sustainability

MDPI

Article

Digital Transformation as a Driver of Sustainability Performance—A Study from Freight and Logistics Industry

Ibrahim Mutambik

Department of Information Science, College of Humanities and Social Sciences, King Saud University, Riyadh P.O. Box 11451, Saudi Arabia; imutambik@ksu.edu.sa

Abstract: Over the past two decades, environmental sustainability has become a key corporate and organisational issue. Today, firms are increasingly turning to existing and emerging digital technologies to help ensure that they meet the medium and long-term needs and expectations of customers and other stakeholders with respect to sustainability performance. This raises the important question of which digitisation factors most significantly impact environmental sustainability performance, as well as the mediating factor of sustainability innovation balance (the ability of a firm to balance the exploration of new innovations with the exploitation of existing innovations). A comprehensive survey instrument was developed and refined through expert feedback and a pilot study, leading to data collection from 374 professionals in the Freight and Logistics industry in Saudi Arabia, all of whom held senior positions in areas such as business development, IT, and Environmental, Social, and Governance (ESG) departments. This data was then analysed using structural equation modelling (SEM). The results of this analysis showed that the key factors impacting sustainability performance were digital competence, strategy alignment, digital adaptability, innovation exploitation and innovation exploration. These findings contribute to the current literature by expanding our understanding of the real-world drivers of sustainability performance. In practical terms, the study will help managers improve sustainability performance by enhancing resource efficiency, streamlining, and supply chain management, as well as improving employee engagement and training, fostering a culture of sustainability within the organisation.

Keywords: digital transformation; sustainability; innovation; strategy alignment; information processing theory

check for updates

Citation: Mutambik, I. Digital Transformation as a Driver of Sustainability Performance—A Study from Freight and Logistics Industry. *Sustainability* **2024**, *16*, 4310. https://doi.org/10.3390/su16104310

Academic Editors: Yashar Salamzadeh, Nadja Damij and Pelin Vardarlier

Received: 18 April 2024
Revised: 16 May 2024
Accepted: 19 May 2024
Published: 20 May 2024

Copyright: © 2024 by the author. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

1. Introduction

Today, environmental sustainability is thought by many to be a key element in helping companies and other organisations contribute to the improvement of global society [1,2]. However, there is evidence to show that, under appropriate circumstances, sustainability can also deliver a wide range of significant business benefits, such as mitigating risk, reducing costs, improving market differentiation, ensuring regulatory compliance, and creating long-term value [3–5]. These benefits can be realised by firms across all sectors of industry, and the Freight and Logistics sector is no exception [6].

However, while a strong environmental sustainability performance (ESP) is important in the Freight and Logistics sector in countries across the world, it is particularly important in Saudi Arabia. This is partly because of the size of the Saudi market, which was valued at $20.47 billion in 2023 and is expected to grow at a compound annual growth rate (CAGR) of 6.95%, reaching $32.12 billion by 2026 [7]. Another key factor, however, is Saudi Arabia's Vision 2030 development plan, which aims to transform the country into a thriving and globally competitive economy and to build a vibrant society [8–10]. Among the key pillars of this vision is the aim of achieving significant environmental and sustainability targets, partly through the transformation of the Saudi logistics sector, which is vital for enabling trade across Asia, Europe, and Africa [11].

In recent years, the Saudi Freight and Logistics industry has contributed significantly to meeting the aims of Vision 2030 [12–14], but much still remains to be done. As a result, there is an increasing focus by firms on improving ESP [11,15]. By doing so, individual organisations can not only help to reduce the industry's overall environmental impact, but they can realise a variety of business benefits, ranging from cost savings and improved brand reputation to enhanced stakeholder value [16,17]. This focus on driving growth in ESP has resulted in increased efforts to utilise the benefits of advanced digital technology [18–20]. Such digital transformation (DT) is recognised as a key enabler of innovation by providing the agility to identify and respond to market trends while simultaneously enhancing sustainability [20–24].

Despite this, though, there is a scarcity of research which examines the specific issue of how DT can enhance innovation in sustainability. Addressing this gap in the literature could be of significant use to businesses and other organisations by providing valuable insights into how they can develop and implement new processes and products or services that result in improved efficiency, effectiveness, competitiveness, and value creation while significantly improving social and environmental performance [25]. Although current research has identified a number of factors which facilitate innovation in sustainability [26,27], there is, as yet, no explicit examination of the broad issue of how innovation in sustainability affects ESP. Currently, the majority of research has a relatively narrow focus, looking at how a specific innovation, such as green packaging, impacts sustainability [28–30]. This narrow research perspective represents a lost opportunity to accelerate progress towards sustainability goals and introduce disruptive business processes [31].

This study seeks to address these research gaps through two research questions, which are as follows:

RQ1: How do DT factors impact the balance between sustainability innovation exploration and sustainability innovation exploitation?

RQ2: How does sustainability innovation balance affect ESP?

Considered together, the exploration of RQ1 and RQ in this study will contribute to the existing literature by developing and testing the validity of a model that defines key aspects of DT and hypothesises how these factors support innovation in sustainability to drive improvements in ESP.

The remainder of this document is organised as follows: Section 2 provides a brief overview of the literature pertinent to this study and introduces the hypotheses to be examined. Section 3 details the research methodologies and the procedures for collecting data. Section 4 reports the outcomes of the data analysis and discusses the implications of these findings. Finally, Section 5 wraps up the discussion, and Section 6 points out the limitations of the current study while proposing avenues for subsequent research.

2. A Review of the Literature

By applying information processing theory (IPT) in the context of organisational innovation [32], this study identifies three aspects (factors) of DT that could play a key role in ESP development: digital adaptability, digital competence, and strategic alignment. This study explores the relationships between these factors, sustainability innovation balance, and ESP.

2.1. Theoretical Background

Organisational IPT seeks to explain how information management can be used to improve a variety of functions, such as decision-making, communication, knowledge management, problem-solving, innovation, and performance management [33]. By increasing their information processing capacity, organisations can enhance their effectiveness, efficiency, and competitiveness in a complex and dynamic business environment [34–36]. The development of information processing capacity should, therefore, play a core role in the strategic growth planning of an organisation [37].

A central concept in IPT is information processing capability, which refers to an organisation's ability to effectively acquire, analyse, interpret, store, and use information in order to support decision-making, problem-solving, and other organisational activities [38]. In a world where organisational strategy and decision-making are increasingly data-driven, the importance of information processing capability becomes ever greater in the context of maximising ESP [39–43]. By harnessing the power of big data analytics, organisations can drive innovation, improve decision-making, and create positive social and environmental impacts at scale [38,44,45].

In the context of the current study, the information processing capability is a theoretical construct. In order to deploy the idea in an operational context—that is, to effectively combine existing IT systems with other resources, both human and machine, as described by Almuqrin et al. [46]—organisations must have a high degree of the factor we refer to, in this research, as digital competence. However, digital competence is not, in itself, sufficient. Organisations must also have the ability to dynamically adjust their digital strategy to meet changing market and social or regulatory requirements [47]. In this study, we define this ability as digital adaptability. Finally, for businesses to effectively leverage technology as an asset that drives innovation, digital strategy must be closely aligned with business strategy [44,45]. Research has shown that, when this is the case, organisations are significantly more likely to show improved operational performance and enhanced innovation [48–51]. In this study, such strategy alignment is proposed as a key construct that affects DT.

These three factors (digital adaptability, digital competence, and strategy alignment) can play a formative role in a model of how information processing can improve innovation outcomes [52]. This is because optimal innovation outcomes depend critically on effective communication and collaboration, as well as effective information collection and sharing [51], and this is enabled by digital technologies. Therefore, by combining the three constructs defined above, organisational management can more easily identify and deploy strategies that generate innovation in sustainability and use their resources more effectively, even in rapidly evolving and dynamic market environments [53–55]. It has been noted in the literature [56] that generating innovation in sustainability represents a challenge that is different from other, more 'conventional' innovations, as it involves a wider and more complex mix of economic, societal, and environmental issues. Innovation in sustainability, therefore, requires greater information processing capability.

As has been noted above, sustainability innovation balance derives its name from the need to balance the risks, processes, and benefits of two forms of innovation in sustainability, i.e., exploration and exploitation [57,58]. The first of these, sustainability exploration innovation, refers to the process of actively seeking and developing new ideas, technologies, business models, products, and practices that contribute to sustainable development and address pressing global challenges. Sustainability exploitation innovation, on the other hand, involves leveraging existing sustainable practices, technologies, or resources for the purpose of driving innovation [59–61]. It has been suggested that businesses or other organisations that succeed in balancing these contrasting factors of innovation in sustainability are likely to demonstrate a higher ESP than those which focus on a single factor [57,58]. This theory is supported by other research, such as that by Tang et al. [61] and Dressler and Paunovic [56], who argue that the expectations of stakeholders associated with ESP are constantly changing as the market evolves and organisations which are adept at exploration are more able to identify and seize new opportunities [62]. At the same time, effective exploitation allows firms to maximise the value of existing resources [57,58].

2.2. Hypotheses

This study proposes eight hypotheses. Six of these hypotheses suggest relationships between the three information processing constructs and innovation balance, while the remaining two suggest how information balance affects ESP. The hypotheses are shown in Figure 1.

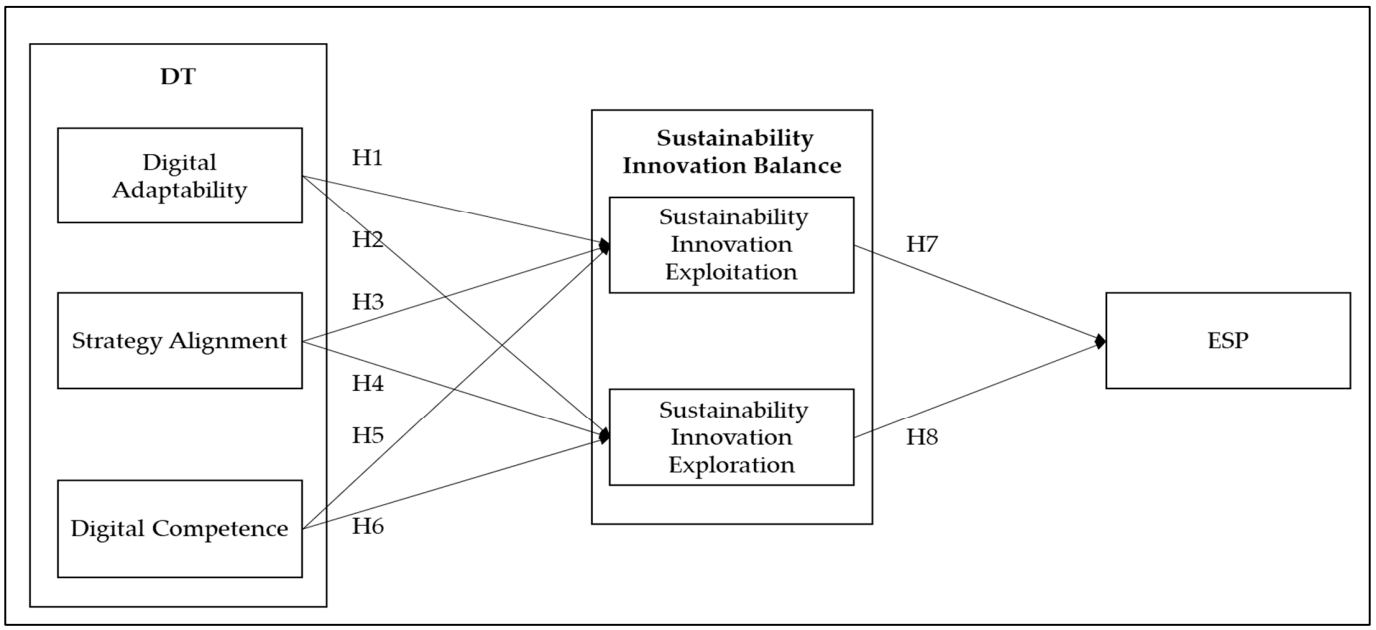


Figure 1. The proposed research model.

2.2.1. Relationship between Digital Adaptability and Sustainability Innovation Balance

Digital adaptability refers to an organisation's ability to effectively and efficiently adapt to changes in digital technologies, practices, and environments to drive innovation and achieve strategic goals [63]. The construct consists of five principal dimensions: technological agility (e.g., responsiveness and flexibility), change management (e.g., communications and training), cultural transformation (e.g., learning and experimentation), customer-centricity (e.g., understanding customer needs and preferences), and decision-making (e.g., data-driven decisions and actions) [64,65].

High digital adaptability supports the exploitation element of sustainability innovation balance in a number of ways. It enables organisations, for example, to use available information to identify trends or quantum changes in stakeholder needs and expectations and respond appropriately in near real-time [53–55]. It also promotes easy collaboration with supply chain partners, facilitating cost-efficiency, reliability, and quality [57,63–65]. This leads to the hypothesis:

H1. *Digital adaptability is positively associated with sustainability innovation exploitation.*

Digital adaptability also supports the exploration element of sustainability innovation balance by facilitating the use of data to analyse social and economic environments in order to conceptualise and develop new products and services that do not merely satisfy existing consumer demand but generate new customers and market opportunities [66]. In addition, the level of transparency and accessibility which results from digital adaptability stimulates interdepartmental collaboration and knowledge-sharing, which can play a key role in fostering a culture of innovation [48–50]. This leads to the hypothesis:

H2. *Digital adaptability is positively associated with sustainability innovation exploration.*

2.2.2. Relationship between Strategy Alignment and Sustainability Innovation Balance

Strategy alignment (i.e., between digital and business strategies) describes how well an organisation's use of digital technology is integrated with its overarching business objectives and goals. A high strategy alignment can enhance business value and competitiveness, as well as drive innovation and business growth [48,49]. By aligning digital and business

strategies, businesses can maximise the value of their investments and establish long-term market competitiveness and resilience [50,51].

Organisations that seek a high alignment of digital and business strategies tend to encourage an internal culture of information sharing between departments. This flow of information, coupled with collaboration between IT specialists and business management, strongly supports sustainability innovation exploitation [67]. This is because projects that involve the exploitation of innovative ideas can also carry a relatively high risk, which demands stakeholder participation and agreement [68]. By ensuring the alignment of business and digital strategy, organisations can use information processing capability to better understand potential risk factors and propose digital solutions which meet business objectives while minimising risk exposure [69]. In short, by aligning digital and business missions and strategies, organisations can create cross-functional teams that bring together diverse perspectives, skills, and expertise to drive sustainability innovation exploitation [70]. This leads to the hypothesis:

H3. *Strategy alignment is positively associated with sustainability innovation exploitation.*

Technology and business strategy alignment can also contribute significantly to high levels of sustainability innovation exploration. By aligning these strategies, for example, organisations can leverage agile methodologies and implement lean startup principles to quickly prototype, test, and iterate innovative solutions. This enables a rapid learning and revision cycle, accelerating the pace of innovation [71]. Strategy alignment can also support sustainability innovation exploration by enabling businesses to allocate resources more effectively and by helping them to identify and prioritise investments in technology, talent, and other resources that are critical for innovation success [72].

Further, as with innovation exploitation, strategy alignment can also foster the development of cross-functional collaboration, which enables organisations to leverage collective intelligence and stimulate the mechanisms of co-creation and out-of-the-box thinking, thus enhancing the quality and impact of innovation outcomes [73,74].

Along with these factors, strategic alignment also helps to ensure that the role of digital technology is well-defined and fully integrated into the business vision and operational approach. This can promote dialogue and understanding between departmental management and specialists, encouraging an environment of trust and fostering attitudes that prioritise exploration and experimentation in the field of new and disruptive technologies [49,50]. This leads to the hypothesis:

H4. *Strategy alignment is positively associated with sustainability innovation exploration.*

2.2.3. Effect of Digital Competence on Sustainability Innovation Balance

Digital competence in a business or organisational environment refers to the ability to effectively leverage digital technologies, skills, and other resources to achieve strategic objectives and drive business value. It encompasses a range of digital competencies, assets and capabilities that help organisations adapt to a dynamic business and digital landscape by innovating faster and more effectively in order to deliver superior customer experiences [46,75].

This ability to manage and deploy various digital resources and assets effectively can be a strong driver of sustainability innovation exploitation for a variety of reasons. The ability of digital technology to enable and enhance communication with external parties (e.g., supply chain or stakeholders) and to facilitate the monitoring of market activity (e.g., competitor initiatives) gives businesses a high degree of agility [76]. This allows the organisation to react quickly and accurately to social, market, or regulatory developments by adapting and/or improving existing products and services using advanced and innovative solutions [48,69]. Digital competence also implies the stability of digital infrastructure, both human and machine, allowing the firm to collect, monitor, and analyse data over relatively

long periods, leading to more accurate and meaningful identification of trends and more effective predictive processes [77]. This can result in more effective innovation exploitation. This leads to the hypothesis:

H5. *Digital competence is positively associated with sustainability innovation exploitation.*

Digital competence also impacts sustainability innovation exploration. By enabling the business to stay informed of market (or other) trends, the information processing capability derived from digital competence allows companies to critically assess their current product/service portfolio through the lens of future customer requirements. This use of business intelligence and analytics enables the organisation to improve existing portfolios, as well as explore the business case for developing diversified and disruptive additions using advanced or emerging digital technologies [53–55]. This leads to the hypothesis:

H6. *Digital competence is positively associated with sustainability innovation exploration.*

2.2.4. Effect of Sustainability Innovation Exploitation on ESP

As noted earlier, the concept of sustainability innovation exploitation refers to the process of utilising existing innovative solutions, practices, or technologies to address sustainability challenges. In a business or commercial context, it involves the identification and implementation of innovations that contribute to sustainable development goals while also delivering business value [78–80].

Sustainability innovation exploitation can enhance ESP in a variety of ways. It can, for example, lead to the development and adoption of practices that optimise resource efficiency and, therefore, reduce environmental footprint [81]. Innovation exploitation can also facilitate market differentiation, allowing businesses to gain a competitive advantage by offering innovative products, services and business models that address customer needs and preferences while meeting sustainability criteria. By establishing a market position as a leader in sustainability, an organisation can contribute to their ESP by attracting environmentally and socially conscious consumers, investors, and partners, driving collective sustainability [72,76,77]. Another way in which ESP can be driven by innovation exploitation is through regulatory compliance and risk management. By exploiting innovative solutions that comply with or exceed regulatory standards and reduce sustainability risks, organisations can minimise compliance costs and build resilience to regulatory changes, thus enhancing their ESP and brand image [82,83]. This leads to the hypothesis:

H7. *Sustainability innovation exploitation is positively associated with ESP.*

2.2.5. Effect of Sustainability Innovation Exploration on ESP

Sustainability innovation exploration is the process of actively seeking new solutions that promote sustainability across environmental, social, and economic dimensions. It involves exploring emerging technologies and processes to address sustainability challenges, drive positive change and create value for organisations at an individual level, as well as society as a whole [78–80]. Exploring the field of technological (and other) innovation can contribute to a better ESP in several ways. It can, for example, result in cost savings and efficiency improvements by identifying ways of optimising resource use and streamlining operational processes [84]. An illustration of this, in the Freight and Logistics context, is the introduction of AI-driven solutions to optimise routes, forecast demand, and predict maintenance requirements [85,86]. Sustainability innovation exploration can also help businesses identify new market opportunities by developing products and services that align with emerging market trends, consumer preferences, and regulatory requirements related to environmental sustainability, social responsibility, and ethical business practices [87]. At the same time, it can contribute to long-term value creation for businesses by aiding in the development of systems and solutions that future-proof operations, create

value for shareholders, and contribute to positive societal and environmental outcomes over the long term [88]. In summary, this paper suggests that sustainability innovation exploration improves ESP by helping firms adapt to current and future requirements in terms of products, processes, knowledge, staff, and organisational culture. This leads to the hypothesis:

H8. *Sustainability innovation exploration is positively associated with ESP.*

3. Methodology

3.1. Survey Development

The survey deployed in this study used a standard 5-point Likert scale to measure participant responses and included (finally) 24 items to evaluate the research model's constructs (Table 1). All of the items were specifically designed to meet the requirements of the study, following accepted guidelines [89,90]. This resulted in some questions that attempted to quantify (via Likert scaling) the intention of actions and others that quantified the effects of actions.

Table 1. Constructs and items alongside factor loadings.

Construct/Items	Loading
Digital Adaptability	
How easy is it for your organisation to upgrade or otherwise modify its digital infrastructure?	0.786
To what extent does your organisation adopt open standards in system development?	0.851
To what extent are your employees empowered to explore new ideas, take calculated risks, and adapt to changing circumstances in a dynamic digital environment?	0.884
Strategy Alignment	
How closely are the digital and business strategies of your organisation integrated?	0.815
How critical is the role of digital technology in your organisation's overall mission?	0.912
To what extent do departments in your organisation collaborate to ensure digital systems meet business goals?	0.803
How critical are DT and analytics to your business managers in their decision-making?	0.765
Digital Competency	
To what extent does your digital infrastructure allow stakeholders to benefit from your systems and processes?	0.913
How effective is your organisation in collecting, analysing, and internally sharing market data to enable rapid adaption to market dynamics?	0.930
How appropriate is your organisation's digital application portfolio to current and emerging needs?	0.723
How effective are your staff in meeting technical briefs, being creative, using initiative and achieving targets?	0.915
Sustainability Innovation Exploration	
How frequently does your organisation update products and services to improve environmental and social impact?	0.886
How often does your organisation completely redesign and re-engineer a product/service to leverage the environmental benefits of the latest technology?	0.893
To what extent is your organisation committed to identifying and implementing new ways of reducing carbon footprint?	0.869
To what extent does your organisation support staff in professional development to ensure they are up to date with the latest innovations in sustainable technology and practices?	0.887
Sustainability Innovation Exploitation	
To what extent does your organisation react positively to sustainability issues raised by external third parties?	0.782
How often does your organisation formally review its environmental policy and position in the context of current national and global sustainability issues?	0.724
To what extent are key stakeholders, such as customers, involved in the product/service development cycle?	0.876
To what extent are innovative sustainable processes integrated into your organisation's vision and philosophy?	0.863
ESP	
To what extent has your organisation improved in terms of cost-efficiency over the past 5 years?	0.708
To what extent has your organisation seen a return on (green) investment over the past 5 years?	0.723
To what extent has your organisation cut waste across all departments?	0.759
To what extent has your organisation improved its compliance with international environmental standards?	0.810
To what extent have innovative green solutions helped your organisation increase revenue?	0.743

To ensure the created items adequately represented the constructs being measured, the survey's content validity was assessed in advance of data collection [91–93]. To achieve this, an expert review of items was carried out to evaluate their relevance and clarity. The experts consulted consisted of a mix of experienced professionals and academics in the logistics field [94,95], including managers, academics, and administrators. Although there exists no widely agreed rule for the number of experts that are required by this process, most researchers recommend a minimum of three [94,96]. The researcher in this study, therefore, invited 20 experts and received feedback from 16. As a result of the subsequent feedback, the originally proposed set of 30 items was reduced to 24.

Following this, a pilot study was implemented to ensure the clarity and relevance of the survey items. This involved 80 respondents, representative of the sample group of participants (Table 2), and resulted in a number of minor changes to the items to eliminate possible ambiguity and ensure the accuracy of responses.

Table 2. Demographic Characteristics of Survey Participants.

Demographic Profile (Organisation/Participant)		Percentage of Respondents
Position of Participant	Manager	84
	Director and above	16
Responsibility of Participant	Innovation	11
	ESG	24
	Performance Management	25
	IT	33
	CSR	10
Age of organisation (years)	0–10	39
	11–20	41
	21+	20
Number of Employees in the Company	1–100	54
	101–200	35
	201+	11

3.2. Sample and Data Collection

All participants in this research (N = 374) were professionals in the Saudi Arabian Freight and Logistics sector, with responsibilities relating to areas of innovation, Environment, Social and Governance (ESG), performance management, IT, and Corporate Social Responsibility (CSR). The sample size was determined using a confidence level of 95% and a margin of error of 5%, which are standard values for social science research [94,96]. The proportion of the phenomenon in the general population was estimated based on industry reports, and the anticipated variability in the responses led to the selection of a larger sample size to ensure robust results. The sample size was therefore considered to be sufficient to be representative of the Saudi Freight and Logistics industry.

To calculate the necessary sample size, the following equation was used:

$$n = \frac{Z^2 \times p\,(1-p)}{E^2}$$

where n is the sample size, Z is the Z-score (1.96 for 95% confidence), p is the estimated proportion of the attribute in the population (assumed at 0.5 for maximum variability), and E is the margin of error (0.05).

In order to recruit appropriate participants, the researcher utilised a convenient sampling technique by visiting organisations in the freight and logistics sector and contacting them via their corporate email addresses. An invitation to participate (which also outlined the purpose of the research) was sent to 500 companies. It is worth noting that the method of drawing subjects for the survey involved direct nominations by the companies. This

approach helped to ensure that the participants were not only accessible but also had relevant experience and authority in areas critical to the research objectives.

Of the 500 companies, 324 companies agreed to nominate a (senior) employee who was qualified and prepared to complete the survey on behalf of their organisation. These individuals were sent an email (again describing the purpose and ethical code of the study) and directed to an online response mechanism (Google Forms). Over a twelve-week period, weekly reminders were sent to all those who had not yet responded, and at the end of this period, a total of 401 surveys had been completed. Of these, 27 were considered invalid due to incomplete, ambiguous, or inconsistent responses, resulting in 374 valid responses for analysis. Table 2 shows a summary of participants' experience and the organisation they represent.

3.3. Bias Mitigation

Due to the extended period of time over which responses were collected, it was recognised that a non or late response bias might affect the accuracy of the survey results. As late responders typically exhibit similar behaviours to non-responders, an appropriate bias response test was carried out [97,98]. This involved comparing the mean scores of two groups (early/late responders) using a two-sample t-test. The result of this test showed $p > 0.05$, suggesting that late/non-response bias does not represent a significant issue in data analysis.

It is worth noting that there are a similar number of participants in each professional area, which reduces the possibility of bias, and the results are less likely to be skewed towards a specific discipline. Further, as has been noted, the table shows that all respondents possess over 10 years of professional experience, making them well-positioned to contribute to the study.

3.4. Ethical Considerations

All relevant ethical guidelines were observed during all stages of the study. All participants were fully informed (prior to participation) of the purpose of the research and were asked to provide informed consent, which could be withdrawn at any time for any reason. No names or personal information, other than job descriptions, were requested, and all participation was fully voluntary, with no incentive of any kind offered to any participant. The research protocol, including the participant recruitment strategy, received full approval from the University's Research Ethics Board (REB).

4. Results and Discussion

4.1. Confirmatory Factor Analysis

A confirmatory factor analysis (CFA) was used to assess the fitness, validity, and reliability of the model's constructs. Table 3 shows the results with fit indices of the model, which indicate a good match between the variables and their respective constructs [99,100].

Table 3. The model fit indices.

Fit Measure Category	Fit Measure	Result	Meets Recommended Criteria?
Absolute fit measures	Chi-Square (χ^2/DF)	2.95	Yes (<3.0)
	SRMR	0.819	Yes (>0.80)
	GFI	0.916	Yes (>0.90)
Parsimonious fit measures	RMSEA	0.033	Yes (<0.05)
	PGFI	0.614	Yes (<0.05)
	PNFI	0.682	Yes (<0.05)
Incremental fit measures	AGFI	0.933	Yes (>0.90)
	IFI	0.913	Yes (>0.90)
	NFI	0.934	Yes (>0.90)
	CFI	0.915	Yes (>0.90)

Table 1 shows that the factor loadings for each item were significant, ranging from 0.708 to 0.930. These values demonstrate a strong relationship between the items and their corresponding factors, emphasising the convergent validity of our study. This confirms that each item accurately represented its associated factor, enhancing the reliability of our findings. The established convergent validity is crucial as it ensures that the constructs identified are truly represented by the measured variables, thereby strengthening the validity and utility of our Factor Analysis outcomes.

To evaluate the internal consistency of our constructs, Cronbach's Alpha (CA) was utilised, and the results are displayed in Table 4. The CA values for each construct varied from 0.81 to 0.85. Furthermore, the Composite Reliability (CR) values were between 0.72 and 0.85, surpassing the recommended threshold of 0.70. These findings indicate a strong internal consistency among the constructs, confirming the accurate measurement of the intended latent constructs [101,102].

Table 4. Results of Correlations, CR, CA, and AVE.

Construct/Factor	CA	CR	AVE	Correlations					
				1	2	3	4	5	6
Digital Adaptability	0.85	0.81	0.64	**0.88**					
Strategy Alignment	0.81	0.85	0.65	0.61	**0.81**				
Digital Competence	0.84	0.86	0.72	0.68	0.69	**0.85**			
Sustainability Innovation Exploitation	0.82	0.78	0.69	0.56	0.64	0.67	**0.83**		
Sustainability Innovation Exploration	0.83	0.72	0.74	0.57	0.68	0.61	0.56	**0.86**	
ESP	0.81	0.83	0.62	0.55	0.66	0.62	0.61	0.53	**0.79**

Note: the square root of AVE is emphasised in bold.

Additionally, we conducted a test for discriminant validity to confirm distinct separations between constructs and their measurements, following the protocols outlined by Hair et al. [97,98]. This test compares the square root of the Average Variance Extracted (AVE) for each construct with its correlation coefficients, with the stipulation that the square root of the AVE should exceed a correlation value of 0.50. The data presented in Table 4 show that our study meets these important criteria, thereby demonstrating robust discriminant validity.

Finally, the study tackled the problem of multicollinearity, which arises when independent variables are highly correlated with each other. We assessed this issue by examining the Variance Inflation Factor (VIF) and tolerance values. The results showed that the VIF values were below 3, and the tolerance values exceeded 0.2, consistent with the guidelines suggested by Hair et al. [97,98]. This compliance with recommended standards reduces the effects of multicollinearity, thereby preserving the reliability of our analysis.

Taking into account these detailed evaluations, the measurement model was confirmed to be both valid and reliable, showing strong model fit, convergent validity, discriminant validity, and well-managed multicollinearity. Together, these findings validate the strength of our model, establishing its accuracy and reliability in capturing the subtleties of the latent constructs being investigated.

4.2. Structural Model Analysis

As can be seen in Figure 2, which shows the structural model based on the collected data, the study's analysis was adjusted for any differences in ESP related to either the age or the size of the organisation. The analysis showed that while the age of the business had no observable effect on ESP performance, the size of the organisation could have a significant impact. This finding aligns with other research that has found that company size has a considerable on sustainability performance [103–105], while other research has reported that, while size is an important factor, neither age nor industry sector is a determinant of performance in either ESG or CSR [106,107]. The reason for this is not fully established, though there are studies which suggest that the economies of scale that derive from size

could be a significant factor in reducing environmental impact, while organisation age does not affect attitudes towards sustainability [108].

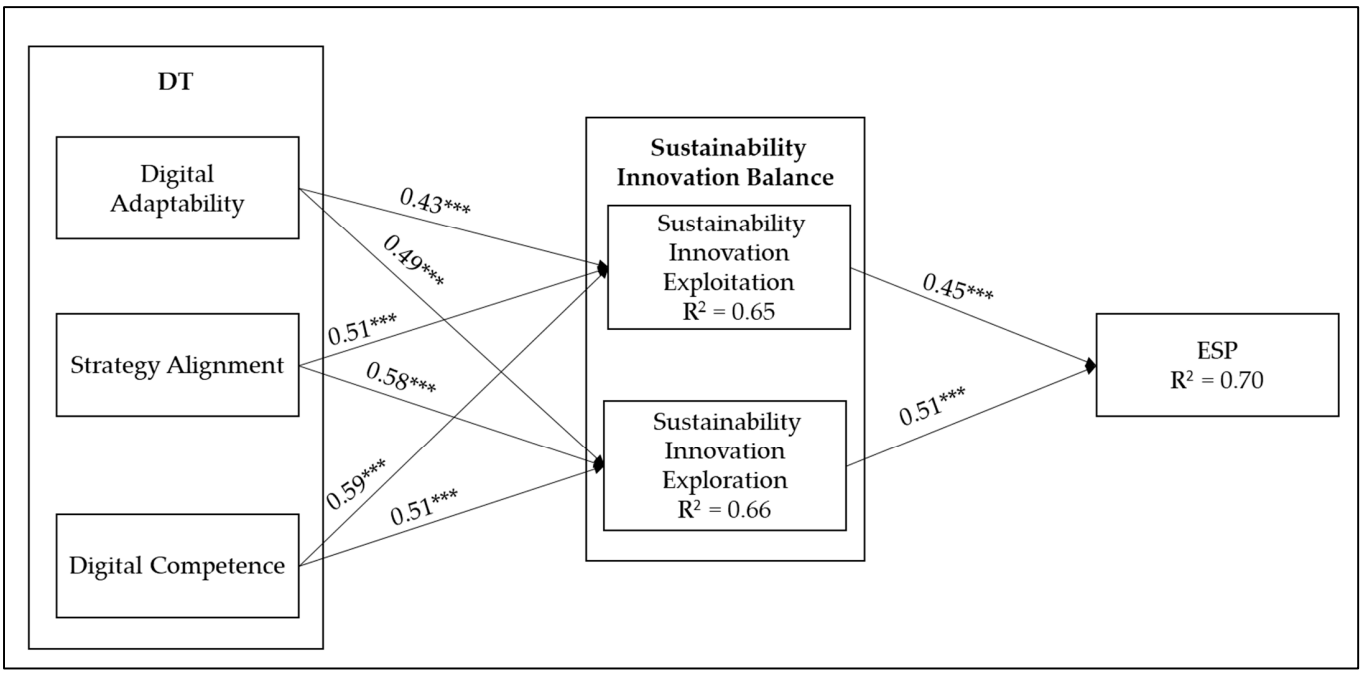


Figure 2. Illustration of the research model (results of structural model). Note: ***: 0.001 significance.

To explore RQ1 (the relationship between DT factors and innovation in sustainability), the results for H1 to H6 are discussed as follows:

- Digital competence. This was found to have the strongest positive relationship with the exploitation element of sustainability innovation and the second strongest on the exploration element. These findings support H5 and H6, suggesting that digital competence engenders a wide range of business advantages, from increased efficiency and productivity to improved customer experiences and competitive advantages. It also optimises the market alignment of existing products and services, in addition to providing opportunities for new product/service development [37,46,75];
- Strategy alignment. This was found to have the second strongest impact on sustainability innovation and the greatest impact on exploration. These positive relationships support H3 and H4 because strategy alignment ensures effective collaboration in the development of information processing capability [48,51]. The difference in the impact of the construct on exploitation and exploration is an important point. In the former case (exploitation), the strong relationship is because the achievement of business goals depends critically on a clear understanding of these goals by IT management. In the second case, the situation is more nuanced. Innovation exploration can involve less well-defined goals and can require closer alignment for those goals to be understood, agreed upon, and achieved [109,110];
- Digital adaptability. Although still positive, the relationship between this construct is with both sustainability innovation exploitation and innovation. However, the positive association supports H1 and H2, as digital adaptability provides the ability to adapt to change, enhance customer engagement, and build a resilient and agile business that is prepared for the challenges and opportunities of a dynamic business environment [49,63]. Although digital adaptability is less significant than the other independent variables in the model, it remains an important influence on sustainability innovation balance.

Although previous studies have reported a positive association between digital competence and innovation performance, particularly with reference to the importance of

strategic alignment in using sustainability goals to achieve competition [111–114], there are few studies which examine the specific issue of how DT can affect sustainability innovation from the perspective of information processing. Equally, there is little research that inductively examines the role of digital adaptability. As a consequence, the findings in this study concerning RQ1 not only provide valuable insights as to the need for high levels of digital competence and strategic alignment but also illustrate the degree to which these factors can help to ensure successful investments in sustainability exploration/exploitation innovation.

With respect to RQ2 (how sustainability innovation affects ESP), the study analysis found that H7 and H8 are both supported, showing that both the exploration and exploitation factors of sustainability innovation have a positive and significant impact on ESP. These findings are consistent with those of other studies, such as that by Alnoor et al. [78]. Sustainability exploration innovation, for example, can enhance ESP by driving the transformation of an existing business approach so that it embraces ideas that create value for society, the environment, and stakeholders while achieving sustainable business success. Innovation exploitation, on the other hand, encourages and facilitates the incremental change and improvement of existing products and services without compromising the continuity of the operational business model. In short, this study found that both aspects of sustainability innovation (exploitation and innovation) contribute equally to ESP.

5. Conclusions

This study set out to explore the effect of DT factors on sustainability innovation balance and, ultimately, on ESP. To achieve this, a theoretical model was developed, which proposed relationships between the defined (DT and innovation balance) constructs using IPT. This model was then tested empirically using a survey methodology that collected data from 373 Freight and Logistics professionals in Saudi Arabia. This data was analysed using CFA.

The findings provided clear answers to both research questions. With respect to RQ1, it was established that organisational digital competence and strategy alignment both had a significant and positive effect on sustainability innovation, and both elements of sustainability innovation (exploration and exploitation innovation) were positively associated with ESP. Finally, a total effect analysis was used to determine the relative impacts of each factor on ESP. This showed that ESP was most strongly influenced by digital competence, followed by (in order of impact) strategy alignment, sustainability innovation exploration, sustainability innovation exploitation, and digital adaptability.

This study contributes to our theoretical understanding in a number of ways. It enhances, for example, the ability to apply IPT in the context of organisational sustainability. While IPT is not widely used, it is proving increasingly relevant in the age of big data, where business success and market differentiation can depend on the ability to collect, handle, and analyse large volumes of data [115–117]. By using IPT to define key constructs (digital competence, strategy alignment, and digital adaptability) to reflect a firm's information processing capacity, this study offers valuable insights to organisations seeking to improve or create products and services which enhance their sustainability performance.

Another important aspect of the methodological approach of this paper is its use of antecedent, mediating, and outcome variables. This approach not only helps to clearly delineate the causal relationships between variables, allowing for more precise hypothesis testing, but it also aids theoretical advancement by clarifying the underlying mechanisms governing the relationships between variables. This helps to refine theoretical frameworks and models in the domain of sustainability [102,118].

In more specific terms, the approach proved valuable by showing that the initial assumptions behind the research model are accurate, i.e., that while the DT antecedents have a direct and significant impact on sustainability innovation balance, they do not directly influence ESP. Instead, their impact on ESP is mediated by innovation balance. The practical implication of this is that, although information processing capability is critical to improving organisational ESP, it is also important in influencing sustainability

innovation balance, which is a key mediating factor. In order to achieve this, management in Freight and Logistics businesses should prioritise the development and implementation of digital competence, as well as ensure a close alignment of digital technology and business strategies.

Refs. [119–121] To ensure strategy alignment, organisations should foster a culture of collaboration between IT and business functions. This involves a number of key elements, such as creating shared goals and metrics, including IT leaders and professionals in the strategic planning process, securing commitment to alignment from executive leadership, and continuously monitoring and assessing IT and business strategy alignment through regular performance reviews, evaluations, and feedback mechanisms [122–124].

Although this study found that digital adaptability was less significant than the previous factors, it is still an important construct. Thus, organisations should build their digital infrastructures around open standards to ensure that systems and applications can be easily modified or upgraded without affecting business continuity. They should also adopt an agile approach to business to allow them to respond quickly and effectively to stakeholder needs, market dynamics and evolving sustainability requirements.

This study also shows the importance of establishing a balance between the exploration and exploitation aspects of sustainability innovation. This can be achieved through the implementation of various processes, such as forming synergistic partnerships with complementary businesses or suppliers, collaborating with research bodies to explore possibilities and early-stage concepts, and regularly updating existing products/services to reflect developments in sustainable technology.

6. Limitations and Future Research

It should be noted that this study has some limitations. One of these limitations is that the study data was collected from a single industry sector (Freight and Logistics) in a single country (Saudi Arabia). The results may, therefore, not be representative of the wider world in terms of either industry or geographic region.

Another limitation of the study is that the factors examined in the model were derived only from IPT and innovation balance. While this approach yielded valuable insights into the importance of information processing capabilities in optimising ESP, future research could usefully explore the impact of other factors that operate via sustainability innovation balance to impact ESP. Future research could also introduce other factors based on different theoretical frameworks, such as absorptive capacity theory, which was proposed by Cohen and Levinthal in 1990 [125–127] to describe an organisation's ability to acquire, assimilate, transform, and use external knowledge to enhance its innovation and performance.

Finally, this study is limited by the methodological approach employed, particularly the reliance on cross-sectional data. This type of data collection does not allow for the assessment of changes over time, which could be crucial in understanding the dynamic aspects of information processing capabilities and sustainability innovation balance in the Freight and Logistics sector. Consequently, the findings might not accurately reflect the long-term impacts or the evolution of ESP. Future research should consider longitudinal studies that can track these variables over time to provide a more comprehensive view of the processes and their outcomes. Additionally, employing a mixed-methods approach could enrich the quantitative data, offering deeper insights through qualitative analyses, such as case studies or interviews.

Funding: This research was funded by the Researchers Supporting Project number (RSP2024R233), King Saud University, Riyadh, Saudi Arabia.

Institutional Review Board Statement: The study was carried out in accordance with the principles outlined in the Declaration of Helsinki and received approval from the Institutional Review Board (Human and Social Research) at King Saud University.

Informed Consent Statement: All participants involved in the study provided informed consent.

Data Availability Statement: Data can be made available upon request to ensure privacy restrictions are upheld.

Acknowledgments: This research was funded by the Researchers Supporting Project (RSP2024R233), King Saud University, Riyadh, Saudi Arabia.

Conflicts of Interest: The author declares no conflicts of interest.

References

1. Samaibekova, Z.; Choyubekova, G.; Isabaeva, K.; Samaibekova, A. Corporate Sustainability and Social Responsibility. *E3S Web Conf.* **2021**, *250*, 06003. [CrossRef]
2. Camilleri, M.A. Corporate Sustainability and Responsibility: Creating Value for Business, Society and the Environment. *Asian J. Sustain. Soc. Responsib.* **2017**, *2*, 59–74. [CrossRef]
3. Hockerts, K. A Cognitive Perspective on the Business Case for Corporate Sustainability. *Bus. Strategy Environ.* **2015**, *24*, 102–122. [CrossRef]
4. Salzmann, O.; Ionescu-Somers, A.; Steger, U. The Business Case for Corporate Sustainability: Literature Review and Research Options. *Eur. Manag. J.* **2005**, *23*, 27–36. [CrossRef]
5. Kim, J.; Kim, J. Corporate Sustainability Management and Its Market Benefits. *Sustainability* **2018**, *10*, 1455. [CrossRef]
6. García-Dastugue, S.; Eroglu, C. Operating Performance Effects of Service Quality and Environmental Sustainability Capabilities in Logistics. *J. Supply Chain Manag.* **2019**, *55*, 68–87. [CrossRef]
7. Market Intelligence. Saudi Arabia Transportation and Logistics Network Outlook. Available online: https://www.trade.gov/market-intelligence/saudi-arabia-transportation-and-logistics-network-outlook (accessed on 7 April 2024).
8. Mutambik, I. The Global Whitewashing of Smart Cities: Citizens' Perspectives. *Sustainability* **2023**, *15*, 8100. [CrossRef]
9. Mohiuddin, K.; Nasr, O.A.; Nadhmi Miladi, M.; Fatima, H.; Shahwar, S.; Noorulhasan Naveed, Q. Potentialities and Priorities for Higher Educational Development in Saudi Arabia for the next Decade: Critical Reflections of the Vision 2030 Framework. *Heliyon* **2023**, *9*, e16368. [CrossRef]
10. Soman, C. The Impact of Saudi Vision 2030 on Educational Reforms and Progress in Dentistry. *Saudi J. Oral Sci.* **2024**, *11*, 1–2. [CrossRef]
11. Amran, Y.H.A.; Amran, Y.H.M.; Alyousef, R.; Alabduljabbar, H. Renewable and Sustainable Energy Production in Saudi Arabia According to Saudi Vision 2030; Current Status and Future Prospects. *J. Clean. Prod.* **2020**, *247*, 119602. [CrossRef]
12. Vision2030. National Industrial Development and Logistics Program. Available online: https://www.vision2030.gov.sa/en/vision-2030/vrp/national-industrial-development-and-logistics-program/ (accessed on 7 April 2024).
13. Mutambik, I.; Lee, J.; Almuqrin, A.; Zhang, J.Z. Transitioning to Smart Cities in Gulf Cooperation Council Countries: The Role of Leadership and Organisational Culture. *Sustainability* **2023**, *15*, 10490. [CrossRef]
14. Harmon, R. Saudi Aramco's Green Leap: Steering the Logistics Sector into a Sustainable Future. Available online: https://www.logisticsmiddleeast.com/logistics/saudi-aramcos-green-leap-steering-the-logistics-sector-into-a-sustainable-future (accessed on 7 April 2024).
15. van den Hoven, M.; Al Qahtani, M. Pathways to Interculturality and the Saudi 2030 Vision. In *English as a Medium of Instruction on the Arabian Peninsula*; Routledge: London, UK, 2023; pp. 113–128. [CrossRef]
16. Farraj, Y.A. Saudi Transportation and Logistics Sectors Claim Global Prominence. Available online: https://economysaudiarabia.com/news/saudi-transportation-and-logistics-sectors-claim-global-prominence/ (accessed on 7 April 2024).
17. Maersk. Sustainable Logistics: Best Practices and Benefits. Available online: https://www.maersk.com/logistics-explained/sustainability/2023/08/27/sustainable-logistics-best-practices-and-benefits (accessed on 7 April 2024).
18. Tolba, K. Green Logistics: A Win-Win Strategy for Saudi Businesses. Available online: https://www.logisticsmiddleeast.com/logistics/green-logistics-saudi (accessed on 7 April 2024).
19. Al Zahrani, S.A. Is Saudi Arabia's Logistics Sector Future-Ready? Available online: https://www.gac.com/insights/eye-on-the-future-saudi-arabias-bold-digital-vision (accessed on 7 April 2024).
20. Appio, F.P.; Frattini, F.; Petruzzelli, A.M.; Neirotti, P. Digital Transformation and Innovation Management: A Synthesis of Existing Research and an Agenda for Future Studies. *J. Prod. Innov. Manag.* **2021**, *38*, 4–20. [CrossRef]
21. Mele, G.; Capaldo, G.; Secundo, G.; Corvello, V. Revisiting the Idea of Knowledge-Based Dynamic Capabilities for Digital Transformation. *J. Knowl. Manag.* **2024**, *28*, 532–563. [CrossRef]
22. Lee, J.; Almuqrin, A.; Zhang, J.Z.; Baihan, M.; Alkhanifer, A. Privacy Concerns in Social Commerce: The Impact of Gender. *Sustainability* **2023**, *15*, 12771. [CrossRef]
23. Feng, H.; Wang, F.; Song, G.; Liu, L. Digital Transformation on Enterprise Green Innovation: Effect and Transmission Mechanism. *Int. J. Environ. Res. Public Health* **2022**, *19*, 10614. [CrossRef] [PubMed]
24. Zhang, J.Z.; Homadi, A. The Growth of Social Commerce: How It Is Affected by Users' Privacy Concerns. *J. Theor. Appl. Electron. Commer. Res.* **2023**, *18*, 725–743. [CrossRef]
25. Guandalini, I. Sustainability through Digital Transformation: A Systematic Literature Review for Research Guidance. *J. Bus. Res.* **2022**, *148*, 456–471. [CrossRef]

26. Hajiheydari, N.; Kargar Shouraki, M.; Vares, H.; Mohammadian, A. Digital Sustainable Business Model Innovation: Applying Dynamic Capabilities Approach (DSBMI-DC). *Foresight* **2023**, *25*, 420–447. [CrossRef]
27. Aloini, D.; Dulmin, R.; Mininno, V.; Stefanini, A.; Zerbino, P. Driving the Transition to a Circular Economic Model: A Systematic Review on Drivers and Critical Success Factors in Circular Economy. *Sustainability* **2020**, *12*, 10672. [CrossRef]
28. Chen, Z.; Liang, M. How Do External and Internal Factors Drive Green Innovation Practices under the Influence of Big Data Analytics Capability: Evidence from China. *J. Clean. Prod.* **2023**, *404*, 136862. [CrossRef]
29. Hariyani, D.; Mishra, S.; Hariyani, P.; Sharma, M.K. Drivers and Motives for Sustainable Manufacturing System. *Innov. Green Dev.* **2023**, *2*, 100031. [CrossRef]
30. Fatma, N.; Haleem, A. Exploring the Nexus of Eco-Innovation and Sustainable Development: A Bibliometric Review and Analysis. *Sustainability* **2023**, *15*, 12281. [CrossRef]
31. Di Vaio, A.; Zaffar, A.; Balsalobre-Lorente, D.; Garofalo, A. Decarbonization Technology Responsibility to Gender Equality in the Shipping Industry: A Systematic Literature Review and New Avenues Ahead. *J. Shipp. Trade* **2023**, *8*, 9. [CrossRef]
32. Makkonen, H. Information Processing Perspective on Organisational Innovation Adoption Process. *Technol. Anal. Strateg. Manag.* **2021**, *33*, 612–624. [CrossRef]
33. Sestino, A.; Prete, M.I.; Piper, L.; Guido, G. Internet of Things and Big Data as Enablers for Business Digitalization Strategies. *Technovation* **2020**, *98*, 102173. [CrossRef]
34. Alomran, A.; Gauthier, J.; Abusharhah, M. Factors Influencing Public Trust in Open Government Data. *Sustainability* **2022**, *14*, 9765. [CrossRef]
35. Ivanov, D.; Dolgui, A.; Sokolov, B. Cloud Supply Chain: Integrating Industry 4.0 and Digital Platforms in the "Supply Chain-as-a-Service". *Transp. Res. Part E Logist. Transp. Rev.* **2022**, *160*, 102676. [CrossRef]
36. Aussu, P. *Information Overload: Coping Mechanisms and Tools Impact*; Springer International Publishing: Cham, Switzerland, 2023; pp. 661–669. [CrossRef]
37. Denicolai, S.; Zucchella, A.; Magnani, G. Internationalization, Digitalization, and Sustainability: Are SMEs Ready? A Survey on Synergies and Substituting Effects among Growth Paths. *Technol. Forecast. Soc. Change* **2021**, *166*, 120650. [CrossRef]
38. Sakas, D.P.; Giannakopoulos, N.T.; Terzi, M.C.; Kanellos, N.; Liontakis, A. Digital Transformation Management of Supply Chain Firms Based on Big Data from DeFi Social Media Profiles. *Electronics* **2023**, *12*, 4219. [CrossRef]
39. Zeng, F.; Lee, S.H.N.; Lo, C.K.Y. The Role of Information Systems in the Sustainable Development of Enterprises: A Systematic Literature Network Analysis. *Sustainability* **2020**, *12*, 3337. [CrossRef]
40. Tjoa, A.M.; Tjoa, S. *The Role of ICT to Achieve the UN Sustainable Development Goals (SDG)*; Springer International Publishing: Cham, Switzerland, 2016; pp. 3–13. [CrossRef]
41. Ordonez-Ponce, E. Exploring the Impact of the Sustainable Development Goals on Sustainability Trends. *Sustainability* **2023**, *15*, 16647. [CrossRef]
42. Nilashi, M.; Ali Abumalloh, R.; Keng-Boon, O.; Wei-Han Tan, G.; Cham, T.-H.; Cheng-Xi Aw, E. Unlocking Sustainable Resource Management: A Comprehensive SWOT and Thematic Analysis of FinTech with a Focus on Mineral Management. *Resour. Policy* **2024**, *92*, 105028. [CrossRef]
43. Nilashi, M.; Keng Boon, O.; Tan, G.; Lin, B.; Abumalloh, R. Critical Data Challenges in Measuring the Performance of Sustainable Development Goals: Solutions and the Role of Big-Data Analytics. *Harv. Data Sci. Rev.* **2023**, *5*, 3–4. [CrossRef]
44. Chatterjee, S.; Chaudhuri, R.; Vrontis, D.; Galati, A. Digital Transformation Using Industry 4.0 Technology by Food and Beverage Companies in Post COVID-19 Period: From DCV and IDT Perspective. *Eur. J. Innov. Manag.* 2022. [CrossRef]
45. Mondal, S.; Singh, S.; Gupta, H. Green Entrepreneurship and Digitalization Enabling the Circular Economy through Sustainable Waste Management—An Exploratory Study of Emerging Economy. *J. Clean. Prod.* **2023**, *422*, 138433. [CrossRef]
46. Almuqrin, A.; Mutambik, I.; Alomran, A.; Zhang, J.Z. Information System Success for Organizational Sustainability: Exploring the Public Institutions in Saudi Arabia. *Sustainability* **2023**, *15*, 9233. [CrossRef]
47. Xu, J.; Naseer, H.; Maynard, S.; Filippou, J. Using Analytical Information for Digital Business Transformation through DataOps: A Review and Conceptual Framework. *Australas. J. Inf. Syst.* **2024**, *28*. [CrossRef]
48. Wu, L.; Sun, L.; Chang, Q.; Zhang, D.; Qi, P. How Do Digitalization Capabilities Enable Open Innovation in Manufacturing Enterprises? A Multiple Case Study Based on Resource Integration Perspective. *Technol. Forecast. Soc. Change* **2022**, *184*, 122019. [CrossRef]
49. AlNuaimi, B.K.; Kumar Singh, S.; Ren, S.; Budhwar, P.; Vorobyev, D. Mastering Digital Transformation: The Nexus between Leadership, Agility, and Digital Strategy. *J. Bus. Res.* **2022**, *145*, 636–648. [CrossRef]
50. Omrani, N.; Rejeb, N.; Maalaoui, A.; Dabić, M.; Kraus, S. Drivers of Digital Transformation in SMEs. *IEEE Trans. Eng. Manag.* **2024**, *71*, 5030–5043. [CrossRef]
51. Calderon-Monge, E.; Ribeiro-Soriano, D. The Role of Digitalization in Business and Management: A Systematic Literature Review. *Rev. Manag. Sci.* **2024**, *18*, 449–491. [CrossRef]
52. Zhang, J.Z.; Alomran, A.; Omar, T.; Floos, A.; Homadi, A. Usability of the G7 Open Government Data Portals and Lessons Learned. *Sustainability* **2021**, *13*, 13740. [CrossRef]
53. Oberländer, A.M.; Röglinger, M.; Rosemann, M. Digital Opportunities for Incumbents—A Resource-Centric Perspective. *J. Strateg. Inf. Syst.* **2021**, *30*, 101670. [CrossRef]

54. Rajagopal, N.K.; Qureshi, N.I.; Durga, S.; Ramirez Asis, E.H.; Huerta Soto, R.M.; Gupta, S.K.; Deepak, S. Future of Business Culture: An Artificial Intelligence-Driven Digital Framework for Organization Decision-Making Process. *Complexity* **2022**, *2022*, 7796507. [CrossRef]
55. Kitsios, F.; Kamariotou, M. Artificial Intelligence and Business Strategy towards Digital Transformation: A Research Agenda. *Sustainability* **2021**, *13*, 2025. [CrossRef]
56. Miceli, A.; Hagen, B.; Riccardi, M.P.; Sotti, F.; Settembre-Blundo, D. Thriving, Not Just Surviving in Changing Times: How Sustainability, Agility and Digitalization Intertwine with Organizational Resilience. *Sustainability* **2021**, *13*, 2052. [CrossRef]
57. Tanjaya, H.N.; Muafi, M.; El Qadri, Z.M.; Suprihanto, J. *The Important Role of Digital Business Intensity on Ambidexterity and Sustaining Organizational Performance*; Springer: Singapore, 2024; pp. 19–27. [CrossRef]
58. Zhou, Y.; Xu, J.; Liu, Z.; Feng, J. Digital Transformation and Innovation Strategy Selection: The Contingent Impact of Organizational and Environmental Factors. *IEEE Trans. Eng. Manag.* **2024**, 1–20. [CrossRef]
59. Leitão, J.; Pereira, D.; Gonçalves, Â.; Oliveira, T. Digitalizing the Pillars of Hybrid Civic Universities: A Bibliometric Analysis and New Taxonomy Proposal. *J. Open Innov. Technol. Mark. Complex.* **2023**, *9*, 100026. [CrossRef]
60. Dressler, M.; Paunovic, I. Sensing Technologies, Roles and Technology Adoption Strategies for Digital Transformation of Grape Harvesting in SME Wineries. *J. Open Innov. Technol. Mark. Complex.* **2021**, *7*, 123. [CrossRef]
61. Tang, D.; Chen, W.; Zhang, Q.; Zhang, J. Impact of Digital Finance on Green Technology Innovation: The Mediating Effect of Financial Constraints. *Sustainability* **2023**, *15*, 3393. [CrossRef]
62. Quilloy, K.; Newman, A.; Pyman, A. Antecedents of the Social Impact of Social Enterprises: A Systematic Review and Agenda for Future Research. *Nonprofit Volunt. Sect. Q.* **2023**, *53*, 08997640231191794. [CrossRef]
63. Mazumder, S.; Garg, S. Decoding Digital Transformational Outsourcing: The Role of Service Providers' Capabilities. *Int. J. Inf. Manag.* **2021**, *58*, 102295. [CrossRef]
64. Grover, V. Digital Agility: Responding to Digital Opportunities. *Eur. J. Inf. Syst.* **2022**, *31*, 709–715. [CrossRef]
65. Soluk, J.; Decker-Lange, C.; Hack, A. Small Steps for the Big Hit: A Dynamic Capabilities Perspective on Business Networks and Non-Disruptive Digital Technologies in SMEs. *Technol. Forecast. Soc. Change* **2023**, *191*, 122490. [CrossRef]
66. Magistretti, S.; Pham, C.T.A.; Dell'Era, C. Enlightening the Dynamic Capabilities of Design Thinking in Fostering Digital Transformation. *Ind. Mark. Manag.* **2021**, *97*, 59–70. [CrossRef]
67. Ye, F.; Liu, K.; Li, L.; Lai, K.-H.; Zhan, Y.; Kumar, A. Digital Supply Chain Management in the COVID-19 Crisis: An Asset Orchestration Perspective. *Int. J. Prod. Econ.* **2022**, *245*, 108396. [CrossRef] [PubMed]
68. Palsodkar, M.; Yadav, G.; Nagare, M.R. Integrating Industry 4.0 and Agile New Product Development Practices to Evaluate the Penetration of Sustainable Development Goals in Manufacturing Industries. *J. Eng. Des. Technol.* **2023**. [CrossRef]
69. Li, X.; Li, X.; Ding, S. Digital Transformation and Innovation Ambidexterity: Perspectives on Accumulation and Resilience Effects. *Eur. J. Innov. Manag.* **2024**. [CrossRef]
70. Lin, J.; Mao, M. How Does Digital Transformation Affect Sustainable Innovation Performance? The Pivotal Roles of Digital Technology-business Alignment and Environmental Uncertainty. *Sustain. Dev.* **2023**. [CrossRef]
71. Biazzo, S.; Panizzolo, R.; de Crescenzo, A.M. *Lean Management and Product Innovation: A Critical Review*; Springer: Berlin/Heidelberg, Germany, 2016; pp. 237–260. [CrossRef]
72. Nisar, Q.A.; Haider, S.; Ameer, I.; Hussain, M.S.; Gill, S.S.; Usama, A. Sustainable Supply Chain Management Performance in Post COVID-19 Era in an Emerging Economy: A Big Data Perspective. *Int. J. Emerg. Mark.* **2023**, *18*, 5900–5920. [CrossRef]
73. Khan, A.; Chen, C.-C.; Suanpong, K.; Ruangkanjanases, A.; Kittikowit, S.; Chen, S.-C. The Impact of CSR on Sustainable Innovation Ambidexterity: The Mediating Role of Sustainable Supply Chain Management and Second-Order Social Capital. *Sustainability* **2021**, *13*, 12160. [CrossRef]
74. Zhang, J.; Lyu, Y.; Li, Y.; Geng, Y. Digital Economy: An Innovation Driving Factor for Low-Carbon Development. *Environ. Impact Assess. Rev.* **2022**, *96*, 106821. [CrossRef]
75. Ciampi, F.; Faraoni, M.; Ballerini, J.; Meli, F. The Co-Evolutionary Relationship between Digitalization and Organizational Agility: Ongoing Debates, Theoretical Developments and Future Research Perspectives. *Technol. Forecast. Soc. Change* **2022**, *176*, 121383. [CrossRef]
76. Xin, X.; Miao, X.; Cui, R. Enhancing Sustainable Development: Innovation Ecosystem Coopetition, Environmental Resource Orchestration, and Disruptive Green Innovation. *Bus. Strategy Environ.* **2023**, *32*, 1388–1402. [CrossRef]
77. Allal-Chérif, O.; Costa Climent, J.; Ulrich Berenguer, K.J. Born to Be Sustainable: How to Combine Strategic Disruption, Open Innovation, and Process Digitization to Create a Sustainable Business. *J. Bus. Res.* **2023**, *154*, 113379. [CrossRef]
78. Alnoor, A.; Atiyah, A.G.; Abbas, S. Toward Digitalization Strategic Perspective in the European Food Industry: Non-Linear Nexuses Analysis. *Asia-Pac. J. Bus. Adm.* 2023. [CrossRef]
79. Nikiforova, A.; Almuqrin, A.; Liu, Y.D.; Floos, A.Y.M.; Omar, T. Benefits of Open Government Data Initiatives in Saudi Arabia and Barriers to Their Implementation. *J. Glob. Inf. Manag.* **2021**, *29*, 1–22. [CrossRef]
80. Mutambik, I.; Almuqrin, A.; Alharbi, F.; Abusharhah, M. How to Encourage Public Engagement in Smart City Development—Learning from Saudi Arabia. *Land* **2023**, *12*, 1851. [CrossRef]
81. Koseoglu, A.; Yucel, A.G.; Ulucak, R. Green Innovation and Ecological Footprint Relationship for a Sustainable Development: Evidence from Top 20 Green Innovator Countries. *Sustain. Dev.* **2022**, *30*, 976–988. [CrossRef]

82. Lee, C.C. Sustainable Advantage: Accelerating from Regulatory Compliance to Environmental Sustainability. *Int. J. Environ. Sustain.* **2017**, *13*, 37–44. [CrossRef]
83. Boros, A.; Fogarassy, C. Relationship between Corporate Sustainability and Compliance with State-Owned Enterprises in Central-Europe: A Case Study from Hungary. *Sustainability* **2019**, *11*, 5653. [CrossRef]
84. Alkaff, M. Variations of Business Process Reengineering: The Conceptual Framework for Teak Production Sustainability. *DIES J. Dalwa Islam. Econ. Stud.* **2023**, *2*, 62–75. [CrossRef]
85. Antamis, T.; Medentzidis, C.-R.; Skoumperdis, M.; Vafeiadis, T.; Nizamis, A.; Ioannidis, D.; Tzovaras, D. AI-Supported Forecasting of Intermodal Freight Transportation Delivery Time. In Proceedings of the 2021 62nd International Scientific Conference on Information Technology and Management Science of Riga Technical University (ITMS), Riga, Latvia, 14–15 October 2021; IEEE: Piscataway, NJ, USA, 2021; pp. 1–6. [CrossRef]
86. Boute, R.N.; Udenio, M. AI in Logistics and Supply Chain Management. In *Global Logistics and Supply Chain Strategies for the 2020s*; Springer International Publishing: Cham, Switzerland, 2023; pp. 49–65. [CrossRef]
87. Lee, J.; Almuqrin, A.; Alkhanifer, A.; Baihan, M. Gulf Cooperation Council Countries and Urbanisation: Are Open Government Data Portals Helping? *Sustainability* **2023**, *15*, 12823. [CrossRef]
88. Rajapathirana, R.P.J.; Hui, Y. Relationship between Innovation Capability, Innovation Type, and Firm Performance. *J. Innov. Knowl.* **2018**, *3*, 44–55. [CrossRef]
89. Greene, J. *Mixed Methods in Social Inquiry*; John Wiley & Sons: San Francisco, CA, USA, 2007.
90. Straub, D.; Gefen, D. Validation Guidelines for IS Positivist Research. *Commun. Assoc. Inf. Syst.* **2004**, *13*, 24. [CrossRef]
91. Lynn, M.R. Determination and Quantification of Content Validity. *Nurs. Res.* **1986**, *35*, 382–386. [CrossRef]
92. Johnson, R.B.; Onwuegbuzie, A.J. Mixed Methods Research: A Research Paradigm Whose Time Has Come. *Educ. Res.* **2004**, *33*, 14–26. [CrossRef]
93. Gorard, S. *Quantitative Methods in Educational Research: The Role of Numbers Made*; Continuum: London, UK, 2001.
94. Bryman, A.; Bell, E. *Business Research Methods*; Oxford University Press: Oxford, UK, 2003.
95. Bryman, A. *Social Research Methods*, 2nd ed.; Oxford University Press: Oxford, UK, 2004.
96. Cohen, L.; Manion, L.; Morrison, K. *Research Methods in Education*; Routledge: London, UK, 2007; Volume 55.
97. Hair, J.F.; Howard, M.C.; Nitzl, C. Assessing Measurement Model Quality in PLS-SEM Using Confirmatory Composite Analysis. *J. Bus. Res.* **2020**, *109*, 101–110. [CrossRef]
98. Hair, J.F.; Ringle, C.M.; Sarstedt, M. PLS-SEM: Indeed a Silver Bullet. *J. Mark. Theory Pract.* **2011**, *19*, 139–152. [CrossRef]
99. Hu, L.; Bentler, P.M. Cutoff Criteria for Fit Indexes in Covariance Structure Analysis: Conventional Criteria versus New Alternatives. *Struct. Equ. Model. Multidiscip. J.* **1999**, *6*, 1–55. [CrossRef]
100. Henseler, J.; Sarstedt, M. Goodness-of-Fit Indices for Partial Least Squares Path Modeling. *Comput. Stat.* **2013**, *28*, 565–580. [CrossRef]
101. Taber, K.S. The Use of Cronbach's Alpha When Developing and Reporting Research Instruments in Science Education. *Res. Sci. Educ.* **2018**, *48*, 1273–1296. [CrossRef]
102. Field, A.P. *Discovering Statistics Using IBM SPSS Statistics: And Sex and Drugs and Rock "n" Roll*; Sage: Los Angeles, CA, USA, 2013.
103. Luan, F.; Qi, W.; Zhang, W.; Chang, V. Do Industrial Robots Matter for Corporate Environmental Governance? Evidence from Chinese Firms. *Inf. Technol. People* **2024**. [CrossRef]
104. Sun, Z.; Sun, X.; Wang, W.; Wang, W. Digital Transformation and Greenwashing in Environmental, Social, and Governance Disclosure: Does Investor Attention Matter? *Bus. Ethics Environ. Responsib.* **2023**. [CrossRef]
105. Wen, H.; Lee, C.-C.; Song, Z. Digitalization and Environment: How Does ICT Affect Enterprise Environmental Performance? *Environ. Sci. Pollut. Res.* **2021**, *28*, 54826–54841. [CrossRef] [PubMed]
106. Farisyi, S.; Al Musadieq, M.; Utami, H.N.; Damayanti, C.R. A Systematic Literature Review: Determinants of Sustainability Reporting in Developing Countries. *Sustainability* **2022**, *14*, 10222. [CrossRef]
107. Badulescu, A.; Badulescu, D.; Saveanu, T.; Hatos, R. The Relationship between Firm Size and Age, and Its Social Responsibility Actions—Focus on a Developing Country (Romania). *Sustainability* **2018**, *10*, 805. [CrossRef]
108. Morioka, S.N.; de Carvalho, M.M. A Systematic Literature Review towards a Conceptual Framework for Integrating Sustainability Performance into Business. *J. Clean. Prod.* **2016**, *136*, 134–146. [CrossRef]
109. Wang, T.; Lin, X.; Sheng, F. Digital Leadership and Exploratory Innovation: From the Dual Perspectives of Strategic Orientation and Organizational Culture. *Front. Psychol.* **2022**, *13*, 902693. [CrossRef]
110. Krishnan, R.; Yen, P.; Agarwal, R.; Arshinder, K.; Bajada, C. Collaborative Innovation and Sustainability in the Food Supply Chain- Evidence from Farmer Producer Organisations. *Resour. Conserv. Recycl.* **2021**, *168*, 105253. [CrossRef]
111. Shah, N.; Moawad, N.F.; Bhatti, M.K.; Abdelwahed, N.A.A.; Soomro, B.A. Orientation and Absorptive Capacity towards Sustainability: A Missing Link between Sustainability and Performance. *Int. J. Product. Perform. Manag.* **2023**. [CrossRef]
112. Barakat, M.; Wu, J.S.; Tipi, N. Empowering Clusters: How Dynamic Capabilities Drive Sustainable Supply Chain Clusters in Egypt. *Sustainability* **2023**, *15*, 16787. [CrossRef]
113. Li, F.; Zhao, Y.; Ortiz, J.; Chen, Y. How Does Digital Technology Innovation Affect the Internationalization Performance of Chinese Enterprises? The Moderating Effect of Sustainability Readiness. *Sustainability* **2023**, *15*, 11126. [CrossRef]
114. Rahmani, A.; Aboojafari, R.; Bonyadi Naeini, A.; Mashayekh, J. Adoption of Digital Innovation for Resource Efficiency and Sustainability in the Metal Industry. *Resour. Policy* **2024**, *90*, 104719. [CrossRef]

115. Mutambik, I.; Almuqrin, A.; Lee, J.; Gauthier, J.; Homadi, A. Open Government Data in Gulf Cooperation Council Countries: An Analysis of Progress. *Sustainability* **2022**, *14*, 7200. [CrossRef]
116. Verhoef, P.C.; Broekhuizen, T.; Bart, Y.; Bhattacharya, A.; Qi Dong, J.; Fabian, N.; Haenlein, M. Digital Transformation: A Multidisciplinary Reflection and Research Agenda. *J. Bus. Res.* **2021**, *122*, 889–901. [CrossRef]
117. Vial, G. Understanding Digital Transformation: A Review and a Research Agenda. *J. Strateg. Inf. Syst.* **2019**, *28*, 118–144. [CrossRef]
118. Pallant, J. *SPSS Survival Manual: A Step by Step Guide to Data Analysis Using SPSS for Windows*; Open University Press: Maidenhead, UK, 2007.
119. Pittaway, J.J.; Montazemi, A.R. Know-How to Lead Digital Transformation: The Case of Local Governments. *Gov. Inf. Q.* **2020**, *37*, 101474. [CrossRef]
120. Fischer, C.; Siegel, J.; Proeller, I.; Drathschmidt, N. Resilience through Digitalisation: How Individual and Organisational Resources Affect Public Employees Working from Home during the COVID-19 Pandemic. *Public Manag. Rev.* **2023**, *25*, 808–835. [CrossRef]
121. Almuqrin, A. Employee Acceptance of Digital Transformation: A Study in a Smart City Context. *Sustainability* **2024**, *16*, 1398. [CrossRef]
122. Reynolds, P.; Yetton, P. Aligning Business and IT Strategies in Multi-Business Organizations. *J. Inf. Technol.* **2015**, *30*, 101–118. [CrossRef]
123. Gartlan, J.; Shanks, G. The Alignment of Business and Information Technology Strategy in Australia. *Australas. J. Inf. Syst.* **2007**, *14*. [CrossRef]
124. Gutierrez, A.; Orozco, J.; Serrano, A. Factors Affecting IT and Business Alignment: A Comparative Study in SMEs and Large Organisations. *J. Enterp. Inf. Manag.* **2009**, *22*, 197–211. [CrossRef]
125. Fuad, K.; Li, P.; Maruping, L.; Mathiassen, L. An Absorptive Capacity Framework for Investigating Enterprise System Ecosystems: The Role of Connectivity and Intelligence. *Enterp. Inf. Syst.* **2024**, *18*, 2330084. [CrossRef]
126. Yildiz, H.E.; Murtic, A.; Zander, U. Re-Conceptualizing Absorptive Capacity: The Importance of Teams as a Meso-Level Context. *Technol. Forecast. Soc. Change* **2024**, *199*, 123039. [CrossRef]
127. Pertiwi, A.; Mursitama, T.N.; Beng, J.T.; Elidjen. The Under-Developed Social Integration Mechanism as Moderating Factor of Two-Dimensional Absorptive Capacity Relationship: Systematic Literature Review. *SAGE Open* **2024**, *14*, 21582440231203904. [CrossRef]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.