

DRIVING SUSTAINABLE INDUSTRIAL TRANSFORMATION: ORGANIZATIONAL READINESS AND THE PREDICTIVE INFLUENCE OF GREEN TECHNOLOGY MANAGEMENT PRACTICES ON SUSTAINABLE INDUSTRIAL PERFORMANCE AMONG CANNING INDUSTRIES IN ZAMBOANGA CITY

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ABSTRACT: *As the manufacturing industries are facing serious environmental issues while remaining economically competitive, industrial sustainability is gaining importance. The study investigated the significance of Green Technology Management (GTM) practices in predicting sustainable industrial performance of selected canning industries in Zamboanga City, Philippines, taking into account organizational readiness as an enabling condition for green technology adoption. A descriptive quantitative research design used 150 respondents of selected canning industries. The data were collected using an adapted survey instrument that measured GTM practices related to energy conservation, pollution prevention, and innovation and technology adoption. Organizational readiness in terms of employee competencies, technological infrastructure and financial capacity. Sustainable industrial performance in terms of production efficiency, environmental compliance and economic sustainability. The data were analyzed using descriptive statistics and linear regression. The results showed that the industries involved have a high degree of GTM practices, a high level of organizational readiness and sustainable industrial performance. The results also showed that GTM practices are important predictors of sustainable industrial performance, implying that the adoption of environmentally responsible technologies and management strategies is critical to enhance operational efficiency, environmental compliance, and long-term competitiveness. The study concludes that GTM is a strategic capability for sustainable industrial transformation and stresses the need to strengthen the organizational capabilities to support the green technology adoption in the manufacturing sector.*

Keywords: Green Technology Management, organizational readiness, sustainable industrial performance, green innovation, sustainable manufacturing, canning industry

INTRODUCTION

Industrial sectors play a vital role in economic development through increased production, employment generation and economic growth. But as industry has grown, so have the problems for the environment. There is more waste, resources are used up, greenhouse gases are emitted and pollution is caused. These concerns have forced the industries to go green in their process and achieve a balance between economic growth and environmental responsibility. Green Technology Management (GTM) is a strategic management framework that uses sustainable technologies, management practices, and organizational strategies to reduce environmental impacts, improve operational efficiency, and improve long-term performance. In this study GTM is measured by energy conservation, pollution prevention and innovation & technology adoption. Policy support for the adoption of green technology is increasing, but translating initiatives into actual organizational practices remains a challenge. Despite the Philippines' efforts to promote the development of green technology, many companies are still unacquainted and unwilling to adopt green and smart technologies. This underscores the significance of organizational readiness which is the ability of an organization to adopt and sustain technology innovations through employee competence, technological infrastructure and financial ability. Organizational readiness improves the economic and environmental performance of organizations adopting green technologies [7]. GTM integration success and organizational readiness support sustainable industrial performance such as production efficiency, environmental compliance and economic sustainability. The adoption of green technologies and environmental management

practices in organizations can improve efficiency, environmental performance and competitiveness [10]. Zamboanga City is the Philippines' largest center of seafood processing and production of canned sardines. But it is struggling more to stay competitive in the industry while keeping up with environmentally sustainable practices. However, there is a paucity of empirical evidence regarding GTM practices, organizational readiness, and sustainable industrial performance in the regional canning industry. This gap is important given the sector's high energy and resource use, waste production, and environmental compliance requirements. Therefore, this study investigates the Green Technology Management practices, organizational readiness and sustainable industrial performance of the canning industries in Zamboanga City. Specifically, it measures the degree of GTM practices, the degree of organizational readiness, the degree of sustainable industrial performance, and whether GTM practices significantly predict sustainable industrial performance.

Research Aim

This study is conducted to determine the organizational readiness and the predictive influence of Green Technology Management on Sustainable Industrial Performance among Canning Industries in Zamboanga City. In particular, it aims to: determine the extent of Green Technology Management practices among canning industries in Zamboanga City, determine the level of organizational readiness for Green Technology Management adoption, determine the level of sustainable industrial performance and examine whether Green Technology Management practices significantly predict sustainable industrial performance.

METHODS

Design and Setting

The study used a descriptive-predictive quantitative research design to investigate Green Technology Management (GTM) Practices, Organizational Readiness, and Sustainable Industrial Performance of selected canning industries in Zamboanga City, Philippines. The descriptive part measured the degree of GTM practices on energy conservation, pollution prevention, and innovation and technology adoption; the degree of Organizational Readiness on employee competence, technological infrastructure, and financial capacity; and Sustainable Industrial Performance on production efficiency, environmental compliance, and economic sustainability. In the meantime, the predictive part identified the GTM practices as a significant predictor of Sustainable Industrial Performance. The study was conducted on some canning industries engaged in the production of canned sardines and processed seafood products in Zamboanga City, a known center of sardine and seafood processing industry in the Philippines during year 2025-2026. The locale was chosen based on the concentration of seafood manufacturing enterprises whose operations involve utilizing resources, technological processes and environmental management practices relevant to the objectives of the study.

Respondents and Sampling

The study was participated by 150 respondents from four (4) selected canning industries in Zamboanga City producing canned sardines and processed seafood. The participants were the middle level managers and the production workers who were involved in the implementation and execution of the Green Technology Management practices. The industries were coded IND 1 to IND 4 for confidentiality purposes. The total population was unknown; thus, the required sample size was estimated using G*Power version 3.1. The minimum number of respondents was 98, based on an effect size of 0.15, $\alpha = 0.05$ and power = 0.80 (Faul et al., 2009). A non-probability sampling approach using purposive and convenience sampling was used. Employees whose roles were relevant to Green Technology Management implementation were selected through purposive sampling, while convenience sampling took into account respondents' availability and willingness to participate.

Instrument

The survey questionnaire was adapted from similar studies and modified to fit to the context of the canning industry and was used for the study. The instrument comprised of respondent profiles, Green Technology Management practices, Organizational Readiness and Sustainable Industrial Performance. Assessment of Green Technology Management was done through energy conservation, pollution prevention and innovation and technology adoption. The measurement of the Organizational Readiness was based on the employee competence, technological infrastructure, and the financial capacity. Sustainable Industrial Performance was measured using production efficiency, environmental compliance and economic sustainability. The 4-point Likert scale ranging from 1 (Strongly Disagree) to 4 (Strongly Agree) was used to measure all variables to determine the extent of practices, level of readiness

and level of sustainable industrial performance in the participating industries.

Validity and Reliability of Instrument

The adapted questionnaire was tested for validity and reliability. External experts in the area of Green Technology Management, industrial sustainability and environmental management were consulted to review the instrument for the relevance, clarity and appropriateness of the items to measure the Green Technology Management practices, Organizational Readiness, and Sustainable Industrial Performance. The recommendations were incorporated to make the instrument more relevant to the study objectives and the local industry context. Reliability of the instrument was determined through Cronbach's alpha test with an overall coefficient of 0.89, indicating high internal consistency and confirming the appropriateness of the instrument for data collection.

Data Collection and Ethics

The ethical clearance was taken from the university ethics committee before the data collection. Permission and informed consent were obtained from all respondents and the participating canning industries. Participants were informed about the study objectives, voluntary participation and confidentiality of their responses. Quantitative data was gathered from the survey questionnaires given to selected employees of the participating canning industries. Data collection was performed at the convenience of the respondents to minimize disruption of the operations of industry. The filled questionnaires were collected, arranged, and prepared for statistical analysis to analyze Green Technology Management practices, Organizational Readiness, and Sustainable Industrial Performance.

Statistical Analyses

The distribution of respondents in the selected canning industries in Zamboanga City was described using frequency count and percentage. Extent of green technology management practices, level of organizational readiness and level of sustainable industrial performance were computed by using weighted mean and standard deviation on the basis of their respective dimensions. In addition, the study utilized simple linear regression analysis to determine if green technology management practices are significant predictors of sustainable industrial performance.

RESULTS

The presentation of this part is anchored on the sequence of postulated aims of the study.

Table 1. Extent of Green Technology Management Practices in the Canning Sector

Indicators	Mean	SD	Interpretation
Energy Conservation	3.37	.589	Very High
Pollution Prevention	3.41	.546	Very High
Innovation and Technology Adoption	3.30	.542	Very High
Overall Mean	3.36	.461	Very High

Results showed that the canning industries who participated in the study practiced a very high level of Green Technology Management (GTM) (Overall $M = 3.36$, $SD = 0.461$). The mean scores of pollution prevention ($M = 3.41$, $SD = 0.546$), energy conservation ($M = 3.37$, $SD = 0.589$), and innovation and technology adoption ($M = 3.30$, $SD = 0.542$) were the highest among the three dimensions and were interpreted as very high. The relatively low standard deviations across dimensions indicate a high degree of consistency in respondents' perceptions, implying that Green Technology Management practices are widely implemented in the participating canning

Table 2. Level of Organizational Readiness of the Canning Industries to Adopt Green Technology Management

Statements	Mean	SD	Interpretation
Our company...			
Employee Competence	3.28	.564	Very High
Technological Infrastructure	3.31	.568	Very High
Financial Capacity	3.25	.568	High
Overall Mean	3.28	.470	Very High

industries

As the results show, the organizational readiness to adopt Green Technology Management among the participating canning industries is at a very high level (Overall $M = 3.28$, $SD = 0.470$). Technological infrastructure was the highest score among the three dimensions ($M = 3.31$, $SD = 0.568$). Employee competence ($M = 3.28$, $SD = 0.564$) was the second highest that was interpreted as very high. The lowest means ($M = 3.25$, $SD = 0.568$) was obtained by financial capacity, but still at a high level. The standard deviation values were relatively low, indicating that the responses were consistent among the participants, which indicates that the selected industries generally have the organizational capabilities to support the successful adoption of Green Technology Management practices.

Table 3. Level of Sustainable Industrial Performance

Indicators	Mean	SD	Interpretation
Production Efficiency	3.25	.570	High
Environmental Compliance	3.33	.512	Very High
Economic Sustainability	3.32	.541	Very High
Overall Mean	3.30	.441	Very High

High degree of sustainable industrial performance (Overall $M = 3.30$, $SD = 0.441$). Among the three dimensions, environmental compliance got the highest rating ($M=3.33$, $SD=0.512$) followed by economic sustainability ($M=3.32$, $SD=0.541$), both of them being interpreted as very high. At the same time, production efficiency was highly rated ($M = 3.25$, $SD = 0.570$). The small values of the standard deviation in all dimensions indicate uniformity in the evaluation by the respondents, which means

Table 4. Direct Effect of Green Technology Management Practices on Sustainable Industrial Performance

Hypotheses	Path Coefficient	P-value	SE	f2	Decision	Interpretation
H1. GTMP → SIP	0.528	<0.001	0.073	0.296	Reject H_0	Significant

that the selected canning industries have a common perception of their ability to achieve sustainable industrial performance.

The results showed that the Green Technology Management Practices had significant positive effect on Sustainable Industrial Performance ($\beta = 0.528$, $p < .001$). The positive path coefficient implies that the higher the level of implementation of Green Technology Management practices, the better the sustainable industrial performance of the participating canning industries. Also, the effect size ($f^2=0.296$) reveals a moderate practical effect, indicating that Green Technology Management practices are significant in explaining the variations in sustainable industrial performance. Thus, null hypothesis was rejected, indicating that Green Technology Management Practices is a significant predictor of Sustainable Industrial Performance.

DISCUSSION

The results revealed that the canning industries that participated had very high levels of Green Technology Management (GTM) practices. This demonstrates that environmentally sustainable methods have been integrated into their production operations. This shows that the industries are actively pursuing pollution prevention, energy conservation and adoption of green technology for improving resource efficiency and reducing environmental impact. This result indicated that GTM integrates sustainable technologies, organizational strategies and management practices to improve operational efficiency while reducing environmental impact. The results also showed that pollution prevention, energy conservation and innovation and technology adoption were strongly implemented indicating that the industries are using proactive environmental strategies to improve production sustainability. This means that environmental innovations can increase resource productivity and deliver both environmental and economic benefits [8]. Furthermore, Centobelli et al. (2020) suggested that the adoption of green innovation and sustainable manufacturing practices results in improved resource efficiency, environmental performance, and organizational competitiveness [2]. Likewise, the incorporation of green technologies and environmental management practices enhances operational efficiency and contributes to sustainable performance in the long run [10]. The results indicated that the industries involved have a high degree of organizational readiness for the adoption of Green Technology Management. The high level of technological infrastructure and the competence of the employees suggest that the industries have the technological resources and workforce capacity to support sustainable production and environmental innovation. In contrast, the relatively lower assessment of financial capacity indicates that while industries do spend resources on sustainability initiatives, the investment decisions on green technologies may still be contingent on competing operational

priorities. This was supported by Technology-Organization-Environment (TOE) framework which recognizes technological capability, organizational resources and internal support as key factors influencing technology adoption [11]. Likewise, organizational readiness facilitates the successful green technology adoption by improving employee capability, technological capacity and resource availability [7]. Also, it highlights the significance of employee competences and continuous development of competences in embedding sustainability into organizational practices [9]. Moreover, recent studies have also shown that organizations with higher technological capabilities and readiness are more likely to have successful green innovation adoption and improved sustainability performance [1]. The results show that the studied industries have a high level of sustainable industrial performance, which means that they have integrated environmental responsibility, operational improvement and economic considerations into their production processes. The high levels of environmental compliance and economic sustainability suggest that industry's view sustainability efforts as an environmental obligation and as a way to ensure long-term competitiveness and business continuity. In contrast, the high level of production efficiency shows the efforts to improve the optimization of resources and operational procedures with the goals of sustainability. Results are consistent on Triple Bottom Line framework, which posits that sustainable performance should be balanced among economic viability, environmental protection and social responsibility [3]. In a similar vein, the drive for environmental improvement can boost productivity through efficient resource use and innovation [8]. Moreover, it indicated that proactive environmental management creates value from sustainability practices and therefore improves financial outcomes [5]. The recent studies have also confirmed that the integration of green technologies, environmental management systems, and sustainable manufacturing practices improve resource efficiency, environmental performance, and long-term competitiveness [10]. The results showed that Green Technology Management practices are good predictors of sustainable industrial performance. The adoption of energy conservation, pollution prevention and innovation and technology adoption lead to improved sustainability performance. This means that industries adopting environmentally responsible technologies and management strategies are better placed to improve operational efficiency, promote environmental compliance, and achieve sustained economic performance. Thus, Green Technology Management is not only an environmental initiative but also a strategic capability for industrial competitiveness. Organizations can achieve competitive advantage by developing capabilities focused on pollution prevention, sustainable development and environmental management [5]. Furthermore, environmental innovations enhance resource productivity by compelling firms to adopt more efficient production processes [8]. Moreover, recent studies have confirmed that the implementation of green technologies, cleaner production methods and environmental management systems results in improved organizational performance, environmental outcomes and competitiveness [10,2].

CONCLUSIONS

The study concludes that the canning industries involved have adopted Green Technology Management (GTM) practices in their operations through pollution prevention, energy conservation and innovation and technology adoption. Such practices demonstrate the industries' dedication to improving resource efficiency, minimizing environmental impacts and producing in a sustainable way. Moreover, the findings show that organizational readiness is the significant basis for GTM implementation. Green technology industries have good technology capability and employee competence but need constant investment in financial resources to support green technology. Therefore, it is suggested to boost workforce development, technological progress and sustainability-oriented investments. Furthermore, the study shows that GTM is a key driver of sustainable industrial performance, suggesting that green practices are not merely environmental strategies but also efficiency, environmental compliance and long-term competitiveness enhancers. The results show that industrial sectors must incorporate GTM in their strategic planning process and policymakers may further improve mechanisms that facilitate the adoption of green technology in manufacturing sectors. Future studies can further investigate the implementation of GTM in different industrial contexts and investigate other organizational factors that affect sustainable industrial performance.

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