

AGILE BEHAVIORS OF ENTERPRISES IN THE ASPECT OF ECOLOGICAL USE OF IT EQUIPMENT

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Purpose: The aim of the article is to examine the agile behavior of enterprises in the context of the ecological use of IT equipment. The focus was on analyzing how enterprises implement Green IT practices and how these activities affect their operational and environmental efficiency.

Design/methodology/approach: The research methodology was based on an anonymous survey among 578 enterprises representing various sectors of the economy. The survey aimed to collect data on practices related to the successive replacement of IT equipment, the implementation of technological innovations, the use of energy-saving devices and the integration of Green IT as an element of a business strategy.

Findings: Research has shown that enterprises that regularly replace IT equipment with new ones are more likely to implement technological innovations and use energy-saving devices. Strong correlations were observed between the implementation of innovations and energy efficiency. Choosing suppliers that promote Green IT is an important factor for companies striving for sustainable development.

Research limitations/implications: Research limitations include the subjectivity of respondents' responses and the lack of full representativeness of the sample. Focusing on specific aspects of the green use of IT equipment may have omitted other important factors. Research results have limited validity due to changing regulations and technologies.

Practical implications: The research results suggest that enterprises should focus on the gradual replacement of IT equipment with modern and energy-saving ones and on the integration of innovative technological solutions. This approach not only reduces energy consumption, but also reduces operating costs and improves the company's image as environmentally responsible.

Social implications: Implementing Green IT solutions as an element of a business strategy contributes to the protection of the natural environment and supports sustainable development. Companies that promote agile and green practices can gain greater trust from customers, business partners and local communities.

Originality/value: The article adds value by comprehensively analyzing the links between enterprise agility and their green practices in the use of IT equipment. The study highlights the importance of integrating Green IT into business strategies and shows how such activities can bring both operational and environmental benefits.

Keywords: agile behavior, ecology, IT equipment, enterprise, Green IT.

Category of the paper: research paper.

1. Introduction

The use of IT equipment in an ecological way is a key issue in contemporary IT management. In the face of growing ecological awareness and increasingly restrictive environmental protection regulations, companies must adapt their practices to new requirements. An ecological approach to IT equipment management not only allows for reducing the negative impact on the environment, but also brings economic and operational benefits (Torres, 2023).

The importance of the ecological use of IT equipment in enterprises results from several key factors. First, the energy consumption of IT infrastructure constitutes a significant part of the total energy consumption of enterprises. Optimizing energy consumption through the use of energy-efficient devices and technologies can lead to significant savings in operating costs. Second, the growing expectations of stakeholders, including customers, investors, and business partners, regarding sustainability and ecological responsibility are forcing companies to implement more sustainable practices (Alshehhi, Nobanee, Khare, 2018).

Agile enterprise behaviors, known as the agile approach, play a key role in integrating green practices in IT management (Trotta, 2018). Enterprises that effectively implement agile principles are more flexible and respond faster to changing market conditions and ecological requirements. This approach includes regular replacement of IT equipment with modern and more energy-efficient ones, which allows the use of the latest technologies with lower energy consumption. Additionally, the implementation of technological innovations, such as server virtualization or cloud computing, enables more efficient use of resources and reduction of energy consumption (Kocot, Kwasek, 2022).

Introducing Green IT practices as an integral part of business strategy is the next step that companies should take. Preferring suppliers offering ecological products and solutions and implementing systems that monitor energy consumption are just some of the actions that can significantly reduce the impact of IT activities on the environment. Enterprises that care about the ecological use of IT equipment gain not only operational benefits, but also build a positive image of socially and ecologically responsible companies (Zhou, Yang, 2016).

In the context of increasing pressure on sustainability, enterprises must adopt a holistic approach to IT management that combines operational agility with ecological responsibility. Research on enterprise agility and their green IT practices is essential to understand what strategies and actions are most effective in achieving these goals. Introducing and maintaining agile, green practices in IT not only benefits the environment, but also increases the competitiveness and innovation of enterprises in the long term.

2. Literature Review

2.1. Agile behavior of enterprises

Agile corporate behavior, known as the agile approach, is a key element of modern management in a dynamically changing business environment (Doz, Kosonen, 2008). Agile allows for quick adaptation to market changes, growing competition and changing customer needs (Womack, Jones, 2003). The key principles of agility include customer focus, dynamic organizational structure, iterative work model, transparency and communication, use of technology, and adaptability (Fitzgerald, Stol, 2017; Kocot, Kwasek, 2022).

In the agile approach, companies focus on understanding and meeting customer needs through direct communication and regular feedback. Organizational structures are flexible and based on cross-functional teams (Lambri, Sironi, Teti, 2024), which enables rapid knowledge exchange and decision-making. The iterative work model, based on short cycles called sprints, allows for ongoing adjustment of projects and minimizing risk by quickly detecting and correcting errors (Nath, Agrawal, 2020; Prahalad, Ramaswamy, 2004).

Transparency and communication are key in agile organizations. Regular team meetings, such as daily stand-ups and retrospectives, promote the exchange of information and build trust (Kt & Sivasubramanian, 2023). The use of modern technologies, such as project management tools and process automation, supports efficiency and innovation (Brown, 2009). Adaptability allows you to quickly respond to market changes and adapt your operating strategy (Sajdak, 2021).

The organizational culture of agile enterprises is based on values such as trust, cooperation, openness to change and continuous improvement (Loeser, 2013). Employees are encouraged to take initiative and experiment, which fosters innovation and commitment. Leaders act as mentors and coaches, supporting the development of teams and promoting agile values (Chen, Li, 2021).

To sum up, agile corporate behavior is a comprehensive management approach that allows for quick adaptation to changing market conditions, increases competitiveness and contributes to achieving better business results.

2.2. Green IT concept in enterprises

The concept of Green IT in enterprises refers to strategies and activities aimed at reducing the negative impact of information technologies on the natural environment. In the face of growing environmental awareness and increasingly stringent environmental regulations, companies are implementing a variety of initiatives to make their IT operations more sustainable and green (Petrescu, Bilcan, Petrescu, Popescu, Anghel, 2020).

Green IT covers a wide range of activities, from the design and implementation of energy-efficient data centers, through the use of energy-saving devices, to recycling and disposal of obsolete electronic equipment. A key element is minimizing energy consumption by IT infrastructure (Modanval et al., 2021), which can be achieved by optimizing cooling systems, server virtualization and using more efficient processors and other hardware components (Ojo, Raman, Downe, 2019).

An important aspect of Green IT is also the promotion of responsible IT product lifecycle management (VersionOne, 2020b). Enterprises take actions to extend the life of equipment, repair and modernize existing equipment, and dispose of it appropriately at the end of its service life (Gao, Zhang, Gong, Li, 2020). Electronic recycling recovers valuable materials and reduces the amount of waste sent to landfills (Hu, Yan, Guo, Cui, Dong, 2017).

As part of Green IT, it is also important to use software supporting energy management (VersionOne, 2020a). These tools enable monitoring and analysis of energy consumption by various components of IT systems, which allows for the identification of areas requiring optimization. Automating energy management, such as automatically turning off unused devices, also contributes to reducing energy consumption (Attar, Almusharraf, Alfawaz, Hajli, 2022).

Enterprises implementing the Green IT concept also engage in initiatives related to the responsible purchase of equipment. Products certified for energy efficiency and low environmental impact are preferred, which includes both computer hardware and peripherals. This approach supports the development of the green technologies market and motivates producers to innovate towards more ecological solutions (Joiner, 2019).

Sustainable IT practices are also an integral part of companies' CSR (Corporate Social Responsibility) strategies. The implementation of Green IT is part of broadly understood activities for corporate social responsibility, contributing to building a positive image of the company and strengthening relationships with stakeholders. Companies undertaking these initiatives often report their environmental activities in CSR reports, which increases transparency and commitment to environmental protection (Awasthi, Awasthi, 2023).

To sum up, the concept of Green IT in enterprises covers a wide range of activities aimed at reducing the negative impact of information technology on the environment. By optimizing energy consumption, responsible product life cycle management, using energy-saving solutions and engaging in responsible purchasing, companies can contribute to sustainable development

and environmental protection. The implementation of Green IT is an important element of the CSR strategy, which translates into building a positive image of the company and long-term business benefits.

2.3. Agile behavior of enterprises and ecological use of IT equipment

Agile behavior of enterprises in the context of ecological use of IT equipment plays a key role in modern IT management. Enterprises that implement the agile approach (Borowski, 2021) increasingly pay attention to aspects related to environmental protection, which affects the way they manage their IT infrastructure (Borowski, Karlikowska, 2023). One of the key elements is the gradual replacement of IT equipment with new ones (Kurnia, Chien, 2020). Agile companies strive to regularly update their technological equipment, which allows them to use the latest, more energy-efficient and ecological solutions. Modern IT equipment is characterized not only by better performance, but also by lower energy consumption, which contributes to reducing operating costs and minimizing the negative impact on the environment (Jones, Adam, 2023).

The implementation of innovations in IT equipment is another important aspect. Companies using agile management methods often invest in modern technologies that allow for more efficient use of resources (He, Harris, 2021). Examples of such innovations include server virtualization, cloud computing, and advanced energy management systems (Ramadhana, 2021). Thanks to these technologies, it is possible to optimally use computing power and reduce energy consumption, which has a direct impact on environmental protection (Bhati, Hansen, Chan, 2017). The use of energy-efficient IT devices is an integral part of the strategy of environmentally conscious companies (Zou, Cheshmehzangi, 2022). Modern laptops, servers, and other peripheral devices are designed to minimize energy consumption (Rosário, Raimundo, 2021). Companies pay attention to energy certificates and technical specifications that confirm low energy consumption. The choice of such devices translates into lower operating costs and a reduction in carbon dioxide emissions (Mrugalska, Ahmed, 2021).

Green IT is becoming an increasingly important factor when selecting suppliers. Agile enterprises that strive for sustainable development prefer to cooperate with suppliers that offer green solutions and products (Luo et al., 2020). Choosing suppliers that promote sustainable practices allows you to build long-term, responsible business relationships that benefit both your business and the environment. Ensuring low energy consumption is a priority in agile enterprises (Prieto, Talukder, 2023). Optimizing energy consumption includes not only the selection of energy-saving devices, but also the implementation of systems that monitor and manage energy consumption in real time (Raschke, 2010). Enterprises implement solutions that allow automatic switching off of unused devices and effective resource management, which leads to a significant reduction in operating costs and negative impact on the environment (Patón-Romero, Baldassarre, Piattini, García Rodríguez de Guzmán, 2017).

The implementation of Green IT solutions as an element of business strategy is becoming more and more common (Chen, Siau, 2020). Enterprises realize that responsible management of information technologies not only contributes to environmental protection, but also strengthens their position on the market (Sedej, Justinek, 2021). Implementing the Green IT strategy allows you to build a positive image of the company as responsible and committed to sustainable development, which is valued by customers, business partners and investors (van den Brom, Meijer, Visscher, 2018).

To sum up, agile behavior of enterprises in the context of the ecological use of IT equipment includes the successive replacement of equipment with new ones, the implementation of innovations, the use of energy-saving devices, the selection of suppliers promoting Green IT, attention to low energy consumption and the implementation of Green IT solutions as an element of the business strategy. This approach allows you to achieve better business results while caring for the natural environment.

2.4. Research Methodology

The aim of the work was to identify the behavior of enterprises in the context of the ecological use of IT equipment and to understand how these behaviors are related to each other. The conducted research aimed to explore how enterprises approach the successive replacement of IT equipment with new ones, the implementation of technological innovations, the use of energy-saving devices, taking into account Green IT as an important factor in the selection of a supplier, ensuring low energy consumption and implementing Green IT solutions as an element of the strategy. business.

The research hypothesis assumed that there are strong correlations between the ecological behavior of enterprises in the field of IT, and especially between the implementation of technological innovations and energy efficiency. It was also assumed that companies that focus on one ecological aspect will be more likely to include other ecological practices in their operations.

The research method was an anonymous survey conducted in 2023, in which 578 respondents representing various enterprises participated. This survey allowed for the collection of data on various aspects of the ecological use of IT equipment and the analysis of the connections between them. Thanks to this, it was possible to obtain a comprehensive picture of enterprises' approach to ecology in the context of information and communication technologies.

The sociodemographic analysis of the study covers three main categories: the geographical scope of the company's operations, the sector to which the company belongs, and the assessment of the company's financial situation. 578 respondents participated in the study. With respect to geographical scope, the companies were divided into four groups. 109 companies declared their international scope of activity, 56 companies had a regional scope, 174 companies had a national scope, and 239 companies operated locally. In terms of sector affiliation, companies were divided into five sectors. Sector 1 (agriculture, forestry, fishing) included 19 companies.

Sector 2 (extractive industry, mining and processing, and construction) included 38 companies. The largest share was had by sector 3 (transport, communications, municipal and housing management and trade) with 205 companies. Sector 4 (finance, insurance, marketing and advertising, and real estate) included 163 companies, and sector 5 (health care, social welfare, education, scientific research, tourism and recreation, public administration, justice, police and military) included 153 companies. In terms of assessing the financial situation of companies, 221 enterprises described their situation as very good, 258 as good, 74 as average, and 25 as bad.

In conclusion, the sociodemographic data of the study present a diverse sample of enterprises in terms of geographical scope, sector of activity and financial situation, which allows for a comprehensive analysis of the ecological behavior of enterprises in various operational contexts.

2.5. Presentation of Research Findings

In the course of the research, attempts were made to identify the behavior of enterprises in the context of the ecological use of IT equipment (see Fig. 1). The answers of 578 respondents regarding various aspects of this issue were analyzed. In the case of successive replacement of IT equipment with new ones, 53 respondents declared a definitely negative opinion, 159 rather negative, 61 had no opinion, while 203 respondents expressed a rather positive opinion and 102 definitely positive. In terms of implementing innovations in the field of IT equipment, 42 people were definitely against it, 130 were rather against it, 73 had no opinion, 222 people rather supported such activities, and 111 strongly supported them.

The use of energy-saving IT equipment was met with mixed reactions: 65 respondents were strongly opposed, 113 were rather opposed, 87 had no opinion, while 200 were rather positive and 113 were strongly positive. Regarding Green IT as an important factor in choosing a specific supplier, 64 people were strongly opposed, 139 rather opposed, 167 had no opinion, 145 respondents rather agreed with this statement, and 63 strongly agreed.

The concern for low energy consumption was assessed by the respondents as follows: 62 people were definitely against it, 113 were rather against it, 96 had no opinion, 208 respondents were rather positive and 99 were definitely positive. The implementation of Green IT solutions as an element of a business strategy was met with responses from 92 people who were strongly opposed, 122 who were rather opposed, 162 who had no opinion, 135 who rather agreed with this approach and 67 who strongly agreed.

The conducted research shows the diversified approach of enterprises to the ecological use of IT equipment, showing both support for such activities and some doubts or lack of opinion on this subject among respondents.

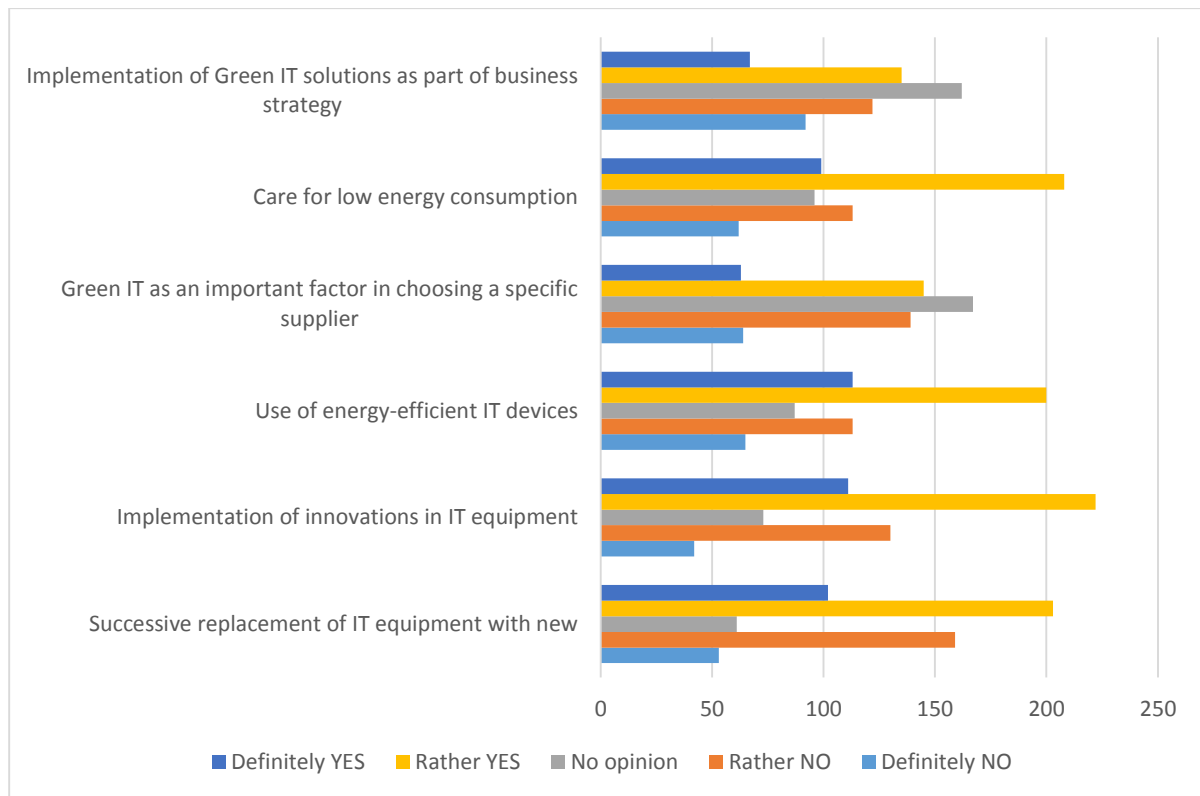


Figure 1. Agile behavior of enterprises in the aspect of ecological use of IT equipment, N = 578.

Source: Own study based on research.

In the course of the research, attempts were made to identify correlations between various behaviors of enterprises in the context of the ecological use of IT equipment. Table 1 presents a correlation matrix that allows us to understand how these behaviors are related to each other. The analysis of the results presented in Table 1 shows that there are strong correlations between many of the variables studied. The correlation between the successive replacement of IT equipment with new ones and the implementation of innovations in the field of IT equipment is very high (0.96), which suggests that enterprises that replace IT equipment with new ones more often are also more likely to implement technological innovations. A similarly strong correlation (0.91) occurs between the successive replacement of IT equipment and the use of energy-efficient IT devices, which indicates the tendency of companies to replace older devices with more energy-efficient ones.

High correlation values are also observed between the implementation of innovations and the use of energy-saving IT devices (0.98), which emphasizes the importance of modern technologies in the context of energy efficiency. In turn, the correlation between the use of energy-saving devices and attention to low energy consumption (0.99) is almost complete, which clearly suggests that companies that focus on energy efficiency in the field of IT equipment also care about minimizing energy consumption in general.

Green IT, as an important factor in choosing a specific supplier, shows moderate correlations with other variables, for example with the successive replacement of IT equipment (0.38) and the implementation of innovations (0.47), which indicates that although it is an important factor, it is not so strongly linked to other ecological behaviors such as energy saving.

The lowest correlation values were recorded for the implementation of Green IT solutions as an element of the business strategy in relation to other variables, with the exception of Green IT as a significant supplier selection factor (0.94), which shows that the strategic approach to Green IT is strongly related to the selection of compliant suppliers. with these principles, but less so with other ecological practices.

Table 1.

Correlation Table, N = 578

	1	2	3	4	5	6
1	1					
2	0.96	1				
3	0.91	0.98	1			
4	0.38	0.47	0.44	1		
5	0.88	0.98	0.99	0.49	1	
6	0.11	0.26	0.28	0.94	0.35	1

Source: Own study based on research.

The analysis of the correlation table shows that the behavior of enterprises in the ecological use of IT equipment is largely interconnected, especially with regard to technological innovation and energy efficiency.

3. Discussion

The research showed that companies are taking a variety of approaches to the green use of IT equipment, reflecting both support for such actions and some doubts and lack of a strong position among respondents. The key conclusion is that enterprises' IT ecology behavior is strongly interconnected, especially in the context of implementing technological innovations and caring for energy efficiency.

Enterprises that successively replace IT equipment with new ones are more likely to implement innovative technological solutions and use energy-saving devices. This type of agile approach demonstrates flexibility and openness to technological changes that have a positive impact on the environment. Such companies are aware of the benefits of modern, energy-saving technologies, which translates into lower energy consumption and lower operating costs.

Additionally, companies that care about low energy consumption show high consistency in their environmental activities, which suggests that energy efficiency is a priority for them. This approach is particularly important in the context of growing ecological awareness and

expectations of customers and stakeholders. These companies use modern technologies not only to increase operational efficiency, but also as part of their sustainable development strategy.

Even though Green IT as a supplier selection criterion is not so strongly related to other ecological practices, companies that take this factor into account demonstrate consistency in selecting business partners consistent with their ecological values. The strategic approach to Green IT, although less related to other green practices, emphasizes the importance of consistency in achieving sustainability goals at different levels of a company's operations.

The implementation of Green IT solutions as an element of a business strategy is less correlated with other ecological practices, which may indicate the need for greater integration of these activities with the overall company strategy. Companies should therefore more consistently incorporate green IT practices into their long-term strategic plans, which will allow them to more fully exploit the potential of innovative, energy-saving technologies.

Agile behavior of enterprises, consisting in quick and flexible adaptation to technological and ecological changes, is key to achieving success in today's dynamically changing business environment. Enterprises that can quickly adapt new technologies and at the same time care for the environment can count on greater operational benefits and better customer perception.

Based on the research conducted, several recommendations for enterprises can be made (see Figure 2). It is recommended that companies focus on developing agile behaviors that enable quick and flexible adaptation to technological and ecological changes. It is important for companies to gradually replace IT equipment with modern and energy-efficient ones, which not only reduces energy consumption, but also reduces operating costs. Investing in innovative technological solutions should be a priority, because modern technologies bring numerous benefits for both the company and the environment.

Companies should strive for consistency in their green operations by integrating energy efficiency with other sustainability practices. Attention to low energy consumption should be treated as an element of the business strategy, which will allow for better use of the potential of modern technologies and strengthen the company's image as ecologically responsible. Educating employees about the benefits of energy-saving technologies and promoting their use can make a significant contribution to achieving sustainable development goals.

The selection of suppliers should take into account ecological criteria, which will ensure consistency of the sustainable development strategy at all levels of the company's operations. Companies should consistently select business partners that share their environmental values to help achieve long-term sustainability goals.

The implementation of Green IT solutions as an element of business strategy should be more integrated with the overall company strategy. Companies should systematically monitor and evaluate their environmental practices to ensure their compliance with sustainable development goals. Regular energy audits and energy monitoring systems can help you identify areas for improvement and further increase energy efficiency.

Long-term planning and a flexible approach to technological and ecological changes remain crucial to success in today's dynamic business environment. Enterprises that can quickly adapt new technologies and at the same time care for the environment gain a competitive advantage, increase their operational efficiency and improve customer perception. Adaptability and flexibility should therefore be the foundation of the business strategy of every modern enterprise.

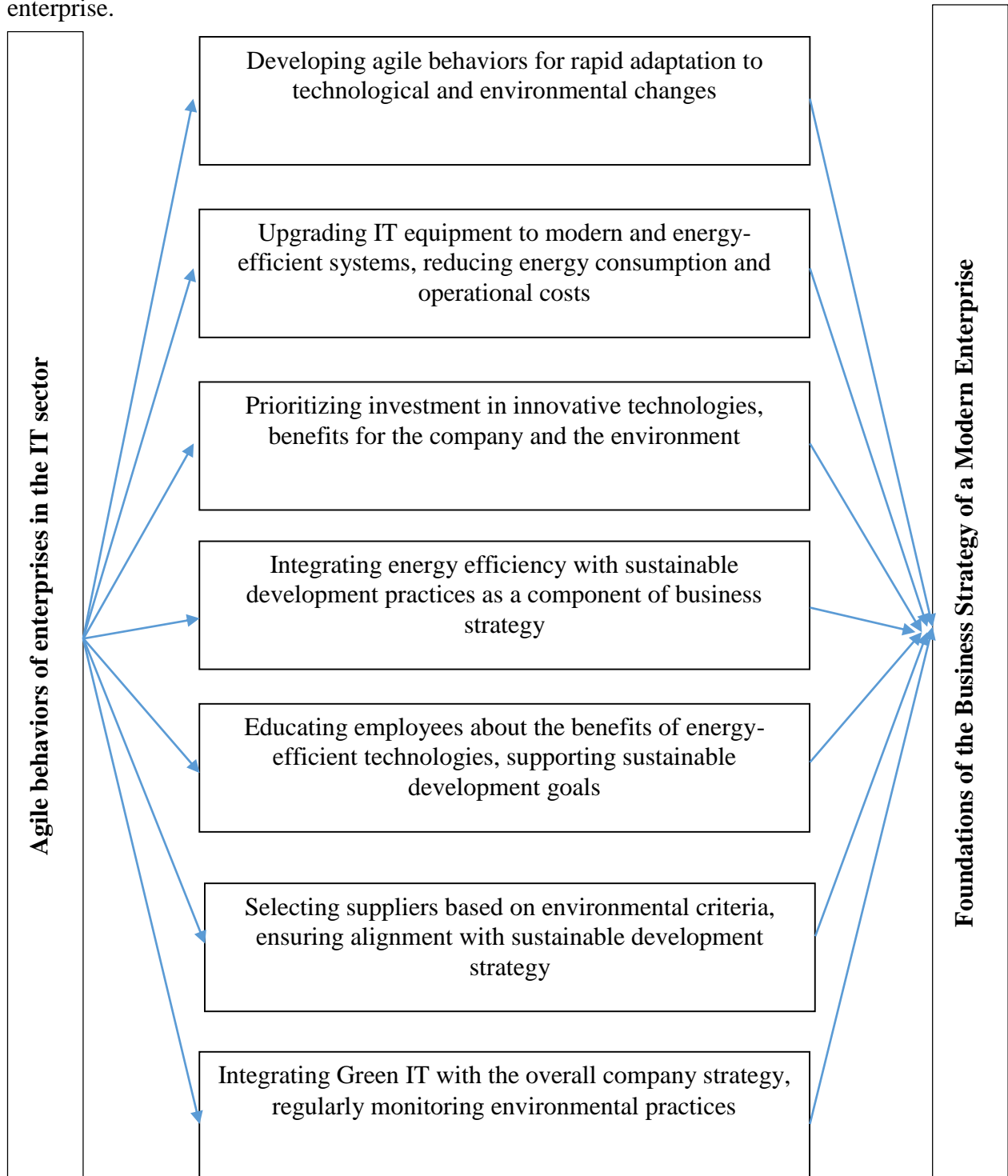


Figure 2. Agile behavior of enterprises in the IT area as the foundations of the business strategy of a modern enterprise.

Source: Own study based on research.

Limitations of the study included several important aspects that may affect the interpretation of the results. First of all, the research was based on anonymous surveys, which limits the possibility of verifying the authenticity and accuracy of the answers provided. Reliance on respondents' self-assessment may lead to subjective interpretations and potential distortions, as participants may want to present their companies in a better light than they actually are.

Another limitation was the size and representativeness of the sample. Although 578 respondents provide a solid basis for analysis, it does not guarantee full representativeness of all sectors of the economy. The study may not have taken into account the specific conditions and challenges faced by different industries, which could have influenced the results. Moreover, the focus on specific aspects of the ecological use of IT equipment may have limited the scope of the analysis and omitted other important factors influencing enterprises' decisions in this area.

Another limitation was the ability to interpret the concepts and terms used in the survey. Respondents may have had different understandings of some questions, which may have led to inconsistent responses. The inability to directly clarify doubts may have influenced the unambiguity of the results.

The timing of the study, 2023, may also have influenced the results, as market conditions and attitudes towards green IT practices may have changed since the data was collected. Changing regulations, policies and technologies may influence business decisions, which means that research results may have limited validity in future periods.

4. Conclusions

It is worth comparing the results of the obtained research with those of other authors. Analysis of enterprises' approach to the ecological use of IT equipment reveals both support for such activities and some doubts among respondents. A study by Luo and colleagues (2020) suggests that managing sustainability issues in companies faces barriers related to environmental and cognitive factors, which make it difficult to adopt proactive sustainability strategies (Luo et al., 2020).

Similarly, Petrescu and colleagues (2020) indicate that sustainability reporting has a significant impact on companies' financial performance. This research shows that metrics related to sustainability reporting can be integrated into the reporting of a company's financial performance, transforming sustainability into real value for all stakeholders (Petrescu et al., 2020).

In terms of the use of energy-efficient IT equipment, research by Alshehhi et al. (2018) shows that sustainable development practices have a positive impact on companies' financial performance, although there are still differences in research methodologies that lead to different views on this topic (Alshehhi et al., 2018). These results are consistent with the positive opinions of respondents of this study, who express support for energy-saving IT devices.

Future directions of research on the ecological use of IT equipment in enterprises, taking into account the aspect of agility, may cover several key areas that will allow for a better understanding of the dynamics and effectiveness of implementing such practices. One of the important areas is the analysis of motivations and barriers that influence enterprises in the context of implementing green IT practices. It is important to understand why some companies are more willing to adopt agile and green technologies, while others remain resistant. Research may focus on identifying internal factors, such as organizational culture, management structure, and external factors, such as legal regulations, customer expectations and competitive pressure, that may influence enterprise decisions.

Another direction of research may be to assess the long-term effects of agile ecological practices in IT on the operational and financial efficiency of enterprises. Analyzing how the rapid and flexible adoption of new technologies translates into reduced operating costs, increased energy efficiency and improved company image can provide valuable information for managers and decision-makers. This research may also include case studies of companies that have achieved success through agility in adopting green technologies, which will allow for the identification of best practices and strategies.

An important element of future research is also to examine the role of technological innovations in the process of ecological transformation of enterprises. It is important to understand what specific technologies and IT solutions are most effective in the context of sustainability and how companies can implement them effectively. Research may also focus on assessing the impact of new technologies, such as artificial intelligence, the Internet of Things (IoT) and blockchain, on the agility and greenness of business processes.

Future research may also take into account sector differences in attitudes towards the green use of IT equipment. Analyzing the specific challenges and opportunities that different industries face can provide a more nuanced picture and enable agile strategies to be tailored to specific needs and market conditions. It is important that this research covers both more technologically advanced sectors and those that are just starting their path to ecological transformation.

An equally important direction of research is the assessment of the impact of government policies and international regulations on the agility of enterprises in adopting green IT technologies. Understanding how different policies and regulations influence companies' incentives to adopt agile green practices can help shape more effective legal frameworks and support for businesses.

In summary, future research should focus on analyzing motivations and barriers, assessing long-term effects, the role of technological innovation, sectoral differences, and the impact of government policies on enterprise agility in the context of green use of IT equipment. Such a multidimensional analysis will allow for a better understanding of the dynamics and effectiveness of implementing green IT practices, which will contribute to promoting sustainable development and increasing the competitiveness of companies.

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