

The Green Practices Outcome on Sustainability Performance: Evidence from Malaysian Manufacturing Companies

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Abstract: Green practices have become an important strategic approach for manufacturing organisations seeking to improve sustainability while maintaining long-term competitiveness. Previous studies have extensively examined the environmental and financial benefits of green practices, and yet, limited research has explored their broader contribution to organisational performance from a qualitative perspective. This study explores the common green practices applied in the manufacturing industry and how these green practices contribute to organisational performance in Malaysian manufacturing companies. A qualitative multiple-case study design was adopted involving seven manufacturing companies located in Selangor, Malaysia. Data were collected through semi-structured interviews with ten informants, complemented by document analysis and workplace observations to strengthen the data credibility. Thematic analysis supported by NVivo software was employed to identify the recurring themes across the participating organisations. The findings reveal that green practices contribute to organisational performance through three interrelated dimensions: safety performance, economic performance, and organisational reputation. Green initiatives such as waste management and work process innovation improved resource efficiency, reduced operational waste, enhanced workplace safety, lowered operational costs, and strengthened stakeholder confidence. The study extends the existing literature by demonstrating that green practices create organisational value beyond environmental sustainability and should be viewed as strategic resources that enhance overall organisational performance. The findings provide practical guidance for manufacturing managers and policymakers in integrating environmental and operational strategies to achieve sustainable business performance.

Keywords: *Green practices; Sustainability; Safety benefit; Organizational performance; Manufacturing industry*

1. Introduction

Global manufacturing industries are experiencing increasing pressure to achieve sustainable growth while maintaining operational efficiency and organisational competitiveness. Increasing environmental regulations, stakeholder expectations, resource constraints, and market competition have encouraged manufacturing organisations to adopt green practices as part of their long-term business strategies. Rather than being viewed solely as environmental initiatives, green practices are increasingly recognised as organisational practices that can improve operational effectiveness, strengthen organisational resilience, and support long-term sustainability. In this context, green practices involve not only the adoption of environmentally responsible technologies and processes, but also the changes in employee practices, organisational procedures, management approaches, and work systems. Therefore, understanding the implementation and outcomes of green practices requires the consideration of both the technical and social dimensions of manufacturing organisations.

The manufacturing industry remains one of the largest contributors to economic development worldwide. In Malaysia, the manufacturing sector continues to play a significant role in national economic growth through employment creation, export earnings, technological development, and industrial development. However, manufacturing activities also consume substantial amounts of energy, raw materials, and natural resources while generating industrial waste, emissions, and occupational hazards. These challenges require organisations to adopt business practices that simultaneously support economic growth, environmental protection, operational efficiency, and employee well-being. Consequently, sustainable manufacturing requires organisations to consider not only the technical aspects of environmental improvement but also the people,

organisational structures, work processes, and management practices involved in implementing such improvements.

Green practices refer to organisational initiatives designed to minimise environmental impacts while improving the efficient utilisation of resources throughout business operations. Such practices include waste management, recycling and reuse programmes, energy efficiency, resource conservation, pollution prevention, and the adoption of environmentally responsible production technologies. These initiatives can enable organisations to reduce environmental burdens while improving operational processes and resource efficiency. Previous studies have reported that green practices can contribute to reduced energy consumption, lower production costs, improved environmental performance, enhanced operational efficiency, and strengthened corporate image. However, the benefits of green practices may depend on how these practices are implemented and integrated into existing organisational systems. The successful implementation of a green practice may require changes in the technology, production processes, employee responsibilities, skills, communication, management support, and organisational procedures.

The Socio-Technical Systems (STS) Theory provides a useful theoretical foundation for understanding these interactions. STS Theory views an organisation as a system consisting of interconnected social and technical subsystems. The technical subsystem includes technologies, machinery, production processes, workflows, and methods of resource utilisation, whereas the social subsystem includes employees, management, skills, communication, teamwork, organisational structures, and workplace practices. The theory emphasises that organisational outcomes are influenced by the interaction between these social and technical elements. From this perspective, the implementation of green practices should not be understood solely as the introduction of environmentally friendly technologies or procedures. Instead, green practices involve changes in the relationship between people, technologies, work processes, and organisational arrangements.

Despite the growing body of literature on green practices, previous research has primarily focused on environmental performance, financial performance, green innovation, or sustainable supply chain management. These studies have provided valuable evidence regarding the potential benefits of green practices; however, the findings are not always consistent across organisational and contextual settings. Some studies have reported that green practices improve operational efficiency, reduce costs, enhance competitiveness, and strengthen financial performance, whereas other studies have highlighted implementation costs, technological limitations, lack of expertise, organisational resistance, and resource constraints as challenges that may limit the benefits of green initiatives. These differences suggest that the relationship between green practices and organisational performance may depend on the organisational context and the manner in which green practices are implemented.

Furthermore, organisational performance should not be viewed solely through financial or environmental indicators. In manufacturing organisations, performance can also encompass operational efficiency, workplace safety, employee well-being, organisational reputation, and long-term sustainability. For example, waste reduction initiatives may improve resource utilisation and streamline production processes; energy management practices may reduce operating costs; cleaner technologies may improve workplace safety; and sustainable practices may strengthen stakeholder confidence and organisational reputation. These interconnected outcomes suggest that green practices can contribute to multiple dimensions of organisational performance. However, relatively limited attention has been given to understanding these interconnected outcomes from the perspective of organisations that have implemented green practices.

The dominance of survey-based quantitative studies represents a further limitation in the existing literature. Quantitative research is valuable for identifying patterns and examining relationships among variables across larger samples. However, it may not adequately capture the contextual experiences, implementation processes, organisational challenges, and meanings associated with green practices. A qualitative approach allows researchers to examine these issues in greater depth by tapping into how organisational members understand and experience green practices within their natural organisational settings. Interviews, observations, and document analysis can provide rich evidence regarding how green practices are implemented, how employees and managers respond to them, what challenges organisations encounter, and how organisational members perceive their contribution to performance.

This methodological gap is particularly relevant in the Malaysian manufacturing context. Although manufacturing organisations in Malaysia are increasingly encouraged to adopt environmentally responsible practices, comparatively limited qualitative evidence exists regarding how these organisations implement green practices within their day-to-day operations and how organisational members perceive their outcomes. Existing research has provided important insights into the adoption and performance implications of green practices, but less attention has been given to the experiences of organisations that have successfully implemented such initiatives. In particular, there is limited understanding of how technological changes interact with employee capabilities, management practices, organisational procedures, and production processes during the implementation of green practices in Malaysian manufacturing organisations.

This study addresses these gaps by exploring the green practices implemented by manufacturing organisations and how these practices contribute to organisational performance through a qualitative multiple-case study involving seven Malaysian manufacturing companies. Drawing on STS Theory, the study examines green practices as organisational practices involving the interaction between the technical and social elements. Through interviews, observations, and document analysis, the study explores how organisations implement green practices, how managers and employees experience these initiatives, how existing work processes and technologies are adapted, and how organisational members perceive the contribution of green practices to operational, safety, economic, and reputational outcomes.

The unique contribution of this qualitative study lies in moving beyond the predominantly quantitative question of whether green practices are associated with improved organisational performance to explore how green practices are implemented and how their contribution to organisational performance is experienced within the manufacturing organisations. The multiple-case design provides an opportunity to identify the common patterns and differences across seven Malaysian manufacturing companies and to examine how organisational contexts shape the implementation and outcomes of green practices. By focusing on organisational experiences, implementation processes, and interactions between social and technical elements, the study complements the existing quantitative evidence and provides a more contextual understanding of green manufacturing practices.

The study also contributes to the literature by adopting a broader perspective of organisational performance. Rather than examining environmental or financial performance in isolation, the study considers operational performance, safety performance, economic performance, and organisational reputation. From an STS perspective, these outcomes may emerge from the interaction between technical improvements and changes in social and organisational practices. Improvements in production technologies and processes may enhance operational efficiency, while employee training, participation, communication, and management support may contribute to safer and more effective work practices. Similarly, the successful integration of green practices may generate economic benefits through improved resource utilisation and cost efficiency and may strengthen organisational reputation through positive perceptions among stakeholders.

The findings of this study contribute to both theory and practice. Theoretically, the study extends the application of the STS Theory to the context of green manufacturing by demonstrating the importance of examining the interaction between technical and social elements when understanding the implementation and outcomes of green practices. Rather than treating green practices as isolated environmental initiatives, the study positions them within the broader organisational system in which technologies, employees, work processes, management practices, and organisational structures interact. The study, therefore, provides a socio-technical explanation of how green practices can contribute to multidimensional organisational performance.

Practically, the findings provide manufacturing managers with insights into the importance of integrating technical improvements with social and organisational considerations when implementing green initiatives. Investments in environmentally friendly technologies alone may not be sufficient to achieve sustainable organisational outcomes. Employee training, participation, management commitment, communication, appropriate organisational procedures, and effective integration of new technologies into existing work processes are also important considerations. Understanding these factors can help manufacturing

organisations implement green practices more effectively while achieving improvements in operational efficiency, workplace safety, economic performance, and organisational reputation.

The study also offers policymakers valuable insights into promoting sustainable manufacturing practices in Malaysia. Policies that encourage green manufacturing should consider not only technological adoption and environmental compliance, but also the organisational and human factors that influence implementation. Supporting employee training, organisational capabilities, technological development, and knowledge sharing may help manufacturing organisations integrate green practices more effectively into their operations. Such efforts can contribute to the broader objectives of sustainable industrial development and organisational competitiveness.

Overall, this study argues that green practices should not be viewed solely as environmental initiatives or regulatory requirements. Rather, they can be understood as socio-technical organisational practices that involve the interaction of technologies, people, work processes, and organisational systems. By examining the experiences of seven Malaysian manufacturing organisations through a qualitative multiple-case study, this research provides insight into how green practices are implemented and how organisational members perceive their contribution to operational performance, safety performance, economic performance, and organisational reputation. In doing so, the study extends the existing research beyond the predominantly quantitative examination of relationships between green practices and performance, and provides a deeper understanding of the organisational processes and contextual conditions through which green practices contribute to sustainable organisational outcomes.

The structure of this paper is organised as follows. The next section reviews the literature on green practices. This is followed by the research methodology, which describes the qualitative multiple-case study design, case selection, data collection, and data analysis procedures. The findings are then presented based on the themes emerging from the seven cases, followed by a discussion of the findings in relation to previous literature and the STS theoretical perspective. The paper concludes by outlining the theoretical contributions, practical and policy implications, limitations, and directions for future research.

2. Literature Review

Green practices adoption

Green practices in the manufacturing industry are manufacturing processes that focus on efficient production processes that use fewer materials, simplified processes, and safe manufacturing practices. Haile and Sing (2026) highlighted that the green practices embedded at the corporate level enhance the prospects of achieving long-term sustainability. Green practices encompass a range of environmentally sustainable initiatives, including green manufacturing (GM), green warehousing, green packaging, and green distribution (Wang et al., 2013). The implementation of these practices enables manufacturing firms to improve operational efficiency while minimising environmental impacts. Specifically, practices such as green manufacturing and green logistics contribute to enhanced product durability, efficient maintenance, reuse, refurbishment, and recycling, thereby supporting sustainable manufacturing operations (Umar et al., 2021).

Previous studies on green practices in the manufacturing industry have consistently identified green manufacturing and green supply chain management (GSCM) as the two most widely examined practices. Green manufacturing has been recognised as a key component of sustainable manufacturing and this has been extensively discussed in the literature (Wang et al., 2013; Ramayah et al., 2013; Sangwan & Choudhary, 2018; Afum et al., 2020; Umar et al., 2021; Wang et al., 2022). Similarly, green supply chain management has received considerable attention as a complementary practice that integrates environmental considerations throughout upstream and downstream supply chain activities (Ninlawan et al., 2010; Conding et al., 2012; Wang et al., 2013; Mardani et al., 2020; El-Mokadem & Khalaf, 2025). Supporting this perspective, Ramayah et al. (2013) incorporated both green manufacturing and green supply chain management as key dimensions for measuring manufacturing performance, highlighting their importance in improving organisational and operational outcomes.

Implementing a green-oriented business plan serves a dual strategic purpose: it secures a distinct competitive advantage while tangibly demonstrating an organisation's commitment to sustainable development (Sarkar et al., 2020). Beyond external positioning, integrating these green practices yields profound internal benefits, specifically enhancing the localised social sustainability within the workplace framework (Sroufe & Gopalakrishna-Remani, 2018, as cited in Govindan et al., 2021). The organisational impetus to adopt these eco-centric models is universally driven by a binary interplay of internal motivations and external pressures (Hasan et al., 2019; Yadegaridehkordi et al., 2023).

Internally, adoption is catalysed by deep-seated social obligations and aggressive competitiveness. Externally, coercive and market-driven pressures exerted by governments, regulatory mandates, non-governmental organisations (NGOs), customers, and local communities compel firms to reshape their operational paradigms (Khan et al., 2018; Hasan et al., 2019). Ultimately, this systemic shift across modern industries is a direct response to a broader public health and ecological crisis, aimed squarely at mitigating the systemic use of hazardous chemicals that drive air pollution, accelerate global warming, and compromise communities' well-being (Khan et al., 2018).

Green Practices Impact

From an environmental perspective, empirical evidence demonstrates that green practices through GM alongside complementary GSCM frameworks substantially mitigate the ecological footprint of industrial activities without triggering adverse environmental trade-offs (Afum et al., 2020). This is achieved through closed-loop manufacturing systems that contain waste, curb hazardous emissions, and optimise energy recovery through aggressive recycling and reuse protocols (Green et al., 2012; Bhool & Narwal, 2013; Sezen & Cankaya, 2013). Consequently, achieving benchmarks such as zero-pollution outputs and maximum material circularity directly correlates with measurable reductions in solid, liquid, and atmospheric waste streams (Yongge et al., 2009; Gao et al., 2019).

Economically, eco-efficiency directly translates into cost reduction and operational optimisation. Rather than acting as a financial drain, green practices catalyse productivity by minimising raw material consumption and lowering the expenditures related to environmental compliance and risk management (Atlas, 1998; Al-Hakimi et al., 2022). For small and medium enterprises (SMEs) in particular, the visibility of these tangible financial gains and operational efficiencies serves as the primary driver for adoption, ultimately mapping clear trajectories for sustained organisational growth (Ramayah et al., 2013; Sahar et al., 2020).

The social dimension of GM underpins long-term organisational sustainability and market competitiveness. Externally, low-impact production and responsible material selection bolster corporate reputation, cultivate stakeholder trust, and stimulate research and design (R&D) innovation (Ratnasingam & Wagner, 2009; Maruthi & Rashmi, 2015; Ghazilla et al., 2015). Internally, GM functions as a critical mechanism for occupational health and safety. By deliberately designing out process hazards, organisations can approximate targets of zero health damage and zero safety risks for operators—thereby safeguarding human capital, reducing accident-related liabilities, and mitigating occupational diseases (Yongge et al., 2009; Schulte et al., 2013; Mamtani, 2020).

3. Methodology

This study employed a qualitative multiple case study design to explore the implementation of green practices and their contribution to safety performance in the Malaysian manufacturing industry. A qualitative approach was appropriate as it enabled an in-depth understanding of organisational practices and the experiences and perspectives of practitioners involved in green and safety management. The multiple case design also facilitated comparisons across manufacturing organisations and the identification of common and case-specific patterns.

A total of 10 informants from seven manufacturing organisations in Selangor participated in the study. They comprised Safety and Health Officers, Safety Executives, Safety Engineers, Environmental Officers, Department Managers, and Senior Management Representatives. Participants were purposively selected based on their direct involvement in, or knowledge of, safety management, environmental management, green practices, or

operational activities. Access was obtained through the participating organisations and their designated representatives. Participation was voluntary, and informed consent was obtained before data collection.

Data were collected through semi-structured interviews, document analysis, and workplace observations. The interview protocol was developed based on the research questions and relevant literature and covered four main areas: safety performance, implementation of green practices, the contribution of green practices to safety performance, and implementation challenges. Open-ended questions and probing techniques were used to obtain detailed information and clarify participants' experiences. Interviews were conducted face-to-face according to the arrangements with each organisation and lasted approximately 2 hours. Interviews were audio-recorded with participants' permission and transcribed for analysis. Documentary evidence included environmental policies, sustainability reports, standard operating procedures, safety documentation, and certification records. Workplace observations provided additional contextual information on operational activities, green practices, and workplace conditions. These multiple sources enabled the triangulation of the findings.

The data were analysed using thematic analysis based on the six-phase approach of Braun and Clarke (2006). The process began with familiarisation through repeated reading of interview transcripts, observation notes, and documents. Initial codes were systematically generated using NVivo and focused on information relevant to the research questions. Both literature-informed concepts and themes emerging from the data were considered. Codes were subsequently compared and grouped into categories, followed by the identification and review of broader themes across the cases. Themes were refined, defined, and named before the final findings were developed. Data from different informants and organisations were continuously compared to identify the similarities and differences in the implementation of green practices and their contribution to safety performance. Data collection and analysis were conducted iteratively. Preliminary analysis informed subsequent interviews and helped determine whether new information was emerging. Data collection was considered sufficient when subsequent interviews generated limited new information, and the themes were adequately developed to address the research questions.

Permission to conduct the study was obtained from the participating organisations, and informed consent was secured from all participants. Participants were informed of the study purpose, the nature of their involvement, and their right to withdraw without penalty. Confidentiality and anonymity were maintained by removing personal identifiers and using pseudonyms or case codes for organisations. Research materials, including recordings, transcripts, and documents, were securely stored and accessed only by the researcher and authorised research personnel.

The trustworthiness of the findings was established based on credibility, dependability, confirmability, and transferability. Credibility was enhanced through methodological triangulation involving interviews, documents, and workplace observations, as well as the comparison of perspectives across participants and cases. Member checking was conducted to verify the accuracy of the transcription process by the researcher. Dependability was supported through the consistent use of a semi-structured interview protocol and systematic documentation of data collection, transcription, coding, categorisation, and theme development. NVivo facilitated the systematic organisation and retrieval of coded data. Confirmability was strengthened by grounding findings in participants' accounts and multiple sources of evidence, while an audit trail was maintained to document the development of codes and themes. Finally, transferability was supported through detailed descriptions of the research context, participating organisations, participants, and practices examined. Although the study does not seek statistical generalisation to all Malaysian manufacturing organisations, the detailed case descriptions allow readers and future researchers to assess the applicability of the findings to similar manufacturing contexts.

4. Findings

Based on the thematic analysis, Green Practices Activities and Green Practices Outcomes emerged as the two principal themes of this study. The findings indicate that manufacturing companies implement three primary categories of green practices, namely waste management, work process innovation, and management initiatives. These categories represent the key green practices adopted by the participating manufacturing

companies to support sustainable operations and enhance organisational performance. Moreover, the findings also highlight that the outcomes of green practices not only focus on environmental benefits but also indicate that the green practices contribute to safety improvement, cost benefits, and increased awareness among stakeholders.

Green Practices Activities

Waste Management- Waste management emerged as one of the main green practices implemented by the participating manufacturing companies. The findings indicate that companies classify waste into two categories, namely scheduled waste and general waste, to ensure systematic handling of waste while protecting the employees and the environment. The waste management system is crucial to provide sufficient resources and ensure effective waste management (Informant 3, Company A).

Scheduled waste refers to hazardous waste regulated under the Environmental Quality Act 1974 and the Environmental Quality (Scheduled Wastes) Regulations 2005. Companies are required to report the quantity and type of scheduled waste through the Electronic Scheduled Waste Information System (eSWIS) and ensure that waste is properly stored, handled, treated, and disposed of. Most companies appointed competent personnel certified by the Department of Environment (DOE) to manage scheduled waste and ensure compliance with regulatory requirements. The findings also revealed that companies strictly complied with the maximum storage limit of six months or 20 metric tons before disposal. (Informant 4, Company B; Informant 13, Company F; Informant 10, Company E). Compliance with these regulations was considered important in preventing environmental pollution and workplace hazards, particularly those associated with hazardous chemical spills. Scheduled waste such as electronic waste (e-waste) was also recovered through third-party contractors to extract reusable materials, particularly copper, demonstrating that waste recovery was integrated into manufacturing operations (Informant 7, Company D).

Other findings also highlighted that general waste consists of non-hazardous waste generated from production, warehouses, and office activities. Although reporting to regulatory authorities is not required, companies voluntarily implemented waste management initiatives to maintain workplace cleanliness and improve environmental performance. Common wastes included plastic, paper, cardboard, and packaging materials, which were segregated for recycling and reuse (Informant 4, Company B; Informant 7, Company D; Informant 13, Company F). Several companies also introduced employee engagement programmes to encourage waste collection and recycling, while others collaborated with suppliers by replacing disposable packaging with reusable containers that could be returned for subsequent deliveries (Informant 4, Company B; Informant 7, Company D). These initiatives demonstrate that waste management extends beyond regulatory compliance by promoting environmental awareness, resource efficiency, and continuous improvement within manufacturing operations.

Work Process Innovation

In addition to waste management, the findings identified work process innovation as another important green practice adopted by the manufacturing companies. Rather than relying solely on waste disposal, companies implemented innovative approaches such as recycling, reuse, and recovery to manage production waste more sustainably. These initiatives reduced waste generation, minimised disposal costs, improved resource utilisation, and generated additional operational and environmental benefits.

Recycling was identified as a key work process innovation implemented by the participating manufacturing companies. The findings revealed that companies recycle various waste materials, including plastics, paper, cartons, scrap metal, packaging materials, and production waste, to reduce waste generation and improve resource efficiency. Rather than disposing of reusable materials, companies process them into raw materials for future production or return them to suppliers for reprocessing (Informant 8, Company D; Informant 9, Company E). The recycling process begins with waste segregation at the source, where employees separate waste according to designated categories before collection by appointed personnel. Although the recycling of general waste is not subject to regulatory reporting, companies monitor the quantity of recyclable materials to evaluate their waste management performance. Several companies also collaborated with third-party contractors or suppliers to recover recyclable materials and maximise resource utilisation (Informant 8, Company D; Informant 9, Company E; Informant 13, Company F).

In addition to recycling, the findings identified reuse as another work process innovation adopted by manufacturing companies to minimise waste generation and improve resource utilisation. Reuse involves extending the lifespan of existing materials, equipment, or resources by applying them for the same or alternative purposes within company operations. This practice enables companies to reduce the consumption of new resources, minimise disposal costs, and support sustainable manufacturing practices (Informant 4, Company B; Informant 8, Company D). The findings revealed that companies implemented reuse initiatives in various operational activities. For example, Company D practised the return and reuse of packaging boxes from customers for subsequent deliveries, reducing the need for new packaging materials. Kaizen activity has also been acknowledged in encouraging employees to identify opportunities for repurposing unused tools, equipment, and materials through continuous improvement activities. These initiatives enabled unused resources, such as pipes, racks, and production components, to be modified and reused for different operational purposes, resulting in cost savings and improved process efficiency (Informant 8, Company D). Furthermore, reuse activities were found to support both environmental and social benefits. Company C demonstrated an innovative approach by reusing contaminated gloves classified as scheduled waste through an internal cleaning process. The activity not only reduced scheduled waste generation and disposal costs but also provided suitable light-duty work opportunities for employees with physical limitations or health-related restrictions (Informant 6, Company C).

Besides recycling and reuse, the findings identified recovery as another work process innovation adopted by manufacturing companies to manage waste sustainably. The recovery process involved transforming waste materials into usable resources or secondary products, thereby reducing disposal requirements and improving resource efficiency. The findings revealed that Companies B and C implemented recovery practices for different types of scheduled waste generated from their production activities, particularly oil sludge and paint sludge. Company B implemented an oil recovery process to address oil sludge generated from oil spillage during the filling process. Previously, the company relied on external contractors for waste disposal, which resulted in additional operational costs. To improve waste management efficiency, the company introduced an oil skimmer system that separates oil from water collected through the drainage system. This initiative reduced waste disposal costs by approximately 30% and prevented workplace hazards associated with oil spillage, particularly slippery floor conditions (Informant 4, Company B). Similarly, Company C applied recovery practices to manage paint sludge generated from its painting activities. Instead of disposing of paint sludge as scheduled waste, the company collaborated with an appointed contractor to recover the material and transform it into second-grade paint for other users. This practice reflects the company's commitment to environmental protection by reducing waste disposal and promoting resource recovery in line with its ISO 14001 environmental management practices (Informant 6, Company C).

Besides waste management and work process innovation, the findings identified management initiatives as another important dimension of green practices adopted by manufacturing companies. Unlike operational-level practices, management initiatives require strategic planning, investment decisions, and collaboration with internal and external stakeholders to achieve long-term sustainability objectives. The main initiatives identified include energy management, water management, and GSCM.

Energy management emerged as a significant green initiative due to the high energy consumption associated with manufacturing operations. The findings revealed that companies implemented several strategies to improve energy efficiency, including solar energy installation, smart air systems, and the replacement of energy-intensive machinery. Solar installation was the most common energy management initiative adopted by the companies (Informant 2, Company A; Informant 4, Company B; Informant 6, Company C; Informant 8, Company D; Informant 9, Company E; Informant 14, Company F). By generating renewable energy from solar panels, companies were able to reduce their dependency on the electricity supplied by external providers, have lower operational costs, and support carbon reduction efforts. In addition to solar energy, a smart air system was used to optimise the compressor performance by maintaining appropriate air pressure and reducing unnecessary electricity consumption (Informant 6, Company C). A company also explored the replacement of the conventional machinery with hybrid machines to improve energy efficiency (Informant 14, Company F).

Water management was another important green initiative identified in the study. Companies implemented water conservation strategies through wastewater treatment plants (WWTP), water reclamation plants (WRP),

and rainwater harvesting (RWH) systems. These initiatives aimed to reduce the dependency on external water sources, minimise wastewater discharge, and improve water resource efficiency. The findings revealed that some companies integrated multiple water management practices into their production processes, such as WWTP and WRP, where treated wastewater was further processed and reused in production activities, creating a closed-loop water management system (Informant 6, Company C). WWTP and RWH were used to support production activities that required significant water consumption (Informant 15, Company G).

The findings further identified GSCM as a management initiative that extends green practices beyond the organisational boundaries by involving suppliers and customers. GSCM practices include green supplier selection, sustainable material sourcing, environmentally friendly packaging, and supplier collaboration. Companies required suppliers to comply with environmental requirements, such as providing Substances of Concern (SOC) certification and disclosing sustainability-related information. These requirements ensured that materials used in production were environmentally compliant and that they supported customers' sustainability expectations (Informant 15, Company G). Companies also collaborated with suppliers to reduce packaging waste through reusable packaging systems, returnable boxes, and rack-based delivery systems (Informant 8, Company D). The findings showed that supplier involvement remains a key challenge, particularly among small and medium-sized suppliers with limited awareness and reporting capabilities. Therefore, companies conducted supplier awareness programmes, assessments, and audits to encourage suppliers to gradually adopt green practices. Green readiness was also incorporated as one of the criteria in supplier selection and contract renewal decisions (Informant 2, Company A; Informant 4, Company B; Informant 8, Company D).

Green Practices Outcomes

The implementation of green practices contributes to several positive outcomes for manufacturing companies, particularly in terms of safety improvement, social benefits, economic benefits, and stakeholder awareness. The findings indicate that green practices should be viewed as a long-term investment that creates shared benefits for organisations, employees, and the environment.

The findings revealed that green practices contribute positively to occupational safety performance through both direct and indirect mechanisms. Effective management of hazardous waste, particularly scheduled waste, was identified as an important practice in reducing worker exposure to harmful substances (Informant 7, Company D). In addition, recycling and reuse activities contributed to safer working environments by promoting workplace organisation and reducing potential hazards such as slips, trips, and falls (Informant 3, Company A). Waste segregation practices also improved employee awareness and responsibility towards maintaining clean and safe work areas. Furthermore, reducing waste volume through recycling minimised manual handling activities, thereby lowering the ergonomic risks associated with lifting and transporting heavy waste materials (Informant 4, Company B; Informant 8, Company D). Recovery processes, such as oil recovery systems, were also able to reduce workers' exposure to hazardous substances and prevent safety risks caused by oil spillages (Informant 4, Company B). The findings further showed that green practices support hazard reduction through the adoption of safer materials and processes. By reducing the use of hazardous substances, companies were able to minimise employee exposure and strengthen preventive safety measures. These findings suggest that green practices complement traditional safety management approaches by addressing hazards at their source (Informant 3, Company A; Informant 15, Company G).

Other than safety benefits, economic benefits emerged as another significant outcome of green practice implementation. Although some initiatives require considerable initial investment, companies reported long-term financial benefits through cost reduction, resource efficiency, and additional income generation. Energy and water management practices, particularly solar installation and water conservation initiatives, contributed to the reductions in utility costs. Companies also recognised these initiatives as strategies to manage future risks associated with increasing energy and water prices (Informant 1, Company A; Informant 6, Company C). The findings also revealed that work process innovations, such as reuse and Kaizen activities, generated economic advantages by reducing the need to purchase new materials and equipment (Informant 8, Company D). In addition, recycling and recovery activities created opportunities for revenue generation through the sale of recyclable materials and recovered products (Informant 4, Company B). Some companies also shared income

generated from recycling activities with employees as a form of recognition and motivation, strengthening employee participation in green initiatives (Informant 13, Company F)

Beyond operational and financial benefits, green practices were found to enhance environmental awareness among employees and other stakeholders. The implementation of green initiatives encouraged employees to adopt more responsible behaviours, particularly in waste segregation, resource conservation, and workplace organisation. The green practices contributed to changes in employees' mindsets. Employees who previously lacked awareness of waste classification gradually developed a greater understanding and responsibility through continuous training and involvement in green programmes. For example, recycling campaigns and employee competitions encouraged active participation and strengthened engagement with sustainability initiatives (Informant 4, Company B; Informant 6, Company C). This finding, it showed that awareness among employees was identified as a critical factor in sustaining green practices. This continuous improvement, supported by top management, encouraged employees to actively contribute ideas and participate in environmental activities. These initiatives not only improved environmental performance but also fostered a culture of sustainability within organisations.

5. Conclusion

In conclusion, this study revealed that the green practices implemented by the companies began with efforts to preserve the environment through proper waste management, involving the handling of both scheduled and general waste, followed by the integration of recycling, reuse, and recovery processes within their production activities. These green initiatives were further expanded through management involvement in energy and water management practices, as well as the implementation of green supply chain management, which requires active collaboration and commitment from suppliers to support the organisations' sustainability efforts. By exploring the companies' green practices, this study shows that these practices generate significant safety-related benefits, minimise workers' exposure to hazardous materials through effective waste management practices and reduce ergonomic risks by decreasing the reliance on heavy and manual labour through recycling, reuse, and recovery processes. Furthermore, the findings highlight that the economic benefits derived from green practices adoption extend beyond environmental improvements, as efficient energy and water management contribute to sustained cost efficiency. These practices not only reduce the costs associated with waste disposal, but also create additional revenue streams through the sale of recyclable waste materials and the production of secondary-grade products. Moreover, the adoption of green practices has enhanced stakeholders' awareness of environmental initiatives, with continuous improvement systematically being integrated into organisational processes. This progress is further supported by employees' proactive involvement in sustainability programmes, reflecting a collective and long-term commitment towards corporate environmental responsibility. Overall, this study provides insights into how green practices are implemented within manufacturing companies, demonstrating that environmental sustainability initiatives can indirectly enhance safety performance. The findings highlight that green practices serve as a proactive approach to minimising potential harm to employees while providing a strategic pathway for organisations to strengthen their safety performance by leveraging the existing sustainability initiatives.

References

- Afum, E., Agyabeng-Mensah, Y., Sun, Z., Frimpong, B., Kusi, L. Y., & Acquah, I. S. K. (2020). Exploring the link between green manufacturing, operational competitiveness, firm reputation and sustainable performance dimensions: a mediated approach. *Journal of Manufacturing Technology Management*, 31(7), 1417–1438. <https://doi.org/10.1108/jmtm-02-2020-0036>
- Al-Hakimi, M. A., Al-Swidi, A. K., Gelaidan, H. M., & Mohammed, A. (2022). The influence of green manufacturing practices on the corporate sustainable performance of SMEs under the effect of green organisational culture: A moderated mediation analysis. *Journal of Cleaner Production*, 376, 134346. <https://doi.org/10.1016/j.jclepro.2022.134346>
- Atlas, M., & Florida, R. (1998). Green manufacturing. In R. Drof (Ed), *Handbook of technology management* (pp. 1385-1393). CRC Press.

- Bhool, R., & Narwal, M. S. (2013). An analysis of drivers affecting the implementation of green supply chain management for the Indian manufacturing industries. *International Journal of Research in Engineering and Technology*, 2(11), 2319-1163.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101. <https://doi.org/10.1191/1478088706qp063oa>
- Condong, J., Mohd Zubir, A. F., Adwini Hashim, S., & Ain Sri Lanang, N. (2012). A Proposed of Green Practices and Green Innovation Model in Malaysian Automotive Industry. *Environmental Management and Sustainable Development*, 1(2). <https://doi.org/10.5296/emsd.v1i2.2183>
- El-Mokadem, M. & Khalaf, M. (2025). Building sustainable performance through green supply chain management. *International Journal of Productivity and Performance Management*, 74(1), 203-223, doi: <https://doi-org.ezproxy.utm.my/10.1108/IJPPM-02-2024-0113>
- Gao, Y., Li, J., & Song, Y. (2009). Performance evaluation of green supply chain management based on membership conversion algorithm. 2009 ISECS International Colloquium on Computing, Communication, Control, and Management. doi:10.1109/cccm.2009.5267895
- Ghazilla, R. A., Sakundarini, N., Abdul-Rashid, S. H., Ayub, N. S., Olugu, E. U., & Musa, S. N. (2015). Drivers and Barriers Analysis for Green Manufacturing Practices in Malaysian SMEs: Preliminary Findings. *Procedia CIRP*, 26, 658-663. doi:10.1016/j.procir.2015.02.085
- Govindan, K., Shaw, M., & Majumdar, A. (2021). Social sustainability tensions in multi-tier supply chain: A systematic literature review towards conceptual framework development. *Journal of Cleaner Production*, 279, 123075. <https://doi.org/10.1016/j.jclepro.2020.123075>
- Green, K. W., Zelbst, P. J., Meacham, J., & Bhadauria, V. S. (2012). Green supply chain management practices: impact on performance. *Supply Chain Management: An International Journal*, 17(3), 290-305. <https://doi.org/10.1108/13598541211227126>
- Haile, M. B., and Singh, S. (2025). Linking Corporate Environmental Strategy to Environmental Performance: The Mediating Role of Employee Green Behavior and the Moderating Effect of Environmental Concern. *Business Strategy & Development*, 8(4), e70215. <https://doi.org/10.1002/bsd2.70215>.
- Hasan, M. M., Nekmahmud, M., Yajuan, L., & Patwary, M. A. (2019). Green business value chain: a systematic review. *Sustainable Production and Consumption*, 20, 326-339. <https://doi.org/10.1016/j.spc.2019.08.003>
- Khan, S. A. R., Jian, C., Yu, Z., Golpira, H., & Kumar, A. (2018). Impact of Green Practices on Pakistani Manufacturing Firm Performance: A Path Analysis Using Structural Equation Modeling. *Computational Intelligence and Sustainable Systems*, 87-97. https://doi.org/10.1007/978-3-030-02674-5_6
- Mamtani, B. (2020). Occupational Safety Practices in the Manufacturing Industry in North India. *International Journal for Research in Applied Science and Engineering Technology*, 8(6), 2301-2310. doi:10.22214/ijraset.2020.6371
- Mardani, A., Kannan, D., Hooker, R. E., Ozkul, S., Alrasheedi, M., & Tirkolaee, E. B. (2020). Evaluation of green and sustainable supply chain management using structural equation modelling: A systematic review of the state of the art literature and recommendations for future research. *Journal of Cleaner Production*, 249, 119383. <https://doi.org/10.1016/j.jclepro.2019.119383>
- Maruthi, G. D., & Rashmi, R. (2015). Green Manufacturing: Its Tools and Techniques that can be implemented in Manufacturing Sectors. *Materials Today: Proceedings*, 2(4-5), 3350-3355. <https://doi.org/10.1016/j.matpr.2015.07.308>
- Ninlawan, C., Seksan, P., Tossapol, K., & Pilada, W. (2010). The implementation of green supply chain management practices in the electronics industry. In *World Congress on Engineering 2012*. July 4-6, 2012. London, UK. (Vol. 2182, pp. 1563-1568). International Association of Engineers.
- Ramayah, T., Mohamad, O., Omar, A., Marimuthu, M., & Leen, J. Y. A. (2013). Green manufacturing practices and performance among SMEs: evidence from a developing nation. In *Green technologies and business practices: an IT approach* (pp. 208-225). IGI Global.
- Ratnasingam, J., & Wagner, K. (2009). Green manufacturing practices among wooden furniture manufacturers in Malaysia. *European Journal of Wood and Wood Products*, 67(4). doi:10.1007/s00107-009-0341-1
- Sahar, D. P., Afifudin, M. T., & Indah, A. B. R. (2020). Review of green supply chain management in manufacturing: A case study. *IOP Conference Series: Earth and Environmental Science*, 575(1), 012239. <https://doi.org/10.1088/1755-1315/575/1/012239>

- Sangwan, K. S., & Choudhary, K. (2018). Benchmarking manufacturing industries based on green practices. *Benchmarking: An International Journal*, 25(6), 1746–1761. <https://doi.org/10.1108/bij-12-2016-0192>
- Sarkar, A., Qian, L., & Peau, A. K. (2020). Overview of green business practices within the Bangladeshi RMG industry: competitiveness and sustainable development perspective. *Environmental Science and Pollution Research*, 27(18), 22888–22901. <https://doi.org/10.1007/s11356-020-08816-y>
- Schulte, P. A., McKernan, L. T., Heidel, D. S., Okun, A. H., Dotson, G. S., Lentz, T. J., Geraci, C. L., Heckel, P. E., & Branche, C. M. (2013). Occupational safety and health, green chemistry, and sustainability: a review of areas of convergence. *Environmental Health*, 12(1). <https://doi.org/10.1186/1476-069x-12-31>
- Sezen, B., & Cankaya, S. Y. (2013). Effects of Green Manufacturing and Eco-innovation on Sustainability Performance. *Procedia - Social and Behavioral Sciences*, 99, 154–163. doi:10.1016/j.sbspro.2013.10.481
- Sroufe, R., & Gopalakrishna-Remani, V. (2018). Management, Social Sustainability, Reputation, and Financial Performance Relationships: An Empirical Examination of U.S. Firms. *Organisation & Environment*, 32(3), 331–362. <https://doi.org/10.1177/1086026618756611>
- Umar, M., Khan, S. A. R., Zia-ul-haq, H. M., Yusliza, M. Y., & Farooq, K. (2021). The role of emerging technologies in implementing green practices to achieve sustainable operations. *The TQM Journal*, 34(2), 232–249. <https://doi.org/10.1108/tqm-06-2021-0172>
- Wang, D., Si, R., & Fahad, S. (2022). Evaluating the small and medium-sized enterprises' motivating factors and influencing barriers to the adoption of green practices. *Environment, Development and Sustainability*, 25(4), 3029–3041. <https://doi.org/10.1007/s10668-022-02166-0>
- Wang, Z., Subramanian, N., Abdulrahman, M., & Liu, C. (2013). Composite practices to improve sustainability: A framework and evidence from a Chinese auto-parts company. 2013 IEEE International Conference on Industrial Engineering and Engineering Management. <https://doi.org/10.1109/ieem.2013.6962570>
- Yadegaridehkordi, E., Foroughi, B., Iranmanesh, M., Nilashi, M., & Ghobakhloo, M. (2023). Determinants of environmental, financial, and social sustainable performance of manufacturing SMEs in Malaysia. *Sustainable Production and Consumption*, 35, 129–140. <https://doi.org/10.1016/j.spc.2022.10.026>
- Yongge, G., Jiyong, L. and Yunfeng, S. (2009). Performance evaluation of green supply chain management based on membership conversion algorithm. 2009 Second ISECS International Colloquium on Computing, Communication, Control, and Management, CCCM 2009.