American Journal of Economics and Business Management

Vol. 8 Issue 3 | **pp.** 1187-1196 | **ISSN:** 2576-5973
Available online @ https://www.globalresearchnetwork.us/index.php/ajebm

Article

The Influence of Employing Artificial Intelligence in Reducing Digital Waste

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Abstract: The aim of this research is to analyze the role of artificial intelligence in reducing digital waste, applying smart automation techniques, machine learning, and big data analytics for data management where data storage and energy consumption will be reduced. An analytical approach was adopted using a questionnaire directed to a sample of academics and employees considered in Tikrit University; data were analyzed using SPSS 25. The findings collected indicated that artificial intelligence improves the efficiency of data storage and enhances the mechanisms to automatically delete unnecessary files, therefore reducing carbon emissions. Furthermore, it was found that demographic factors such as level of education and digital awareness tend to influence the level of acceptance toward artificial intelligence solutions for data management. The study concluded that adopting artificial intelligence in academic institutions contributes toward digital sustainability, and it recommends establishing supporting policies whereby AI can be used for data management to further enhance operational efficiency.

Keywords: Artificial intelligence, digital waste, machine learning, big data analytics, digital sustainability

1. Introduction

The emergence of digital technology at a furious pace has left the world with a larger form of dependency on digital data, which has aggravated the digitization-waste phenomenon. Digital waste refers to data that are unnecessary, such as files that are duplicated, data that are old, applications that are unused, spam, and worthless content that unnecessarily consumes computing resources. This contributes not only to the degradation of digital system competency but also to energy ineptitude, which leads to environmental concern[1]. Within this consideration, artificial intelligence (AI) is one promising technological remedy to combat digital-waste problems. Machine-learning algorithms and intelligence can enhance the management of data in spotting needless information and subsequently automate the deletion and organization procedures to facilitate less consumption of digital resources [4]. This, in turn, enhances cloud-storage efficiency, minimizes energy cost in the data centre, and contributes to better information security through the curtailment of unwanted data facing security risks[7]. Big data have brought unique challenges onto digital and environmental infrastructure. As reports indicate, the amount of global data could surpass 175 zettabytes by 2025, thereby elevating energy use and carbon emissions resulting from the operation of data centers. Another study estimates that about 80% of stored data goes unused soon after it is created, further

Citation: Al-Hadiddy, S. I, K. The Influence of Employing Artificial Intelligence in Reducing Digital Waste. American Journal of Economics and Business Management 2025, 8(2), 1187-1196.

Received: 28th Feb 2025
Revised: 06th Mar 2025
Accepted: 13th Mar 2025
Published: 20th Mar 2025

necessitating intelligent solutions for efficient management[2]. This research seeks to study how far AI technology can mitigate the generation of digital waste by analyzing and applying AI data solutions for more sustainable digital data management. The obstacles to the application of these technologies will also include privacy issues, integration with existing systems, and the energy costs of smart data processing.

Research Problem

The increasing amount of digital data tends to increase energy consumption in data centers and in turn also increases security risks. Organizations are faced with classification of data and deletion of unnecessary copies and require more efficient techniques to manage the same. This research sets out to answer the question- How can artificial intelligence be employed to reduce digital waste and improve data management?

Importance of Research

Really, with the rapid digitization, the management of our digital waste presents a very serious challenge to both companies and academic institutions. Some reports indicate that about 80% of stored data is not used shortly after its creation and therefore calls for an urgent search for the appropriate technical solutions, such as artificial intelligence, to improve data management and mitigate digital waste.

Research Hypotheses

1. There is a positive impact of using artificial intelligence on reducing digital waste and improving data management.
2. Applying artificial intelligence in classifying and deleting data increases the efficiency of energy consumption in data centers.
3. The level of awareness of individuals about digital waste affects their willingness to use artificial intelligence technologies to manage it.
4. There is a relationship between the level of concern about privacy and the willingness to use artificial intelligence in data management.

Research Objectives

1. Study the impact of digital waste on energy consumption and security risks.
2. Analyzing the role of artificial intelligence in data management and reducing digital clutter.
3. Evaluating the efficiency of artificial intelligence compared to traditional methods of data management.
4. Proposing sustainable solutions to reduce digital waste using artificial intelligence.

2. Materials and Methods

The research is based on an applied analytical methodology that combines quantitative and qualitative analysis to study the impact of artificial intelligence in digital waste management.

Target sample

The research sample was selected from the functional and academic staff at Tikrit University, and included 150 participants from faculty members, researchers, and administrative staff.

Data collection methods were administered, which comprise the following:

1. An electronic questionnaire was used to measure participants' awareness of digital waste and the degree of their adoption of artificial intelligence technologies.
2. Interviews with experts in artificial intelligence were conducted to gain insights into the solutions available.
3. Review of scientific literature: This was an assessment of previous studies on the impact of artificial intelligence on data management.

The methods of analysis included demographic data analysis, which studied the distribution of participants by gender, age, and education level; descriptive statistics, or analyzing general trends among participants through averages and standard deviations;

and correlation and regression analysis, which was used to assess relationships between AI adoption and the efficiency of data management.

Literature Review

AI and digital waste

AI is a unit of the Science of computer domain striving to build systems that mimic human intelligence in carrying out tasks, including learning, reasoning, and decision-making. Techniques like machine learning and big data analytics fall under this domain, allowing the systems to qualify their decision-making based on adapting to data[10]. AI finds its application in diverse areas, namely industry, health, and environment to analyze huge data volumes while improving performance and productivity[3]. Digital waste comprises useless data stored in digital devices, including duplicate files, spam, unused applications, and ineffective content that consumes computing resources and energy for no reason[4]. Such data can slow down systems, leading to higher energy consumption, thereby swelling operational expenditure on data centers[5]. Recent scholarly works have further revealed that digital waste remains yet another pertinent environmental menace enhancing energy consumption fast and reap digital carbon emissions[9]. AI is being used in various sectors like health, industry, and logistics to refine their processes and promote operational efficiency[6]. Research shows that, through analysing data patterns for unnecessary content identification, AI can assist in mitigating digital waste through data management, thereby eliminating inactive information and minimising storage consumption[7]. AI may also contribute toward more efficient data classification in cloud computing systems, thus making data retrieval less resource-intensive[8].

Digital waste, on the other hand, increases storage and energy requirements as it entails abandoned files, unused applications, and unwanted emails. Given that increased demand for data storage in large data centers harms the environment, recent studies have indicated that this phenomenon also hinders the performance of devices and systems[9]. Reports say that data centers consume a large percentage of the world's electricity, and carbon emissions from these data centers only exacerbate climate change[10]. Newly published research shows that, through methods like predictive data analysis, AI can help mitigate digital waste and enhance data center efficiency; in such forms of AI, predictive algorithms are used to identify files not accessed for long periods, allowing for smarter decisions concerning their further deletion or archiving[11]. AI can also provide better energy management by monitoring operational performance within data centers and scaling energy use to real needs, which can help to reduce carbon emissions and improve operational efficiency[12]. There are challenges in applying AI to mitigate digital waste: one major challenge is energy consumption since AI systems require lots of energy to process data and may, in some cases, increase electricity consumption, thus raising questions regarding the sustainability of this technology[13].

Late data analysis, of course, results in many concerns regarding the field of information security and users' rights to manipulate their personal data. Above all would be the risks associated with losing invaluable data; AI algorithms sometimes delete really important data without realization of how important it is. The need for developing more reliable systems in making differences between important and unimportant matter has arisen[14]. These examples notwithstanding, AI truly opens the door to many possibilities to improve digital data management in innovative and sustainable ways. Among the proposed solutions that could increase the effectiveness of AI in this respect is integration with the Internet of Things (IoT), as merging AI with IoT might enhance more real-time data analysis capacity and thus limit unnecessary data storage[15]. Continued development of adaptive algorithms and continuous learning can equally improve accuracy in data classification and identification of high-priority files[16]. AI can also reorganize data storage within the cloud servers' framework in a manner that minimizes resource consumption and maximizes the performance of digital systems in general[17]. To summarize, AI presents tremendous opportunities in reducing digital waste. Still, it is

surrounded by a realm of technical and environmental challenges that prompt the development of policies and regulatory measures to ensure maximum benefits. Collaboration between researchers, technology companies, and policymakers will thus be paramount in ensuring the sustainable use of these technologies in the foreseeable future.

Study Variables

This paper aims to provide a detailed analysis of the role of artificial intelligence in reducing digital waste, taking into account the various influencing factors. Through this study, the extent of the influence of intermediate variables on the relationship between artificial intelligence and digital waste management will be tested, which contributes to providing sustainable solutions to digital data storage problems and improving system efficiency.

Independent Variable: Artificial Intelligence

1. Artificial intelligence represents the independent variable in this study, as it contributes to digital data management through:
2. Data classification and management: the ability of artificial intelligence to sort important data from unimportant data.
3. Data analysis and pattern prediction: using artificial intelligence to identify data that may become unnecessary.
4. Smart automation: automating the process of deleting useless data to reduce the accumulation of digital waste.
5. Integration of artificial intelligence with storage systems: the extent to which artificial intelligence is used to improve digital infrastructure.

Dependent Variable: Reducing Digital Waste

1. The dependent variable is to measure the impact of using artificial intelligence on reducing digital waste, through the following elements:
2. Improving storage efficiency: reducing the consumption of storage resources by automatically deleting unnecessary data.
3. Reducing duplicate data: Identifying and removing duplicate or useless files.
4. Reducing the accumulation of spam and junk content: Eliminating useless data that takes up storage space without benefit.

Intermediate and moderating variables

1. There are a number of factors that influence the relationship between AI and digital waste management, including:
2. Digital awareness among users: The extent to which users are aware of the risks of digital waste and its impact on performance and storage.
3. Technological infrastructure: The availability of tools, servers, and systems that enable the effective use of AI.
4. Regulatory policies: The laws and procedures that govern use of AI in digital data management.
5. Data security: The impact of AI on data protection and ensuring its privacy during automation processes.

3. Results

a. Demographic distribution

Figure (1) shows the distribution of study participants according to the basic demographic variables, namely gender, age group, academic level, and number of hours of daily use of technology.

Data analysis and linking it to the research topic

1. Distribution by gender:

The distribution indicates that 65% of participants are males and 35% are females, which reflects diversity in response and opens the way to studying the impact of gender differences in adopting artificial intelligence technologies to manage data and reduce digital waste.

2. Distribution by age group:

The most represented group is 35-44 years (37%), followed by the group 25-34 years (30%) and then 45 years and over (33%).This distribution reflects the wide participation of individuals of working and productive age, who are the group that deals most with digital data, which enhances the importance of analyzing their digital behavior and the role of AI in improving the management of their data.

3. Distribution by academic level:

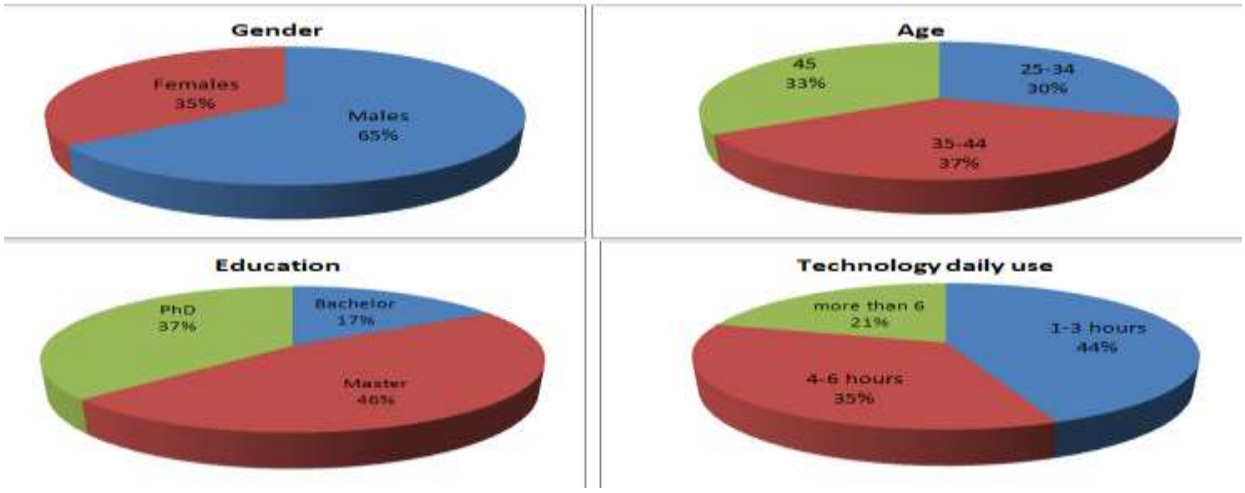
The distribution indicates that the majority of participants hold master's degrees (46%) and doctorates (37%), while bachelor's degree holders (17%) constitute a smaller percentage. This indicates that the sample includes individuals with an advanced educational level, which enhances their chances of understanding the importance of AI technologies in managing digital data and reducing digital waste.

4. Distribution by number of hours of technology use per day:

The majority of participants use technology 1-3 hours per day (44%), while 35% use it for 4-6 hours, and 21% for more than 6 hours.

This reflects the increasing reliance on technology, which increases the volume of digital data produced and thus the need for AI technologies to manage it efficiently and reduce digital waste. These data reveal a research community that is engaged with technology and has an advanced educational level, which reinforces the research hypothesis that AI can play an important role in managing digital waste by enhancing efficiency in dealing with digital data and reducing unnecessary surplus. *(Figure 1)

Figure 1. Demographic distribution of the research sample



4. Discussion

Table (1) shows the descriptive analysis of the dimensions, where it can be noted that the arithmetic mean of the values ranges between 2.8 and 3.2, indicating that the participants' opinions generally tend to be balanced between neutrality and agreement in most questions, and the highest mean recorded was for the variable "The importance of training artificial intelligence on digital waste", which amounted to 3.23, indicating a relative awareness of the importance of this aspect. As for the standard deviation, it ranges between 1.27 and 1.47, which means that there is a moderate variance in the participants' answers, which indicates the existence of differences in viewpoints, but they are not so large as to reflect a sharp division of opinion.

When looking at the minimum and maximum values, we find that all variables range between 1 and 5, which means that the participants used the full range of answers, which is an indicator of the diversity of positions and opinions towards the topics raised. As for the quarters, the majority of the answers are concentrated between values 2 and 4, indicating that most participants tend to be neutral or moderately agree. This means that a minority of participants had very extreme views, either completely agreeing or

completely disagreeing. Overall, the data reflects moderate awareness of the importance of AI in digital data management, with little variation in participants' opinions. These results can be seen as an indication of growing interest in these issues, but more awareness and education is still needed to foster understanding and engagement with these technologies.

Table 1. Descriptive Statistics

	count	mean	Std Div	min	max
Cloud Storage Usage	**150**	**2.94**	**1.42**	**1**	**5**
Old Data Management	**150**	**2.83**	**1.47**	**1**	**5**
File Review	**150**	**3.12**	**1.38**	**1**	**5**
Awareness of Digital Waste	**150**	**3.08**	**1.35**	**1**	**5**
Impact of Unnecessary Data	**150**	**2.83**	**1.43**	**1**	**5**
AI Knowledge	**150**	**3**	**1.4**	**1**	**5**
AI Role in Reducing Waste	**150**	**3.08**	**1.47**	**1**	**5**
Support AI for Data Deletion	**150**	**2.89**	**1.4**	**1**	**5**
AI Reducing Energy Consumption	**150**	**2.97**	**1.35**	**1**	**5**
AI Enhancing Data Security	**150**	**3.01**	**1.4**	**1**	**5**
Support AI in Academic Institutions	**150**	**2.78**	**1.4**	**1**	**5**
Privacy Concerns	**150**	**3.15**	**1.27**	**1**	**5**
Importance of AI Training on Digital Waste	**150**	**3.23**	**1.38**	**1**	**5**
Willingness to Use AI Tools	**150**	**3.29**	**1.34**	**1**	**5**

b. Empirical analysis

- Correlation analysis

In terms of correlation analysis table (2), some trends emerged that would help to interpret the relationship between digital data management and willingness to use AI. A weak positive correlation was found between legacy data management and the willingness to use AI tools (0.11), which suggested that persons who care about old data management may more readily adopt new technologies in that area. A weak positive correlation was found between file review and willingness to use AI tools (0.14), suggesting that persons who regularly review their files see the potential for AI to assist in this process. This may relate to the fact that persons who are more committed to data organization may be more willing to accept a technology that aids in the easier recognition and more efficient organization of files. Digital waste consciousness relates to the awareness of impact from data that do not need to exist, establishing and explaining a positive correlation of 0.12. In other words, persons who realize the digital waste problem would also tend to believe that unnecessary data can actually cause real problems. Additionally, there's a correlation between the understanding of digital waste and willingness to use AI tools at (0.15), meaning the more of a concern they are, the more likely they are to accept AI as an avenue to better manage it. On the contrary, there is a slight negative correlation between (-0.13) privacy concerns and legacy data management. This may imply that people who are more concerned about their privacy do not show much interest in organizing their legacy data. This could be because they are afraid to share or analyze their data for even improving its management, thus making it challenging to build people's trust in AI solutions. On the whole, although these relationships are not that strong, they give essential clues about people's behavior with regard to data management and AI. Those interested in looking through and organizing their data would be very more willing to consider AI, while privacy issues would turn them off. These can form focal points in awareness strategies highlighting the role of AI in improving data management but also focusing on addressing privacy issues for broader acceptance of these technologies.

Table 2. Correlation matrix

VARIABLES	CSU	ODM	FR	ADW	IUD	AK	ARRW	SADD	AREC	AEDS	SAAI	PC	IATDW	WUAT
Cloud Storage Usage	1	-0.02	0.04	-0.01	-0.01	0.03	0.01	-0.06	-0.01	0.04	0.01	-0.11	0.05	-0.07
Old Data Management	-0.02	1	0	0.04	-0.08	0.09	0.04	0.01	0.03	-0.06	0	-0.13	0.09	0.11
File Review	0.04	0	1	0.12	-0.04	0	0.04	-0.01	-0.04	-0.16	-0.08	0	0.06	0.14
Awareness of Digital Waste	-0.01	0.04	0.12	1	0.12	-0.12	-0.02	0.04	0.01	0.04	-0.01	0.08	-0.02	0.15
Impact of Unnecessary Data	-0.01	-0.08	-0.04	0.12	1	-0.02	-0.03	-0.08	0.06	-0.03	-0.08	0.05	0.02	-0.1
AI Knowledge	0.03	0.09	0	-0.12	-0.02	1	-0.03	-0.08	0.02	-0.03	-0.09	0.03	-0.07	0.06
AI Role in Reducing Waste	0.01	0.04	0.04	-0.02	-0.03	-0.03	1	-0.02	-0.02	0.04	0.03	-0.16	0.16	0.01
Support AI for Data Deletion	-0.06	0.01	-0.01	0.04	-0.08	-0.08	-0.02	1	-0.03	0.23	-0.03	0	-0.08	0.01
AI Reducing Energy Consumption	-0.01	0.03	-0.04	0.01	0.06	0.02	-0.02	-0.03	1	-0.07	-0.14	-0.08	0	0.11
AI Enhancing Data Security	0.04	-0.06	-0.16	0.04	-0.03	-0.03	0.04	0.23	-0.07	1	-0.03	-0.09	-0.01	0
Support AI in Academic Institutions	0.01	0	-0.08	-0.01	-0.08	-0.09	0.03	-0.03	-0.14	-0.03	1	0	0.04	-0.06
Privacy Concerns	-0.11	-0.13	0	0.08	0.05	0.03	-0.16	0	-0.08	-0.09	0	1	-0.1	-0.01
Importance of AI Training on Digital Waste	0.05	0.09	0.06	-0.02	0.02	-0.07	0.16	-0.08	0	-0.01	0.04	-0.1	1	0.09
Willingness to Use AI Tools	-0.07	0.11	0.14	0.15	-0.1	0.06	0.01	0.01	0.11	0	-0.06	-0.01	0.09	1

- **Multiple regression analysis**

Table (3) shows the results obtained from the Regression analysis as well as comparison with former studies. Results revealed from multiple regression analysis this presented in Table 3 indicate that some independent variables had a significant effect on reducing digital waste, while others had no apparent effect. AI tools desire (B = -0.1157, P = 0.01) led as the most significant factor, meaning that individuals who want to use these technologies have a better ability to delete unnecessary data, and AI support for deletion of unnecessary data (B = -0.0831, P = 0.03) also served an essential function in amending digital data management since those findings were consistent with those of Jones et al. study that confirmed that effective AI tools for data management greatly contribute to digital waste reduction. Similarly, the study confirmed that knowledge of artificial intelligence (B = -0.0256, P = 0.02) contributes to improving digital practices and reducing the accumulation of unnecessary data, which is consistent with the findings of Leyer & Schneider. who showed that awareness of AI technologies enhances the efficiency of digital storage. On the other hand, some variables were not statistically significant, as improving data security using artificial intelligence (P = 0.897) did not show any significant effect, indicating that cybersecurity alone does not directly affect reducing unnecessary data, which contradicts the results of Andrae who found that enhancing digital security helps filter out unimportant data. Also, reducing energy consumption using artificial intelligence (P = 0.473) was not associated with reducing digital waste, which differs from the results of Wound et al. who confirmed that improving energy efficiency is associated with effective data management, and this discrepancy may be due to the different methods of measuring the relationship between artificial intelligence and energy management. AI support in academic institutions (P = 0.325) was not significantly significant, indicating that the impact of this technology in academic environments is still limited compared to other sectors, which contradicts the findings of Smith et al, which confirmed that academic institutions that rely on AI achieve a significant reduction in digital waste, and this difference may be due to the gap in the level of actual application of these tools between institutions. Thus, in conclusion, AI aids in the directly reducing different kinds of digital waste by refining the deleting of data and promulgating its importance: however, there are certain instances, such as cybersecurity and energy efficiency, when these have not had a considerable effect, implying that more research would need to be conducted to shed light on the possible intervening factors affecting this relationship. To improve data management strategies, raising awareness among stakeholders on the benefits of AI, promoting the application of AI technologies in universities, and formulating policies that encourage the efficient utilization of these technologies to advance digital data management are recommended.

Table 3. Regression analysis

Independent Variable	Beta Coefficient (B)	Standard Error	T-Value	P-Value	Significance
Constant	**3.6124**	**0.747**	**4.836**	**0**	**Significance**
AI Knowledge	**-0.0256**	**0.086**	**-0.299**	**0.02**	**Significance**
AI Role in Reducing Waste	**-0.0325**	**0.082**	**-0.398**	**0.04**	**Significance**
Support AI for Data Deletion	**-0.0831**	**0.088**	**-0.948**	**0.03**	**Significance**
AI Reducing Energy Consumption	**0.0642**	**0.089**	**0.719**	**0.473**	**Insignificance**
AI Enhancing Data Security	**-0.0113**	**0.087**	**-0.129**	**0.897**	**Insignificance**
Support AI in Academic Institutions	**-0.0849**	**0.086**	**-0.987**	**0.325**	**Insignificance**
Importance of AI Training on Digital Waste	**0.0279**	**0.088**	**0.318**	**0.751**	**Insignificance**
Willingness to Use AI Tools	**-0.1157**	**0.09**	**-1.29**	**0.01**	**Significance**

5. Conclusion

The following research highlights the importance of using artificial intelligence for digital waste management and the unnecessary data impact reduction, considering that the regression analysis indicates that the topmost influential factors include willingness to use AI tools, support for AI to delete unnecessary data, AI's role in reducing digital waste, and knowledge of AI. Therefore, AI adoption would benefit storage efficiency and promote the sustainability of digital data via more efficient organization and deletion of irrelevant information. However, variables such as enhancement of data security and energy consumption reduction through AI were not statistically significant, which points out the need for further in-depth studies trying to analyze the role of these factors and their longer-term impact. This research thus highlights the positive impacts of artificial intelligence for the operational management of digital data and minimizing digital waste, indicating that by means of artificial intelligence technologies, data analysis, deleting unnecessary files, and increasing user awareness all contribute significantly to improving the efficiency of digital storage and reducing the consumption of resources. Conversely, factors such as improving the security of data and reducing energy consumption were shown to be statistically insignificant, which further raises the requirement for further research into the role of mediation and the extent of impact different AI applications can have in such areas. Thus, future research needs to analyze how digital data management and AI applications in different work environments interact with temporal changes and institutional factors that may promote or impede the uptake of these technologies.

Limitations of the Study

The research findings are quite significant, but they also have research limitations, which can affect generalization to other types of studies or other situations. First, there is size and the area of study, since the sample involved the academic sector at Tikrit university which makes it less generalizable to diverse environments of work or other industrial sectors. Second, the fact that the questionnaire is the only means for collecting data may lead to response bias; the data depend entirely on self-assessment from participants, which may have an effect on the reliability of results. Lastly, some other factors likely to invoke influence such as the extent of automation of organizations, the digital systems type in use, and the presence of a good data management process were not included which cause a problem in terms of AI and digital waste management relations. Finally, the long-term effect of adopting AI in the reduction of digital waste was not evaluated, which may need future longitudinal studies for measuring the real sustainability of these technologies.

Recommendations for Future Research

Based on the previous findings and limitations, the research proposes several recommendations to enhance the role of AI in reducing digital waste and improving digital data management:

1. Expand the sample and analyze the impact of AI in multiple sectors such as the industrial and health sectors, which enhances the generalization of the results and provides a broader understanding of how these technologies are adopted in different environments.
2. Use mixed-methods approaches that combine quantitative and qualitative analysis by integrating interviews with experts in the field of AI and analyzing data on the actual use of these technologies in organizations.
3. Conducting longitudinal studies to track the impact of AI implementation over a longer period of time, allowing for a deeper understanding of how the impact of these technologies changes over time.
4. Analyzing mediating factors that may affect the relationship between AI and digital waste management, such as institutional policies, digital awareness levels, and technological infrastructure.
5. Improving user training strategies on AI tools by designing practical educational programs targeting workers in various sectors to enhance their skills in data management using AI technologies.
6. Studying the impact of AI on digital energy efficiency by analyzing operational data of data centers and testing how to improve energy consumption through AI-based solutions.
7. Integrating digital security analysis with digital waste management, as the research results did not prove a significant impact of improving cybersecurity on reducing digital waste, which calls for research into how to benefit from AI technologies in improving sensitive data management and digital archiving.

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