

RESEARCH PAPER

Knowledge Management Strategies and Green Innovation Practices: Empirical Evidence from the Malaysian Public Sector

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ABSTRACT

This research study was conducted to determine the effect of knowledge management strategies (knowledge creation, knowledge acquisition, knowledge sharing, and knowledge application) on green innovation practices. Knowledge management strategies are processes that arise in organizations that involve the creation and development of knowledge and the dissemination of information among stakeholders to support and improve their business performance. It is crucial that organizations harness knowledge not only to stay competitive but also to become innovative for sustainability. Green innovation practices have become a topic of interest for scholars and policymakers in recent years because of their ability to deal with environmental issues. Additionally, a lot of organizations are aware of the significance of green practices, which has compelled globally competitive organizations to constantly improve their competencies in order to stop the environment from getting worse and to improve overall organizational performance. Thus, this study has identified knowledge management strategies as variables that are able to increase green innovation practices. This study adopted a quantitative research technique and used a closed-ended questionnaire for data collection. The questionnaire was adapted from the previous study and distributed among employees in the public sector located in Klang Valley, Malaysia. The sampling technique employed was purposive sampling. A total of 256 data have been successfully collected and analyzed. This study used SPSS software to assess descriptive and inferential statistics. The finding of this study indicates that knowledge management strategies, namely knowledge creation, knowledge acquisition, knowledge sharing, and knowledge application, have a positive and significant influence on green innovation practices, with the knowledge sharing factor being the most influential factor that affects green innovation practices. This study confirms that knowledge management practices are important for organizations if they want to succeed in green innovation practices. Therefore, it is suggested, organizations should support knowledge management practices and activities to improve the adoption of green innovation.

KEYWORDS: Knowledge management strategies; Green innovation practices; Malaysia.

1. Introduction

Nowadays, the issues of environmental, pollution, asset sustainability, resource

constraints, and pollution have become major worldwide concerns. Green innovation (GI) is a concept of businesses developing environmentally friendly products to meet Sustainable Development Goals [1]. A recent study expresses GI as new products and processes, including technological, managerial, and organizational innovations, that contribute to environmental sustainability [1,2]. In another word, green innovation is a method of eradicating businesses that limit the potential negative effects of their activities on the environment to increase performance and business sustainability [3]. Green innovation can be divided into two types which are Green Technology Innovation (GTI)

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and Green Management Innovation (GMI). Green technology innovation (GTI) integrates environmental studies technologies to optimize existing or create new products or to stop and reduce the negative impact on business operations [4]. It becomes a creation of procedures, technology, and management structures that protect the natural environment by minimizing resource consumption, waste management, and pollution [5]. Whereas, GMI is implement new management systems which allow an organization to improve management and production processes, reducing or eliminating negative environmental effects [6]. Furthermore, according to Rizwan et al. [7] organizations can enhance their performance through green innovation as green practices guide them to devise strategies that can help them use fewer resources, reduce the chances of harm, and create a carbon footprint in the organization. The green revolution is a unique strategy that enables businesses to develop innovative methods and systems that improve businesses' performance. Therefore, it is important for an organization that aims to sustain its business to investigate this issue and pursuit a strategy on how to increase green innovation practices in the organization. In addition, to accomplish the objective of sustainable development and green innovation as reported by Wang et al. [2] organizations need to employ a variety of tactics that have been proven to improve organizational performance, such as knowledge management (KM). KM has gotten a lot of attention in the business sector over the last two decades, and it's now recognized as a critical component in defining strategies, producing new products and services, and managing operational processes [8]. Knowledge is an intangible asset that is vital to every organization's success or failure [9]. It is used as an instrument by organizations to improve customer satisfaction and successfully compete in the market which leads to higher organizational performance [10]. Innovative organizations have, however, extended the scope of KM and begin involving it in light of the environmental issues [11]. Thus, knowledge management has developed into an essential strategic resource for many businesses, giving them a competitive advantage in achieving the SDG: to make environmentally friendly product development easier for businesses through the notion of "green innovation" [11]. The study fills a gap in the literature on green innovation practices and knowledge management towards organizational performance. The previous literature is inconclusive regarding the

association between knowledge management and green innovation for organizational sustainability in the public sector in Malaysia. Therefore, the current study offers conclusive and direct outcomes in this regard. Even though there are scholars have looked at KM and organizational performance from various angles, little emphasis has been dedicated to the role of KM in achieving organizational performance, particularly with the support of green practices and innovation [11]. Moreover, Mardani et al. [8] and Wang et al. [2] both emphasized the need to expand the current literature on knowledge management and green innovation, for organizational sustainability. Therefore, this study aims to find out the relationship between knowledge management strategies i.e knowledge creation, knowledge acquisition, knowledge sharing, and knowledge application towards green innovation practices.

2. Literature Review

Green innovation is a popular topic these days, with all the concerns about the environment, the well-being of the world, global warming, and the fact that the earth's resources will run out at some point. The issues of green innovation and the differences between regular innovation have frequently been discussed in recent research studies. The green innovation concept is to improve productivity and efficiency by converting the content into reusable material to minimize the consumption of natural resources and to capitalize on renewable resources to minimize waste [5]. In addition, according to some scholars as early as 1997, environmental improvement must be integrated into all parts of the business, this study looked at how to use green innovation to lessen environmental risks in the garment sector by starting with raw materials [12]. Furthermore, many academics have concentrated on the implementation of green technologies such as energy-saving technology and sewage treatment technology [13]. Furthermore, several studies also stated that green innovative organizations and even that practice green in their processes achieve a considerable level of efficiency through reducing waste and enhancing the overall productivity [1,2,5,6].

Knowledge has been regarded as one of the most important components of innovation; without knowledge, there can be no creativity and innovation. Although there is a lot of technical knowledge about green innovation, there is still far behind on how to put these green innovations into practice in the organization [2]. Moreover,

green innovation is distinct from regular innovation, as previously noted. Green innovation processes have their own set of issues. As a result, it is not always possible to adapt traditional innovation contexts to green innovation. To ensure what distinctions exist and what these variations signify for the implementation of green innovation versus normal innovation, new knowledge is needed to ensure what differences are and what these differences mean for the implementation of green innovation. As reported by Yang [14], the definition of KM was written as the process of converting tacit information into explicit knowledge, which allows for ease of knowledge transfer within an organization. The current study uses four dimensions of KM, namely knowledge creation, acquisition, sharing, and application. Given Rusland et al. [15], knowledge creation involves engaging with others using tacit and explicit knowledge to generate new ideas and concepts. As reported in Green-Technology-Master-Plan-Malaysia (GPMT) - 2017-2030 [16], innovation and green associations are still less broadly rehearsed in Malaysia. As Malaysia anticipates building up a country in 2030, the aptitudes and information on innovation and green technology inside the association are significant. The importance of green innovation's contribution to economic progress, a cleaner environment, and improved well-being is critical. The GTMP is designed to pave the path for ambitious goals to be met by 2030. GTMP places Malaysia at the vanguard of the global movement to combat climate change, while also addressing the country's desire to become a high-income country through green growth.

Knowledge management is a method that aids businesses in classifying, selecting, organizing, disseminating, and transferring critical knowledge and skills required for activities such as problem-solving, dynamic learning, strategic planning, and decision-making. Knowledge management necessitates a significant shift in business culture as well as a societal commitment at all levels. An organization may bring all of its organizational learning and expertise to bear on any problem, wherever in the globe, at any time, if it has a supportive organizational climate and, ideally, excellent knowledge management. Despite the necessity for adequate drivers, previous research suggests that improved organizational performance and competitive advantage through green practices will be achieved through good knowledge management strategies [6]. These elements are critical in

overcoming the technical obstacle of green innovation. As stated in Li et al. [4], in aimed at encouraging green innovation, the organization and government should encourage knowledge management implementation, and facilitate and encourage businesses to innovate by enabling them to produce high-quality goods and services while consuming the least amount of natural resources. Is also essential that organizations allocate enough resources and knowledge for the acquisition of new ideas as they improve their creativity and innovation and the emergence of new products [17]. Additionally, organizations also need to encourage and facilitate the process of green product development, and also constantly consider the impact of their operations on the environment [18].

Knowledge creation is the result of interaction between knowledge and the act of knowing, which is done through action, practice, and interaction with people Abbas and Sagsan [6]. Firms must allocate adequate resources for creating new knowledge as it will enhance their innovation capabilities and development of new technologies which ultimately will facilitate firms to achieve sustainability. Abbas and Sagsan [6] define knowledge creation as the relationship between knowledge and the act of knowing, which is accomplished through action, practice, and engagement with others. Firms must devote sufficient resources to the creation of new information to improve their innovation capabilities especially green innovation and the development of new technologies, which will help them attain business sustainability. Thus, based on the above discussion below hypothesis was formulated.

H1 Knowledge creation positivity influences green innovation practices.

A study was done by Wang [2] reported that knowledge acquisition plays an important role in green learning orientation and exploitative and exploratory green innovations. Environmental organizational culture moderates not only the relationship between green learning orientation and green knowledge acquisition but also the link between knowledge acquisition and exploratory green innovation. Knowledge acquisition refers to hierarchical exercises to secure, remove and sort out information from an assortment of sources [10]. The point of information obtaining is to comprehend the requirements of clients and their involvement in authoritative items and administrations. This study shows knowledge acquisition is important and will mediate the green innovation process. Therefore, this study

has formulated a hypothesis as below:

H2 Knowledge acquisition positivity influences green innovation practices.

According to Alzoud [19], knowledge sharing is a must for firms to share their knowledge to be able to access external knowledge that could help in developing or enhancing their innovation activities. Knowledge sharing was similarly referred to as the process through which explicit or tacit knowledge is relayed to an individual or group of individuals [6]. Knowledge sharing has a significant role in improving employee knowledge, reducing errors and mistakes, and enhancing sustainable operations and economies. In turn, these allow the organization to obtain financial advantages, and establish green innovation, while mitigating the hazardous activities to the environment [6]. Research done by Alzoud [19], has confirmed knowledge sharing does have a positive and significant effect on green innovation. Therefore, based on the discussion above this study has formulated a hypothesis as below:

H3 Knowledge-sharing positivity influences green innovation practices.

Knowledge application is the focal point of knowledge management because it makes knowledge more active and relevant for the creation of organizational value [20]. The empirical findings of the study done by Ode and Ayavoo [20] have confirmed the important role of knowledge application in boosting innovation performance. Research done by Shazaad et al. [21] has revealed that the knowledge management process and its all constructs (acquisition, dissemination, and application) lead toward green innovation. This study was done in a manufacturing organization in Pakistan. Based on the discussion above, this study has formulated a hypothesis as below:

H4 Knowledge application positivity influences green innovation practices.

3. Methodology

This research study was cross-sectional, which is to find out the relationship between knowledge

management strategies namely knowledge creation, knowledge acquisition, knowledge sharing, and knowledge application towards green innovation practices. Employees from the public sector in Klang Valley, Malaysia, were among those who took part in this study, from which the respondents came from working groups such as professional, administration, clerical, and service. A survey instrument with a five-point Likert scale was adapted from previous research studies to examine the effect between variables [20,22,23,24,25]. The instrument had been modified according to the culture and beliefs of the Malaysian context. The validity of the questionnaire was checked by experts from industry and academia. Researchers have revised the questionnaire based on comments from an expert. The questionnaire consists of six sections, among which section A focuses on demographic information, section B focuses on knowledge creation, section C gathers information on knowledge acquisition, section D about knowledge sharing, section E focuses on knowledge application, and lastly, Section F focuses on green innovation practices. The sampling technique used for this study was a convenient sampling technique, where researchers approached the respondents through electronic means via email. Following one week of questionnaire distribution, a follow-up email was sent. A total of 256 data were successfully collected and analyzed. All data was sorted, organized, and arranged according to the identification number, which was tagged on the left upper side of each set of questionnaires. This was done to avoid double-entry of the data and make it more accessible for quick reference if needed. The data were analyzed by multiple regression using SPSS Version 26.

3.1. Conceptual framework

Figure 1 depicts the conceptual framework of this research study which is to determine the relationship between knowledge management strategies and green innovation practices.

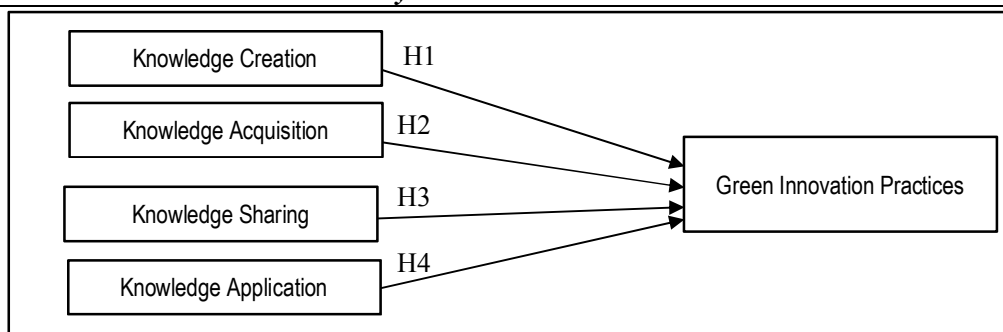


Fig. 1. Conceptual framework of knowledge management strategies and green innovation practices (Sources: [6])

As for the independent variable, knowledge management strategies, which consist of activities of knowledge creation, knowledge acquisition, knowledge sharing, and knowledge application, the dependent variable was green innovation practices. This conceptual framework was developed based on the theory of RBV [26], which stated that successful product innovation can be attributed to a capability consisting of a bundle of resources, i.e., knowledge controlled by the organization. A firm's resources are used to enable it to establish strategies to improve the overall efficiency and performance of the organization, and these can be quite wide-ranging. Moreover, according to Barney [26], a resource is valuable if it can reduce the cost or increase the price of a product or service. Therefore, a bundle of valuable resources can be used to conceive and implement strategies. In this study, knowledge was determined as a resource, and it is believed that it can improve green

innovation performance.

4. Findings

Regression analysis is a set of statistical methods used to estimate relationships between a dependent variable and one or more independent variables. Thus, regression analysis was done in this study to determine the effect between variables, and the findings are reported in the next section.

4.1. Respondent profile

Table 1 indicated that the majority of the respondents that participated in this study are female (60.1%) respondents. Besides that, the majority of the respondents were in the range of 31 years old to 40 years old (30.9%) that joined this study. Furthermore, the majority of the respondents had a master's degree (43%) qualification and most of them had at least 10 years of working experience (52.3%).

Tab. 1. Respondent profile

	Profile	Frequency	Percentage
Gender	Male	102	39.9
	Female	154	60.1
Age	21-30 years old	42	16.4
	31-40 years old	79	30.9
	41-50 years old	71	27.7
	51 years old and above	64	25.0
Academic Qualification	Secondary School (SPM/SPMV)	9	3.5
	Diploma / STPM / Certificate	46	18.0
	Bachelor's Degree	52	20.3
	Master's Degree	110	43.0
	Doctor of Philosophy	39	15.2
Working Experience	5 years and below	31	12.2
	6-10 years	91	35.5
	More than 10 years	134	52.3

4.2. Reliability Analysis and normality analysis

The reliability test using Cronbach's Alpha analysis was performed for each group of variable indicators to test the consistency of the grouped indicators to measure the specific variable and the cut-off value for this test is 0.70 indicating the grouped indicators were consistent

and reliable [27]. In addition, the normality test was also performed to test the normality assumption of each variable via the value of Skewness and Kurtosis statistics. Pallant [27] also stated that the variable can be considered approximately normally distributed if the value of Skewness and Kurtosis statistics are in the range of ± 1.00 .

Tab. 2. Reliability and normality analysis of the variables

Variable	Number of Indicators	Cronbach's Alpha	Skewness Statistic	Kurtosis Statistic
Knowledge Creation	5	0.777	-0.194	-0.491
Knowledge Acquisition	5	0.715	-0.419	0.129
Knowledge Sharing	5	0.782	-0.519	0.365
Knowledge Application	5	0.772	-0.650	0.308
Green Innovation Practices	5	0.763	-0.764	0.187

Table 2 indicated that all variables were having an acceptable level of reliability value since each Cronbach's Alpha value was above 0.70, which is in the range of 0.715 to 0.782. Besides that, the distribution of each variable can be considered approximately normally distributed since all the Skewness and Kurtosis statistics were in the range of ± 1.00 .

independent variables on a dependent variable [28]. The analysis reported in Table 3 indicated that Knowledge Creation (Beta = 0.150, $t = 2.034$, $p < 0.05$), Knowledge Acquisition (Beta = 0.173, $t = 2.244$, $p < 0.05$), Knowledge Sharing (Beta = 0.182, $t = 2.229$, $p < 0.05$), and Knowledge Application (Beta = 0.210, $t = 2.049$, $p < 0.05$) were significantly influence the Green Innovation Practices with a positive direction. In addition, this set of independent variables was able to explain around 27.9% of explained variance toward the Green Innovation Practices.

4.3. Multiple linear regression

A multiple linear regression analysis was performed as for accessing the effect of the set of

Tab. 3. Summary results of multiple linear regression analysis

Variable	B (SE)	Beta	t-statistics	p-value	TOL, VIF
Knowledge Creation	0.235 (0.116)	0.150	2.034*	0.043	0.530, 1.886
Knowledge Acquisition	0.245 (0.109)	0.173	2.244*	0.026	0.484, 2.068
Knowledge Sharing	0.255 (0.114)	0.182	2.229*	0.027	0.429, 2.332
Knowledge Application	0.210 (0.103)	0.143	2.049*	0.041	0.590, 1.696

Note: Dependent variable = Green Innovation Practices; $R^2 = 0.279$; Model fits = $F(4, 251) = 24.248$, $p < 0.01$; B = Unstandardized coefficient; Beta = Standardized coefficient; SE = Standard error; TOL = Tolerance; VIF = Variance Inflation Factor; * $p < 0.05$.

In terms of model evaluation, the regression model was fit to the data because the ANOVA test was significant at a 5% level of significance ($F(4,251) = 24.248$, $p < 0.01$). Besides that, the multicollinearity issue in this model does not exist because the TOL and VIF values are above 0.20 and below 10.00 [27]. By examining the

Normal Probability plot (Figure 2), the majority of residual values (small dots) lie on a straight line, hence it is indicated that the residual values of the model follow a normal distribution [28]. In addition, the residual variances of the model can be considered constant because the pattern of the scatter plot of standardized residual value against

the standardized predicted value (Figure 3) was at a random pattern. On the other hand, in terms of outliers, Figure 3 indicated that there are no outliers outside the boundary of ± 3.0 standard deviation. Therefore, the results of this multiple linear regression can be considered valid and unbiased.

The result of multiple linear regression in Table 3 indicated that if the average level of Knowledge Creation or Knowledge Acquisition, Knowledge Sharing, or Knowledge Application was high,

then the average level of Green Innovation Practices should be high, assuming other variables remain constant. The analysis also indicated that Knowledge Sharing can be considered the most influential factor that affects the Green Innovation Practices because it holds the highest value of standardized coefficient value (Beta = 0.182), followed by Knowledge Sharing (Beta = 0.173), Knowledge Creation (Beta = 0.150), and Knowledge Application (Beta = 0.143).

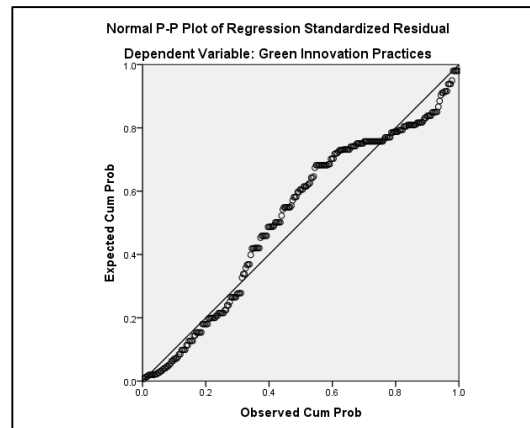


Fig. 2. The normal probability plot of standardized regression residual values

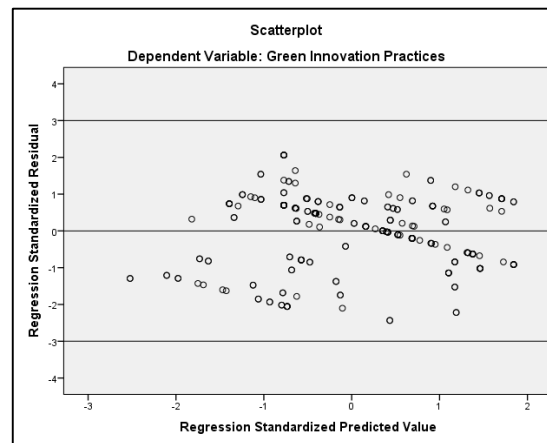


Fig. 3. The scatter plot of standardized regression residual values and standardized predicted values

5. Discussion

This research study was carried out to determine the effect of knowledge management strategies, i.e knowledge creation, knowledge acquisition, knowledge sharing, and knowledge application, on green innovation practices among employees in the public sector located in Klang Valley, Selangor, Malaysia. According to the findings of this study, knowledge creation, knowledge acquisition, knowledge sharing, and knowledge application all had a significant impact on green

innovation practices in the public sector. This reveals that organizations or businesses that wish to increase green innovation practices need to ensure knowledge management strategies in the organization are ready and well developed. The results support Abbas and Sagsan [6], who has proven a positive and significant influence on knowledge management and green innovation. Abbas and Sagsan [6] have done research in Pakistan among the manufacturing and service industries. Moreover, this result demonstrates

that their management is demonstrating a strong commitment to knowledge management and motivating their people to generate, acquire, share, and apply knowledge in their operations. The outcomes of this study highlight the importance of people working together to create effective knowledge sharing in organizations and platforms to create a collaborative knowledge-based work environment. The findings also reveal that knowledge sharing is the most significant among the knowledge management strategies that are studied in this research. Therefore, organizations need to focus more on knowledge sharing to ensure the activities related to sharing knowledge are efficient. This finding is also similar to that of Alzoud [19] whereby the study was done in Jordan among industrial firms. This study has reported that knowledge sharing has been shown to increase staff knowledge, resulting in fewer errors and mistakes, as well as improved operational and economic sustainability. These improvements allow businesses to gain economic benefits and generate green innovation while also reducing the risk of unsafe activities in the environment. From this result, the researcher has recommended that industrial firms in Jordan concentrate on the dimensions examined in this study so that their green innovation culture is promoted, and green innovation practice is enhanced [19].

The research results and contributions have some implications for the public sector. The research result provides some knowledge and feedback on the development of green innovation to increase organizational performance and also the development of knowledge management strategies that will increase green innovation practices. Therefore, organizations must emphasize the importance of knowledge management strategies in their business planning and funding. While the research results provide some insight to the researchers, recommendations to organizations and employees, and also contribute to the body of knowledge, there are a couple of cautions to keep in mind when looking at these results. The current study has some limitations that should be mentioned. This paper only focuses on employee work in the public sector located in Klang Valley. Therefore, including other sectors is recommended to gain a clear and comprehensive understanding of the green innovation practices in Malaysia. The presented model investigates certain constructs that are relevant to green innovation practices; hence, it is advisable to include other constructs like organizational performance, innovation

culture, and innovative work behavior to extend the literature and existing knowledge regarding green issues. The mediating variables also should be explored, such as management support, employee behavior, and the size of the organization. It is also recommended to be explored through which the insight related to the role of the public sector and government agencies to go green will be clear to both practitioners and decision-makers.

In conclusion, this study contributes to practice and has implications for the government, management of organization, employees, and other relevant stakeholders in their policy formulation and decision making. The public sector is essential in all countries, and it has played an important role in fostering economic growth and stability. The findings of the study can be used in policy formulation to improve green practices. Additionally, the findings of this study can assist the government in implementing green concepts in various business sectors.

6. Practical Implications

Since knowledge management strategies are believed to improve awareness of green innovation practises and the organizational performance of public sector, thus, management of organizations must promote knowledge management by setting a good example, offering incentives to workers, or encouraging the proper mindset among staff members. Additionally, management must create rules to encourage environmentally friendly behaviours within the company to improve overall organisational performance. A green innovation practise can also be developed with the help of management to establish activities associated with green practises, such as a recycling programme, energy consumption reduction, etc. By giving managers orientations and training, as well as by giving staff socially responsible duties to complete while considering the green practises and processes for promoting the smart use of information and resources available which inturn will lead to green innovation practices [29].

7. Conclusion and Recommendation

It has been concluded that the results and outcomes of the findings have been analyzed and found to achieve the objectives of this research study, which are to determine the relationship of knowledge management strategies toward green innovation practices in an organization. Findings have shown a positive relationship between knowledge management strategies, i.e.,

knowledge creation, knowledge acquisition, knowledge sharing, and knowledge application towards green innovation practices. The finding shows that knowledge management strategies are significant and have an influence on green innovation practices in the organization. The findings align with research done by Ahmad et al. [1], Internal knowledge sharing benefits the in-house strategy and will aid in developing the organization's creative approach to drive green practices.

To summarize, knowledge management strategies are crucial, which will reduce the cost of inefficiency by making organizational knowledge more readily accessible, and accurate. If everyone in the organization has effective knowledge management, it will reduce mistakes or repetition of the same mistakes by employees and lead to save cost and resources which in turn will improve performance. Furthermore, when knowledge is readily accessible, it will encourage green innovation practices which employees will be able to demonstrate their creativity and ideas when important resources are available when needed and this situation lead to increment of overall performance [29].

In addition, this study promoted a good work environment in the workplace, employee motivation, and effective knowledge management. The study demonstrates that organizations need to willingly invest in knowledge management practices and develop good strategies to share knowledge within the organization. An efficient system must be implemented to ensure activities on knowledge sharing are efficient to increase the adoption of green innovation strategies. According to Buyong [30], employees must also understand the concept of green innovation practices to enable an organization to achieve successful green innovation performance. This study also proposed that the top management or executives emphasize green innovation and inventiveness in their firm's culture to sustain their businesses. Organizations in various industries, with various characteristics, can refer to the appropriate green ideas to apply green innovation methods, save time, resources, and capital, and improve the efficiency of green innovation.

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9. Paper Contribution to Related

Field of Study

This paper contributes a body of knowledge in the area of knowledge management strategies and green innovation in the context of the public sector and also provides information on green innovation practices among employees.

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