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The Impact of Green Knowledge Management on Sustainable Development Goals and Green Innovation in French Economic Firms: A Structural Analysis

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Abstract

The study aimed to test the impact of Green Knowledge Management (GKM) on Sustainable Development Goals (SDGs) and Green Innovation (GI) in economic firms. The researcher collected data from lower, middle, and upper-level managers of small, medium, and large-sized manufacturing and services firms located in France. The data were analysed using structural equation modelling (SEM) to explore how GKM processes (creation of green knowledge, acquisition, sharing, and application) impact SDGs (environmental, social, and economic sustainability) and GI (green technology, management innovation). According to the results, GKM significantly impacts both SDGs and GI. The dimensional analysis indicated that, except for acquiring green knowledge and its application, it showed an insignificant impact on green innovation. Finally, firm size and industry type were examined in relation to SDGs and GI. Regarding SDGs, firm size presented significant positive results. However, an insignificant result was found for firm size concerning GI. Similarly, the role of industry type was examined in relation to SDGs and GI, revealing significant results for both paths.

Keywords: green knowledge management; sustainability; green innovation; organisational strategy; French economic firms

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Introduction

The 19th-century Industrial Revolution lifted millions out of poverty. However, its prosperity came at a cost, including environmental and resource degradation; the economic progress of emerging markets is threatened by their vulnerability to global warming and the depletion of natural resources (Wang et al., 2022). In the past, the success of organisations was largely dependent on promoting economic value. However, today, companies must pay great attention to reducing the effects of environmental pollution and give importance to social factors. In addition to economic and financial considerations, organisations need to address these aspects to achieve the goals of sustainable development (Ahmad et al., 2023).

Sustainable development has become an essential requirement to achieve justice and equity in the distribution of the fruits and gains of economic development and wealth between the present and future generations; this was proposed at many forums, such as the Johannesburg Summit held in South Africa in 2022, and the United Nations also supported this proposal (Chen et al., 2023). Organisations have come to recognise the importance of a green environment, which has led them to rethink their operations and management systems. Dynamic firms are now using knowledge, quality, and environmental practices to create a competitive advantage in today's business world (Al-Qudah et al., 2023).

Knowledge Management KM is a rapidly emerging field of management science that is becoming increasingly essential for modern managers. KM helps organisations leverage their knowledge assets to improve customer satisfaction and gain a competitive advantage (David & Eva, 2017). In recent years, KM has become increasingly attractive to businesses of all sizes. KM is now seen as a critical component of strategic planning, product and service innovation, and operational efficiency (Wang et al., 2022). In response to environmental challenges, dynamic organisations have broadened the scope of KM to include environmental considerations (Ni et al., 2023).

Green knowledge management (GKM) is a process that assists companies in developing products that are less harmful to the environment. This contributes to the achievement of the Sustainable Development Goals (SDGs) (Xie et al., 2019). It has become a vital strategic resource for many firms in the current globalised market. GKM is a novel concept in knowledge management that aims to integrate green or environmental aspects into all dimensions of KM, providing them with a competitive advantage over their rivals in achieving SDGs (Yu et al., 2022).

The SDGs constitute a worldwide call to action to attain a better and more sustainable future for all. They seek to tackle the interrelated challenges of poverty, inequality, climate change, environmental degradation, green innovation, peace, and justice. (Juan et al., 2023). The SDGs were adopted by all United Nations Member States in 2015 and provide a blueprint for achieving a better life for all, now and into the future. These are the goals that firms strive to achieve (Rant, 2020).

Green Innovation (GI) is the development and implementation of new products, services, processes, and business models that reduce environmental impact and

improve resource efficiency. It is a key component of the transition to a more sustainable economy.

Although several researchers have studied GKM and SDGs from various perspectives, inadequate attention has been given to exploring the impact of GKM on achieving SDGs, particularly with the assistance of GI. Considering the above discussion, the current research aims to investigate:

- What is the role of GKM in SDGs and GI within economic firms?
- Are there statistically significant differences related to the size of the firms and the nature of their activities that affect this relationship?

The empirical part of the paper describes the sample, the methods used in the research, and the interpretation of the results obtained. Finally, the conclusion provides practical implications of the results, limitations of the work, and a proposal for future research.

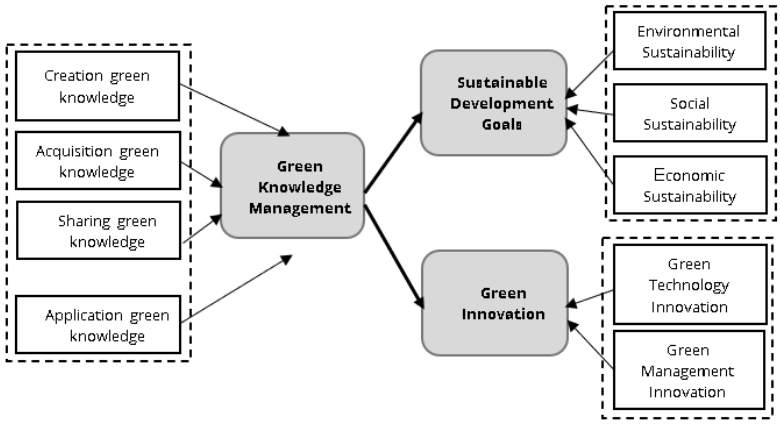
In the following sections, the author reviews the literature, discusses the study's theoretical framework, explains the methodology and data analysis, discusses the findings and their implications, and concludes the study with recommendations for future research.

Theory and Hypotheses

The current research is based on the theories and concepts of Green Knowledge Management (GKM), Sustainable Development (SDG), and Green Innovation GI. Figure 1 presents the conceptual framework of this study.

Figure 1

Conceptual framework



Green Knowledge Management

Knowledge is an intangible concept that exists independently of the physical world. It can be classified into two forms: explicit knowledge (can be codified, verbalised, transferred, and articulated) and tacit knowledge (is hidden and unwritten, existing in people's minds) (Maravilhas & Martins, 2019). KM is a comprehensive approach to identifying, capturing, analysing, storing, and disseminating an organisation's data assets, including databases, records, regulations, procedures, and the knowledge of its employees (Idrees et al., 2023). KM is a vital asset for organisations, as demonstrated by previous research identifying KM as a core tactical component of organisational processes. As a result, KM has become essential for organisational success (Pepple et al., 2022). Modern knowledge has increasingly focused on various environmental aspects within the framework of what is known as Green Knowledge (GK) to address various environmental challenges. It is also related to sustainable development (Everard, 2015). This knowledge includes an understanding of ecosystems and the relationships between humans and the environment, as well as the technologies and practices that can help protect the environment, promote environmental awareness, and develop new technological solutions (Pan et al., 2022).

This study employs four dimensions of Green Knowledge Management (GKM): Creation of green knowledge (CrGK), Acquisition of green knowledge (AcGK), Sharing of green knowledge (ShGK), and Application of green knowledge (ApGK), in view of (Vo & Nguyen, 2023; Fan & al, 2023; Zhou & al, 2020):

- Creation of green knowledge (CrGK) is the process of developing and sharing knowledge about how to reduce environmental impact and improve sustainability. This can include a wide range of topics, such as renewable energy, energy efficiency, waste reduction, sustainable materials, and green management practices (Khan et al., 2024). Green knowledge is an essential part of building a sustainable organisation. By investing in green knowledge, organisations can create a better future for the planet and their bottom line (Amoako et al., 2020).
- Acquiring green knowledge (AcGK) is the process of identifying, gathering, and evaluating information about how to reduce environmental impact and improve sustainability. It is an essential part of building a sustainable organisation by investing in green knowledge (Fan et al., 2023).
- Sharing green knowledge (ShGK): The process of communicating information on how to reduce environmental impact and enhance sustainability to employees, stakeholders, and the public is crucial. This can be achieved through various means, and sharing green knowledge plays an essential role in building a more sustainable future (Olaisen & Revang, 2017). By sharing green knowledge, organisations can help to raise awareness of environmental issues and promote sustainable practices (Zhou et al., 2021).

Application green knowledge (ApGK) involves utilising information to minimise environmental impact and enhance sustainability, thereby modifying an organisation's

operations, products, or services. This can be accomplished through various means. The Application of green knowledge is a crucial aspect of constructing a sustainable organisation (Fan et al., 2023).

Sustainable Development

Sustainable Development was inspired by the Brundtland Commission report "Our Common Future," which was submitted to the United Nations in 1987. In other words, the SDGs were created to achieve the objective of sustainable development, defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Hummels & Argyrou, 2021, p.1). Sustainable development is important because it helps protect the environment and ensures that everyone has a good quality of life; it is a prominent topic in development economics because human economic activity is having a negative impact on the planet and leading to inequality (Nguyen, 2023). The overall aim of (SD) is to achieve economic, social, and environmental sustainability by integrating all approaches into the decision-making process. The concepts of (SD) also relate to a modern and multidisciplinary approach called the green theory, which states that firms should focus on adopting green management strategies and capitalise on modern technology to develop environment-friendly products and services (Abbas & Sağsan, 2019).

This study employs three dimensions of SDGs: Environmental Sustainability (EnS), Social Sustainability (SoS), and Economic Sustainability (EcS):

- Environmental Sustainability (EnS): is about minimising the organisation's environmental impact and operating in an environmentally responsible manner. It involves conserving natural resources, reducing pollution, and mitigating the effects of climate change. This is important for organisations for various reasons. It can help to reduce costs, improve brand reputation, and attract and retain top talent (Nguea, 2023).
- Social Sustainability (SoS): An organisation is about creating a workplace that is fair, equitable, and inclusive and that promotes the well-being of its employees and the communities in which it operates. It involves building strong relationships with stakeholders and operating responsibly and ethically. This approach can help attract and retain top talent, improve productivity and morale, and reduce turnover (Pitkänen et al., 2023).
- Economic Sustainability (EcS) is about achieving long-term financial success while also operating in a socially and environmentally responsible manner. It involves making decisions that benefit both the business and the community. EcS is an essential part of building a sustainable organisation, achieved through investing in employees and innovation (Fatourehchi & Zarghami, 2020).

Green Innovation Theory

Innovation is the process of creating something new or improving upon something that already exists. It can involve developing new products or services, improving existing ones, or finding new ways to do things. Innovation is essential for economic growth and social progress, including technological advances, market forces, and the creativity of individuals and organisations (Geissinger et al., 2023). The theory of innovation is a broad field of study that seeks to understand the processes and factors that lead to the creation and adoption of new ideas, products, services, and processes. There are many different theories of innovation, each with its own focus and perspective (Bhatt et al., 2023).

This study employs three dimensions of GI: Green Technology Innovation (GtI) and Green Management Innovation (GmI), in view of (Khan et al., 2024):

Green Technology Innovation (GtI): involves the development and implementation of new technologies aimed at reducing environmental impact. This can encompass a broad spectrum of technologies, including renewable energy, waste reduction, and sustainable materials. It is an essential component of establishing a sustainable organisation. By investing in green technology, a company can contribute to mitigating its environmental footprint and fostering a more sustainable future (Luo et al., 2019).

Green Management Innovation (GMI) is the development and implementation of new management practices and processes that reduce environmental impact and enhance sustainability. It can encompass a broad array of practices and is a crucial component in establishing a sustainable organisation (Ma et al., 2018).

Green Knowledge Management and Sustainable Development Goals

GKM is the systematic development (creation, acquisition, sharing, and application of knowledge and information related to environmental sustainability; its goal is to encourage more sustainable practices and reduce the impact of human activity on the environment (David & Eva, 2017). It is the systematic creation, acquisition, sharing, and application of knowledge and information related to environmental sustainability to promote more sustainable practices and reduce the impact of human activity on the environment. GKM can play a significant role in helping organisations achieve their SDGs (Hummels & Argyrou, 2021). GKM is a powerful tool that can help organisations achieve their sustainability goals. By effectively managing their green knowledge, organisations can make a real difference in the fight against climate change and other environmental challenges (Ma et al., 2018). Therefore, the first principal hypothesis of the study is:

H1. Green Knowledge Management GKM has a positive impact on achieving sustainable development goals (SDGs) in the economic firms under study.

This main hypothesis is divided into the following sub-hypotheses:

H1a. There is a positive Impact of the Creation of Green Knowledge (CrGK) on achieving Sustainable Development Goals SDGs in the economic firms under study;

H1b. There is a positive impact of Acquisition Green Knowledge (AcGK) on achieving Sustainable Development Goals SDGs in the economic firms under study;

H1c. There is a positive impact of Sharing Green Knowledge (ShGK) on achieving Sustainable Development Goals SDGs in the economic firms under study;

H1d. There is a positive impact of Application Green Knowledge (ApGK) on achieving Sustainable Development Goals SDGs in the economic firms under study.

Green Knowledge Management and Green Innovation

There is a strong positive relationship between GKM and GI in organisations. GKM provides the foundation for GI by creating a shared understanding of environmental challenges and opportunities and by facilitating the transfer and application of green knowledge throughout the organisation (Abbas & Sağsan, 2019). For example, a company with a robust GKM system may be able to develop a new green product more quickly and efficiently because it has easy access to relevant knowledge and expertise from across the company (Bhatt et al., 2023). Additionally, a company with a strong GKM system is more likely to be aware of the latest green technologies and trends, which can help it develop new green products and processes (Luo et al., 2019). Therefore, the second principal hypothesis of the study is:

H2. Green Knowledge Management GKM has a positive impact on achieving Green Innovation GI in the economic firms under study.

This main hypothesis is divided into the following sub-hypotheses:

H2a. There is a positive impact of Creation Green Knowledge (CrGK) on achieving Green Innovation GI in the economic firms under study

H2b. There is a positive impact of Acquisition Green Knowledge (AcGK) on achieving Green Innovation GI in the economic firms under study

H2c. There is a positive impact of Sharing Green Knowledge (ShGK) on achieving Green Innovation GI in the economic firms under study

Application Green Knowledge (ApGK) has a positive impact on achieving Green Innovation GI in the economic firms under study.

Methodology

Target population and sampling procedure

In this study, the target population comprises manufacturing and service firms in France with only an ISO 14001 certificate. The researcher collected data from five departments of each company. The researcher specifically requested responses from

junior, middle, and senior managers of these firms to assess their firm's performance in (GKM), (GSDs), and GI activities using a five-point Likert scale.

The researcher contacted managers through electronic means (e.g., via email). Data collection focused on management staff due to their possession of the most accurate and up-to-date information about the company's policies and practices. Additionally, managers bear responsibility for communicating and implementing company policies within their respective departments. The data collection period spanned from June 2023 to February 2024, utilising a non-probability convenience sampling technique. A total of (429) questionnaires were distributed to the target sample, with (397) questionnaires retrieved. After scrutiny, it was evident that (8) of them were invalid, resulting in an estimation of (389) valid questionnaires for the study. Responses included (28) from large-sized firms, (102) from medium-sized firms, and (99) from small firms. Moreover, the number of participating males was estimated at (210), females at (170), and (9) respondents preferred not to reveal their gender. Detailed demographic information about the respondents is provided in Table 1.

Table 1

Demographic of respondents

Particulars	Description	Value	Percentage
Total received responses	Large firms	28	12.22 %
	Medium firms	102	44.54 %
	Small firms	99	43.23 %
Job position	Upper management	83	21.33 %
	Middle management	104	26.73 %
	Lower management	202	51.92 %
Industry type	Services	130	56.76 %
	Manufacturing	99	43.23 %
Gender	Female	170	43.70 %
	Male	210	53.98 %
	Prefer not to disclose	9	2.31 %
Years of Experience	Up to 5 Years	58	14.91 %
	6-10 Years	111	28.53 %
	11-15 Years	74	19.02 %
	More than 15 Years	146	37.53 %

Source: Author's calculation

The measurement instrument

The instrument was divided into four sections, with the first containing demographic information about the participants. The second section focused on the four key

processes of Green Knowledge Management (GKM): Creation of Green Knowledge, Acquisition of Green Knowledge, Sharing of Green Knowledge, and Application of Green Knowledge. Each of these four dimensions was assessed through a series of items, with five items measuring the Creation Green Knowledge and Acquisition of Green Knowledge and six items measuring the Sharing Green Knowledge and Application of Green Knowledge. The specific items used in this section were sourced from (Vo & Nguyen, 2023; Fan et al., 2023; Zhou et al., 2020). Fifteen items within the third section explore the three key dimensions of Sustainable Development Goals SDGs: Environmental Sustainability, Social Sustainability, and Economic Sustainability. Each dimension is meticulously evaluated through five specific items. The final section comprised eight items, delving into the two critical aspects of Green Innovation GI: Green Technological Innovation and Green Market Innovation. The items for this section were derived from (Khan et al., 2024). A pilot test was conducted to guarantee the instrument's reliability and validity in the context of French firms. The results demonstrated satisfactory internal consistency for the constructs, with values ranging from (0.89) to (0.94). This comfortably exceeds the minimum requirement of (0.7) set by (Miller, 2010). Consequently, the researcher proceeded with the full-scale survey.

Data analysis and results

To investigate the connection between (GKM), SDGs, and GI, the researcher employed the structural equation modelling (SEM) method because it is effective at establishing the hierarchy of latent constructs and eliminating the biasing impact of measurement errors (Cooper & Prajogo, 2010). To interpret the gathered information, the researcher employed statistical software packages SPSS v.23 and AMOS v.23. Prior to conducting multivariate analysis and subsequent SEM; the researcher must verify the sample's adequacy, check for the absence of multicollinearity, and ensure the elimination of common method bias (CMB), as recommended by (Lee et al, 2010). For valid multivariate analysis and subsequent SEM, researchers need to address three key concerns: sample size adequacy, multicollinearity, and common method bias (CMB). A previous study by (Hair et al., 2010). suggested a minimum of (200) participants for factor analysis; this research meets that requirement with a sample size of (389) respondents. The Variance Inflation Factor (VIF) was used to assess multicollinearity. The resulting value, (2.359), indicates that multicollinearity is not present. Following (Cooper & Prajogo, 2010). The researcher conducted Harman's single-factor test to assess the presence of common method bias (CMB). This test revealed a single factor explaining only (39.81%) of the variance, significantly lower than the (50%) threshold for CMB concern. This finding suggests a negligible influence of CMB on the data.

Analysis of measurement and structural model

The researcher conducted confirmatory factor analysis (CFA) to scrutinise the measurement model. The researcher evaluated the reliability of their measurement using Cronbach's alpha, resulting in a value of (0.911), which surpasses the

recommended minimum of (0.8) suggested by (Hair et al., 2010). This discovery implies that the measurement is adequately reliable. Additionally, the researcher assessed the validity of their measurement through convergent and discriminant validity tests, proposing that items should ideally have a loading exceeding (0.6). They recommend that the minimum AVE value for all constructs should be greater than (0.5). The findings from the convergent validity analysis support these suggestions, revealing item loadings exceeding (0.6) and AVE values surpassing (0.5) for all constructs.

The details of items loading, along with AVE values and composite reliability, are given in Table 2 (Cooper & Prajogo, 2010), which suggested that the correlation values among pairs of predictor variables should be less than (0.9).

Table 2

Validity and Reliability of the Instrument

Construct	Items	Factor Loading	Composite Reliability1	AVE[2]
Green Knowledge Management	22	0.728 - 0.877	0.888	0.762
Sustainable Development Goals	15	0.766 - 0.922	0.896	0.642
Green Innovation	8	0.772 - 0.898	0.913	0.799
[1] Ideal value ≥ 0.7 (Cooper & Prajogo, 2010)				
[2] Ideal value ≥ 0.5 (Hair et al., 2010)				

Source: Author's calculation

The authors propose favouring high correlations with a specific construct's indicator (square root values of AVE) and maintaining inter-predictor correlations below 0.90 to ensure adequate differentiation between constructs (Hair et al., 2010). Table 3 provides evidence that the model's distinct concepts are adequately differentiated. Several statistical measures, including the Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Normative Fit Index (NFI), Comparative Fit Index (CFI), Standardized Root Mean Squared Residuals (SRMR), chi-square to the degree of freedom, and RMSEA, collectively assess how well the measurement model represents the underlying data (Kaynak, 2003). With ideal Trucker-Lewis index (TLI) scores, as seen in Table 4, we can confidently claim that the model accurately reflects real-world phenomena. Both its measurement and structural components excel at capturing the observed data.

Table 3

Constructs' discriminant Validity

Construct	(GKM)	SDGs	GI
(GKM)	**0.834**		
(SDGs)	0.423	**0.893**	
GI	0.534	0.429	**0.822**

Source: Author's calculation

Table 4

Structural and measurement models

The goodness of fit measures	CMIN/ DF	NFI	GFI	AGFI	CFI	TLI	RMSEA	SRMR
Seggested value	≤ 3[1]	≥ 0.9[2]	≥ 0.9[2]	≥ 0.9[2]	≥ 0.9[2]	≥ 0.9[2]	≤ 0.08[3]	≤ 0.08[4]
Measurement Model	1.111	0.922	0.916	0.907	0.906	0.934	0.021	0.0289
Structural Model	1.145	0.968	0.933	0.912	0.934	0.932	0.037	0.0312

[1] (Lee et al., 2010).

[2] (Luo et al., 2019).

[3] (Everard, 2015).

[4] (Miller, 2010).

Source: Author's calculation

Using (SEM), the researcher tested their idea (Table 5).

Table 5

Results of hypothesis testing

Hypothesis	Constructs	B-value	Critical ratio	p-Value	Decision
H1	GKM→SDGs	0.299	3.223	0.003*	Supported
H1a	CrGK→SDGs	0.151	0.211	0.011*	supported
H1b	AcGK→SDGs	0.189	3.789	0.007*	Supported
H1c	ShGK→SDGs	0.117	2.015	0.033*	Supported
H1d	ApGK→SDGs	0.343	1.155	0.017*	Supported
H2	GKM→GI	0.218	3.089	0.045*	Supported
H2a	CrGK→GI	0.089	3.184	0.048*	Supported
H2b	AcGK→GI	0.342	0.895	0.075	Not Supported
H2c	ShGK→GI	0.220	1.019	0.013*	Supported
H2d	ApGK→GI	0.123	0.111	0.099	Not Supported
Control Variables					
Firm size	FS→SDGs	0.342	3.892	0.033*	Significant
	FS→GI	0.021	0.213	0.099	Not significant
Industry type					
	Ind-Typ→SDGs	0.045	2.989	0.009*	Significant
	Ind-Typ→GI	0.234	3.129	0.029*	Significant
* p ≤ 0.05;					
**p ≤ 0.01; GKM = green knowledge management; GI = green innovation; SDGs = sustainable development goals; CrGK = creation green knowledge; AcGK = Acquisition green knowledge; ShGK = sharing green knowledge; ApGK = Application green knowledge; FS = Firm size; Ind-Typ = Industry type.					

Source: Author's calculation

Discussion

The study found a positive link between GKM and achieving SDGs in businesses. The strength of this connection suggests that GKM likely helps companies reach their sustainability goals. Based on this, the first hypothesis (**H1**) is likely supported.

Essentially, the study suggests that firms that effectively manage and utilise their environmental knowledge for decision-making are better positioned to contribute to a more sustainable future. Put another way, GKM practices can lead to more environmentally friendly innovations GI. This can be a win-win for businesses, as it can help them save money and attract environmentally conscious consumers. This result generally aligns with the study of (Wang et al., 2022), which also showed a positive impact of GKM on achieving SDGs.

Table 5 also shows the results of the sub-hypotheses as follows:

- **H1a**: Supported: There is a positive impact of (CrGK) on achieving SDGs in the studied economic firms (B-value = 0.151 and p-value = 0.011). (CrGK) can provide educational resources and training programs to businesses on how their operations impact the environment and society. This can help firms understand the SDGs and identify areas for improvement in their sustainability practices. (CrGK) can also create platforms for businesses to share best practices and collaborate on sustainability initiatives. This collaboration can accelerate progress and ensure that businesses are aware of the latest advancements in sustainable practices.
- **H1b**: Supported: There is a positive impact of (AcGK) on achieving SDGs in the studied economic firms (B-value = 0.189 and p-value = 0.007). The results suggest that firms that acquire green knowledge (AcGK) are better positioned to achieve Sustainable Development Goals SDGs. This could be because they develop practices that are more environmentally friendly, reduce their resource consumption, or create products and services that contribute to a sustainable future.
- **H1c**: Supported: There is a positive impact of Sharing Green Knowledge (ShGK) on achieving Sustainable Development Goals SDGs in the economic firms under study (B-value = 0.117 and p-value = 0.033). The result suggests that spreading knowledge about environmentally friendly practices (ShGK) helps businesses achieve the goals laid out in the SDGs. In other words, when companies learn and implement sustainable practices, it can boost economic growth (or consider an alternative specific benefit), benefiting the environment and society as a whole, which aligns with the overall vision of the SDGs. Overall, (ShGK) is seen as a valuable tool for businesses to contribute to achieving the SDGs and create a more sustainable future.
- **H1d**: Supported: There is a positive impact of (ApGK) on achieving SDGs in the economic firms under study, (B-value = 0.343 and p-value = 0.017). This result suggests that using Application Green Knowledge (ApGK), a tool or program likely focused on sustainable practices, has a beneficial effect on businesses' ability to

achieve the Sustainable Development Goals SDGs. by using (ApGK), businesses can contribute to achieving the SDGs while potentially improving their economic standing.

The second main hypothesis (H2) was accepted, which is generally consistent with the study (Abbas & Sağsan, 2019), which also showed the positive impact of GKM on achieving GI. By effectively creation, sharing, Acquiring and Applying green knowledge, firms can develop innovative solutions for environmental challenges. These innovations can address resource efficiency, renewable energy, pollution reduction, and other aspects relevant to specific SDGs.

The results of the sub-hypotheses are as follows:

- **H2a**: Supported: There is a positive impact of (CrGK) on achieving GI in the economic firms under study (B-value = 0.089 and p-value = 0.048). The result suggests that creating and utilising knowledge specifically focused on environmental sustainability (Creation Green Knowledge) has a beneficial effect on businesses' ability to develop new ideas and products that are also environmentally friendly (Green Innovation). In other terms, the more firms focus on building knowledge about sustainable practices and eco-friendly solutions, the better equipped they are to innovate in ways that benefit both the environment and their bottom line.
- **H2b**: not Supported: There is no positive impact of (AcGK) on achieving GI in the economic firms under study (B-value = 0.342 and p-value = 0.075). This result suggests that companies that actively seek out and acquire knowledge related to environmentally friendly practices (Acquisition Green Knowledge) do not necessarily have a higher likelihood of achieving success in developing new green technologies and processes (Green Innovation). However, the more a company learns about eco-friendly solutions, the better equipped they are to invent and implement them.
- **H2c**: Supported: There is a positive impact of (ShGK) on achieving GI in the economic firms under study (B-value = 0.220 and p-value = 0.013). The result suggests that firms sharing knowledge about environmentally friendly practices are more likely to develop new and innovative ways to be sustainable (green innovation). In addition, by openly discussing and collaborating on these practices, firms can spark creativity and develop better solutions for sustainability. This can lead to a win-win situation for both the environment and the firm's financial performance.
- **H2d**: not Supported: There is not a positive impact of (ApGK) on achieving GI in the economic firms under study (B-value = 0.123 and p-value = 0.099). The result suggests that the study did not find evidence to support the idea that the Application of Green Knowledge (ApGK) has a positive impact on achieving Green Innovation GI in economic firms. It is important to note that the absence of evidence does not necessarily mean (ApGK) has no impact. Further research with more comprehensive data and longer timeframes might reveal a positive connection.

Finally, firm size and industry type were examined in relation to SDGs and GI. With SDGs, firm size presented significant positive results, which means that large firms tend to engage in SDGs activities higher than small or medium-sized firms. However, an insignificant result concerning GI was found for firm size. Similarly, the role of industry type was examined concerning SDGs and GI, which presented significant results for both paths.

Research implications and limitations

This research reveals that Green Knowledge Management (GKM) is not just for the big players (big firms)—it can also help you achieve impressive sustainability goals. Whether you are in manufacturing or services, implementing GKM effectively unlocks numerous benefits.

This research breaks new ground by exploring the link between green knowledge management GKM and green innovation GI, with an emphasis on how these factors combine to achieve sustainable development goals and SDGs. It challenges the traditional separation of knowledge management and environmentalism, proposing that their convergence holds immense potential for competitive advantage and environmental performance. By employing cutting-edge statistical methods, the study uncovers the critical role of green innovation in bridging the gap between GKM and sustainability, highlighting the need for strong GKM systems to translate green ideas into reality and achieve sustainable development goals.

This study's limitations lie in its restricted data source and potential for perceptual bias. Excluding operational staff and relying solely on managers' views limit the study's generalizability and introduce possible bias. Future research should broaden data collection to include diverse perspectives and incorporate additional data sources (financial reports, etc.) to enhance validity. Furthermore, expanding the study's scope to other countries and integrating additional variables can strengthen the model and deepen our understanding of the key constructs.

Conclusion

The study reveals that strong GKM significantly enhances green innovation and sustainable development goals across manufacturing and service sectors. This suggests that policymakers should integrate GKM initiatives into overall business strategies to foster economic growth and environmental progress. Decision-makers in the French firms under study must support efforts to strengthen knowledge acquisition and apply green knowledge to achieve green innovation, particularly in the products, goods, and services offered. This will increase effectiveness and contribute to well-being and the achievement of established goals.

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