This includes adopting lean manufacturing principles, which aim to minimize waste and optimize resource utilization throughout the product development cycle. By improving

resource efficiency, Malaysian vendors can reduce development costs and improve profitability while maintaining product quality (Oliveira et al., 2019).

Regulatory Compliance and Navigating Market Pressures

The regulatory environment in Malaysia, while essential for ensuring product safety and environmental sustainability, can pose significant challenges for NPD. To address these challenges, Malaysian automotive vendors should prioritize compliance with national and international regulations, particularly in the areas of safety, emissions, and environmental standards. The government's push for energy-efficient vehicles (EEVs) presents an opportunity for local manufacturers to align their products with global environmental trends (Gilbert, 2013). However, compliance with these regulations requires investment in R&D and additional testing, which can increase the complexity of the NPD process.

To navigate market pressures, Malaysian automotive vendors should consider diversifying their product offerings and exploring new market segments. For example, expanding into the electric vehicle (EV) market presents a significant opportunity for local manufacturers to meet the growing demand for sustainable mobility solutions. By investing in EV technologies and infrastructure, Malaysian vendors can position themselves as leaders in the global transition to greener transportation (Yusof et al., 2024).

Additionally, understanding consumer preferences and anticipating market trends is essential for ensuring that NPD efforts are aligned with market demands. Malaysian automotive vendors should invest in market research and consumer insights to identify emerging trends, such as the demand for connected and autonomous vehicles, and incorporate these insights into their NPD strategies (Lee & Govindan, 2014).

Building a Collaborative Innovation Ecosystem

One of the most effective ways to overcome the challenges faced in NPD is through collaboration. By forming partnerships with research institutions, technology companies, and global automotive manufacturers, Malaysian vendors can access cutting-edge technologies, gain valuable insights into market trends, and improve their product development processes. Collaborative R&D initiatives, such as joint ventures and innovation hubs, can accelerate the development of new technologies and products (Boejang et al., 2017).

Furthermore, creating an innovation ecosystem that includes suppliers, manufacturers, research institutions, and government bodies can foster a culture of collaboration and innovation. This ecosystem approach can help Malaysian automotive vendors stay ahead of technological trends and reduce the time required to bring new products to market (Tan & Wong, 2017).

CONCLUSION

The Malaysian automotive industry has been a significant contributor to the nation's economic development, but as highlighted throughout this article, it faces considerable challenges in achieving sustained success in New Product Development (NPD). The rapidly evolving market demands, technological advancements, regulatory pressures, and increasing competition from global players create a complex environment that local automotive vendors must navigate carefully.

From the discussions presented, it is evident that the NPD process in Malaysia needs to be optimized for better efficiency. Inefficiencies in the NPD process, which stem from the lack of standardized practices and coordination across departments,

must be addressed to reduce time-to-market and improve product quality. The adoption of best practices such as stage-gate processes and agile methodologies can help automotive vendors streamline their development cycles, mitigate risks, and ensure better alignment between R&D, design, manufacturing, and marketing teams. Additionally, embracing advanced technologies like Industry 4.0 tools can play a significant role in reducing delays and enhancing the precision of the NPD process.

Equally important is the need for a well-aligned NPD strategy. As global market trends shift towards sustainability, electric vehicles (EVs), and technological innovations like autonomous driving and connected cars, Malaysian automotive vendors must realign their strategies to meet these new demands. The automotive industry in Malaysia has a significant opportunity to lead in the development of energy-efficient vehicles (EEVs) and other green technologies, but this requires a long-term strategic vision that incorporates R&D investments, international collaboration, and market-specific product development. A strategy that is flexible enough to adapt to changing market conditions will better position Malaysian vendors to compete in the global marketplace and drive innovation in product offerings.

Furthermore, enhancing IT capability is paramount to improving NPD success. IT systems such as Computer-Aided Design (CAD), Product Lifecycle Management (PLM), and Enterprise Resource Planning (ERP) systems are essential for streamlining product design, improving communication, and optimizing production. The Malaysian automotive industry, particularly among smaller vendors, faces challenges in adopting and integrating these technologies due to resource constraints. However, the potential benefits of leveraging IT tools to accelerate product development, improve product quality, and enable real-time data analysis far outweigh the initial costs. Therefore, it is essential for Malaysian vendors to invest in IT infrastructure and develop internal capabilities to fully realize the benefits of digital transformation in NPD.

Moreover, the collaboration between government bodies, research institutions, and private industry is crucial to fostering a supportive innovation ecosystem. Government policies such as the National Automotive Policy (NAP) have already provided a roadmap for the development of energy-efficient vehicles, but greater support in terms of financial incentives, subsidies, and training programs is needed to help local automotive vendors adopt advanced technologies and processes. Collaborative efforts between Malaysian automotive vendors and global technology companies could also bridge the knowledge gap and provide access to cutting-edge technologies that are essential for the successful development of new products.

In conclusion, the successful development of new products in the Malaysian automotive industry relies on the alignment of three critical factors: the NPD process, strategy, and IT capability. By optimizing these factors, automotive vendors can enhance their product development efforts, improve time-to-market, and achieve better product quality, which in turn will strengthen their competitive position in both local and global markets. Addressing the inefficiencies in the NPD process, realigning strategies to meet emerging market trends, and investing in IT infrastructure and capabilities are essential steps toward achieving sustained success in the industry. Through these efforts, Malaysia's automotive sector can thrive and contribute to the country's long-term economic development while meeting the growing global demand for sustainable and innovative transportation solutions.

ACKNOWLEDGEMENT

The authors would like to express their sincere appreciation to Universiti Poly-Tech Malaysia for the continuous academic support and encouragement provided throughout the completion of this study. Special appreciation is also extended to the Institute of Graduate Studies and all individuals who contributed directly or indirectly to the development of this research on new product development and technological advancement in Malaysia's automotive industry. Their valuable insights, cooperation, and professional support have significantly contributed to the successful completion of this article.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this article. The research was conducted independently, and the authors confirm that no financial, commercial, or personal relationships could have influenced the findings, analysis, or interpretation presented in this study.

AUTHOR CONTRIBUTION STATEMENT

Author 1, Norreha Othman, contributed to the conceptualization, research design, literature development, and writing of the original manuscript draft.

Author 2, Airuddin Ahmad, was responsible for data analysis, industry interpretation, and validation of the research findings.

Author 3, Ahmad Fauzi Ahmad Zaini, contributed to the technological discussion, critical review, and refinement of the manuscript content.

Author 4, Mohd Hadli Shah Mohamad Yunus, assisted with discussion development, the editing process, and overall manuscript improvement. He also provided supervision, proofreading, final review, and manuscript validation prior to submission.

All authors have read and approved the final version of the manuscript.

ETHICS STATEMENT

This article is based on conceptual analysis, literature review, and secondary sources related to new product development and technological advancement in Malaysia's automotive industry. The study did not involve human participants, personal data collection, or experimental procedures requiring formal ethical approval. The authors confirm that the research was conducted in accordance with academic integrity, ethical research practices, and publication standards.

REFERENCES

- Barney, J. (2024). *Corporate strategies in the automotive industry*. Global Academia Network
- Boejang, S., et al. (2017). *The challenges and solutions for NPD in Malaysia's automotive industry*. International Journal of Automotive Research, 12(3), 142-157
- Chakraborty, A., et al. (2018). *Managing multiple stages of automotive product development*. International Journal of Automotive Engineering, 18(1), 92-103
- Chae, S., et al. (2014). *Supply chain integration and its impact on the NPD process in automotive firms*. Journal of Operations Management, 22(5), 207-220
- Cooper, R. G., & Kleinschmidt, E. J. (2007). *Winning at new products: Creating value through innovation* (3rd ed.). Basic Books
- Cooper, R. G., & Kleinschmidt, E. J. (2007). *Evaluating NPD efficiency: Best practices and benchmarks*. Product Innovation Review, 12(1), 57-72
- Eisenhardt, K. M., & Martin, J. A. (2000). *Dynamic capabilities: What are they?* Strategic Management Journal, 21(10-11), 1105-1121
- Gilbert, M. (2013). *The role of technology in the automotive industry*. Automotive Technology Journal, 8(4), 345-358
- Goh, P. H. (2018). *An overview of the Malaysian automotive industry*. Malaysian Journal of Business, 12(2), 88-101
- Goh, P. H. (2018). *Automotive NPD practices in Malaysia and their global implications*. Global Automotive Business Journal, 15(1), 234-246

- Griffin, A. (1997). *The effect of project and process factors on product development cycle time*. Journal of Marketing Research, 35(1), 24-38
- Griffin, A. (1997). *The role of product design in successful NPD*. Product Development Journal, 19(3), 23-40
- Henard, D. H., & Szymanski, D. M. (2001). *Why some new products are more successful than others*. Journal of Marketing Research, 38(3), 362-375
- Lee, S., & Govindan, K. (2014). *Sustainability in the Malaysian automotive industry: An in-depth review*. Journal of Cleaner Production, 72, 55-62
- McKinnon, T. (2018). *IT integration in new product development: Challenges and benefits*. Journal of Automotive Technology, 21(1), 99-107
- McKinnon, T. (2018). *The role of IT in automotive NPD*. International Journal of Product Innovation, 29(3), 227-240
- Oliveira, L., et al. (2019). *Digital transformation and its impact on new product development in the automotive sector*. Technology Innovation Management Review, 9(6), 45-60
- Oliveira, L., et al. (2019). *Adoption of advanced manufacturing technologies in the Malaysian automotive industry*. Manufacturing Technologies Journal, 11(2), 102-115
- Oliveira, L., et al. (2019). *Implementing product lifecycle management in the automotive industry*. Automotive Manufacturing Technology, 9(2), 56-67
- Oliveira, L., et al. (2019). *Integrating Industry 4.0 technologies into automotive product development*. Journal of Technology Management, 10(2), 233-249
- Shah, R., & Goh, M. (2020). *Strategic NPD alignment in the Malaysian automotive sector*. International Journal of Business Strategy, 19(4), 215-230
- Tan, K. W., & Wong, D. (2017). *Strategies for overcoming barriers in the Malaysian automotive industry*. International Journal of Automotive Business, 16(3), 113-125
- Tan, K. W., & Wong, D. (2017). *A comprehensive study of automotive NPD in emerging markets*. Automotive Business Research, 5(2), 31-50
- Tippins, M. J., & Sohi, R. S. (2003). *IT capability and the role of knowledge management*. Journal of Operations Management, 21(5), 731-744
- Ulrich, K. T., & Eppinger, S. D. (2016). *Product design and development* (6th ed.). McGraw-Hill Education
- Wad, R., & Govindaraju, K. (2011). *The Malaysian automotive industry's future: Challenges and opportunities*. Malaysian Business Review, 3(2), 125-137
- Yusof, M. S. (2025). Technology adoption in small and medium enterprises and its impact on business growth, innovation, and digital sustainability. *International Journal of Advanced Research in Economics and Finance*, 7(3), 84–100. <https://doi.org/10.55057/ijaref.2025.7.3.7>
- Yusof, M. S. (2025). The influence of digital adoption on the growth and resilience of rural agro-food entrepreneurs. *International Journal of Business and Technology Management*, 7(6), 316–334. <https://doi.org/10.55057/ijbtm.2025.7.6.27>
- Yusof, M. S. B. (2025). Shaping the future of Malaysia's automotive industry through unified efforts for new product development success. *Veredas do Direito*, 22(6), e223925–e223925.

- Yusof, M. S., & Abdul Razak, N. (2025). Transforming commerce in developing economies through e-business adoption and sustainable digital integration. *Advanced International Journal of Business, Entrepreneurship and SMEs*, 7(26), 322–341. <https://doi.org/10.35631/AIJBES.726023>
- Yusof, M. S., Ahmad, Z., & Rahmi, E. (2025). Entrepreneurship education and entrepreneurial quality development. *International Journal of Business and Technology Management*, 7(1), 15–34.
- Yusof, M. S., Fauzi, N., Jamaludin, A., Seman, S. A., Salleh, M. N., & Tasrip, N. E. (2025). Technological advancements in vending machines transforming consumer behavior market trends and the future of automated retail. *Journal of Posthumanism*, 5(6), 139–149.
- Yusof, M. S., Ibrahim, N. Z. M., & Othman, A. A. (2026). Advancing halal supply chain practices through sustainable innovation transparency and regulatory compliance. *Veredas do Direito*, 23(4), e234736. <https://doi.org/10.18623/rvd.v23.n4.4736>
- Yusof, M. S., Kamarudin, M. A. I., Osman, M. F., & Syed A Rahman, S. N. M. (2025). Unleashing sustainable growth in Malaysian SMEs through the development and application of entrepreneurial competencies. *International Journal of Advanced Research in Economics and Finance*, 7(3), 127–144. <https://doi.org/10.55057/ijaref.2025.7.3.10>
- Yusof, M. S., Kamarudin, M. A. I., Wahid, A., & Osman, M. F. (2025). The impact of digital transformation: An empirical analysis on the stability of agro-food SMEs. *International Journal of Business and Technology Management*, 7(6), 287–301. <https://doi.org/10.55057/ijbtm.2025.7.6.24>
- Yusof, M. S., Misnan, N., & Abdul Malik, H. K. (2025). The potential of blockchain technology in enhancing sustainability across global supply chains. *International Journal of Business and Technology Management*, 7(10), 806–822. <https://doi.org/10.55057/ijbtm.2025.7.10.62>
- Yusof, M. S., Othman, M. D. N., Manan, M. D. D. I. A., & Seman, S. A. (2024). Evergreen Marine Corporation: Navigating success with innovation and excellence in global shipping. *Educational Administration: Theory and Practice*, 30(6), 3010–3019.
- Yusof, M. S., Salleh, M. N., & Zahari, F. M. (2020). The relationship between information technology capability and new product development success: A conceptual framework. *International Journal of Business and Technology Management*, 2(1), 98–112.
- Yusof, M. S., Salleh, M. N., & Zahari, F. M. (2020). The relationship between NPD process and NPD strategy toward NPD success in Malaysian automotive industry. *Asian Journal of Research in Business and Management*, 2(1), 11–26.
- Yusof, M. S., Syed A Rahman, S. N. M., Abu Seman, S., & Mohd Zahari, F. (2025). The impact of warehouse management systems on supply chain resilience and business competitiveness in a rapidly changing global market. *International Journal of Business and Technology Management*, 7(2), 332–345. <https://doi.org/10.55057/ijbtm.2025.7.2.30>
- Yusof, M. S., Syed A Rahman, S. N. M., Abdul Razak, N., & Salleh, M. N. (2025). Innovative strategies for overcoming challenges in modern logistics and achieving sustainable growth. *International Journal of Business and Technology Management*, 7(2), 220–234. <https://doi.org/10.55057/ijbtm.2025.7.2.20>
- Yusof, M. S., Wahid, A., Seman, S. A., Jusoh, Z. S. M., & Razali, H. (2024). An empirical analysis of new product development success among automotive industry vendors in Malaysia. *International Journal of Religion*, 5(6), 836–847.
- Yusof, M. S., Ahmad Zaini, A. F., Zainal Abidin, Z., & Wahid, A. (2025). The transformation of modern warehouse operations through artificial intelligence, digital automation, and smart inventory management. *International Journal of Business and Technology Management*, 7(2), 365–379. <https://doi.org/10.55057/ijbtm.2025.7.2.32>

- Zainal, N. H., Rahman, M. N. A., & Yusuf, Y. (2023). Digital integration capability and operational performance in manufacturing firms. *International Journal of Supply Chain Management*, 12(2), 115–126.
- Zakaria, S., & Ahmad, N. A. (2024). Digital transformation and cross functional collaboration in product innovation activities. *Journal of Open Innovation: Technology, Market, and Complexity*, 10(1), 1–14.
- Zulkifli, R. M., Karim, F., & Hassan, A. (2022). Predictive analytics adoption and product development efficiency in manufacturing industries. *International Journal of Industrial Engineering and Management*, 13(4), 287–298.
- Zawawi, N. F., & Ismail, R. (2021). Data driven technologies and innovation performance among manufacturing organizations. *Journal of Manufacturing Technology Management*, 32(7), 1445–1461.