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Posted Date: 11 June 2024

doi: 10.20944/preprints202406.0637.v1

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 doi:10.20944/preprints202406.0637.v1

Article

Exploring Digital Management Intensity and Its Relationship with Environmental Performance: Greek Managers' Perspective

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Abstract: Digital transformation process gained significant research interest over the past years especially when related with achievements in sustainability goals. Even though there exist growing research regarding various aspects of digital transformation and sustainability procedure, a more detailed analysis is needed in different national environments. Proposed study empirically analyzes the Greek managers' perspective for the relationship between digital management intensity and environmental performance. Almost 60 Greek senior managers from various organizational sectors were interviewed, while a synthetic index already developed from previous studies was used. Results indicate that Greek companies are not fully exploit digital technologies to further develop their environmental practices. Digital transformation strategy is contributing effectively to environmental strategies in the case of reducing emissions of waste and avoid environmental accidents, while in the rest of cases emerging technologies play a less important role and not as a part of an holistic digital strategy.

Keywords: environmental practices; digital management intensity; digital transformation; business strategy; environmental performance; sustainable management; Greek managers

1. Introduction

Digital transformation has been a growing research trend over the last 10 years, gaining significant interest between academics and business professionals, while changing the whole business environment in terms of production, consumption and value chains (Oliveira et al., 2021). The concept has been theoretically and empirically associated with several business aspects including new ways of resource allocation (Reis et al. 2018), value creation and business evolution (Chen et al., 2022; Lee & Suh, 2022), competitive advantage (Cahyadi 2020), cultivation of digital culture (Krasonikolakis, Tsarbopoulos, and Eng 2020; Isensee et al. 2020), efficiency (Gebayew et al. 2018; Kraus et al. 2021), increased competitiveness (Helmy, Khater, and Zaki 2017), productivity (Heredia et al., 2022), innovation (Appio et al. 2021; Peng and Tao, 2022), economic benefits (Kayikci, 2018; Dana et al., 2022), creating agile methodologies of management (Kargas and Aretos 2023; Troise et al. 2022), quick decision – making (Corso et al. 2018), cost reduction (Saini 2018), integration of new technologies (Chaparro-Peláez et al. 2020; Loske and Klumpp 2022), development of new digital business models (Brynjolfsson and Hitt 2000; Frank, Dalenogare, and Ayala 2019; Loebbecke and Picot 2015; Vial 2019).

A careful reader could easily understand that all the above – mentioned business aspects are related with internal factors that are affected and at the same time affecting digital transformation. Moreover, there exist several external factors associated with the implementation of digital strategies, including digital technologies (for example 5G technologies, Virtual Reality, Artificial Intelligence, Augmented, Blockchain, etc.) that spawned a series of new industries (Song et al., 2022; Veile et al., 2022), the implementation of big data analysis as an operational aspect of doing business (Kostakis and Kargas 2021; Reinsel et al. 2018), customers' need for personalized services / products (Von

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Leipzig et al. 2017) and changes occurred to expected work force's skills (Kargas et al. 2024a, Kargas et al. 2022a, Kargas et al. 2022b).

At the same time, another one external factor arises as a necessity for businesses, namely "sustainability" as the core of circular economy that aim to overpass the linear economic model (Genovese et al., 2017), which failed to address issues such natural resources preservation, efficient waste management and increased socioeconomic performance alongside with environmental responsibility (Jayarathna et. al., 2023). New, sustainable strategies emerged (Lahane et al., 2020) to tackle issues about how recovering or recycling resources can be part of products and services development process (Atasu et al., 2021). Existing research mainly focus on the manufacture's perspective about sustainability (Ciliberto et al., 2021; Kumar et al., 2019; Negri et al., 2021) or provide evidence about sustainability's interrelation with environmental, social, and corporate governance (ESG) factors as far as services sector is concerned (Sepetis et. al., 2024).

Even though both concepts, digital transformation and sustainability issues, their interconnection is not an easy task to be accomplished. Some scholas claim that such a difficulty arise from the lack of a wide – accepted methodology to measure digital transformation (Paunov & Rollo, 2016), while others propose as a reason the theoretical nature of both issues (George and Schillebeeckx, 2022). Even so, there is strong evidence that digital transformation can support sustainable management (George et al., 2020; Parida and Wincent, 2019) or even promote it by developing a new business logic (He et al., 2022). Researchers point out that digital transformation not only reshapes the nature of entrepreneurship (Nambisan, 2017; Yoo et al., 2012), but moreover can change how businesses approach sustainability issue as well (Seele and Lock, 2017; Stuermer et al., 2017), leading to the development of new business models and of a whole new business ecosystem (Hinings et al., 2018; Holzmann et al., 2017; Nambisan et al., 2017; Tauscher and Laudien, 2018). Moreover, researchers enlighten how the implementation of emerging technologies, alongside with cyclical economy's practices can lead to sustainable benefits (Jabbour et al., 2019; Okorie et al., 2018; Ozkan-Ozen et al., 2020).

As far as Greek business environment is concerned, there exist a few research works incorporating sustainability elements in digital transformation processes (Kargas et. al. 2024b; Kargas et. al. 2023), as well as research that examine how the concept of sustainability is perceived in Greek businesses environment and if it can provide a competitive advantage (Bafas et. al. 2023). Moreover, other studies associate emerging technologies with several aspects of Greek business environment, such as sustainable marketing (Kalogiannidis et. al. 2024), employees' acceptance of new technologies (Kitsios et. al. 2021) or sustainability strategies during COVID-19 pandemia (Michailidi et. al. 2021).

Such a condition provide evidence that there is lot space for research exploration when it comes to the synergies between digital transformation and sustainable development in Greek business environment. While sustainable practices gain more and more importance as part of a worldwide – accepted commitment to efficient, environmental management (Zhang et al., 2019; Dantas et al., 2020), at the same time business ecosystem shifts towards digital transformation (Nascimento et al., 2019). But these two tensions are not independent one each other, since digital technologies are regarded as potential enablers for cyclical economy's business models (Ranta et al., 2021) and as means to minimize resource consumption, to reduce greenhouse emissions and to apply efficient waste management (Agrawal et. al., 2022).

Proposed research aims to address the gap about the relationship between digital transformation and environmental performance, by using data from Greek business environment. Enlightening such a research question can provide a useful insight about how digital transformation strategy can be accompanied by sustainable entrepreneurship. Our results indicate that in companies with a strong environmental orientation, there also exists a strong tension for extensive use of digital technologies. In most cases, such a tension is embedded in organizational processes as part of a digital transformation strategy, especially when it comes to companies with a strong orientation to reduce emissions of waste and to avoid environmental accidents. In contrast when companies are oriented to reduce energy consumption, there still exists a digital orientation but mainly for using emerging technologies as part of an environmental strategy rather than developing an holistic digital strategy.

 doi:10.20944/preprints202406.0637.v1

Finally, the companies with main environmental purpose to reduce the consumption of hazardous or toxic materials are the less likely to develop a digital transformation vision in Greek business environment.

The article contributes to further enlight the relationship between sustainable management and digital transformation strategy in the Greek business environment. Differences to environmental orientation are not only associated with the existence or not of a digital transformation strategy but moreover with the strength of this relationship and its direction. Results can be used by companies' executives to reevaluate and further improve the development of both environmental and digital strategies. Moreover, results provide a useful insight to policy makers about weaknesses of Greek companies to fully exploit emerging technologies and to develop strong digital strategies to minimize their environmental footprint.

2. Materials and Methods

An already established research framework, developed by Ribeiro-Navarrete et. al. (2023), was used to collect data from 156 Greek companies from various sectors. Questionnaire was completed by conducting interviews to senior managers, capable to answer about both company's environmental strategy and digital transformation strategy, while whole process of data collection started in October 2023 and ended in February 2024. The companies were randomly selected and were all established in Greek Capital City, Athens. A first contact was made via email and when there was a positive answer to participate in the research, then the interview was arranged. All research items included in the questionnaire were measured on a 7-point Likert scale (from completely disagree to completely agree).

Research items included in the questionnaire developed 9 dimensions, including more traditional strategic orientations but moreover new, innovative strategic eras (Ardito et al., 2021; Gatignon & Xuereb, 1997). Research items were selected from literature, as presented below, while dimensions were formulated by Ribeiro-Navarrete et. al. (2023). Research items are presented in Table A1 (Appendix A), while environmental items are also presented below. The proposed dimension and the literature behind the research items (Sok et al., 2013; Westerman et al., 2014) included in each dimension are:

- Environmental performance (Ardito et al., 2021), including (a) reducing the emission of waste, (b) reducing the consumption of hazardous and toxic materials, (c) reducing the frequency of environmental accidents and (d) reducing energy consumption.
- Digital skills and application of technology (Venkatraman, 1994; Ulas, 2019),
- Digital management intensity (Westerman & McAfee, 2012; He et al., 2023),
- Digital business process (Westerman & McAfee, 2012; Nasiri et al., 2020; He et al., 2023),
- Digital innovation performance (Vickery et al., 2003; Tippins & Sohi, 2003; Liang & Frosen, 2020),
- Digital management and departmental agility (Li et al., 2021),
- Digital vision (Li et al., 2021),
- Digital orientation (Nasiri et al., 2020).

Due to the large number of research items (variables) a factor analysis was used as a statistical technique for data reduction and to identify underlying relationships between variables. Factor analysis helped in reducing the number of variables by identifying a smaller set of underlying factors, which made the data more manageable and interpretable. Each variable was given a factor loading score, indicating how much it contributes to each factor, while variables with high loadings on the same factor are grouped together. Moreover, it helped to uncover the latent structures or patterns in data that were not immediately obvious. After this analysis, six factors were developed, namely:

1. Digital orientation,
2. Business strategy,
3. Innovativeness,
4. Customer Centricity,
5. Environmental orientation and
6. Organizational Structure.

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A detailed analysis of these factors and the proposed results are provided in the next section. Moreover, it should be mentioned that a series of demographic measures and explanatory measures were collected, namely:

- Company age (in years), with answers varying to the following categories including 1-3years (6,4% of the answers), 4-6 years (2,6% of the answers), 7-10years (6,4% of the answers), 11-15years (8,3% of the answers), 16-20years (12,8% of the answers), 20-40years (35,9% of the answers) and >40years (27,6% of the answers).
- Company size (number of employees), with answers varying to the following categories including 1-3 employees (0,6% of the answers), 4-9 employees (7,7% of the answers), 10-20employees (14,1% of the answers), 21-30 employees (5,8% of the answers), 31-50 employees (2,6% of the answers), 51-250 employees (13,5% of the answers) and >250 employees (55,8% of the answers).
- Turnover of sales revenues (in million euros), with answers varying to the following categories including <2 million € (21,8% of the answers), 2-5 million € (12,8% of the answers), 5-10 million € (1,9% of the answers), 10 million € (10,9% of the answers), 10-20 million € (3,2% of the answers), 20-50 million € (10,3% of the answers) and >50 million € (39,1% of the answers).
- Company Sector, including sectors such as Accommodation (0,6% of the answers), Retail (12,2% of the answers), Communications (6,4% of the answers), Financial services(3,8% of the answers), Business (3,2% of the answers), Engineering(1,9% of the answers), Military / Security (3,8% of the answers), Health services (5,1% of the answers), Public Sector (7,1% of the answers), Technology (53,8% of the answers), Transport (0,6% of the answers) and Others (1,3% of the answers).
- The organization is digitally mature at the moment, acting as an explanatory variable, with the answers varying to the following categories (Likert 7 scale) Completely disagree (0,6% of answers), Disagree (0,6% of answers), Somewhat disagree (3,8% of answers), Either agree or disagree (12,2% of answers), Somewhat agree (23,7% of answers), Agree (38,5% of answers) and Completely agree (20,5% of answers).
- The organization has a digital transformation strategy, acting as an explanatory variable, with the answers varying to the following categories (Likert 7 scale) Completely disagree (1,3% of answers), Disagree (2,6% of answers), Somewhat disagree (5,1% of answers), Either agree or disagree (12,8% of answers), Somewhat agree (18,6% of answers), Agree (39,7% of answers) and Completely agree (19,9% of answers).

The descriptive statistics are presented in Table 1, that business involved in the research are in average 5.37 years old, having a mean of 5.65 employees and turnover of sales revenues 4.48 million euros, while most respondents have the sense that their organization has a certain level of digital maturity (mean 5.55 in a Likert – 7 scale) and has an established digital transformation strategy (mean 5.44 in a Likert – 7 scale).

Table 1. Descriptiva Statistics.

	Mean	Std. Deviation
Company age (in years)	5.37	1.716
Company size (number of employees)	5.65	1.837
Turnover of sales revenues (in million euros)	4.48	2.503
Company Sector	14.29	5.822
The organization is digitally mature at the moment.	5.55	1.160
The organization has a digital transformation strategy.	5.44	1.335
Valid N (listwise)		156

3. Results

The significance of the study is to reveal factors that promote environmental orientation through digitalization upgrading in organizations. Companies in the digitalization era are expected to develop and optimize their performance and their operations by incorporating environmental factors that extend their growth. By being engaged in sustainable development, companies establish

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environmental and social responsibility, and they have environmental concerns and set social goals and policies while providing superior products and services (Ribeiro-Navarrete et al., 2023). Digital orientation adopted by organizations may differ across sectors. Managers at sectors with lower digitalization maturity may overlook necessary organizational transformations and delay digital implementation (Ribeiro-Navarrete et al., 2023).

The scales of the construct were based on an existing instrument which was proposed by an 8-item instrument cited by (Ribeiro-Navarrete et al., 2023) for assessing environmental issues and digitalization. The aim of the study is to reveal factors contributing to the sustainable development through corporate activities.

Data used in the research were gathered through questionnaires and analysis of the data was done using the SPSS (25) for univariate and multivariate analysis to ensure that were suitable for subsequent factor assessment. Data were tested through normality test revealing the normality of data. The suitability of the factor analysis was evaluated by assessing the Kaiser-Meyer Olkin measure of sampling adequacy, which is considered very good at 0.841. According to Bartett's test statistic the significance level was marked as 0.000<0.001.

The exploratory factor analysis of the research was proceeding by integrating the Varimax Rotation which created 6 factors. Every item was loading on its factor with a higher value of 0.4. The total variance explained by the six factors was 54,15%. At Table A2 (Appendix B) are presented the scales of measurement of the factor analysis. As far as composite reliability and Cronbach's alpha are concerned, these proved to be higher than the threshold of 0.7 (Hair, 2016) indicating a rather high reliability as we can see in Table 2.

Table 2. Reliability Analysis.

Factor	*Crombach's alpha*	*Items*
Digital orientation	*0.900*	*14*
Business strategy	*0.876*	*8*
Innovativeness	*0.853*	*10*
Customer centricity	*0.816*	*9*
Environmental orientation	*0.757*	*4*
Organizational culture	*0.783*	*2*

We applied a multivariate technique on data, cluster analysis, in order to group objects based on their proximity-characteristics (Hair, 2016). We are interested in the environmental orientation of the companies and we applied a K-means algorithm based on the minimum distance to the initial cluster. We focus on the four questions about company's environmental perceptions. Two initial cluster centers were formed. The number of cases in each cluster are as follows: In the 1st cluster there are 53 companies and in the 2nd cluster there are 103 companies, creating a data sample of 156 valid cases (companies). The number of cases per cluster and per environmental activity are presented in Table 3.

In the first cluster of 53 companies, there exist small companies, younger in age with smaller turnover. In contrary in the second group there exist bigger (in size) companies, with higher number of employees (mean 5.80>5.41) and higher turnover (mean 4.74>3.96). Moreover, in the second cluster belong older companies (mean 5.42>5.24).

Table 3. Clusters' number of cases.

Cluster Number of Case		Our organization reduces the emission of waste (air, water and/or solids).	Our organization reduces the consumption of hazardous and toxic materials.	Our organization reduces the frequency of environmental accidents.	Our organization reduces energy consumption.
1st Cluster	Mean	3.2075	3.7358	4.2642	3.2830
	N	53	53	53	53
2nd Cluster	Mean	5.6311	5.8544	5.3786	5.4854
	N	103	103	103	103

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Total	Mean	4.8077	5.1346	5.0000	4.7372
	N	156	156	156	156

Moreover, Table 3 provides the means that each cluster has per environmental activity, while most values are over the average (of the Likert 7 scale). Comparing these two clusters of companies in terms of "mean" we can characterize Cluster 1 as "Environmental Neutral", while Cluster 2 can be characterized as "Environmental Worried". Such characterizations are not an absolute but rather a comparative measure of the degree of environmental orientation between the two clusters.

Such a tension in environmental orientation is also common in digital transformation orientation (……..Kargas……), where larger in size firms are capital intensive and can exploit more easily resources. Smaller organizational structure can facilitate digital transformation, but financial constraints faced by SMEs can hinder the whole process (Ardito et al., 2021). Managers of smaller companies may recognize more easily the importance of digitization for the company's survival and growth, but they usually face financial obstacles and lack of resources to implement digitization (Ribeiro-Navarrete et al., 2023).

The emphasis given in financial factors, seem to be important as far as it concerns environmental oriental companies. The following Table 4 presents the distribution of mean values of the 2 clusters in relation with the company's age, the number of employees and the turnover. Results indicate the existence of less significant differences when it comes to company's size and moderate differences when it comes to company's size, while most significant differences exist when it comes to turnover. Under every situation, companies of Cluster 2 have higher mean values, explaining why it can be characterized as more environmentally worried.

Table 4. Cluster Number of Cases per age, size, turnover.

		N	Mean	Std. Deviation
Company's age (in years)	Environmental Neutral	53	5.2453	1.70864
	Environmental Worried	103	5.4272	1.72412
Company's size (number of employees)	Environmental Neutral	53	5.4151	1.82329
	Environmental Worried	103	5.8058	1.78808
Turnover of sales revenues (in million €)	Environmental Neutral	53	3.9623	2.67440
	Environmental Worried	103	4.7476	2.37932

Another interesting result comes when comparing results according to company's sector. As seeing in Table 5 the Cluster Number of Cases per sector presents that companies belonging to sectors as Retail, Communications, Financial services and Business, are more environmental worried and managers take actions towards environmental orientation. Only public sector companies, accommodation and transport's sector companies have more environmental neutral rather than environmental worried companies. All other sectors have more environmental worried companies indicating a strong tension in Greek business era when it comes to environmental factors.

Table 5. Cluster Number of Cases per sector.

Company's Sector	Environmental Neutral	Environmental Worried	Total
Accommodation	1	0	1
Retail	7	12	19
Communications	2	8	10
Financial services	0	6	6
Business	1	4	5
Engineering	1	2	3
Military / Security	1	5	6
Health services	3	5	8

 doi:10.20944/preprints202406.0637.v1

Public Sector	6	5	11
Technology	28	56	84
Transport	1	0	1
Other	2	0	2
Total	**53**	**103**	**156**

At a confirmatory level, four (4) distinct multiple regression analyses were conducted in order to reveal whether dependent variables concerning environmental performance are affected by the various research items briefly present in the previous section and analytically presented in Table A1 (Appendix A). The proposed number of multiple regression analyses conducted derived from the four environmental questions posed, namely:

- 5.1 Our organization reduces the emission of waste (air, water and/or solids).
- 5.2 Our organization reduces the consumption of hazardous and toxic materials.
- 5.3 Our organization reduces the frequency of environmental accidents.
- 5.4 Our organization reduces energy consumption.

As far as the first dependent variable is concerned, namely reducing the emission of waste, results indicate that there exist a strong, positive relationship with reducing the consumption of hazardous and toxic materials, alongside with reducing energy consumption. Companies having this triad of environmental practices interconnected are positively affected by emerging technologies in supply chain management, while they have a clear vision of how new digital technologies help the organization create value. At the same time, the more digital marketing technologies customer service systems are used, the less aware for waste management these companies are. Results indicate, that in Greek business environment, companies incorporating supply chain activities, are more aware about using technological means for waste management, while a clear digital transformation's vision further enhance this tension. Moreover, companies that adopt environmental practices for reducing air / water / solid emissions is more probably to do the same for energy and toxic materials. Finally, Greek companies putting emphasis on marketing practices and market penetration tend to be less environmental aware. Results are presented in Table 6 below.

Table 6. Multiple regression analysis for Model 1.

Model 1	Dependent Variable: 5.1: Our organization reduces the emission of waste (air, water and/or solids).						
	R=0.787, R^2 =0.619, adjR^2 =0.603, F=40.317, P=0.000						
	Unstandardized Coefficients		Stand. Coef.			Collinearity Statistics	
Independent Variables	B	Standard error	Beta	t-statistic	Sig.	Tolerance	VIF
(Constant)	0,406	0,569		0,712	0,477		
5.2: Our organization reduces the consumption of hazardous and toxic materials.	0,561	0,059	0,519	9,432	0	0,845	1,183
5.4: Our organization reduces energy consumption.	0,317	0,054	0,341	5,811	0	0,742	1,347
1.21 We have explored or adopted technology in supply chain management.	0,166	0,043	0,2	3,821	0	0,932	1,072
8.1: We develop a clear vision of how new digital technologies (social media, mobile devices, analytics, cloud computing) help the organization create value.	0,295	0,07	0,237	4,228	0	0,813	1,231
6.5: It uses digital technology for marketing activities.	-0,263	0,088	-0,168	-2,996	0,003	0,818	1,223
6.7: It uses a cloud-based intelligent customer service system to provide real-time user reviews and after-sales product information.	-0,137	0,059	-0,133	-2,335	0,021	0,786	1,272

 doi:10.20944/preprints202406.0637.v1

When it comes to reducing the consumption of hazardous and toxic materials (as dependent variable), there also exists a strong, positive interconnection with waste management and moreover reducing the frequency of environmental accidents (Table 7). Moreover, it seems that in contrast to the above – mentioned results, digital marketing activities have a positive impact to environmental practices of companies that are using hazardous and toxic materials. Such a tension indicates that most probably these companies are using their environmental awareness as part of their digital marketing strategies. From the other hand, digital technologies are not contributing positively when it comes to increase performance or add value to products / services. It should be noted that results indicate that Greek companies related with hazardous and toxic materials are less involved to digital transformation strategies, even though environmental practices are appreciated.

Table 7. Multiple regression analysis for Model 2.

Model 2	**Dependent Variable: 5.2: Our organization reduces the consumption of hazardous and toxic materials.**						
	R=0.748, R^2 =0.559, adjR^2 =0.548, F=47.926, P=0.000						
	Unstandardized Coefficients		Stand. Coef.			Collinearity Statistics	
Independent Variables	B	Standard error	Beta	t-statistic	Sig.	Tolerance	VIF
(Constant)	0,873	0,594		1,47	0,144		
5.1: Our organization reduces the emission of waste (air, water and/or solids).	0,541	0,053	0,585	10,202	0	0,886	1,128
5.3: Our organization reduces the frequency of environmental accidents.	0,373	0,062	0,342	5,971	0	0,888	1,126
1.4 We use digital technologies to increase performance or add value to our products and services.	-0,229	0,08	-0,173	-2,868	0,005	0,801	1,249
6.5: It uses digital technology for marketing activities.	0,194	0,086	0,134	2,258	0,025	0,832	1,202

The next regression presented in Table 8 is related with reducing the frequency of environmental accidents (as dependent variable). It is strongly and positively related with the consumption of hazardous and toxic materials, while it is also enhanced by the implementation and development of a digital strategy and an orientation to data analytics technologies. Such a framework implies a strong tension among Greek companies to associate environmental accidents with hazardous / toxic materials and digital transformation is regarded as a solution for risk reduction in the field. Especially data analytics seem to have been implemented and regarded as part of the company's digital strategy. Finally, a managerial issue is the absence of clearly defined roles / responsibilities for digital initiatives, which has a negative impact on environmental practices as well.

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Table 8. Multiple regression analysis for Model 3.

	Dependent Variable: 5.3: Our organization reduces the frequency of environmental accidents.						
Model 3	R=.627, R^2 =0.393, adjR^2 =0.376, F=24.399, P=0.000						
	Unstandardized Coefficients		Stand. Coef.			Collinearity Statistics	
Independent Variables	B	Standard error	Beta	t-statistic	Sig.	Tolerance	VIF
(Constant)	0,955	0,516		1,851	0,066		
5.2: Our organization reduces the consumption of hazardous and toxic materials.	0,459	0,06	0,5	7,714	0	0,958	1,044
1.19 We have explored or adopted data analytics technology.	0,223	0,052	0,274	4,267	0	0,973	1,028
7.4: We have continually evaluated and adapted the digital strategy over time.	0,265	0,081	0,235	3,251	0,001	0,769	1,3
3.4 Roles and responsibilities for managing digital initiatives are clearly defined.	-0,179	0,067	-0,193	-2,683	0,008	0,781	1,281

The last regression used as dependent variable the reduction of energy consumption, an issue related with larger number of companies from both production and services sectors. From all the above – mentioned dependent variables is the one with the larger number of statistically significant independent variables. As expected, the proposed dependent variable is also positively related with reducing the emission of waste. In this kind of companies, there a strong joint culture of how digital technologies are implemented in business strategy and a constant process of reevaluation and adaptation to changes. Data analysis plays a significant role in decision making and business management as well there is a strong orientation to digital transformation related with products / services' research, development and (re)design. Even though such strong tensions exist, companies putting emphasis in reduced energy consumption seem to mainly have an environmental rather than a strong digital transformation vision. Technologies are mainly used as a mean to achieve environmental performance and not to improve products / services quality and efficiency. To this analysis contributes also the fact that these companies are negative to look forward for new ways to improve the effectiveness of use of digital technology, since their priorities are posed in sustainable management. Results are presented in Table 9.

 doi:10.20944/preprints202406.0637.v1

Table 9. Multiple regression analysis for Model 4.

	Dependent Variable: 5.4: Our organization reduces energy consumption.						
Model 4	R=.793, R^2 =0.629, adjR^2 =0.609, F=31.127, P=0.000						
	Unstandardized Coefficients		Stand. Coef.			Collinearity Statistics	
Independent Variables	B	Standard error	Beta	t-statistic	Sig.	Tolerance	VIF
(Constant)	0,759	0,491		1,546	0,124		
5.1: Our organization reduces the emission of waste (air, water and/or solids).	0,402	0,059	0,373	6,851	0	0,852	1,174
6.10: We jointly plan how digital technology will enable business strategy.	0,392	0,083	0,321	4,723	0	0,547	1,829
8.1: We develop a clear vision of how new digital technologies help the organization create value.	-0,387	0,085	-0,289	-4,564	0	0,631	1,584
6.3: It uses smart appliances to improve product production quality and efficiency.	-0,277	0,074	-0,217	-3,757	0	0,759	1,318
3.2 We have established how we can give data a central role in decision making and business management.	0,217	0,065	0,192	3,343	0,001	0,766	1,306
7.4: We have continually evaluated and adapted the digital strategy over time.	0,249	0,094	0,174	2,66	0,009	0,589	1,698
8.7: We are constantly looking for new ways to improve the effectiveness of our use of digital technology.	-0,171	0,081	-0,144	-2,104	0,037	0,537	1,861
6.4: It uses integrated networked technology: computer-aided design / engineering / manufacturing and product data management (CAD/CAE/CAM and PDM) for product research, development and design.	0,457	0,061	0,451	7,528	0	0,704	1,42

 doi:10.20944/preprints202406.0637.v1

4. Discussion

Society urges companies to take actions to incorporate sustainability in their business models. The classic business models have gradually been replaced by flexible ones where companies may respond more quickly to changes of needs and habits of consumers and emerging environmental issues (Ulas, 2019). The positive economic outcomes and the competitive advantage will be achieved with socially responsible economic growth and development (Popescu & Popescu, 2019). Sustainability and social environmental performance aim to establish a new business model providing information beyond financial performance which will guide the long-term strategy of companies. The occurring transformation can establish new organizational drivers and will most probably generate changes in the way shareholders evaluate companies' success. Moreover, new models can facilitate companies to exhibit their social responsibility and their actions toward environmental protection, usage of clean technologies, provision and care for employees and the local community.

As far as Greek companies are concerned, our research contribute theoretically and empirically, of how sustainable management can be implemented in the proposed entrepreneurial context taking into account emerging technologies (Davies and Chambers, 2018; Hahn et al., 2018; Stubbs, 2017; Teran-Yepez et al., 2020). Results in Greek business ecosystem, follow existing studies (Gregori and Holzmann, 2020), indicating that different environmental practices can be associated with a selective use of technologies and a variety of the business intensity to implement a digital transformation strategy. Reducing emissions of waste and avoiding environmental accidents seem to require the cultivation of digital strategies, while reducing energy consumption just require using of technologies as means to enhance convenience and efficiency in the proposed era. Finally, when companies are oriented to reduce the use of hazardous or toxic materials just introduce digitally enabled practices as a mean to expand their sustainability boundaries (Caputo et al., 2019).

Despite these variations, Greek business ecosystem follows the global tension to recognize digital strategies / technologies as a key element for achieving the United Nations Sustainable Development Goals (Secundo et. al. 2020). In most cases to reach sustainable market activities, companies face the challenge of developing digital business models (Li et. al. 2020; Minatogawa et. al. 2019) and to implement emerging technologies capable to reduce waste in supply chain, to minimize resource consumption, to alternate the value creation / capture models and to enforce customer interaction with environmental practices (Centobelli et. al. 2020; Kirchherr et. al. 2017; George et. al. 2020; Holmström et. al. 2017). Proposed research added significant information by providing novel insights about the usage of digital technologies and the development of digital strategies when implementing specific environmental practices, expanding the body of knowledge (Parida et al., 2019; Parida and Wincent, 2019; Spieth et al., 2019) regarding the complementarities between "sustainable – digital".

An any research, the current face some limitations. The first one derives from collecting data under a certain business environment, namely the Greek business ecosystem. As part of future research, it could be expanding the research sample to various European Union's member – states business ecosystems in order to develop a more holistic approach regarding the existence of "sustainable digital" strategy. Moreover, it should be mentioned that proposed quantitative results have not been validated with qualitative research, by interviewing business stakeholders in order to gain novel insights that are transferable to other contexts (Gioia et al., 2013). Expanding research towards such a direction can help transfer results, for example to small – medium enterprises (SMEs) level and to family businesses.

Author Contributions: Conceptualization, A.K., E.G. and A.S.; methodology, A.K. and E.G.; validation, A.K. and E.G.; formal analysis, A.K.; investigation, E.G.; data curation, E.G.; writing—original draft preparation, A.K., E.G. and A.S.; writing—review and editing, A.K. and E.G.; supervision, A.K.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

 doi:10.20944/preprints202406.0637.v1

Data Availability Statement: Dataset available on request from the authors.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Table A1. Research Items.

Part	Question Code Number	Question
Part 0. Initial questions	0.1	Company age (in years)
	0.2	Company size (number of employees)
	0.3	Turnover of sales revenues (in million euros)
	0.4	Company Sector
	0.5	The organization is mature at the moment
	0.6	The organization has a digital transformation strategy
Part 1: Digital skills and application of technology	1.1	We use digital technologies (social media, mobile devices, analytics, cloud computing, etc.) to understand our clients and make better operational decisions.
	1.2	We use digital channels (social media, mobile devices, analytics, cloud computing, etc.) to market and distribute products and services.
	1.3	We use digital channels in our customer service.
	1.4	We use digital technologies to increase performance or add value to our products and services.
	1.5	We have launched new business models based on digital technologies.
	1.6	We have explored or adopted the Internet of Things (IoT).
	1.7	We have explored or adopted smart manufacturing application technology.
	1.8	We have explored or adopted computer-aided office technology.
	1.9	We have explored or adopted cloud computing technology.
	1.10	We have explored or adopted customer relationship management (CRM) technology and/or product data management (PDM) technology.
	1.11	We have explored or adopted artificial intelligence (AI) technology.
	1.12	We have explored or adopted blockchain contract management technology.
	1.13	We have explored or adopted 5G.
	1.14	We have explored or adopted customer to organization radio frequency identification (RFID) technology.
	1.15	We have explored or adopted blockchain technology.
	1.16	We have explored or adopted robotic process automation technology.
	1.17	We have explored or adopted big data technology.
	1.18	We have explored or adopted data visualisation technology.
	1.19	We have explored or adopted data analytics technology.

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	1.20	We have explored or adopted data warehousing technology.
	1.21	We have explored or adopted technology in supply chain management.
	1.22	We have explored or adopted wireless local area network (WLAN) technology.
	1.23	We have explored or adopted information and communications technology (ICT).
Part 2: Digital management intensity	2.1	Senior managers take a transformative approach to the organization's digital future.
	2.2	Digital initiatives are assessed using a common set of key performance indicators (KPIs).
	2.3	Information technology (IT) and business leaders work together as partners.
	2.4	The performance of the IT unit meets the needs of the organization.
	2.5	Senior executives and middle managers share a common digital transformation vision.
	2.6	There is scope for all members to participate in the digital transformation discussion.
	2.7	We have explored or adopted smart manufacturing application technology.
	2.8	The organization is investing in the development of the necessary digital skills.
	2.9	Digital initiatives are coordinated using criteria such as roles and responsibilities.
	2.10	Roles and responsibilities for managing digital initiatives are clearly defined.
Part 3: Digital business process	3.1	We have digital solutions that connect core business activities with customers, suppliers, employees and organization resources.
	3.2	We have established how we can give data a central role in decision making and business management.
	3.3	We use an open digital platform to put innovative ideas into practice and quickly gain support.
	3.4	Roles and responsibilities for managing digital initiatives are clearly defined.
Part 4: Digital innovation performance	4.1	We bring more digital solutions to market than our competitors.
	4.2	We have a larger number of successful digital solutions than our competitors.
	4.3	The time to market of our digital solutions is inferior to that of our competitors.
	4.4	The quality of our digital solutions is superior to that of our competitors.
	4.5	Our digital solutions are superior to those of our competitors.
	4.6	The applications of our digital solutions are totally different from those of our competitors.
	4.7	Some of our digital solutions are new to the market at the time of launch.

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Part 5: Environmental performance	5.1	Our organization reduces the emission of waste (air, water and/or solids).
	5.2	Our organization reduces the consumption of hazardous and toxic materials.
	5.3	Our organization reduces the frequency of environmental accidents.
	5.4	Our organization reduces energy consumption.
Part 6: Digital management and departmental agility	6.1	It uses technologies and other digital resources to improve proactive and strategic decision-making systems.
	6.2	It uses technology and other digital resources to improve decision support systems.
	6.3	It uses smart appliances to improve product production quality and efficiency.
	6.4	It uses integrated networked technology: computer-aided design / engineering / manufacturing and product data management (CAD/CAE/CAM and PDM) for product research, development and design.
	6.5	It uses digital technology for marketing activities.
	6.6	It uses a digital logistics system so that all nodes in the logistics service process are dynamically connected and can provide real-time feedback.
	6.7	It uses a cloud-based intelligent customer service system to provide real-time user reviews and after-sales product information.
	6.8	We integrate digital technology and business strategy to achieve a strategic balance.
	6.9	We create a shared vision of the role that digital technology should play in business strategy.
	6.10	We jointly plan how digital technology will enable business strategy.
	6.11	We consult with others before making strategic decisions.
Part 7: Digital vision	7,1	We have a clear vision to stay competitive with respect to the 5- to 10-year digital strategy.
	7.2	We have a clearly defined digital strategy.
	7.3	We have implemented a digital strategy in all business units.
	7.4	We have continually evaluated and adapted the digital strategy over time.
	7.5	We have established new business models based on digital technology.
Part 8: Digital orientation	8.1	We develop a clear vision of how new digital technologies (social media, mobile devices, analytics, cloud computing) help the organization create value.
	8.2	We integrate business and digital strategy.
	8.3	We develop the ability for functional and management areas to understand the value of new in-vestments in digital technology.
	8.4	We always stay abreast of digital technology innovations.

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	8.5	We have the capacity to test and continue testing new digital technologies as much as necessary.
	8.6	We have an environment that is conducive to trying new ways of using digital technologies.
	8.7	We are constantly looking for new ways to improve the effectiveness of our use of digital technology.

Appendix B

Table A2. Factor analysis.

Factor	Measures	Factor Loadings
Digital orientation (Eigenvalue =12.830, % of variance explained=27.297)	4.5 Our digital solutions are superior to those of our competitors.	0,747897
	2.6 There is scope for all members to participate in the digital transformation discussion.	0,69558
	1.19 We have explored or adopted data analytics technology.	0,680334
	2.5 Senior executives and middle managers share a common digital transformation vision.	0,652203
	1.17 We have explored or adopted big data technology.	0,64956
	1.3 We use digital channels in our customer service.	0,647165
	1.18 We have explored or adopted data visualization technology.	0,64253
	4.4 The quality of our digital solutions is superior to that of our competitors.	0,635501
	8.6: We have an environment that is conductive to trying new ways of using digital technologies.	0,625392
	2.7 We have explored or adopted smart manufacturing application technology.	0,598398
	4.7 Some of our digital solutions are new to the market at the time of launch.	0,57889
	8.5: We have the capacity to test and continue testing new digital technologies as much as necessary.	0,507291
	6.7: It uses a cloud-based intelligent customer service system to provide real-time user reviews and after-sales product information.	0,464042
	4.3 The time to market of our digital solutions is inferior to that of our competitors.	0,409649
Business strategy (Eigenvalue =3.719, % of variance explained=7.913)	7.4: We have continually evaluated and adapted the digital strategy over time.	0,735214
	7.1: We have a clear vision to stay competitive with respect to the 5 to 10-year digital strategy.	0,691871
	7.3: We have implemented a digital strategy in all business units.	0,651797
	6.10: We jointly plan how digital technology will enable business strategy.	0,642018
	7.5: We have established new business models based on digital technology	0,629528

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	8.1: We develop a clear vision of how new digital technologies (social media, mobile devices, analytics, cloud computing) help the organization create value.	0,582692
	6.8: We integrate digital technology and business strategy to achieve a strategic balance.	0,557856
	8.7: We are constantly looking for new ways to improve the effectiveness of our use of digital technology.	0,538586
Innovativeness (Eigenvalue =2.904, % of variance explained=6.178)	1.6 We have explored or adopted the Internet of Things (IoT).	0,730645
	1.15 We have explored or adopted blockchain technology.	0,711037
	1.12 We have explored or adopted blockchain contract management technology.	0,668383
	1.8 We have explored or adopted computer-aided office technology.	0,638336
	1.7 We have explored or adopted smart manufacturing application technology.	0,620426
	1.20 We have explored or adopted data warehousing technology.	0,589115
	1.11 We have explored or adopted artificial intelligence (AI) technology.	0,526167
	6.3: It uses smart appliances to improve product production quality and efficiency.	0,511099
	1.16 We have explored or adopted robotic process automation technology.	0,473953
	1.4 We use digital technologies to increase performance or add value to our products and services.	0,421848
Customer Centricity (Eigenvalue =2.333, % of variance explained=4.964)	1.10 We have explored or adopted customer relationship management (CRM) technology and/or product data management (PDM) technology.	0,669982
	3.1 We have digital solutions that connect core business activities with customers, suppliers, employees and organization resources.	0,663128
	2.2 Digital initiatives are assessed using a common set of key performance indicators (KPIs).	0,64101
	1.22 We have explored or adopted wireless local area network (WLAN) technology.	0,545914
	4.2 We have a larger number of successful digital solutions than our competitors.	0,507784
	1.23 We have explored or adopted information and communications technology (ICT).	0,490572
	0.8 The organization has a digital transformation strategy. (according to my personal opinion)	0,467147
	2.1 Senior managers take a transformative approach to the organization's digital future.	0,463247
	1.5 We have launched new business models based on digital technologies.	0,445315
Environmental orientation (Eigenvalue =1.984, % of variance explained=4.222)	5.2: Our organization reduces the consumption of hazardous and toxic materials.	0,802512
	5.1: Our organization reduces the emission of waste (air, water and/or solids).	0,770194

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	5.3: Our organization reduces the frequency of environmental accidents.	0,607582
	5.4: Our organization reduces energy consumption.	0,527312
Organizational Structure (Eigenvalue =1.681, % of variance explained=3.576)	2.9 Digital initiatives are coordinated using criteria such as roles and responsibilities.	0,767824
	2.10 Roles and responsibilities for managing digital initiatives are clearly defined.	0,719686

Kaiser-Meyer-Olkin measure of sampling adequacy=0.841, Bartlett's Test of Sphericity=4306.733.

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