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Integrated management systems and culture in the digital era – Impact on sustainability performance: Empirical insights

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Abstract

Purpose
At the intersection of total quality and human resource management and in the context of digital transformation, this study proposed a conceptual framework bringing together organisational culture and integrated management systems. The research hypotheses aimed to test the effect of three dimensions of organisational culture – lean, digital, and sustainable – on the integration of management systems and corporate sustainability performance.

Methodology
To test this conceptual model, an empirical survey collected data from organisations with multiple management systems. A total of 186 usable responses were received. Partial least squares-structural equation modelling approach was used to analyse the findings.

Findings
The findings emphasised the role of culture on successfully integrating lean principles and digital advancements into management system operations to increase performance. A lean-digital IMS mediates the relationship between culture on performance.

Research limitations/implications
Managers should go beyond mere digitisation and recognise technologies as drivers of sustainability when integrated in organisational culture along with lean thinking.

Lean-digitalised processes can improve operations, reduce waste, and increase stakeholder satisfaction.
The sample size and scope were limitations in this study. Future studies could collect more responses from different countries to validate the scales and generalise the findings.

Originality/Value
This study introduced and validated a scale to measure the level of lean and digital transformation of integrated management systems. Furthermore, a scale was developed and tested to assess the long-term impact of Industry 4.0 technologies on the sustainable development of companies.

Keywords
integrated management system; sustainability; performance; digital transformation; lean; organisational culture

Paper type
Research paper

1. Introduction

As Industry 4.0 technologies gradually become embedded within organisational structures, they are transforming existing operations and driving technological progress in the delivery of products and services. At the same time, people have been forced to adapt to this challenging environment and meet the constantly emerging novel work demands. Adopting a lean mindset can help to navigate this digital tug-of-war, yielding a new way of thinking and managing things that is driven by sustainability principles and practices. Furthermore, the rapid technological progress and, at the same time, increasing environmental concerns stemming from climate change and the impacts of industrial activities on the environment. These conditions are capable of pushing more and more businesses today to adopt an Integrated Management System (IMS) as their fundamental strategic approach to improve their operational performance, especially in terms of their social responsibility towards the environment and society at large (Samy et al., 2015; Masuin et al., 2019; Wagar et al., 2025).

The digital era we are living in (usually referred to as Industry 4.0) has radically changed the way businesses operate, which is now characterized by greater integration of data and information, the monitoring of daily activities in real time and the use of advanced data analytics. Typical examples of such technologies are the use of Artificial Intelligence (AI), the Internet of Things (IoT), Machine Learning (ML), Cloud Computing, etc. These technological innovations enable businesses that implement them to adopt a positive attitude towards sustainability, while strengthening their ability to evaluate, control and improve their performance on an environmental, social and economic level. Consequently, integrated management systems not only help companies achieve compliance with various standards and regulations (e.g. the ISO standards), but also foster a corporate culture that promotes continuous improvement and responsible management of their resources (Asif et al., 2013; Bittencourt et al., 2021; Martínez-Peláez et al., 2023).

An IMS is a single system that unifies various management systems that address the quality of products and/or services, environmental protection, occupational health and safety, information security, asset management, etc. This integration offers significant benefits, including seamless communication with its stakeholders, the optimization of processes, but also the alignment of systems with strategic goals, ultimately leading to increased operational efficiency and sustainability (Zeng et al., 2020). From a sustainability performance perspective, an IMS can deliver significant environmental, social and economic benefits to a company. These include reducing waste volumes, minimising energy consumption and improving stakeholder engagement in business decision-making processes. These benefits are quite significant as both the consumer and investment public expect companies to be transparent and accountable regarding their environmental and social responsibility (Bortolotti et al., 2015; Siltori et al., 2021).

In line with the above reasoning, the purpose of this study is to theoretically and empirically investigate IMS in the midst of the digital era, as well as their contribution to the sustainability performance of organisations in Greece. To serve this purpose, the following research questions (RQs) were generated.

RQ1. To what extent have Greek organisations adopted the digital and lean culture, which supports the implementation of corresponding IMS?

RQ2. To what extent do Greek organisations support the implementation of digital and lean IMS and to what extent are they connected to the respective cultures they have adopted?

RQ3. To what extent have Greek organisations adopted a culture of corporate sustainability?

RQ4. How is IMS related to the adoption of a sustainability-oriented culture?

RQ5. To what extent do Industry 4.0 technologies affect the sustainability of organisations?

These questions were addressed in this study, both theoretically and empirically, with the use of specific data and analysis tools.

Lastly, the structure of this study is as follows. The first section is the present introduction. The second section constitutes the theoretical review and overview of the topic. The third section describes the methodology used for the empirical analysis of the data. The fourth section includes the results that emerged from the data analysis. The fifth section includes the discussion of the findings, the conclusions that arise from it, as well as some suggestions that will be useful both for the practical significance of the findings (e.g. for entrepreneurs and other interested parties) and for future research.

2. Research background

2.1 Digital transformation

The concept of digital transformation, as defined by the global software and technology company IBM, "is a business strategy initiative that integrates digital technology into all areas of a business or organization. It evaluates and modernizes the processes, products, functions and technologies of a business or organization in order to provide continuous, rapid innovation with a customer focus." In other words, today, customers expect to be able to interact with businesses and experience their daily lives using the latest technological innovations. The ultimate goal of digital transformation is thus, through businesses, to meet these customer expectations.

The implementation of digital transformation in practice, of course, differs between companies, which means that, given the capabilities of each company, in some the digital transformation may begin as a single technology project, while in others it may be a comprehensive initiative that unifies all business functions. This transformation may include the integration of digital technology and digital solutions into existing processes and products, the creation of new processes and products, or even the creation of entirely new ways of generating revenue using emerging technologies.

Recent studies stressed that 69% of IT decision-makers consider digital transformation as a key way to improve their companies' performance, while 77% of companies worldwide are already in a digital transformation phase (Baker McKenzie, 2021). Moreover, the majority of organisations believe that digital transformation in the workplace can lead to greater collaboration between work teams (Vuchkovski et al., 2023). Cloud computing, AI and IoT are the three main technology areas that companies are delving into during digital transformation (Akter et al., 2022).

At EU level, in 2023, almost 10 million people worked as specialists in the Information and Communications Technology (ICT) sector, representing almost five percent of total employment. Among EU countries, the share of employed ICT specialists was highest in Sweden (9%), Luxembourg and Finland (8%). The lowest rates were

observed in Greece (2%) and Romania (3%). Furthermore, in 2022, 22% of EU enterprises provided training to their staff to develop or improve their ICT skills. Finland (40%), Sweden (34%), Denmark and Belgium (both with 33%) are the leading EU Member States. In 2023, 59% of all EU enterprises achieved a basic level of digital intensity. Large enterprises, due to their capabilities, had a higher proportion of very high (26%) and high digital intensity (42%) compared to only 4% of SMEs with a very high level, and almost 20% with a high level of digital intensity (Eurostat, 2024).

2.2 Integrated management systems

By definition, IMSs incorporate all the elements of an enterprise into a unified structure so that its purpose and mission can be achieved (Domingues et al., 2016; Vieira Nunhes et al., 2022). An IMS thus constitutes, compared to individual management systems, a more consistent, streamlined and effective system and provides multiple benefits to enterprises that are obliged to comply with various rules and standards relating to the quality and safety of their activities. IMSs incorporate various management standards and frameworks, most notably the standards published by the International Organization for Standardisation (ISO), such as the ISO 9001 for Quality Management Systems, the ISO 14001 for Environmental Management Systems, the ISO 45001 for Occupational Health and Safety Management Systems and the ISO 50001 for Energy Management Systems. Integrating these management systems aims of unifying the objectives and requirements of each standard into a common framework of objectives, policies, processes and methods to improve business performance (Majerník et al., 2017).

By integrating these systems into an IMS, better coordination is facilitated, any overlaps that may occur in the goals of each system are reduced, and the overall performance of the company is enhanced through the IMS. In other words, an IMS fosters the standardisation of processes across the entire spectrum of the company's processes, in accordance with the unified objectives and procedures, thus providing a more specific approach to their implementation that enhances its efficiency and effectiveness (Rebelo et al., 2015). The integration allows companies to align their strategic path with their business processes, thus creating a more unified and improved approach to management (Wilkinson & Dale, 1999; Vieira Nunhes et al., 2022). Furthermore, a successful IMS relies to a significant extent on the accessibility and acceptance by the organisation's stakeholders, i.e. managers, employees, shareholders, customers, suppliers, etc., thus encouraging their participation in decision-making processes guided by the IMS and promoting a culture of continuous improvement of the company in all its aspects (Carvalho et al., 2019).

2.3 Lean Digital Organisational Culture

Taking into account the rapid technological developments and constantly changing market conditions and demands, according to what has been mentioned so far, businesses, in order to survive in this new dynamic environment, must innovate and remain competitive. Even their traditional organisational culture itself needs to adapt to the new digital data as this ensures its social responsibility (Martínez-Peláez et al., 2023). Two prominent types of culture that have attracted significant interest from entrepreneurs and researchers in management in recent years are digital and lean organisational culture (Kocak & Pawlowski, 2023; Gianni & Gotzamani, 2024). Although these types differ in

their origin and practical application, they are nevertheless characterised by a common goal: enhancing efficiency and optimizing the overall performance of businesses. Each type is described separately below, along with their implications for businesses seeking to ensure their sustainability.

Digital organisational culture refers to the set of values, policies, attitudes, and practices that influence the way a business integrates and uses new digital technologies to increase its productivity and ensure customer loyalty. It also includes the attitude of its employees towards the adoption of new digital technologies and the digital communication that is developed at all levels (Duerr et al., 2018; Serpa et al., 2022). In essence, digital culture enables businesses to be flexible and adapt quickly to changes and market demands. If the degree of adoption of digital culture is high, it encourages more innovation, providing employees with the necessary resources for training and familiarization with digital technology (Dash & Gatharia, 2015; Deep, 2023). In addition, companies with a digital culture prioritise data-driven decision-making, a practice that refers to the use of analytics and measurements to update strategies, evaluate results, and improve customer experience.

By contrast, a lean organisational culture is based on a management philosophy known as 'The Toyota Way', which has not only transformed the automotive industry, but also the world of business management as a whole (Marksberry, 2011; Coetzee et al., 2016). This culture emphasises minimising a company's waste while maximising its value to ensure long-term sustainability (Hardcopf et al., 2021; Kumar et al., 2022). Companies with a lean culture aim to provide value for their customers by identifying and optimising or eliminating activities that add little or no value (Bortolotti et al., 2015). In other words, lean organisational culture seeks to maximise the value of the business at the minimum cost, including overproduction, high waiting time, inadequate transportation infrastructure, excessive stock, defective products or processes, and underutilization of new or existing talents (which refers to the specialized skills of employees). In this context, lean culture constantly reviews the processes to minimise or ideally eliminate any types of costs that harm the business. Based on the “respect for people” principle, a lean culture magnifies the role of employees in every aspect of business operations, thus motivating them to participate in problem identification and solving, and decision-making, thus enhancing their sense of ownership and responsibility (Kumar et al., 2022).

Although based on what has been previously mentioned about the two cultures, their philosophy and background are essentially different, certain commonalities are identified that can act complementary in achieving specific goals. These commonalities include: (i) optimisation of decision-making processes, (ii) increased performance, (iii) flexibility to reduce costs, (iv) collaborative innovation, and (v) employee empowerment and engagement (Moraes et al., 2023; Johansson et al., 2024). Consequently, in today's competitive landscape with the strong integration of digital technologies into the business environment, the merging of digital and lean elements within organisational culture offers a framework for transforming organizations and enhance their sustainability.

2.4 Corporate sustainability and digital transformation

The interplay between sustainability and digital transformation has emerged as a critical area for businesses seeking to respond to the complexity of today’s marketplace. As businesses increasingly integrate digital tools and related technologies, the need to

align these initiatives with sustainable business practices is increasingly pressing (Asif et al., 2024; Lei & Jialbao, 2024). This alignment is particularly important when considering organisational cultures, especially digital and lean cultures (Asif et al., 2024; Gianni & Gotzamani, 2024).

In particular, corporate sustainability, according to the definition given by the Organization for Economic Cooperation and Development (OECD), "involves the integration of environmental and social parameters into the strategy and operations of a company. It enhances good governance and decision-making and helps investors to better understand the long-term risks and opportunities of a company". It thus constitutes a set of basic principles and practices that companies must apply in order to ensure long-term prosperity, while minimising environmental impacts, promoting social responsibility and maintaining their economic viability. In other words, adopting a culture that complies with corporate sustainability implies achieving environmental, social, and economic goals (Ying & Jin, 2023).

Within this framework of corporate sustainability, both digital and lean organisational cultures can play an important role in promoting business sustainability. Digital organisational culture, favours innovation, communication and familiarity with new technologies. Hence, it enables executives and even frontline employees, to participate in data-driven decision making, which can lead to decisions that are sustainable (Isensee et al., 2020; Martínez-Caro et al., 2020; Asif et al., 2024; Zhang & Jin, 2023). In addition, digital culture promotes communication and collaboration in teams, particularly with regard to sustainability initiatives, such as monitoring sustainability indicators and sharing best practices. This makes knowledge about sustainability and its goals accessible to all employees, enabling them to contribute ideas and solutions to specific issues. Furthermore, digital culture enhances the company's communication with its customers regarding sustainability efforts. That is, companies can utilise various technological tools, such as social media and websites, to communicate their environmentally friendly practices to the public, thus strengthening customer loyalty to them and attracting potential consumers who are aware of sustainability issues (Zhen et al., 2021; Tajpour et al., 2023).

On the other hand, a lean organisational culture can also contribute to achieving business sustainability in several ways. Its emphasis on eliminating or at least minimising waste implies achieving sustainability, rationalizing the consumption of resources (e.g. water, energy) and reducing environmental impact (Ho, 2010; Kamble et al., 2020). Furthermore, a lean mindset aligns with sustainability initiatives, as employees are encouraged to constantly seek ways to improve operations. This lean orientation can lead to the adoption of sustainable practices, such as reusing materials or optimising supply chains to reduce polluting emissions (Ghafar & Razali, 2022). Finally, when employees participate in sustainability initiatives, they develop a deeper sense of ownership and responsibility, strengthening the culture of continuous improvement and leading to the integration of sustainable practices into daily operations (Yetim & Gur, 2024).

Based on these findings the following research hypotheses are formulated:

RH 1: Lean organisational culture has a significant positive impact on an integrated management system.

RH 2: Sustainability-oriented organisational culture has a significant positive impact on an integrated management system.

RH 3: Digital organisational culture has a significant positive impact on an integrated management system.

RH 4: A lean-digital integrated management system has a significant positive impact on corporate sustainability performance

3. Methodology

Structural equation modelling (SEM) was used to test the hypothesised relationships. SEM has become the most widely used method in validating instruments and testing linkages between constructs (Henseler et al., 2009). This study used a five-point Likert-scale questionnaire to collect empirical data. Apart from the demographic questions, the questionnaire included four questions on digital organisational culture using the scale of Martínez-Caro et al. (2020), fourteen questions on lean organisational culture using the subscales for soft lean culture of Bortolotti et al. (2015), seven questions on corporate sustainability culture using the scale of Tomšič et al. (2015).

To measure the level of implementation of lean - digital practices in the integrated management systems, a fourteen item-scale was developed based on IMS and lean literature (Asif et al., 2013;2020; Ho et al., 2010; Jewalikar & Shelke, 2015; 2017; Sony & Naik, 2020). To assess corporate sustainability performance (CSP) in the context of digital transformation, this study employed a series of questions derived from Siltori et al.'s (2021) exploratory research into the influence of Industry 4.0 on business sustainability. The questionnaire was administered electronically to employees of Greek organisations with at least two management systems in place, in the form of links sent via email (one link per company). An introductory note explained the purpose and scope of the research to the participants. Participants' anonymity was maintained throughout the data collection process. Data were collected over a period of two months, from November to December 2024. Out of a total of 200 employees, 186 usable responses were received.

4. Results

For data processing, this study used the statistical software SPSS 22. Next, partial least squares - structural equation modelling (PLS-SEM) method tested the research hypotheses via SmartPLS software. The sample breakdown in terms of age and years of employment are presented in Tables 1 and 2.

Table 1. Age Sample breakdown

Age	Number of respondents	Percentage (%)
18-25	21	11.3
26-35	66	35.5
36-45	50	26.9
46-55	35	18.8
Over 55	14	7.5

Table 2. Sample breakdown in terms of years of employment

Years of employment	Number of respondents	Percentage (%)
Less than 1	25	13.4
1-2	32	17.2
3-5	50	26.9
6-10	26	14.0
Over 10	53	28.5

The results of the reliability and validity analyses are listed in Table 3. All construct scales were found to be highly reliable, with coefficient values over 0.8. Convergent validity was confirmed for most constructs, except lean culture, which was marginally below the threshold value of 0.5. However, values between 0.4 and 0.5 are acceptable when the respective composite reliability values are well above 0.6, granting convergent validity (Fornell & Larcker, 1981). Discriminant validity results, based on the Heterotrait-Monotrait ratio (Henseler et al., 2014), are also satisfactory (see Table 4). Blindfolding analysis Q-square values were all above zero providing evidence of predictive relevance (Henseler et al., 2009).

Table 3. Construct reliability and validity analysis

Construct	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average Variance Extracted (AVE)
CSP	0.882	0.891	0.905	0.517
Digital culture	0.886	0.888	0.921	0.745
Lean culture	0.881	0.890	0.903	0.485
Lean Digital IMS	0.939	0.942	0.947	0.564
Sustainability culture	0.888	0.905	0.919	0.698

Table 4. Discriminant Validity - HTMT ratio values

Construct	CSP	Digital culture	Lean culture	Lean Digital IMS
Digital culture	0.403			
Lean culture	0.450	0.772		
Lean Digital IMS	0.537	0.777	0.803	
Sustainability culture	0.470	0.665	0.736	0.840

Table 5 presents the findings regarding the direct effects between the variables of the research model. The results show that the direct positive effect of the digital culture variable on the Lean Digital IMS variable ($b = 0.261$, $t = 4.119$, $p < 0.001$), and the direct positive effect of the lean culture variable on the lean digital IMS variable ($b = 0.283$, $t = 4.367$, $p < 0.001$). Furthermore, the results show that the direct positive effect of the lean digital IMS variable on the CSP variable is confirmed ($b = 0.493$, $t = 10.405$, $p <$

0.001). Finally, the results show that the direct positive effect of the sustainability culture variable on the lean digital IMS variable is confirmed (b =0.427, t = 8.383, p < 0.001).

Table 5. Total direct effects - bootstrapping (5000 resamples)

Effect	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Digital culture -> Lean Digital IMS	0.261	0.259	0.063	4.119	0.000
Lean culture -> Lean Digital IMS	0.283	0.288	0.065	4.367	0.000
Lean Digital IMS -> CSP	0.493	0.501	0.047	10.405	0.000
Sustainability culture -> Lean Digital IMS	0.427	0.425	0.051	8.383	0.000

Table 6 presents the findings regarding the total indirect effects between the variables of the research model. The results show that the indirect positive total effect of the digital culture variable on the CSP variable (b = 0.129, t = 3.855, p < 0.001), and the indirect positive total effect of the lean culture variable on the CSP variable (b = 0.140, t = 3.836, p < 0.001). Furthermore, the results show that the indirect positive total effect of the sustainability culture variable on the CSP variable is also confirmed (b = 0.211, t = 6.486, p < 0.001).

Table 6. Total indirect effect - bootstrapping (5000 resamples)

Effect	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Digital culture -> CSP	0.129	0.130	0.033	3.855	0.000
Lean culture -> CSP	0.140	0.145	0.036	3.836	0.000
Sustainability culture -> CSP	0.211	0.213	0.032	6.486	0.000

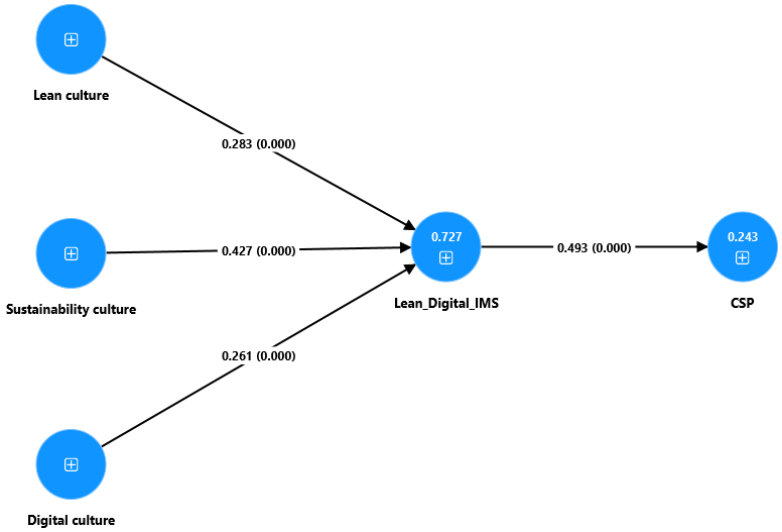

Figure 1. Model path loadings and p-values

Fig. 1 shows the path coefficients and the corresponding p-values for the hypothesized relationships. Empirical evidence supports the theoretical framework by confirming the expected positive correlations between cultural elements, IMS and CSP.

5. Discussion and Conclusion

This study highlights the importance of integrated management systems in the digital age and their effect on business sustainability. While previous studies have demonstrated the IMS positive impact on business sustainability in the digital era, this research not only confirms existing theories but also systematically examines the influence of digital culture and Industry 4.0 technologies (e.g. IoT, AI, and cloud computing) on sustainability (Waqar et al., 2025). Consequently, it provides new empirical evidence on the effectiveness of IMS and the role of digital and lean strategies, offering new directions for future research.

Statistical analysis confirmed that organisations integrating digitalisation and lean management principles into their IMS (Lean Digital IMS) achieve better sustainability performance. At the same time, factors related to digital, lean and sustainability cultures showed a strong and positive correlation with IMS adoption, and these relationships were statistically significant. Path coefficients revealed that a lean-digital IMS has a strong impact on sustainability performance. These results are in line with the existing literature, which argues that technology and lean management complement each other towards sustainable development. The results showed that digital culture directly influences the implementation of IMS, highlighting the importance of modern technologies in effectively managing business operations. Additionally, sustainability culture also emerged as a determining factor in the successful implementation of IMS, confirming that corporate responsibility and sustainable development are key priorities for modern businesses.

5.1 Research implications

This study has the following implications:

- The proposed and tested novel IMS incorporates lean principles and transforms its processes to adopt digital technologies by integrating them in lean quality practices.
- Management system processes are more than simple parts of a rigid structure but rather dynamic components of a transformational system.
- The effect of a Lean Digital IMS on sustainability performance is strong.
- The validated direct and indirect effects in the model support the idea that organisational culture influences the sustainable development of organisations.
- Managers should draw on the findings, and engage employees and focus their efforts on fostering specific cultural elements.

In more detail, capitalising on the findings of this study, managers should prioritise:

- digitalisation, and encourage employees to adopt and use modern technologies to improve operations;
- lean thinking, and promote a mindset of standardisation, teamwork, and respect for people, continuous improvement and waste reduction;
- sustainability, and instil a sense of corporate responsibility throughout the organization, making sustainable development a strategic pillar.

Furthermore, by linking digital transformation with lean thinking and sustainability, academics and practitioners can

- recognise that technology is not just a tool for efficiency,
- acknowledge digital transformation as a driver of sustainability, and
- use digital tools to improve processes, reduce waste, and gain real-time insights into business operations.

5.2 Research limitations

As with most studies, this research has certain limitations that are important to acknowledge. The sample consisted of employees working in Greek companies that implement multiple management systems. Collecting data from a wider range of geographical areas could provide a more comprehensive overview of the impact of integrated management systems on corporate sustainability. The cross-sectional nature of the particular study is also a limitation, as it captures a specific moment in time. Rapid technological developments and changes in business practices may narrow replicability. Future research could examine the long-term effectiveness of IMSs by looking at how they evolve over time and the adjustments needed to maintain sustainability. Organisations deploying IMSs must incorporate continuous improvement and respond to changing market needs, so it is necessary to explore the associated challenges and opportunities.

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