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SUSTAINABLE DEVELOPMENT OF SME AND GREEN IT: BIBLIOMETRIC ANALYSIS

The purpose of this paper is to systematize scientific literature on the sustainable development of small and medium-sized enterprises (SMEs) using green information technologies (IT). Bibliometric and textual analysis was performed using the literature found in the Web of Science (WoS) database for 2014-2025. Bibliometric analysis examined the trends, documented types of relevance to the UN Sustainable Development Goals (SDGs), country of origin, and citation analysis. While for textual analysis, VOS viewer software was used to identify clusters and relationships between keywords and terms extracted from the publications.

The analysis of 93 publications shows a growing interest in the research area, with the number increasing annually. The main types of documents are research articles, and the publications largely correspond to SDG 9 (Industry, Innovation and Infrastructure) and SDG 12 (Responsible Consumption and Production). The keywords network analysis identified three clusters of research areas: SME impact and tangible benefits, behavioral and managerial aspects, and implementation and strategy. The abstracts 'terms analysis also revealed two clusters: the role and impact of green IT, and circular economy and sustainable resource management.

The study identifies gaps for future research, including the need to study deeper into SDGs 10, 16 and 17, strengthen empirical research, and consider the behavioral and managerial aspects of green IT adoption in SMEs.

Keywords: Green IT, SME, SDG, VOS viewer, sustainable development

Introduction

The growing global challenge of electronic waste (e-waste) is an urgent environmental and socio-economic issue. Central Asia generated 400 million

kg of e-waste in 2022, with Kazakhstan leading the sub-region at 200 million kg [1]. The recycling rate across Central Asia remains critically low at 3.2 %, reflecting the region's insufficient infrastructure and awareness of proper e-waste management [1].

Green IT is the philosophy and practice of using computing and mobile devices and IT resources in an environmentally efficient manner. It includes not only energy conservation but also aspects such as design, production, consumption, and disposal of equipment with minimal impact on the environment [2]. With the increasing awareness of climate change and the depletion of natural resources, green IT has become an important consideration for businesses and individuals alike.

Green IT is important because of its potential to reduce energy consumption, minimize waste, and promote sustainable practices in various industries [3]. By adopting Green IT strategies, organizations can reduce their carbon footprint, save money on energy costs, and improve their reputation as environmentally responsible entities. The adoption of green IT practices in alignment with Sustainable Development Goal (SDG) 12 emphasizes responsible consumption and production [4].

Small and medium-sized enterprises (SMEs) are the largest commercial structures and a vital component of a country's economic development. SMEs often face unique challenges in adopting sustainable practices due to limited resources, a lack of expertise, and financial constraints. Small and medium-sized enterprises are adopting cyclical business models by reusing waste, purchasing recycled materials, and optimizing packaging and transportation systems. Such approaches reduce costs while reducing environmental waste [5]. However, they also have opportunities to leverage their agility and new green technologies to implement innovative and sustainable solutions. Considering their contributions, a lot of small and medium-sized businesses struggle to fully adopt environmentally friendly IT practices due to issues such as a lack of funding and experience. To overcome these obstacles, governments and others must provide support.

The study aims to systematize scientific literature relating to the sustainable development of SME through utilizing green IT by bibliometric and textual analysis.

For this purpose, the authors used bibliometric and textual analysis. Bibliometric analysis is a quantitative method that uses the Web of Science (WoS) database to identify and analyze publications related to green IT and SME sustainability from 2014 to 2025. As usual, researchers employ bibliometric analysis for several purposes, including examining the intellectual structure of a particular field in the body of existing literature and identifying new trends in article and journal performance, collaboration patterns, and research constituents. It is important to note that this analysis has advantages in predicting trends in

specific areas of research. It is widely used to analyze the status of investigation, cutting-edge areas, and trends in the development of specific fields. It examines parameters such as publication years, document types, relevance to UN Sustainable Development Goals (SDGs), country of origin, and citation counts. While textual analysis is also a qualitative method, we utilized VOS viewer software to analyze keywords and terms extracted from the selected publications. It identifies clusters and relationships between these terms, providing insights into the main themes and research directions in this field.

Materials and methods

E-waste management is a growing concern in Kazakhstan, where limited infrastructure and low recycling rates (3.2%) exacerbate the problem [1]. Current approaches primarily focus on basic recycling, but they fail to address the root causes of e-waste generation, such as inefficient IT practices in SMEs and consumer habits regarding electronic waste disposal. Although there have been some efforts to raise awareness, the concept of Green IT adoption has not been comprehensively explored. This project is novel because it introduces a country-specific Green IT information system framework aimed at reducing e-waste generation from both production (SMEs) and consumption (citizens) perspectives [4]. Preliminary studies suggest that SMEs are open to adopting sustainable technologies but face barriers such as cost and resistance to change.

SMEs are the main drivers of economic growth and socio-economic development, as well as in achieving numerous SDGs. In a sustainable development way, SMEs adopting new technologies play a crucial role. In this context, studies relating to green technology and particularly green IT adoption by SMEs became essential [6].

Research by Mukwarami & van der Poll, (2024)large enterprises continue to lead in implementing EMA, small and medium enterprises (SMEs indicates that Environmental Management Accounting (EMA) plays a crucial role in facilitating knowledge transfer and fostering environmental innovations, which ultimately enhance environmental performance, as EMA supports the adoption of green IT practices among small and medium-sized enterprises (SMEs). By promoting environmental innovations through effective knowledge management, EMA lays the groundwork for improving the environmental impact of SMEs. This perspective is supported by researchers examining the implementation of Environmental Management Systems (EMS) in small and medium-sized enterprises (SMEs) across developing countries, which demonstrates its role in fostering positive attitudes toward environmental management [7] large enterprises continue to lead in implementing EMA, small and medium enterprises (SMEs].

Research by Zandi, Khalid, & Islam, (2019) also stresses that Environmental Management Accounting (EMA) has a significant effect in fostering and improving environmental performance [8]. This is particularly relevant to the current project, as EMA supports the adoption of green IT practices among small and medium-sized enterprises (SMEs) in Kazakhstan. By promoting environmental innovations through effective knowledge management, EMA lays the groundwork for improving the environmental impact of SMEs in Kazakhstan.

The results of previous research by Khalid, Salykova, & Capar, (2020) reveal that entrepreneurial innovations significantly contribute to enhancing energy efficiency and environmental improvements, offering a model for Kazakh SMEs to enhance their operational activities through the adoption of green IT [9].

In the studies by Ali et al., (2020) on the theory of consumption values to understand consumer intentions toward green IT products, it was found that functional, social, and emotional values are particularly significant, which is supported by the data presented in the study [10]. This data will help tailor consumer outreach and education campaigns in Kazakhstan to encourage the use of green IT products. Furthermore, Ali, Danish, Khuwaja, Sajjad, & Zahid, (2019) compare several models of green IT adoption and, by providing recommendations on how to structure programs, identify the most effective strategies to encourage organizations to adopt green IT practices [11]. The findings from this and other research provide a strong basis for creating strategies aimed at accelerating the adoption of green IT among small and medium-sized enterprises (SMEs) in Kazakhstan. These strategies can leverage insights into effective practices and innovations that promote sustainability, helping SMEs transition towards more environmentally friendly operations. By focusing on tailored approaches that address the specific needs and challenges faced by these enterprises, stakeholders can significantly enhance the integration of green technologies and practices in the Kazakhstani market

The results of previous research by Gallotta, Baranova, & Paterson (2023) al reveal that entrepreneurial innovations significantly contribute to enhancing energy efficiency and environmental improvements, offering a model for Kazakh SMEs to enhance their operational activities through the adoption of green IT [12].

Furthermore, Abdelbasir et al. (2018) compare several models of green IT adoption and, by providing recommendations on how to structure programs, identify the most effective strategies to encourage organizations to adopt green IT practices [13]representing 1-3% of the general waste generated yearly worldwide. The large quantities of outdated and life-ended electrical and electronic equipment make it a fast-growing waste production all over the world. Printed circuit boards (PCBs. The findings from this and other research provide a strong basis for

creating strategies aimed at accelerating the adoption of green IT among small and medium-sized enterprises (SMEs) in Kazakhstan. These strategies can leverage insights into effective practices and innovations that promote sustainability, helping SMEs transition towards more environmentally friendly operations. By focusing on tailored approaches that address the specific needs and challenges faced by these enterprises, stakeholders can significantly enhance the integration of green technologies and practices in the Kazakhstani market.

Moreover, some research examine the challenges employees face in the adoption and use of green information systems from both a temporal dimension (the theory of innovation diffusion) and an activity dimension (activity theory), expanding existing knowledge in the field of green information systems research aimed at changing sustainable behavior and offering several theoretical and practical avenues for future inquiry [2;14].

Various country-specific studies relating to the adoption of green IT by SMEs also identified different degrees of compliance with environmental practices, resulting in different impacts on sustainability indicators [3]. Among the main factors affecting the adoption of green innovations, the studies emphasize such factors as top management support for adoption levels, availability of organizational readiness, competitive pressure, government support, and perceived usefulness [3].

Although there have been some efforts to raise awareness, the concept of Green IT adoption has not been comprehensively explored.

In this study, we performed a bibliometric analysis adopted from Zupic & Čater, (2014) [15]. The study flow diagram is shown in Figure 1. Bibliometric and textual analysis of scientific literature by searching in the Web of Science (WoS) database for the periods from 2014 to 2025. For the searching in the WoS database, the following keywords were used: «green IT», «SME», «sustainability». By this search in the first stage, we identified 115 related publications, then the search was refined for the timeline from 2014 to the present time (February 2025). For the final analysis, we chose 93 documents from the WoS database. Bibliometric analysis uses statistical methodologies, such as citation rates, to evaluate countries and publication years statistically [16]. For findings, authors also applied bibliometric analyses through the following parameters: years of publication, type of documents, relevance to SDG, countries, and citation. Bibliometric analysis also includes qualitative metrics such as citations. Citation analysis shows how particular papers were influential and subsequently studied by others.

On the second stage, we applied a textual analysis of keywords and terms through VOS viewer software. The textual analysis helped us to reveal and identify the main clusters of studies relating to our topic. To prepare the data for analysis, bibliometric data of the selected papers were converted to RIS format, and co-

occurrence of keywords identified at least three times and terms extracted from abstracts occurring at least six times were performed.

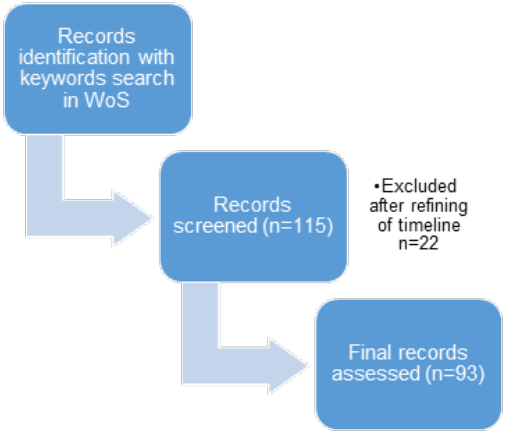

Figure 1 – The study flow diagram

Source: Compiled by authors

Each «vertex» and «node» in the network represents an individual member of the network. Frequency of occurrence is shown by the size of the nodes, while high-frequency phrases are represented by the vertex symbol. Smaller nodes appear less frequently compared to other nodes. The line represents the relationship between the two terms that exists between the two keywords, indicating that they were in the same publication. It is constructed in such a way that it is proportional to the relationship that exists between the keywords. When there is a stronger relationship between two concepts, the line that connects them will appear thicker. The map visualization and network characteristics (centrality, density, core-periphery structure, strategy diagram, and network diagram) were constructed using this reasoning.

Results and discussion

A review of scholarly publications from the last decade reveals that research on sustainable development in SMEs, particularly in Green IT applications, peaked in 2024, with the highest annual publication amount. And considering the fact that 2025 only started and in our search, only two months were included, publications in this field are steadily growing year by year (Figure 2).

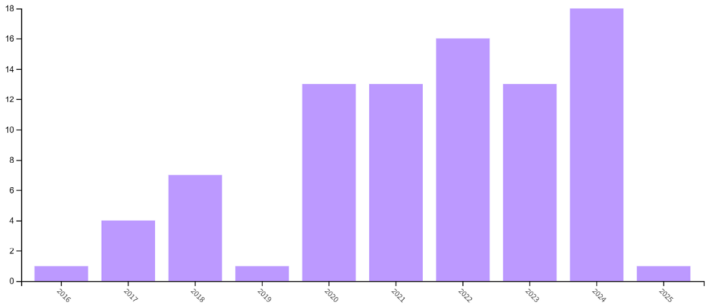

Figure 2 – The publications overtime (2014–2025)
Source: Compiled by authors

The significant increase in publications, especially in 2024, demonstrates the growing academic interest in the interaction of green IT and SME sustainability. This reflects the growing global awareness of environmental issues and the pressure on businesses to implement sustainable practices. The consistent growth year by year suggests that this is not a passing trend but a sustainable area of research. The fact that there are already publications in 2025, even though the data only includes a few months, confirms this.

Table 1 – Document types

Document Types	Record Count	% of 93
Article	79	84.946
Book Chapters	1	1.075
Early Access	3	3.226
Proceeding Paper	13	13.978
Retracted Publication	1	1.075
Review Article	1	1.075
Source: Complied by authors		

Findings indicate that the main document types relating to the topic in the WoS database are research articles (89 %), while only one review article was counted. The overwhelming predominance of research articles suggests a strong emphasis on empirical research and data-driven analysis in the field. This is positive as it implies a focus on generating evidence-based practical ideas and recommendations. The paucity of review articles points to a potential need for a more comprehensive

synthesis of existing research to identify gaps and future research directions. The current study contributes to this area by systematization research.

The review article in this area, conducted by Hawken, Rahmat, Sepasgozar, & Zhang, (2021), concludes that most research articles considered SDGs independently of green IT. Furthermore, green technologies were not generally considered as a sustainable alternative. The authors also concluded that interdisciplinary research is needed to address the gap [6].

Table 2 – Publication related to SDGs

Sustainable Development Goals	Record Count	% of 93
01 No Poverty	3	3.226
02 Zero Hunger	3	3.226
03 Good Health and Well Being	1	1.075
04 Quality Education	3	3.226
05 Gender Equality	3	3.226
06 Clean Water and Sanitation	3	3.226
07 Affordable and Clean Energy 12 12.903		
08 Decent Work and Economic Growth	4	4.301
09 Industry Innovation and Infrastructure	73	78.495
11 Sustainable Cities and Communities	10	10.753
12 Responsible Consumption and Production	23	24.731
13 Climate Action	13	13.978
14 Life Below Water	5	5.376
15 Life on Land	4	4.301
*2 record(s) (2.151%) do not contain data in the field being analyzed *Source:* Complied by authors		

Relating to the UN Sustainable Development Goals (SDGs), the chosen publications mostly related to Goal 09 Industry innovation and infrastructure (78,5 %) and Goal 12 Responsible consumption and production. Overall, the publications cover almost all SDGs except Goal 10 Reduce inequalities, Goal 16 Peace, justice, and strong institutions, and Goal 17 Partnerships for the goals.

The alignment with SDG 9 (78.495 %) highlights the crucial role of green IT in stimulating innovation and developing sustainable infrastructure within SMEs. The significant attention to SDG 12 (24.731 %) reflects the importance of promoting sustainable consumption and production patterns through green IT practices. While SDGs 9 and 12 dominate, the coverage of almost all other SDGs (except 10, 16, and 17) suggests that green IT has multifaceted implications for

sustainable development. The lack of information regarding SDGs 10, 16, and 17 implies that there is a gap in the current research. More research is needed to examine green IT and SME sustainability as well as in relation to these SDGs.

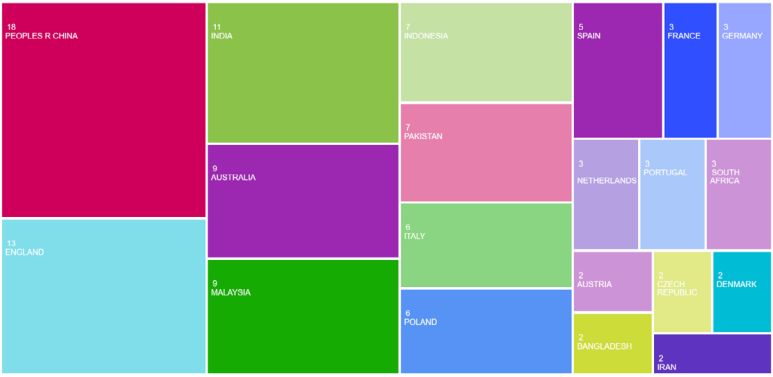

Figure 3 – Publications by counties
Source: Compiled by authors

A global analysis of publications among these reveals that researchers from the People's Republic of China (18 studies) dominate the field, followed by England (13), India (11), Australia (9), and Malaysia (9), as it is shown in Figure 3.

The diversity of countries included in the study (China, England, India, Australia, Malaysia) indicates the global interest in this topic. The prominence of countries such as China and England may reflect their advanced technological infrastructure, strong research capabilities and proactive environmental policies.

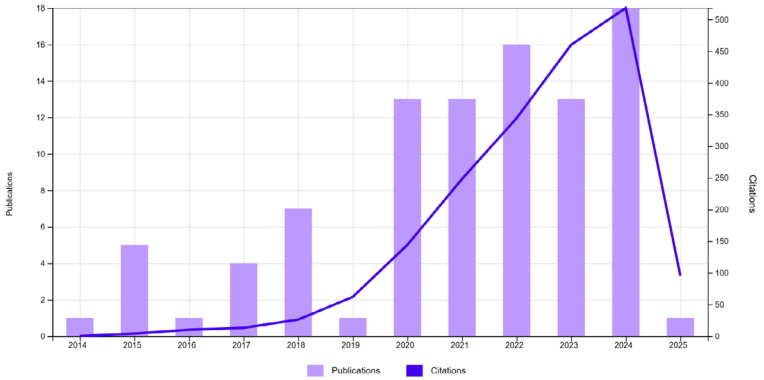

Figure 4 – Publications and citations overtime (2014–2015)
Source: Compiled by authors

Citation analysis of 93 publications related to the topic shows a high level of citing. A total 93 publications were cited 1924 times and 1910 times without self-citation. Average 20,69 times per item. Distribution of citations over time is shown in Figure 4.

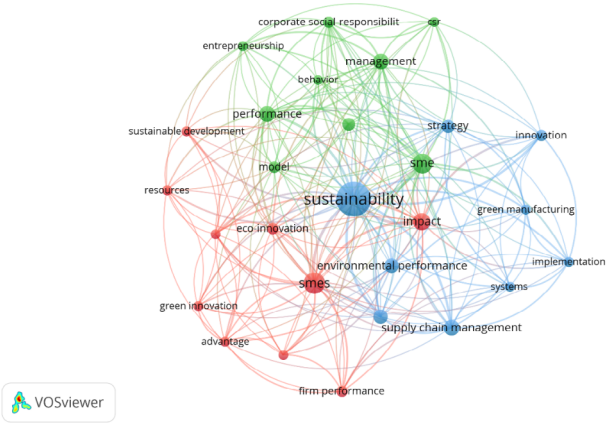

Figure 5 – Keywords network
Source: Compiled by authors using VOS viewer

Citation increased during the last three years, which also proves the high interest in the topic. The high citation count (1924 citations in total) demonstrates the significant impact and relevance of these publications in the academic community. In addition, the upward trend in citations in recent years suggests that the research is attracting increasing attention and having an increasing impact.

For textual analysis of the 93 publications, we used VOS viewer software. The keywords network analysis association test with co-occurrence of authors' keywords three times or more. As a result, 28 items were identified and divided into three clusters. These 28 items have 229 links with a total link strength of 384 (Figure 5).

Keywords network

First red cluster with SME focus includes keywords: advantages, eco-innovation, financial performance, firm performance, green innovation, impact, product innovation, resources, SMEs, and sustainable development. This cluster focuses on the impact of green IT on SMEs, specifically examining how it drives eco-innovation, financial performance, and sustainability. The keywords suggest an emphasis on the tangible benefits of implementing green IT for SMEs. The studies confirmed that green innovations significantly and positively affect SME performance [17;18]the role of managerial environmental concern (MEC. Furthermore, the sustainability readiness of SME plays a key role in this relationship [18]it explores the impact of firm size and sustainability readiness on SME performance and examines the moderating and mediating effects of these factors on the relationship between innovation and firm performance. Structural equation modeling (SEM. Research in this area also confirms that the relationship between sustainable practices and business performance, measured by financial and non-financial indicators, becomes more understandable when the influence of innovativeness is taken into account as a mediating variable [19]the research on how it influences the business performance of smalln – and medium-sized enterprises (SMEs).

The second green is the Behavioral and Managerial cluster and includes 9 items: behavior, corporate social responsibility, CSR, entrepreneurship, management, medium-sized enterprises, model, performance, and SME. This cluster highlights the behavioral and managerial aspects of implementing green IT in SMEs. Keywords such as 'behavior', 'corporate social responsibility', 'entrepreneurship' and 'governance' highlight the importance of organizational culture, leadership and stakeholder engagement in promoting sustainable practices. Although many studies have been conducted on the antecedents of green entrepreneurial behavior, there is no single approach or commitment. Some studies have shown that environmental commitment and motivation have a positive effect

on green entrepreneurial behavior. Entrepreneurial education, training programs, and sustainability values have had a significant positive effect on environmental commitment [20]. SME owners and managers consider green and sustainable development via competitive advantage, which positively influences business performance [5].

The third blue cluster relates to Implementation and Strategy and includes 9 items: barriers, environmental performance, green manufacturing, innovation, implementation, strategy, supply chain management, sustainability, and systems. This cluster focuses on the practical aspects of implementing green IT strategies in SMEs. Keywords such as 'barriers', 'implementation', 'strategy' and 'supply chain management' suggest an emphasis on identifying challenges and developing effective solutions for integrating green IT into business operations. Research highlights that the key parameters for the implementation of sustainable practices by SMEs are various input factors such as consumer characteristics, managerial behavior, adoption of new technologies, social pressure, legal provisions, and government pressure [17]the role of managerial environmental concern (MEC. In the implementation of sustainable practices for SME, governmental support and green economic incentives play a key role. While green IT and other green technologies perform as enablers for green and lean manufacturing practices of SME.

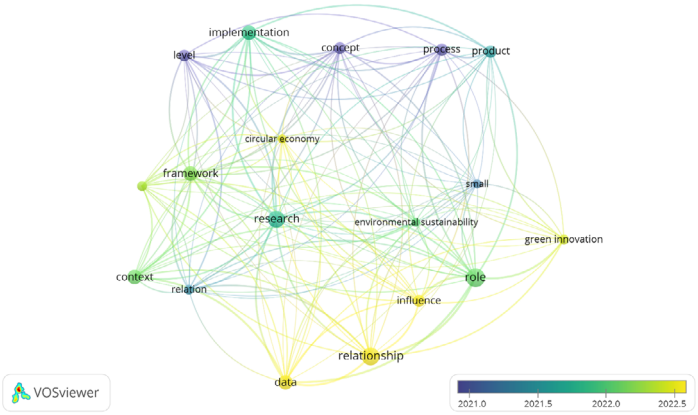

Figure 6 – Abstract terms textual analysis
Source: Compiled by authors using VOS viewer

These clusters reveal that the research on Green IT and SME sustainability is multifaceted, encompassing the direct, measurable benefits of Green IT for SME performance, the crucial role of organizational behavior and management in driving

sustainable practices, and the practical challenges and strategic considerations involved in implementing Green IT. The findings underscore the need for a holistic approach to Green IT adoption, considering not only the technological aspects but also the behavioral, managerial, and strategic dimensions.

Terms extracted from abstracts were also analyzed by VOS viewer. From this analysis, we identified 2 clusters with 9 items in each, 18 items in total, 145 links with a total link strength of 414 (Figure 6).

Cluster 1 terms: Small, data, environmental sustainability, green innovation, influence, process, product, relationship, role.

Cluster 2 terms: circular economy, concept, content, environmental performance, framework, implementation, level, relation, research.

The first cluster of abstract terms is centered around the role and impact of green IT on environmental sustainability. Keyword phrases such as «green innovation», «environmental sustainability», «impact,» and «relationships» suggest a focus on understanding how green IT leads to positive environmental outcomes. The second cluster highlights the growing interest in the concept of circular economy in the context of green IT and SME sustainability. Keyword phrases such as «circular economy, «implementation», «framework,» and «research» suggest a focus on developing and applying frameworks for sustainable resource management and waste reduction.

The text analysis reveals a multifaceted understanding of Green IT and SME sustainability. The study covers not only the technological aspects of Green IT, but also its behavioral, managerial, and strategic dimensions. The focus on both keywords and abstract terms provides a comprehensive view of the key themes and research directions in this area.

From our analysis, we identified gaps in scientific literature for future research and divided them into the next directions:

Expanding the Scope of SDGs, particularly uncovered by current studies, including SDG 10 – How can Green IT adoption in SMEs contribute to reducing inequalities within and among countries? SDG 16 – What is the role of Green IT in promoting peaceful and inclusive societies, providing access to justice, and building effective, accountable institutions at the SME level? SDG 17 – How can Green IT facilitate and strengthen partnerships between SMEs, governments, and other stakeholders to achieve sustainable development goals?

Strengthening Empirical Research by conducting longitudinal studies to examine the long-term impacts of Green IT adoption on SME performance and sustainability. Also, comparative studies across different countries, industries, and SME sizes to identify contextual factors that influence the success of Green IT initiatives.

Addressing Behavioral and Managerial Aspects by exploring the behavioral barriers that hinder Green IT adoption in SMEs and developing strategies to overcome them. Furthermore, additional research is needed to examine the determinants of green entrepreneurial behavior in SMEs and to develop evidence-based interventions that effectively promote such practices.

Conclusions

A bibliometric and textual analysis of 93 publications from the WoS database identified the main topics on the sustainable development of SMEs through green IT for the period 2014-2025. The annual number of publications indicates a growing interest in this research area. The most significant SDGs are SDG 9 and SDG 12, while the study also covers other SDGs. The leading countries in this research area are China and England. The study focuses on the impact of green IT on SMEs, in particular, on examining how it stimulates eco-innovation, financial efficiency and sustainable development. The study identified three main clusters among the scientific publications they concern the impact of green IT on SME activities, behavioral aspects of green IT implementation for sustainable development, and prerequisites and barriers to the implementation of green IT in SME activities for their sustainability. The article also suggests directions for future research, which should focus on the antecedents of green entrepreneurial behavior, barriers to green IT adoption, and the relationship between sustainable practices and business performance. According to the reviewed literature, government support and green economic incentives play a key role in the adoption of sustainable practices by SMEs.

The study was based exclusively on the Web of Science (WoS) database. Although WoS is an authoritative source, it may not cover all relevant publications. Other databases such as Scopus or Google Scholar, may provide a more comprehensive view.

The results of this study may not be generalizable to all SMEs, as the study focused on publications indexed in WoS, which may be biased towards certain regions and industries. However, the results of this research will be necessary for further investigation in the successful adoption of Green IT practices among SMEs and citizens in Kazakhstan as a background for leading to a measurable reduction in e-waste generation and improved sustainability in IT usage.

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УСТОЙЧИВОЕ РАЗВИТИЕ МСП И ЗЕЛЕНЫЕ ИТ: БИБЛИОМЕТРИЧЕСКИЙ АНАЛИЗ

Целью данной статьи является систематизация научной литературы по устойчивому развитию малых и средних предприятий (МСП) с использованием зеленых информационных технологий (ИТ). Библиометрический и текстовый анализ были выполнены с использованием литературы, найденной в базе данных Web of Science (WoS) за 2014-2025 годы. Проведен библиометрический анализ публикаций по их релевантности Целям устойчивого развития ООН (ЦУР), стране происхождения и цитируемости. В то время как для текстового анализа использовалось программное обеспечение VOS Viewer для выявления кластеров и связей между ключевыми словами и терминами, извлеченными из публикаций.

Анализ 93 публикаций показывает растущий интерес к области исследований, причем их число ежегодно увеличивается. Основными типами документов являются научные статьи, а публикации в значительной степени соответствуют ЦУР 9 (Промышленность, инновации и инфраструктура) и ЦУР 12 (Ответственное потребление и производство). Анализ сети ключевых слов выявил три кластера областей исследований: влияние на МСП и выгоды, поведенческие и управленческие аспекты, а также реализация и стратегия. Анализ терминов аннотаций также выявил два кластера: роль и влияние зеленых ИТ, а также циркулярная экономика и устойчивое управление ресурсами.

Исследование выявляет пробелы для будущих исследований, включая необходимость более глубокого изучения ЦУР 10, 16 и 17, усиления эмпирических исследований и рассмотрения поведенческих и управленческих аспектов внедрения зеленых ИТ в МСП.

Ключевые слова: зеленые ИТ, МСП, ЦУР, VOS viewer, устойчивое развитие.

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ШАҒЫН ЖӘНЕ ОРТА БИЗНЕСТІҢ ТҰРАҚТЫ ДАМУЫ ЖӘНЕ ЖАСЫЛ АҚПАРТТЫҚ ТЕХНОЛОГИАЛАР: БИБЛИОМЕТРИЯЛЫҚ ТАЛДАУ

Бұл жұмыстың мақсаты – жасыл ақпараттық технологияларды (АТ) пайдалана отырып, шағын және орта кәсіпкерліктің (ШОБ) тұрақты дамуы бойынша ғылыми әдебиеттерді жүйелеу. 2014-2025 жылдарға арналған Web of Science (WoS) деректер базасында табылған әдебиеттерге библиометриялық және мәтіндік талдау жүргізілді. Библиометриялық талдау басылымдардың түрлерін, тенденцияларды, БҰҰ Тұрақты даму мақсаттарына (ТДМ) сәйкестіктігін, шыққан елдерін және дәйексөздерді зерттеді. Мәтіндік талдау үшін VOS viewer бағдарламалық құралы түйінді сөздер мен басылымдардан алынған терминдер арасындағы кластерлер мен қатынастарды анықтау үшін пайдаланылды.

93 жарияланымның талдауы зерттеу саласына қызығушылықтың артып келе жатқанын көрсетеді, олардың саны жыл сайын артып келеді. Құжаттардың негізгі түрлері зерттеу мақалалары болып табылады, ал жарияланымдар негізінен ТДМ 9 (Индустрия, инновациялар және инфрақұрылым) және ТДМ 12 (Жауапты тұтыну және өндіріс) сәйкес келеді. Желілік талдаудың түйінді сөздері зерттеу бағыттарының үш кластерін анықтады: ШОБ әсері және нақты пайдалар, мінез-құлық және басқару аспектілері, іске асыру және стратегия. Аннотациялар «терминдерін талдау» сонымен қатар екі кластерді анықтады: жасыл АТ рөлі мен әсері, айналмалы экономика және тұрақты ресурстарды басқару.

Мақалада болашақ зерттеулер үшін бағыттар анықталған, соның ішінде ТДМ 10, 16 және 17 тереңірек зерттеу қажеттілігі, эмпирикалық зерттеулерді күшейту және ШОБ-та жасыл АТ-ны қабылдаудың мінез-құлық және басқарушылық аспектілерін қарастыру.

Кілтті сөздер: Жасыл АТ, ШОБ, ТДМ, VOS viewer, тұрақты даму.

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