

Sustainable Development Goals and Blockchain: A Systematic Literature Review from a Business Studies Perspective

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Abstract: This study reviews the state-of-the-art relationship between sustainable development and blockchain technology, which can be intertwined concepts within business language, enterprise structures, and managing processes. It explores further comprehension of concepts such as digital technologies, blockchain technology, and the United Nations' Sustainable Development Goals. A systematic literature review using the Prisma Protocol is conducted to identify the main researched topics and the most used sustainable development goals. In addition, the main articles, authors, and journals of the research field are identified. An analysis of the results is applied to acknowledge the findings' contribution. As an outcome, the study identifies 14 main subject research areas that can serve as a framework for the future, including 49 main topics relevant to blockchain technology's relation with sustainable development goals in business studies. This systematic literature review contains an extensively researched database about the subject, and its results and findings are valuable in the scientific and professional sectors for further studies in sustainable development using blockchain technology.

Keywords: Sustainable development goals, Blockchain technology, Business studies, Systematic literature review

1. Introduction

Blockchain technology (BT) growing interest is reflected in the accumulated use number of applications and research articles about the subject, with a particular focus on its relationship with sustainability and the circular economy from different industrial sectors emerging from it (Kouhizadeh et al., 2021; Saberi et al., 2019). Besides, distributed ledger technologies (DLTs), which BT is part of, not being new, the renewed interest grew, in 2008, with the publication of the white paper "Bitcoin: A Peer-to-Peer Electronic Cash System" (Nakamoto, 2008). Since then, this emerging technology has grown drastically regarding the number of intervenients. Its usage also supports decentralised transactions across various business fields, promoting disintermediation, authentication, data integrity, traceability, trust and transparency across different applications (Yadav and Singh, 2015).

However, the disparity of use cases and applications can lead to disconnected strategies and paths when addressing common causes such as sustainability. Therefore, as a framework, the United Nations Sustainable Development Goals (UN SDGs) can serve as a guideline for a renewed agenda to embrace organisations and individuals in an aligned sustainable development process until 2030. By substituting the old Millennium Development Goals and introducing a more complex approach, collaboration and engagement of the different intervenient is necessary (United Nations, 2023), and technology, in particular BT, can boost sustainability transition and must be considered vital to sustainable business models.

1.1 Importance of the Study

This research reviews the main concepts of BT and the SDGs in business studies to analyse their relationship. It also aims to understand the main applications of BT and how and in which particular topics and more extensive subject areas the technology addresses the SDGs.

The present systematic literature review (SLR) adds relevant research to the business studies literature and offers paths for further research. The present research addresses the question: "What is the relationship between BT and SDGs and which topics are being explored in business studies?".

1.2 Methodology

We developed an SLR based on Scopus and Web of Sciences (WoS) scientific databases to address this question and used the PRISMA protocol. We structured the article as follows: a) the next section presents the main concepts and the theoretical background of the SLR, presenting the SDGs and then the BT relationship with sustainability; b) afterwards, we expose the methodology used at the SLR, where the review focused on peer-reviewed articles published between 2008 and May 2024, resulting in a final selection of 441 articles after applying inclusion and exclusion criteria; c) then, we present and discuss our results by categorising the articles and analysing their contribution to the different SDGs and the business context they address; d) we finish the paper by addressing the conclusions and limitations of the paper.

1.3 Main Contributions

The study presents an extensive and comprehensive database of key articles, authors, and journals that can be used for further research on the intersection between BT and sustainable development. By bridging theoretical and empirical insights, it highlights BT as a promoter of sustainability across different sectors, emphasising supply chain, circular economy and smart cities subjects. These are included in a framework identification of 14 leading research areas and 49 topics addressing BT’s impact on SDGs in business studies. They can serve for future research by outlining its potential research directions and exploring potential BT’s applications to enhance sustainable practices within business models.

2. Theoretical Background

2.1 United Nations Sustainable Development Goals

The SDGs is a group of 17 interrelated goals and 169 associated targets representing a comprehensive and multidimensional approach to addressing the three pillars of sustainability – environmental, social, and corporate governance (ESG) - for today’s world’s challenges. The full SDGs list is shown below in Table 1. The UN General Assembly adopted them in 2015, and they were designated to be adopted as a framework to achieve a better and more sustainable future for all by 2030. The SDGs are a significant advancement from the previous Millenium Development Goals, as they integrate social needs and environmental limits in a more holistic approach to sustainable development (Howard-Grenville et al., 2019; Jägermeyr, 2020; Kleespies and Dierkes, 2022). These goals address global challenges, including poverty, inequality, climate change, environmental degradation, peace, and justice. They also recognise that ensuring health and well-being and providing quality education is essential for achieving proper development and sustainable prosperity, an inclusive and peaceful society and a global interconnected partnership (United Nations, 2023).

For SDGs’ accomplishment, they must be perceived, accepted, and evaluated by people, but also by organisations worldwide, as their success depends on global engagement and commitment (Kleespies and Dierkes, 2022). Organisations play an essential role in achieving the 2030 agenda, and they need to promote sustainable practices and foster this mindset among their employees to drive the transformation (Elias et al., 2023). Only active engagement of organisations and integration of more sustainable practices can help realise this transformative vision and ensure a more sustainable future for all.

Table 1: UN SDGs

UN SDGs			
Goal 1: No poverty	Goal 2: Zero hunger	Goal 3: Good health and well-being	Goal 4: Quality education
Goal 5: Gender equality	Goal 6: Clean water and sanitation	Goal 7: Affordable and clean energy	Goal 8: Decent work and economic growth
Goal 9: Industry, innovation and infrastructure	Goal 10: Reduce inequalities	Goal 11: Sustainable cities and communities	Goal 12: Responsible consumption and production
Goal 13: Climate change	Goal 14: Life below water	Goal 15: Life on land	Goal 16: Peace justice and strong institutions
Goal 17: Partnerships for the goals			

2.2 Blockchain Technology and Sustainability

BT is a decentralised, transparent, and safe distributed ledger that can maintain transaction history along its chain in all nodes through peer-to-peer operations (Hastig and Sodhi, 2020; Hughes et al., 2019). Unlike centralised databases, where verification of information transactions is the responsibility of a central authority, BT employs cryptography and an agreement mechanism for confirming and enrolling new deals into a shared registry and removing intermediaries. These records can be shared either publicly or privately amongst the agents that participate in the BT (Kouhizadeh et al., 2021; Saberi et al., 2019).

The decentralised peer-to-peer operational and smart execution way that BT works allows it to have more transparency and traceability, giving more visibility, data integrity, and accountability to its operations and further enhancing also sustainability by giving more monitoring and verification allowance on the sustainability-related performance indicators (Park and Li, 2021; Saberi et al., 2019). It also allows for potentially reducing costs and more operational efficiency of business models by reducing or eliminating intermediaries.

When addressing sustainability and the SDGs, we can find a potential direct linkage benefit of using this technology by contributing to a more sustainable approach where there is more visibility and audibility on areas such as resource consumption, emissions, traceability, waste generation, fair trade and wages, and many others that can promote a transformative vision for a more sustainable future (Kamble et al., 2020; Park and Li, 2021; Saberi et al., 2019).

3. Methodology

This study aims to provide an overview of prior research on the relationship between BT and SDGs. SDGs are a guiding framework to expand the study's scope, and they conduct a comprehensive examination of the available literature focusing on the multifaceted relationship between the domains where BT can enhance sustainability from a business studies perspective. To establish a knowledge base for exploring various research streams, suggesting future research directions, and identifying commonalities and differences in research approaches and methods, we accessed and compiled an extensive database of relevant articles to guide this research process and outcome. We made an effort to access and collect crucial and trustable information accurately, as inaccuracies could bias the research results and compromise desired quality standards. Therefore, we used an appropriate and well-designed methodology to synthesise the research systematically, transparently, and context-sensitively and to help overcome the bias in the results (Tranfield et al., 2003). The findings of this study serve as a solid foundation for future scientific research by academics and professionals, which could inspire the development of an evidence-based strategy for addressing the critical challenge of sustainable development.

3.1 Question Formulation

A clear review question, developed at the beginning of the review process, is a crucial driver for a successful SLR (Nguyen et al., 2018). After defining the search strings and the scientific databases to search, based on the preliminary theoretical study, we formulated the following research question: *“What is the relationship between BT and SDGs and which topics are being explored in business studies?”*. This question leads the way for an exploration focusing on the interconnection of the UN guidance framework for a sustainable future and the emerging usage of BT across the different SDGs, thereby addressing and agglomerating main subject areas that are fast developing within the academic and professional communities.

3.2 Definition of the Review Protocol and Studies Evaluation

The SLR process and objectives, when guided by PRISMA’s diagram protocol (Page et al., 2021), lead to more reliable and precise findings. The use of unambiguous and systematic procedures, such as clearly defining inclusion and exclusion criteria, is instrumental in the identification and validation of relevant studies. It also plays a significant role in reducing the potential for errors or subjective decision-making. The endorsement of PRISMA by editorial organisations and its adoption by researchers conducting SLRs it is key in promoting transparency, reproducibility, and confidence in the reported findings (Moher et al., 2009). It also provides a comprehensive and reproducible search strategy, which is vital for the reliability, by minimizing bias, and the validity of the review (Mengist et al., 2020). Figure 1 shows the complete applied PRISMA’s protocol interaction process steps through identification, screening, eligibility, inclusion, and final records result. The subsections following Figure 1 describe in detail each step of the research review process.

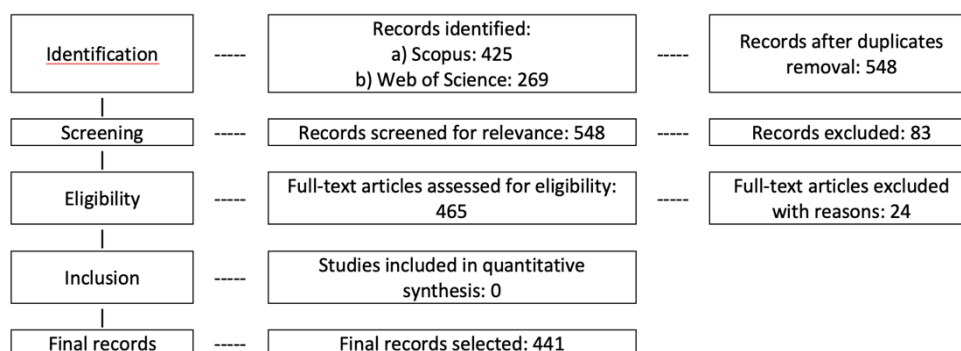


Figure 1: PRISMA’s review process of the research

3.2.1 Database selection

We restricted the systematic review search to peer-reviewed journals listed in the Scopus and WoS databases. Both sources combine a vast range of results in business studies from top-level journals, which allowed search outcomes with the most important subjects' results.

3.2.2 Search and identification strategy

Given that the context of this review is about the relationship between BT and SDGs in business studies, our search started in 2008, because this was the published date of the Bitcoin paper (Nakamoto, 2008), and we ended it by May 2024. The search string applied in both databases used the mandatory search terms "sustainab*" and "blockchain", ensuring the relevance of the retrieved search results from titles, abstracts, and keywords. We only searched data in the subject areas of Business, management and accounting. All the documents' results were limited to peer-reviewed articles with a finalised publication stage and English language.

We exported the relevant articles to a reference management software package (Mendeley). After eliminating duplicates, the two databases combined contained 548 articles.

3.2.3 Screening and exclusion criteria

In the screening step, we defined the articles criteria for a full review eligibility. We analysed all the articles' titles, abstracts, and keywords to ensure they were directly related to the mandatory topics of sustainability and BT, both of which needed to be framed by the SDGs. From this screening, we excluded 83 documents with the following criteria: E1: Articles unrelated to BT; E2: Articles unrelated to sustainability; E3: Articles unframed within SDGs; E4: Articles unwritten in English; E5: Articles unpublished between 2008 and May 2024; E6: Articles from non-peer-reviewed scientific sources; E7: Articles unrelated with business, management and accounting subjects.

3.2.4 Eligibility and inclusion

In the eligibility phase, we analysed the text of the articles to ensure they were aligned with the pre-screening phase criteria, but now, in more detail. From this eligibility procedure, we excluded 24 articles and kept 441 records to include in the SLR's final selection. We decided not to include other documents from other sources and keep with the outcomes from the Scopus and WoS databases.

3.2.5 Data extraction, structuring and analysis

The final stage of our SLR involved data processing and creating data networks to extract meaningful insights from scientific publications. The data was exported to Microsoft Excel software to organise all the entries into a single database. The accuracy of the data was assured by verifying its reliability, and the articles' content information was categorised. Ultimately, we coded each article with the relevant search terms and the SDGs it addressed. This coding process allowed us to obtain specific outputs for a more focused analysis in each group later.

Furthermore, we processed and structured the data to enhance its legibility, which facilitated the extraction of results such: a) publications per year, b) top publishing sources and authors, c) journals' quartile distribution and h-index values, d) most researched subjects, and e) top-cited articles as well as the distribution of articles per SDG and the subjects they cover. Lastly, we generated a list of topics the SDGs address and grouped them into suggested future research subject areas.

4. Analysis of the Results

The selected articles mainly cover business, management, and accounting subjects as specified in the previous section and contribute essentially to the research area of business studies. Figure 2 also shows that the number of publications on the research subject has grown substantially over the past years, reaffirming its importance. Besides starting the search in 2008, we only have two first results in 2017, assuring this is a recent research area. We can identify a growing trend of publications until 2024. This trend continues in 2024 because we already have more than half of the publications by May compared with 2023.

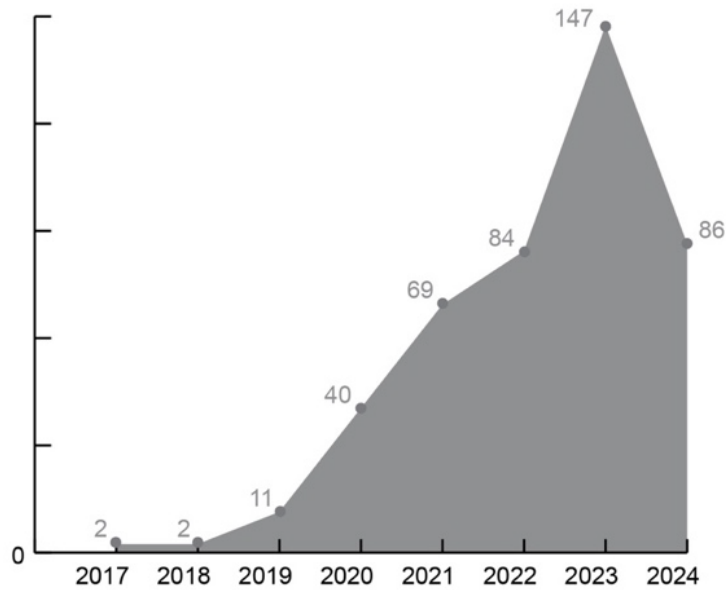


Figure 2: Publications by years

Table 2 presents a comprehensive summary of the most influential journals in our research. It details the number of published articles, the source, and the relevance. By utilising the Scimago Institutions Rankings, an internationally recognised ranking system for over 2000 research institutions and organisations (Dumay, 2014), we can identify that most articles integrate the first and second quartiles, except one journal classified in the third quartile. The outcome demonstrates the articles’ scientific quality and relevance to the research field.

Three leading researchers are more active in the literature contribution: Kumar, Anil; Sarkis, Joseph; and Mangla, Sachin Kumar. Table 3 exhibits their significant contributions, detailing the number of publications, main research subjects, affiliation, and the h-index. This comprehensive view lets us disclose their impact on advancing knowledge in this field. Table 4 summarises the most cited articles in the research field, their publication source, quartile acknowledgement and the Chartered Association of Business Schools Journal Ranking 2021 positioning.

Table 2: Most contributing journals

Source	Documents published	Quartile	H-index
Journal of Cleaner Production	39	Q1	309
Technological Forecasting and Social Change	30	Q1	179
Business Strategy and the Environment	26	Q1	147
Operations Management Research	16	Q1	41
International Journal of Production Research	12	Q1	186
Transportation Research Part E Logistics and Transportation Review	11	Q1	144
IEEE Engineering Management Review	10	Q2	38
Logforum	9	Q3	14
Journal Of Business Research	8	Q1	265
International Journal of Information Management	7	Q1	177
Corporate Social Responsibility And Environmental Management	6	Q1	113
IEEE Transactions On Engineering Management	6	Q1	112
International Journal Of Logistics Management	6	Q1	94
Logistics	6	Q2	23
International Journal Of Production Economics	6	Q1	231

Table 3: Most contributing authors

Source	Documents published	Research subjects	Affiliation contributed	H-index
Kumar, Anil	13	Sustainability; Net zero/circular economy; Sustainable operations; Industry 4.0/5.0; AI/machine	London Metropolitan University	44
Sarkis, Joseph	12	Management; Operations management; Sustainability; Supply chain management; Environment	Worcester Polytechnic Institute	115
Mangla, Sachin Kumar	9	Circular economy and industry 4.0; Supply chain; Sustainability; Decision support system; Cross-disciplinary research in OM	University of Plymouth & O.P. Jindal Global University	66
Luthra, Sunil	6	Industry 4.0; Sustainable supply chains; Circular economy; Cleaner technologies; Sustainable societies	All India Council for Technical Education	65
Bai, Chunguang April	5	Sustainable supply chain; Carbon neutrality; Industrial 4.0	University of Electronic Science and Technology of China	38
Rejeb, Abderahman	5	Supply chain; Sustainable development; Blockchain	Széchenyi István University	29
Agrawal, Rohit	4	Business and economics; Environmental sciences and ecology; Engineering; Science and technology; Materials science	Indian Institute of Management Bodh Gaya	21
Dal Mas, Francesca	4	Sustainability; Digital transformation and new business models; Intellectual capital; Knowledge management; Healthcare management;	Ca Foscari University of Venice	28
Garza-Reyes, Jose Arturo	4	Operations Management, Business Excellence, Lean Manufacturing, Six Sigma, Supply Chain Management, Manufacturing Management, Sustainable Operations	University of Derby	54
Massaro, Maurizio	4	Risk management; Hazard and operability study; Intangible asset; Intellectual capital; Business model; Sustainable business	Ca Foscari University of Venice	29
Mishra, Ruchi	4	Supply chain; Flexible manufacturing system; Commerce; Cyber physical systems; Embedded systems; Industry 4.0	Institute of Rural Management Anand	20
Mubarik, Muhammad Shujaat	4	Supply chain; Sustainability; Management; Intellectual capital; Intangible assets; Human resources; Industry	Heriot-Watt University Edinburgh	29
Yu, Zhang	4	Supply chain management; Logistics management; Green supply chain management; Green practices	Chang'an University	16

Table 4: Most cited articles

Article	Source	Quartile	ABS Journal Ranking 2021	Citations
(S Saberi et al., 2019)	International Journal of Production Research	Q1	3	1943
(Kouhizadeh et al., 2021)	International Journal of Production Economics	Q1	3	624
(Kamble et al., 2020)	International Journal of Information Management	Q1	2	544
(Hughes et al., 2019)	International Journal of Information Management	Q1	2	542
(Hastig and Sodhi, 2020)	Production and Operations Management	Q1	4	471
(Wong et al., 2020)	International Journal of Information Management	Q1	2	427
(Bai and Sarkis, 2020)	International Journal of Production Research	Q1	3	385
(Upadhyay et al., 2021)	Journal of Cleaner Production	Q1	2	333
(Di Vaio and Varriale, 2020)	International Journal of Information Management	Q1	2	287
(Saurabh and Dey, 2021)	Journal of Cleaner Production	Q1	2	280

Figure 3 resumes the number of articles contributing to each SDG and the related topic addressed. Each article can contribute to more than one SDG and, therefore, be linked more than once to the same topic. The result is 49 articles' addressed topics, highlighting the "supply chain's traceability, transparency and trust through blockchain technology" as being, by far, the most addressed topic by the articles.

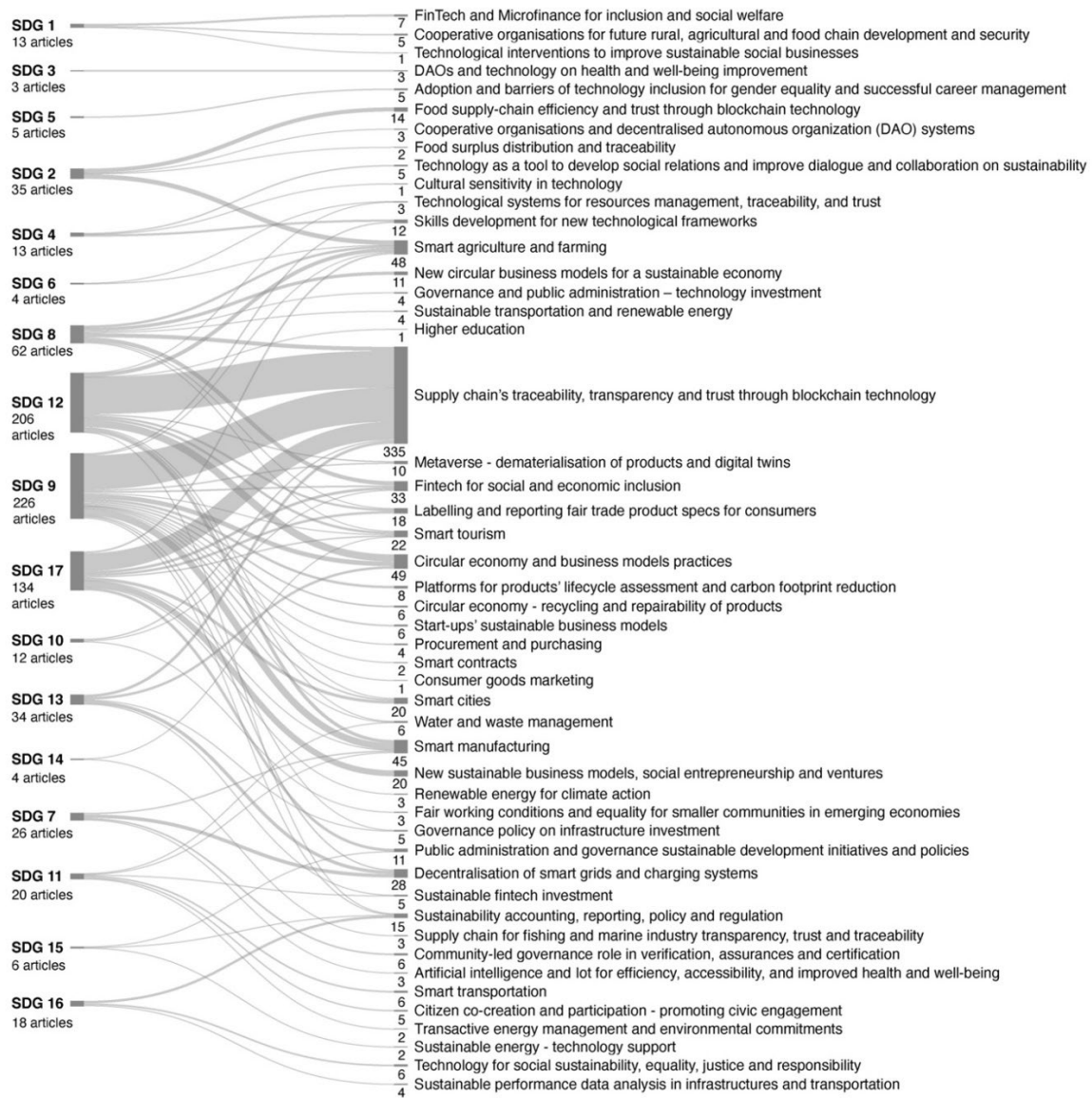


Figure 3: SDGs articles' topics

5. Conclusion and Future Research Directions

In this SLR, we analysed the main concepts, applications, topics, and subjects in which BT has intertwined with SDGs since 2008. The study's relevance and the information gathered allowed us to respond, along with the previous sections, to the initially defined research question: "What is the relationship between BT and SDGs, and which topics are being explored in business studies?". These insights resulted in acknowledging the growing trend of publications about the research area. We also gathered related information about the most contributing journals and authors and the most impactful articles crossing BT and SDGs in business studies. When using SDGs as a framework for BT in business studies, we found that SDG 9 and SDG 12 are the goals addressed the most, followed by SDG 17. The supply chain is, by far, the most addressed topic by the articles.

In order to foster future research areas in this field, we have identified 14 main subject research areas in which the explored topics are inserted. Figure 4 shows the exploration dimension of the overall research areas so far, and based on these, we describe what is addressed in each section. This information can inspire potential studies to shed more light on each and acknowledge new future research when crossing BT, SDGs, and business studies.

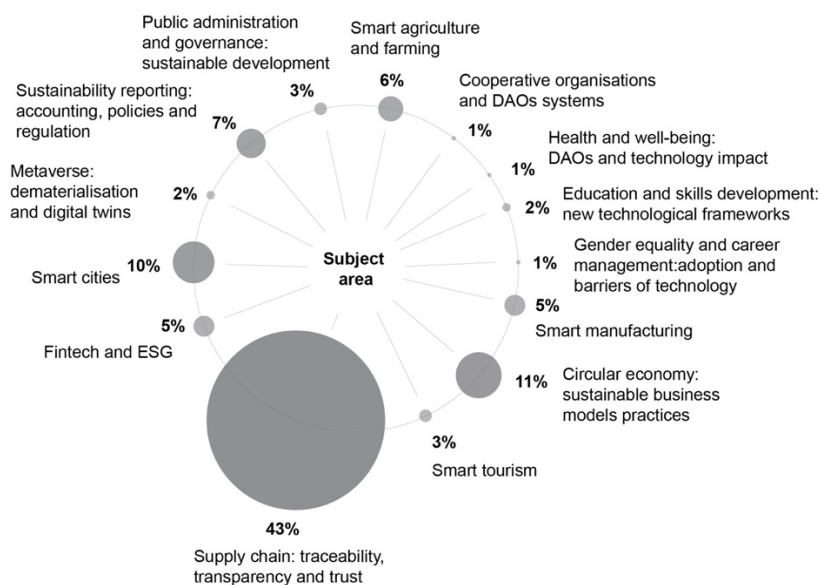


Figure 4: Subject areas

1. *Circular economy: sustainable business models practices (11%)*: with rising environmental concerns, innovative digital technology and circular business models enable a circular economy and enhance existing business models. BT, big data, Internet of Things (IoT), and other applications of digital technologies are all shaping different business fields and pushing them toward a transition with less resource consumption, less emissions, lower waste, and more organisational and private company performance and stability from an economic perspective (Khan et al., 2021; Saurabh and Dey, 2021).
2. *Cooperative organisations and DAOs systems (1%)*: although in many countries, organisations form cooperatives for business cooperation, a lack of formal mechanisms to enforce contractual agreements or other obstacles lead to decentralised autonomous organisations (DAOs) as an alternative form of governance independence (Amend et al., 2023).
3. *Education and skills development: new technological frameworks (2%)*: explores the sustainability determinants of adopting BT by higher education institutions and other stakeholders linked to the technology's growing popularity (Alshamsi et al., 2024). It also acknowledges that if we foster new technologies' knowledge and skills within organisations, this can turn into new forms of intellectual capital and have the potential to support value creation and realise SDGs (Al-Htaybat et al., 2019).
4. *Fintech and ESG (5%)*: fintech, powered by innovative technology, is driving a significant transformation in the financial industry by designing and delivering high-quality financial products and services. This transformation is being propelled by the key drivers of digitalisation and sustainability. The growing concepts of green fintech and financial inclusion prove this transformation and shape the industry's future (Mehrotra, 2023; Puschmann and Khmarskyi, 2024).
5. *Gender equality and career management: adoption and barriers of technology (1%)*: examines the role and potential of BT in promoting gender equality through the lens of new technology-oriented corporate governance models (Di Vaio et al., 2023). It also addresses financial inclusion and gender equality by exploring facilitating access to microfinance for female entrepreneurs (Kanegae et al., 2021).
6. *Health and well-being: DAOs and technology impact (1%)*: secure information holistically that can connect and assure its provenience and trustworthiness for the diverse stakeholders in healthcare, such as clinicians, scientists, and patients, and how to use technology to lead effective mechanisms for public administration (Jung and Pfister, 2020).
7. *Metaverse: dematerialisation and digital twins (2%)*: dematerialisation and digital twins, by substituting actual items for their digital counterparts, are adapting to consumer expectations (Schauman et al., 2023) and creating a relationship between the virtual and real world that can foster a more circular economy by promoting waste elimination and boosting continuous resource availability and traceability (Das et al., 2023).
8. *Public administration and governance: sustainable development (2%)*: the investigation is centred on the adoption of BT by public administration and governance in areas such as digital identity, social

- provision, and innovative climate finance that can lead to more effective administrative mechanisms and decentralisation of power (Schulz et al., 2020). Besides the effort of the adoption, there are identified barriers to keeping BT as a support tool for sustainability, such as low dissemination and high cost, energy consumption and processing time (Bai and Sarkis, 2020).
9. *Smart agriculture and farming (6%)*: explores the design, development, and application of innovative methods to transform the field with more sustainable agricultural and farming practices where technology enhances food security and information (Leduc et al., 2021).
 10. *Smart cities (10%)*: this area explores how to improve efficiency, transparency, accessibility, and quality of life in cities (Szpilko et al., 2023), from transport and logistics to smart grids and decentralisation of power energy (Said, 2023), BT enables sustainable future cities where there is empowered citizen participation and co-creation (Bagloee et al., 2021; Marsal-Llacuna, 2020).
 11. *Smart manufacturing (5%)*: it demonstrates how manufacturing can become more sustainable by balancing ESG goals. To do so, it also includes explorations about digitalisation and the disruptive combination of technologies with BT, such as artificial intelligence, machine learning, the IoT, and big data (Agrawal et al., 2023).
 12. *Smart tourism (3%)*: promoting new and innovative business models, improving the efficiency of the tourism service value chain, having a positive impact from a sustainable perspective, and enhancing the quality of the service provided to the end customer, mainly in related areas such as marketing, logistics, and smart business models (Prados-Castillo et al., 2023).
 13. *Supply chain: traceability, transparency and trust (43%)*: BT has gained attention to ease global supply chain management issues. Managing and control have become complex in a globalised world where chains have gotten too long (Wong et al., 2020). Its sustainability is also challenging to track (Di Vaio and Varriale, 2020). However, with the pressure from local and global governments, in addition to the final consumers, BT and smart contracts are supporting a change with the potential to bring more efficiency, transparency and traceability to the chain (Upadhyay et al., 2021). The technology has seen rapid acceptance in food, healthcare, logistics, and other supply chains. However, there are still barriers keeping it from its potential, such as technological unpreparedness by the intervenient and the complexity of extensive supply chains. Besides BT being well-accepted and explored, inter and intra-organizational barriers also arise, and the true blockchain-led transformation is still in its early stages (Kouhizadeh et al., 2021; Saberi et al., 2019).
 14. *Sustainability reporting: accounting, policies and regulation (7%)*: the pressure from authorities and supervisors on ESG reporting is demanding more consistency. Information unclarity can lead to different interpretations and non-comparability. BT addresses this area by creating frameworks for mitigation, automatisisation, agility, and transparency either by publicly or privately undisclosed the data (Dario et al., 2021; Pizzi et al., 2022).

Academics and professionals can use the results of the present SLR as the starting point for elaborating new research and business strategies to foster the adoption of BT and promote sustainability, taking it into account within the SDGs framework to attain meaningful impact in achieving their objectives.

Finally, we shall consider the limitations of the SLR methodological approach since it can only give us a partial overview of the literature search from a limited number of databases. Other studies may also foster more profound content analysis research, particularly in this paper's outcome subject areas and topics list.

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