

How Do Business Digitalisation, Organisational Leadership, Innovation, and Entrepreneurship Sustainability Interact? A Meta-Analysis Approach

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ABSTRACT:

This study explores the interrelationships among business digitalisation (BD), organisational leadership (OL), business innovation (BI), and entrepreneurship sustainability (ES) to assess whether synergistic effects exist and how they influence business sustainability outcomes. A mixed-method approach was applied, combining bibliometric techniques, such as citation analysis, frequency distributions, co-word analysis, co-occurrence mapping, and relational frequency matrices, with qualitative content analysis and conceptual synthesis. The dataset includes 311 peer-reviewed articles published between 2001 and 2023, drawn from Web of Science, SCOPUS, and selected grey literature, all focusing on at least one of the four constructs.

Findings show strong evidence of multiple interconnections, particularly BD–OL and BI–BD, with Asia, especially India, demonstrating how leadership drives digitalisation and innovation. However, ES–BI and ES–OL remain underexplored, representing significant research opportunities. Results confirm BD as a key enabler across innovation and sustainability, often mediated by leadership and innovation dynamics.

Implications suggest that policymakers should support integrated digital, leadership, and innovation frameworks to foster sustainable entrepreneurship, while business leaders are encouraged to invest in digital capabilities and innovation-driven leadership. Educational institutions should emphasise interdisciplinary training that integrates digitalisation, leadership, and sustainability. By highlighting overlooked connections and offering a global perspective, this study advances theoretical and practical understanding of sustainable digital entrepreneurship.

Keywords: Business digitalisation; Organisational leadership; Business innovation; Entrepreneurship sustainability; Bibliometric analysis; Sustainable digital entrepreneurship.

1. Introduction

Business digitalisation, organisational leadership, entrepreneurship, sustainability, and innovation have experienced significant transformations over the past two decades. From 2001 to 2023, this period has witnessed a remarkable convergence of these

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multidisciplinary domains, driven by globalisation, technological advancements, and the increasing importance of sustainability. The interplay between these dimensions has created a rich academic exploration and practical application landscape.

The importance of exploring these interconnections lies in their profound impact on modern business ecosystems. Organisations today are under increasing pressure to remain agile, technologically adept, socially responsible, and economically viable. Digital transformation is reshaping the nature of work, leadership, and innovation, while sustainability is redefining long-term business success. Understanding how these domains intersect and influence each other is crucial for enabling resilient and future-ready entrepreneurial ecosystems.

Entrepreneurship sustainability is understood mainly with the philosophical dimensions of serving/benefiting the more significant component of society, backed by long-term organisational innovations (Schaltegger, 2013) that can generate and deliver value for the greater interest of society, along with their business interest because of a specific business strategy (Porter and Kramer, 2011). However, little importance has been given by researchers or studies to explore the role of organisational innovations with the role of the entrepreneur, called sustainable entrepreneurs, for their commitment towards significant contributions to sustainable development (Schaltegger and Wagner, 2011), where sustainable entrepreneurs are recognised as creative destroyers who demolish the conventional way of production and consumption and establish superior and more acceptable methods for the future generations (Schumpeter, 1934). So logically, sustainable entrepreneurship should be understood by integrating tangible and philosophical dimensions rather than only the latter. This logical integration is one of the motivations of the present study.

This study is unique in its comprehensive meta-analytical approach that examines the synergistic relationships among four critical business constructs—business digitalisation (BD), organisational leadership (OL), business innovation (BI), and entrepreneurship sustainability (ES). Unlike previous studies that often focused on bilateral relationships, this study captures the complexity of multidimensional interactions, providing a holistic view. Notably, it addresses a significant research gap by incorporating psychological (leadership and behaviour) and technological (digitalisation and innovation) dimensions to understand sustainable entrepreneurship—an integration rarely explored in the existing literature.

The concept of sustainable entrepreneurship heralds an era where business ventures are no longer isolated from their broader social and environmental context. As of February 2023, there are a total of 92,683 DPIIT (Department for Promotion of Industry and Internal Trade) recognised startups in India, which was merely at 471 in the year 2016 and due to government initiatives like startup India it has rapidly grown to 5233 in 2017, 8635 in 2018, 11279 in 2019, 14498 in 2020, 20046 in 2021, 26542 in 2022, and to where it is today. These startups epitomise the dynamic nature of contemporary entrepreneurship, technological innovation, sustainability, and economic growth.

This study aims to critically examine and synthesise the interrelationships among BD, OL, BI, and ES to determine whether synergistic effects exist and how they influence business sustainability outcomes. By aggregating and analysing existing studies from 2001

to 2023, the research provides an evidence-based foundation for theoretical development and practical application in entrepreneurship and innovation ecosystems.

The rapid proliferation of digitalisation has played a pivotal role in shaping these developments. In the digital age, Dynamic Capabilities (DCs) are essential for Business Model Innovation (BMI), and organisations can gain from entrepreneurial leaders and thinkers during digitisation. Businesses must use DCs and BMI to stay ahead in the digital age (Witschel et al., 2022). Digitalisation has also transformed the very nature of leadership, with organisations increasingly adopting post-bureaucratic structures, recognising the pivotal role of leadership in navigating the digital landscape (Mustafa et al., 2022). The digital era has given rise to new paradigms where information is king, and organisations must scan the business world to understand its present and future state, using information in ways that align with strategic goals (Gupta et al., 2023). Innovation and leadership skills are two of the four most important things organisations need to do to improve their performance in the industry (Brrar et al., 2023). A system design based on uncertainty and information processing is necessary for knowledge management and execution on digital platforms.

Problem statement of the study: Does the interplay of business digitalisation (BD), business innovation (BI), organisational leadership (OL), and entrepreneurship sustainability (ES) carry a synergising effect on each other?

The following research questions guide this study:

- What is the nature and pattern of the relationship existing among business digitalisation (BD), business innovation (BI), organisational leadership (OL), & entrepreneurship sustainability (ES)?
- What is the strength of the relationships among BD, BI, OL, and ES across the major geographical areas of the world?
- How can these relationships be strategised to carry synergising effects on each other for business success in entrepreneurship?

This study examines whether business digitalisation, innovation, leadership, and sustainability create synergy. However, it also recognises that these relationships may vary across industries, as different sectors exhibit unique digital transformation patterns, innovation capabilities, and sustainability pressures. But, sector-specific effects are not the primary focus of this review-based study. Further, scanning the business world to understand its present and future state and using information to fit the company's strategic goals is very important (Gupta et al., 2023). Implementing digital transformation is imperative for firms to maintain their competitiveness and ensure survival amidst the swift technological progress. Employees' contribution is essential for digital transformation, with their perceptions and attitudes towards technological change as significant considerations (Trenerry et al., 2021). The effect of digitalisation extends beyond leadership and organisational innovation and infiltrates the very heart of sustainable entrepreneurship. The players in the value creation component become more connected because of digital technology, identified three practices—community building (engagement), co-creation, and expanding stakeholder integration—often tied to one another where the use of digital logic enabled an expansion of the boundaries of value creation and improved the integrative-ness of this component (Gregori and Holzmann,

2020; Sahoo, Cagánová, Pattnaik, Sahu and Sahoo, 2024). However, environmental sustainability and digitalisation have a complex relationship, as they negatively influence process innovation performance and are not as necessary for product innovation performance (Ardito *et al.*, 2021).

The remainder of the study is structured as follows:

- Section 3 offers an in-depth literature review across six thematic dimensions linking BD, BI, OL, and ES;
- Section 2 details the research methodology used to conduct the meta-analysis, including data collection, selection criteria, and analytical techniques;
- Section 4 presents the findings, including co-word analysis, citation trends, and geographic distribution of research;
- Section 5 provides concluding insights, drawing logical inferences from the patterns observed;
- Section 6 discusses limitations and future research directions to expand this emerging field further.

Integrating multidisciplinary concepts is in demand for business and society. Researchers try to see the synergised effect, as it shows both positive and negative results. To summarise, we say that an industry initiative generated the motivation for the study because innovation through digitalisation is the present and future agenda of every entrepreneurial project in the world. Entrepreneurs must innovatively channel their resources within the digital landscape to sustain themselves in the highly competitive startup environment. However, it is important to acknowledge that these processes might not be equally accessible to all. Structural barriers, including limited digital infrastructure, unequal access to capital, and varying cultural contexts can significantly influence entrepreneurial sustainability specifically in underdeveloped or resource-constrained areas.

2. Literature Review

The literature review proposed for this study is based on Bibliometric techniques. For this, we systematically searched and reviewed academic literature databases from the Web of Science (WOS), SCOPUS, and other reputed sources. Target to cover scholarly articles, conference papers, and journals, which provide comprehensive coverage of the selected multidisciplinary domains: Business digitalisation and organisational leadership, business innovation and business digitalisation, business innovation and organisational leadership, entrepreneurship sustainability and business digitalisation, entrepreneurship sustainability and business innovation, entrepreneurship sustainability, and organisational leadership. These domains are chosen based on the 'resource-based view' (Barney, 1991).

Business digitalisation is a global trend that requires organisations to adapt their operations and offerings to remain competitive (Zavatin *et al.*, 2023) as higher strength of digital economy can bring improvement in resource-mismatch of traditional & emerging service industries (Qian, Liu, and Pan, 2022). So, appropriate leadership style should be strategized for the success of digital businesses, because leaders manage the rapidly changing digital environment, innovation and agility (Hargitai and Bencsik, 2023), where visionary and customer-focused leadership are responsible for success of digitalization

(Tagscherer and Carbon, 2023). Furthermore, digital transformation is influenced by leadership style, training, digital readiness, and trust, which can shape the learning organisation's culture (Feshchenko et al., 2023). Organisational culture, knowledge management, and digitalisation are interconnected and impact sustainable leadership (Gupta et al., 2022; Tagscherer and Carbon, 2023). The emergence of digital technologies has also transformed corporate communication, leading to the evolution of digital corporate communication practices in the era of the digital economy (Abidi et al., 2023). Successful digitalisation requires visionary, customer-centred leaders to embrace change, empower employees, possess digital savviness, and actively build strategic partnerships, manage diversity and cultural differences (Trenerry et al., 2021; Baranauskas and Raisiene, 2021; Sahoo, Sahoo and Cagaňová, 2024). However, inadequate digital infrastructure, limited resource (Idemudia et al., 2023), cultural barrier, and lack of visionary leadership (Chandani et al., 2025) may not attract the small business to adopt and grow with digitalization, especially in the underdeveloped & developing countries, which may limit the resilience capability of those small entrepreneurs in adverse conditions (Morris et al., 2022).

Extending the above discussion, it can be said that in the digital age, dynamic capabilities (DCs) are essential for business model innovation (BMI), and organisations can gain from entrepreneurial leaders and thinkers during digitisation. Businesses must also use DCs and BMI to stay ahead in the digital age (Witschel et al., 2022). Innovation and leadership skills are two of the four most important things organisations need to do to improve their performance in the industry (Brrar et al., 2023). Getting better at them will help the company in many ways. Additionally, the post-bureaucratic organisational structure works better than the bureaucratic organisational structure for getting the most out of going digital (Mustafa et al., 2022). This shows that studies should be conducted on the impact of leadership styles on digital transformation, defining the role of dynamic capabilities in sustaining competitive advantage, how organisational culture and knowledge management can benefit entrepreneurs in the digital age, and how balancing diversity and cultural differences in global digitalisation can be done.

Business innovation and digitalisation are closely linked. Digitalisation, the introduction of digital technologies to optimise business processes and improve communication, is a crucial driver of business innovation (Koval and Zahorodnia, 2023; Wang et al., 2023). Digital technologies such as cloud computing, big data analytics, and artificial intelligence enable businesses to innovate, create value, and improve performance (Wintjes and Vargas, 2023). Digital capabilities, including basic digital capabilities, digital operation capabilities, and digital integration capabilities, significantly positively affect enterprise and financial performance (Vartiak, 2016; Cannistrà et al., 2022; Panchenko and Dovhenko, 2023). Business model innovation, driven by digital capabilities, further enhances company performance (Radicic and Petković, 2023). However, the impact of digitalisation on innovation activities varies among small and medium-sized enterprises (SMEs). Engagement in internal R&D activities can moderate the innovation effects of digitalisation (Holzmann and Gregori, 2023), with different impacts observed in R&D and non-R&D SMEs (Kusa et al., 2022). Digitalisation is crucial in driving business innovation and improving performance, but its effects can vary depending on the enterprise's context and size, especially in startups (Muhos et al., 2019). Thus, more studies could be done on

the differentiated impacts of digitalisation on SMEs, different challenges in the digitalisation process for startups, the role of digital capabilities in long-term sustainability, industry-specific impacts of digitalisation, and measuring innovation performance.

Business innovation and organisational leadership are intricately linked. The outbreak of COVID-19 has accelerated the adoption of digital products and services (Hackbarth and Kettinger, 2004), leading to the need for established organisations (Tseng, 2010) to undergo digital transformation and adapt their business models to stay relevant (Montasser *et al.*, 2023) and achieve high quality leading to Business Excellence status (Rentková and Vartiak, 2017). Leadership competencies, such as cognitive, interpersonal, and results-oriented competencies, significantly impact organisational learning, innovation, and business performance (Mai *et al.*, 2022). Creativity drives organisational innovation, and leadership is a hub for disseminating innovative ideas (Watts and Henderson, 2006; Cacciatore, 2023). Leadership style, including charismatic, transformational, and transactional leadership, influences innovative work behaviour through the organisational climate for innovation (Nilasari *et al.*, 2023). Responsible leadership is also essential for fostering innovation in private and public sector organisations (Prisca, 2022). Effective leadership and a supportive organisational climate are crucial for promoting business innovation (Han and Gao, 2019) and driving organisational success. Addressing these areas can provide valuable insights into optimising leadership practices to enhance innovation and organisational success in an increasingly dynamic business environment.

Entrepreneurship, sustainability and business digitalisation are closely linked. Digital technologies play a crucial role in value creation, delivery, and capture within the business models of sustainable entrepreneurship (Fuerst *et al.*, 2023; Gregori and Holzmann, 2020). Entrepreneurs need to leverage digital technologies, foster a digital culture, and innovate with technology to build successful and sustainable businesses in the digital era (Satjharuthai and Lakkhongkha, 2023). Additionally, the role of digitalisation and information and communication technologies (ICT) in product innovation is significant for sustainable business and entrepreneurship (Ferreira *et al.*, 2022). Implementing marketing digitalisation strategies is also vital for small companies to achieve sustainable development and competitiveness (Surmanidze *et al.*, 2023; Ardito *et al.*, 2021).

Furthermore, digitalisation positively affects entrepreneurial activity and sustainable competitiveness, with connectivity, internet use, and digital integration as crucial components (Dabbous *et al.*, 2023). Integrating digital technologies into business strategies is essential for entrepreneurship sustainability and can drive sustainable development and competitiveness (Lesinskis *et al.*, 2023). Hence, studies on how digital technologies can be more effectively integrated into sustainable business models can provide a comprehensive understanding of digitalisation and its role in strengthening sustainable entrepreneurship.

Entrepreneurship drives sustainability and business innovation (Kajtazi *et al.*, 2023). Business model innovation is crucial for achieving corporate sustainability (Wang *et al.*, 2021; Lüdeke-Freund and Schaltegger, 2023). By incorporating sustainability principles into their activities, companies can create value for themselves and their stakeholders while addressing environmental and social challenges (Irimias and Mitev, 2020). Sustainable entrepreneurs are essential in forming sustainable business models that enhance competitiveness and success (Tavanti, 2023). Intrapreneurship within large

organisations also contributes to sustainable innovation by fostering creativity and driving change from within (Aamer and Al-Awlaqi, 2022; Schroedel, 2023). Lastly, the impact of change management is highlighted, with minimal effects on organisations' commitment to green development but a more direct positive influence on digital maturity and overall business performance. This underscores the distinct roles of change management in different dimensions of organisational evolution (Irimias and Mitev, 2020). Sustainable, frugal innovation also emphasises resource optimisation, affordability, and inclusivity in addressing social and environmental issues. Overcoming obstacles such as dominant logic can be achieved through using sustainable business model patterns, which provide examples of successful companies' activities and enable sustainable business model innovation. Hence, studies could be done to focus on how companies can effectively integrate sustainability principles into business models across various industries.

Entrepreneurship, sustainability and organisational leadership are closely linked. Research has shown that entrepreneurial leadership behaviours positively affect managerial sustainability in small and medium-sized enterprises (Jan and Maulida, 2022). Sustainable management and leadership practices are also crucial for enhancing business performance and ensuring organisational sustainability (Sarfraz and Ivascu, 2023). Furthermore, the study found that leadership style, change management, creativity, and feedback play a significant role in achieving sustainable goals (Jardon and Martínez-Cobas, 2019) and improving the microclimate and interpersonal trust within an organisation (Kondrotaitė and Burinskienė, 2023). Moreover, utilising networking resources, innovativeness, and pro-activeness, sub-elements of entrepreneurial marketing, positively affect organisational sustainability (Udofia et al., 2022). However, it is essential to note that the impact of motivation on organisational agility may vary (Bang and Cho, 2022). These findings highlight the importance of entrepreneurial leadership and sustainable management practices in driving organisational sustainability and performance (Akanmu et al., 2023). Further, studies can enlighten different leadership styles and their impact on organisational sustainability in diverse cultural and industrial contexts.

Significant learning extracted from the literature review is as follows:

- Strategic leadership is critical for managing digital transformation, promoting innovation, and fostering agility.
- Leadership style, training, digital readiness, and trust significantly influence digital transformation outcomes, but the extracted literature could be not reflecting any particular leadership style as more effective than others regarding digitalization, innovation for entrepreneurial sustainability.
- Digitalisation is a primary driver of business innovation, enabling value creation through technologies like AI, big data, and cloud computing.
- Responsible and adaptive leadership is essential for fostering innovation and navigating change in dynamic environments.
- Fostering a digital culture and leveraging ICT supports sustainable product innovation and competitiveness.
- Sustainable entrepreneurs contribute to competitiveness by integrating sustainability principles into business models.

- Entrepreneurial leadership behaviours positively impact managerial sustainability in SMEs.

The literature broadly supports a positive relationship between business digitalisation (BD) and organisational leadership (OL), highlighting leadership's role in driving digital transformation. Studies such as Mustafa *et al.* (2022) and Witschel *et al.* (2022) emphasise that adaptive, post-bureaucratic leadership fosters innovation and change, aligning with Dynamic Capabilities Theory.

However, critical differences emerge regarding how leadership exerts influence. Some scholars (e.g., Trenerry *et al.*, 2021) stress that digital transformation success also depends on employee engagement, while others (e.g., Gupta *et al.*, 2023) highlight the importance of information processing and strategic alignment rather than leadership alone.

There is a limited consensus on which leadership styles are most effective, and few studies examine these dynamics in emerging markets. Theoretical grounding is firm in RBV and dynamic capabilities, but integration with broader institutional or stakeholder frameworks is lacking. Furthermore, analysis reveals that while OL is essential for BD, its impact is often context-dependent and mediated. These insights underline the need for more nuanced, comparative research—particularly across diverse industries and global regions—to fully understand the BD–OL relationship.

3. Research Methodology

This study aims to critically examine and synthesise the interrelationships among BD, OL, BI, and ES to determine whether synergistic effects exist and how they influence business sustainability outcomes. By aggregating and analysing existing studies from 2001 to 2023, the research provides an evidence-based foundation for theoretical development and practical application in entrepreneurship and innovation ecosystems.

The study adopts a mixed-method approach, integrating quantitative and qualitative techniques to achieve a robust meta-analytical investigation. The combination of bibliometric analysis (quantitative) and conceptual synthesis (qualitative) enables a comprehensive exploration of the synergistic relationships among business digitalisation (BD), organisational leadership (OL), business innovation (BI), and entrepreneurship sustainability (ES) over a defined period. The quantitative component consists of citation analysis, co-word mapping, frequency distributions, and percentage-based evaluations of relationships among variables across selected articles. The qualitative component involves content analysis, thematic classification, and interpretive synthesis to understand contextual insights, patterns, and conceptual linkages in the literature. This mixed-method approach strengthens the reliability and depth of the research findings by validating data trends with conceptual reasoning.

The study conducted extensive keyword-based searches using academic databases, specifically Web of Science (WOS), SCOPUS, and selected Grey Area Journals to build a comprehensive and relevant data set. The keywords were based on critical terms related to the research domains such as “digitalisation,” “organisational leadership,” “innovation,” “entrepreneurship sustainability,” “business model,” and “strategic capabilities.” Selection criteria included (i) peer-reviewed articles published between 2001 and 2023, (ii) studies explicitly discussing at least one of the target variables (BD, BI, OL,

ES), (iii) articles published in English language, and (iv) a combination of empirical, conceptual, qualitative, and review-based studies. Out of the initially identified sources, a final sample of 311 articles was selected based on relevance and methodological quality for in-depth analysis.

To address the research questions, the study employed several methodological tools:

- Bibliometric analysis:
 - conducted using frequency and citation count analysis;
 - allowed identification of highly influential studies, key themes, and dominant relationships;
- Co-word analysis:
 - applied to detect the strength and frequency of associations among BD, BI, OL, and ES in the literature;
 - the results were classified by "Yes/No" existence of relationship and percentage distribution;
- Content analysis:
 - enabled thematic categorisation of findings under six core dyadic relationships;
 - provided qualitative validation of quantitative trends;
- Descriptive statistical analysis:
 - utilised for quantifying the presence of relationships across databases and regions;
 - helped in estimating average citation rates, variable co-occurrence, and journal impact;
- Model application:
 - While this study did not employ an econometric or structural equation model, it is underpinned by a conceptual research model that maps out the interrelationships among the four variables. This model guides the interpretation of how digitalisation and leadership feed into innovation and, ultimately, entrepreneurship sustainability.

The primary variables investigated and operationalised for relational analysis are BD (Business Digitalisation); BI (Business Innovation); OL (Organisational Leadership); and ES (Entrepreneurship Sustainability). Each variable was coded based on (1) presence or absence in the literature and measured through frequency of co-occurrence; (2) citation strength; and (3) thematic association within and across studies. These variables were further used to calculate the (i) interrelationship percentages; (ii) geographical distribution of research; and (iii) research-type classification (empirical, conceptual, qualitative, review).

The hypotheses in this study were developed using deductive research logic supported by a comprehensive literature-based conceptual synthesis. This approach involved identifying consistent patterns, conceptual relationships, and theoretical propositions within existing research that formulated testable assumptions.

The hypotheses were derived based on three key theoretical perspectives:

1. Resource-Based View (RBV) (Barney, 1991): This theory posits that sustainable competitive advantage stems from a firm's internal resources and capabilities, including digital assets, innovation capacity, and leadership quality.
2. Dynamic Capabilities Theory (Teece et al., 1997): This framework supports the idea that firms must continuously adapt, integrate, and reconfigure internal and external competencies to address rapidly changing environments, especially in digital contexts.
3. Sustainable Entrepreneurship Theory (Schaltegger & Wagner, 2011): This concept emphasises the role of entrepreneurs in creating social and environmental value alongside economic gain, often driven by innovation and leadership within a technological framework.

A systematic literature review was conducted using Web of Science, SCOPUS, and other reputable databases to identify recurrent relational themes among the four core constructs: business digitalisation (BD), business innovation (BI), organisational leadership (OL), and entrepreneurship sustainability (ES). The following logical associations emerged:

- Numerous studies demonstrated the strong role of leadership in guiding digital transformation (Mustafa et al., 2022; Gupta et al., 2023).
- Others highlighted how digitalisation acts as a precursor to innovation, enabling agility and new value creation (Gregori & Holzmann, 2020; Wang et al., 2023).
- The link between innovation and sustainability was also frequently observed, though often moderated by digital capabilities (Kajtazi et al., 2023).
- Contradictory findings regarding the direct impact of leadership on sustainability motivated further examination and hypothesis testing.

Based on the observed relationships and theoretical justifications, five hypotheses were proposed:

- H1: Business digitalisation is positively related to organisational leadership.
- H2: Business digitalisation significantly enhances business innovation.
- H3: Business digitalisation has a positive impact on entrepreneurship sustainability.
- H4: Business innovation positively influences entrepreneurship sustainability.
- H5: Organisational leadership is positively associated with entrepreneurship sustainability.

Each hypothesis reflects a testable claim derived from thematic overlaps in the literature and framed within the broader theoretical context.

4. Results and Discussion

This section presents the empirical outcomes derived from a meta-analysis of 311 studies published between 2001 and 2023 and discusses the implications of the findings in the context of existing literature. The core objective was to assess whether there are statistically and conceptually significant relationships among the four constructs: business digitalisation (BD), business innovation (BI), organisational leadership (OL), and entrepreneurship sustainability (ES). The relationships were evaluated through co-word analysis, frequency mapping, and citation impact studies across three primary data sources: Web of Science, SCOPUS, and Grey Area Journals.

Table 1: YES/NO Relationships: Among the Factors of the Study

Links (Index)	TSPL	Yes	No	Yes (Percent @TSPL)	No (Percent @TSPL)	No. of journals published @ no. of articles	Weightage of journals for every linkage (% in each)
BD-OL (WOS))	68	7	1	10.30	1.47	8 – 1	1.47
BD-OL (SCOPUS)		46	10	67.64	14.70	54 - 1 3 – 2	1.47 2.94
BD-OL (GA)		4	0	5.88	0.00	4 – 1	1.47
BI-BD (WOS)	83	28	8	33.73	9.63	12 - 1 5 - 2 3 - 3 1 – 5	1.20 2.41 3.61 6.02
BI-BD (SCOPUS)		32	10	38.55	12.04	12 - 1 4 – 2	1.20 2.41
BI-BD (GA)		4	1	4.81	1.20	5 – 1	1.20
BI-OL (WOS)	95	10	2	10.52	2.10	8 - 1 2 – 2	1.05 2.10
BI-OL (SCOPUS)		56	24	58.94	25.26	76 - 1 2 – 2	1.05 2.10
BI-OL (GA)		3	0	3.18	0.00	3 – 1	1.05
ES-BD (WOS)	27	18	2	66.67	7.40	8 - 1 2 - 2 1 – 8	3.70 7.41 29.6
ES-BD (SCOPUS)		2	0	7.40	0.00	2 – 1	3.70
ES-BD (GA)		4	1	14.81	3.70	1 - 1 2 – 2	3.70 7.41
ES-BI (WOS)	23	1	2	4.34	8.69	1 - 1 1 – 2	4.34 8.68
ES-BI (SCOPUS)		11	5	47.82	21.73	16 – 1	4.34
ES-BI (GA)		4	0	17.40	0.00	4 – 1	4.34
ES-OL (WOS)	15	4	9	26.66	60	7 - 1 1 – 6	6.66 40.0
ES-OL (SCOPUS)		0	2	0.00	13.33	2 – 1	6.66
ES-OL (GA)		0	0	0.00	0.00	00	00%

Note: Each section has a different total number of studies, and the percentages are based on the respective section total. In total, 311 articles are considered in this table for calculations and further interpretations.

TSPL: Total Studies Per Linkage. WOS: Web of Science, SCOPUS, GA: Grey Area Journals. BD: Business Digitalisation, BI: Business Innovation, OL: Organisation Leadership, and ES: Entrepreneurship Sustainability.

Source: Compiled by authors by extracting from various data-base

Based on Co-word analysis (Table 1), we came across the following facts:

- The relationship between 'business digitalisation and organisational leadership' has been explored in 68 studies from Web of Science, SCOPUS, and other indexes, which is 'evenly distributed' as only 3 journals have 2 studies each, and the rest are published in different journals.

- The relationship between 'business innovation and business digitalisation' is explored in 48 studies, which is a 'little more concentrated' as 5 of these studies are published in the International Journal of Business Research, 3 each in Review of Managerial Science, Sustainability, and Technovation. Also, many studies are published in pairs in 9 journals. 16 of these studies are published separately in different journals.
- The relationship between 'business innovation and organisational leadership' is the 'most explored area' of this study, with 92 studies around this area. Only 4 journals have published 2 studies each. Other than that, all the published articles are from different journals.
- Only 27 studies on the relationship between 'entrepreneurship sustainability and business digitalisation' exist, 8 of which are published in sustainability journals. Additionally, 8 studies are published in pairs in 4 different journals, and 11 are published individually in separate journals.
- The relationship between 'entrepreneurial sustainability and business innovation' has also been explored less, with only 21 studies. All these studies are published differently, except for one proceeding, which has two studies from this area.
- The relationship between 'entrepreneurial sustainability and organisational leadership' is 'the least explored area', with only 18 studies. All of them are published differently, barring one journal, 'Sustainability,' with 6 studies from this area alone. A few articles have been changed from one relation to another, like (BD and OL to ES and BI), according to their due appropriateness after a thorough review. Supposedly, a few articles found better suited in BD and BI are brought from ES and OL or removed from the table because they are not suited or better suited elsewhere.

Key findings include:

- BD–OL: Found to be significant in 83.82% of studies, indicating strong empirical support for a relationship between digitalisation and leadership effectiveness.
- BI–BD: Supported by 77% of studies, reinforcing the critical role of digital technologies in driving innovation.
- BD–ES: The most supported relationship, confirmed in 88.88% of sources, demonstrating digitalisation's central role in sustainable entrepreneurship.
- BI–ES: Validated in 69.56% of studies, showing a positive yet moderately explored connection between innovation and sustainability.
- ES–OL: Found to be significant in only 26.66% of studies, suggesting a limited direct empirical linkage between leadership and sustainability.

Table 2: Classification of Interrelationships: Based on research type with respective citations

Inter-Relations	Empirical	Conceptual	Qualitative	Review - Based	Total Citations	Average citations	Relation-wise Total
BD-OL	20	21	14	9	1413	22.08	64
BI-BD	19	28	19	15	3250	40.12	81
BI-OL	27	25	27	9	4049	46.01	88
ES-BD	12	6	7	2	3012	111.55	27

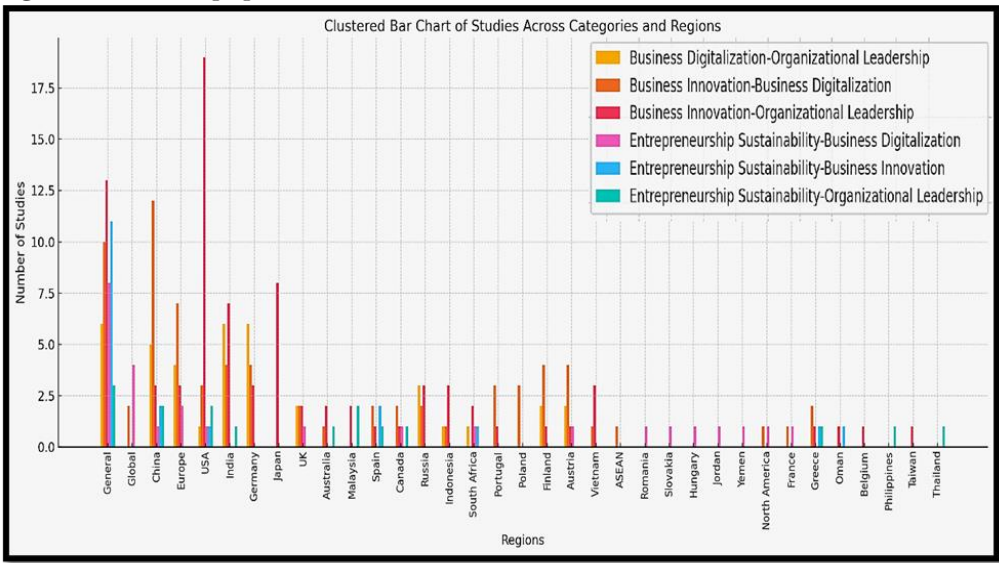
ES-BI	4	7	3	6	512	25.60	20
ES-OL	8	4	1	2	245	16.33	15
Total	90	91	71	43	12481	42.30	295

Source: Compiled by authors by extracting from various data-base

295 articles/studies have been considered fit (Table 2). The results are as follows:

- Out of these studies, it has been found that the relationship between BI and OL is the most researched aspect in terms of the number of studies as well as the total number of citations in this area, followed by the relation between BI and BD, which is the second most researched aspect of the study.
- BD and ES as a relation have been explored in merely 27 studies in comparison to BD and OL, which have been studied in 64 studies, but the numbers change when it comes to citations of these to relations, as BD and ES have more than double the citations BD and OL have. Further, the BD - ES relationship is highly cited, with an average of 111.55 citations per article.
- ES with BI and OL as relations have 20 and 15 studies, respectively, and it can be inferred that these areas are relatively underexplored in terms of citations.

Figure 1: Studies along regions



From the above figure, we witnessed the following results:

- Regarding the geographical spread of studies of these interrelationships, the relationship between BD and OL has been studied extensively. The highest number of studies has been witnessed in the Indian and German contexts, with six studies each, followed by five Chinese and four European studies. The rest of the countries with a significant number of studies include Russia, UAE and Sweden, with three studies each.

Norway, Finland, Spain, Italy, and the UK have two studies. Lithuania, Latvia, Estonia, Lebanon, Indonesia, Brazil, South Africa, Singapore, Portugal, Austria, Lagos, Nigeria, Malaysia, New Zealand, the Republic of Kosovo, the Czech Republic, and Switzerland, with one study each. Apart from the mentioned countries, some studies addressing the above linkage have been conducted and are not specific to any particular geographic region. Looking at the significance of India and China, it can be inferred that effective organisational leadership can drive business digitalisation in Asian and European contexts significantly, but context and nature studies say that the applicability will be helpful worldwide.

- The relationship between BI and BD has also been widely studied worldwide. The highest number of studies has been done in the Chinese context, with twelve studies, followed by Europeans with seven studies. India, Germany, Finland, and Austria also have four studies each; the USA and Portugal have three studies each, followed by Spain, Greece, Global, Canada, UK, Russia, Switzerland, Sweden, and Brazil, with two studies each. Serbia and Kazakhstan also have one study each on the landscape. Apart from these studies, ten articles have general contextual applicability, and two studies have been conducted globally. By examining the importance of China, India, and Europe, it can be deduced that implementing digitalisation strategies can significantly enhance company innovation in Asian settings.
- There has been a disproportionate amount of research worldwide on OL and its connection to BI. The American setting has been the site of the most research, with nineteen studies, followed by Japan and India with thirteen and eight studies, respectively, and then Germany, Europe, Vietnam, China, Indonesia, and Korea, with three studies each. Further, Australia, South Africa, Taiwan, Thailand, and Spain are the other countries with two studies. Followed by Poland, Mexico, Morocco, Portugal, and Italy, each with one study. Thirteen studies in this field are in the general context. Business innovation in the American and Asian contexts can be significantly boosted by solid organisational leadership.
- There may not be many studies examining the connection between ES and BD, but the literature on the topic is extensive and high-quality. Much research has focused on a worldwide scale, and some studies are more regionally specific but relevant. Evidence suggests that European academics are just as enthusiastic about this topic in two studies. Yet, Asians have not yet delved into this field of study. Countries that have started setting foot on these matters with one study each include Romania, Slovakia, the UK, Hungary, Jordan, Yemen, North America, the USA, Austria, Africa, Italy, China, and France.
- Due to the few studies concentrating on a single country or region, most research on ES and BI does not pertain to any specific nation. This connection is still in its early stages. However, two studies have been conducted in several countries, including Spain and China, followed by the USA, South Africa, Belgium, and Oman, with one study each. It follows that further research into this area is warranted, which will lay the groundwork for promising future investigations.
- Among all the relevant relationships in this study, the one between ES and OL has received the least research. So far, the US, China, and Malaysia have served as the region's unofficial emblem bearers with two studies each. The partnership is still in its early

stages but has already expanded to other areas, including the Philippines, India, Poland, Spain, and Australia, with one study each. To summarise, this field of study has not yet established its place in the larger body of knowledge.

We can highlight significant geographic diversity in studies exploring BD, BI, ES, and OL relationships. While certain regions, such as India, China, Europe, and the USA, dominate research landscapes in these interrelationships, others, like Africa, Southeast Asia, and Eastern Europe, are underrepresented. This imbalance highlights the need for broader exploration to enhance the global applicability of findings. The substantial focus on BD-OL and BI-BD relationships in Asia and Europe underscores the importance of digitalisation and innovation driven by strong leadership. Conversely, the limited studies on ES-BI and ES-OL relationships indicate these areas are developing but hold the potential for impactful insights. To maximise the global relevance of findings, future research should target underexplored regions and examine how local institutional, cultural, and technological contexts influence the dynamics between digitalization, leadership, innovation, & sustainability, thereby expanding the applicability of these interconnections, providing diverse contexts, and strengthening the global understanding of how these elements influence organisational success. Furthermore, longitudinal studies are essential to understand how these relationships evolve as organisations advance in their digital maturity, offering richer insights into cross-regional and sector-specific transformations.

Based on the above, the study verifies the following working assumptions:

- H1: There is a strong positive relationship between business digitalisation and organisational leadership → Verified
- H2: Business digitalisation significantly drives business innovation → Verified
- H3: Business digitalisation enhances entrepreneurship sustainability → Strongly Verified
- H4: Business innovation supports entrepreneurship sustainability → Moderately Verified
- H5: Organisational leadership independently drives entrepreneurship sustainability → Not Verified

The empirical findings indicate that business digitalisation is a central enabler, connecting leadership, innovation, and sustainability. Conversely, the weaker link between OL and ES suggests that leadership affects sustainability outcomes indirectly through innovation and digitalisation.

The strong correlation between BD and OL aligns with Mustafa et al. (2022) and Witschel et al. (2022), who emphasise the role of adaptive leadership in post-bureaucratic digital organisations. The role of digitalisation as a catalyst for innovation (BI) echoes findings by Gregori and Holzmann (2020) and Wang et al. (2023), who document the transformative power of digital infrastructure in creating value and agility.

However, the limited support for a direct OL–ES link contradicts earlier assumptions by Schaltegger and Wagner (2011) that leadership alone drives sustainability. Our results suggest that leadership's influence on ES remains constrained without the mediating effects of innovation and digital transformation.

6. Conclusion and Implications

This meta-analytical study sought to explore the synergistic interrelationships among business digitalisation (BD), organisational leadership (OL), business innovation (BI), and entrepreneurship sustainability (ES) across a global sample of scholarly literature published between 2001 and 2023. 311 empirical, conceptual, qualitative, and review-based studies were analysed using bibliometric and content analysis methods.

The findings confirmed that business digitalisation is a central enabler of innovation and entrepreneurship sustainability. Specifically, the study found that:

- 83.82% of studies confirm a positive relationship between BD and OL, highlighting leadership's role in driving digital transformation.
- 77% of studies validate the link between BD and BI, underscoring the importance of digital tools in fostering innovation.
- 88.88% of the literature supports a significant relationship between BD and ES, confirming the digital foundation for sustainable ventures.
- The link between BI and ES is supported by 69.56% of studies, suggesting that innovation indirectly supports sustainability when mediated by digitalisation.
- The ES-OL relationship received the least support, with only 26.66% of studies affirming a direct link, indicating that leadership influences sustainability mainly through digital or innovative pathways.

These results verify the hypothesis that BD, OL, BI, and ES are interconnected and exhibit synergistic effects that can be strategically harnessed to enhance entrepreneurial sustainability. Notably, the research also reveals underexplored regional contexts, particularly in Asia and Africa, where specific linkages such as ES-BI and ES-OL are still in the nascent stages of investigation.

This study presents several practical implications:

- For policymakers: The results highlight the need for targeted support policies that promote digital capacity-building and leadership development to foster sustainable entrepreneurship.
- For economic development agencies: Emphasising innovation ecosystems and digital infrastructure can accelerate the growth of sustainable enterprises and startups.
- For industry leaders: A dual focus on digital transformation and leadership agility is essential to navigate competitive markets and achieve long-term sustainability goals.
- For businesses and entrepreneurs: The research underscores the value of investing in digital tools, fostering innovation, and adopting forward-looking leadership practices to build resilient and socially responsible organisations.

6. Limitations and Future Research Avenues

This study is subject to following limitations:

- It relies exclusively on secondary data from published literature without incorporating primary data. So, while the meta-analysis integrates findings of multiple studies, the absence of primary data and empirical analyses may reduce the depth of causal analysis.

- Although the meta-analysis covers many studies, manual literature review methods may introduce subjectivity and potential selection bias.
- The study focuses only on articles in English, which may restrict the global applicability of the findings by excluding valuable insights from non-English literature.
- No econometric modelling or regression testing was applied, limiting the statistical depth of causality verification.
- Studies focusing on African countries, south Asian countries, and South American countries could not be extracted specifically, which evolved as a limitation of this study.
- Sector-specific effects are not the primary focus of this review, acknowledging these distinctions provides a more nuanced foundation for future research.
- Leadership styles specifically not been studied connecting to business innovation, and sustainable entrepreneurship, which can provide new dimensions of implications.

These limitations suggest that, although the findings provide meaningful insights, they remain somewhat constrained and should be interpreted with caution.

Based on these findings and limitations, several future research directions are recommended:

1. Primary data collection through surveys or interviews and empirical validation through quantitative modelling or structural equation models can strengthen the directional relationships between constructs, which can broaden the implications and generalizability of this study.
2. Include non-English literatures to broaden the geographical and cultural scope of the insights.
3. Geographical expansion, especially in underrepresented regions such as Africa, Southeast Asia, and South America, is needed to understand context-specific dynamics.
4. Sector-specific studies to explore how these relationships vary across industries such as manufacturing, tech, healthcare, or education.
5. Longitudinal studies will be conducted to analyse how these synergies evolve with digital maturity and market development.
6. Integration of sustainability metrics, such as ESG performance indicators, to link academic analysis with practical sustainability outcomes.
7. Future researchers can extract some widely accepted grey area literature specifically on African countries, south Asian countries, and South American countries, which can enhance the global implications of this study.
8. Exploring various contextual barriers such as digital readiness, financial accessibility, and cultural norms that affect entrepreneurs' ability to leverage digitalization effectively.
9. Future researchers can acknowledge the distinctions among different industries as this aspect provides more nuanced foundation for future research both empirically & theoretically.
10. Leadership styles can be considered by the future researchers as intersecting point among business innovation, digitalization and sustainable entrepreneurship, which can explore new dimensions of competitive advantage of entrepreneurs.

In conclusion, this review establishes that digitalisation plays a pivotal role in driving innovation and sustainability, supported by strong global evidence. By synthesising

insights from diverse studies, it offers an integrated understanding of how digitalisation, organizational leadership, innovation, and entrepreneurial sustainability interacts. While the review recognises regional gaps and limited evidence on direct leadership-sustainability links, these areas provide opportunities for deeper inquiry. Overall, the study bridges theory and practice by presenting a comprehensive synthesis of existing knowledge and setting a foundation for future empirical investigations across different sectors and regions.

Acknowledgment: This study was created as a part of the project entitled Rozvoj Vysoké školy NEWTON, a.s. with number CZ.02.02.XX/00/23_022/0008969, which is co-financed by the European Union through the European Social Fund Plus (ESF+) within the Jan Amos Komenský Operational Program (OP JAK).

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