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Review

Towards a connected world: Collaborative networks as a tool to accomplish the SDGs

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A R T I C L E I N F O

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A B S T R A C T

Collaborative networks (CNs) are joint entities of autonomous partners that work towards a common goal with shared resources and roles. In 2016, the United Nations announced 17 sustainable development goals (SDGs) as part of the 2030 agenda. SDG 17 is "Partnerships for the goals" highlighting the importance of cross-country and cross-company collaborative action. Although the link between CNs and sustainable development is frequently declared, no study in the literature investigates the connection between CNs and the SDGs. This systematic literature review (SLR) follows the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines. Based on the SLR results, a context-interventions-mechanisms-outcomes (CIMO) framework for CNs is proposed, serving as a tool to comprehend the types of CNs to achieve the SDGs. Only 10 out of 77 articles mentioned the SDGs they address. The norm is to focus on a single SDG per study and not assess the dimension of the impact on the SDGs or the trade-offs that can be established between them. The most frequently mentioned SDGs in the text are SDG 9 and SDG 12, with only 2 articles focusing on the social dimension. SDG 10 and SDG 16 were not mentioned in any of the articles. The majority of articles are case studies and technical papers, developing scale-up solutions and creating value from waste. The identified gaps lead to the proposition of several potential research areas: 1) the need for developing mechanisms that allow CNs to effectively implement interventions that achieve specific SDGs; 2) the lack of studies incorporating the social dimension given the social nature of the SDGs; 3) few SDGs are addressed by CNs (particularly SDG 9 and SDG 12) and majority of SDGs are ignored; 4) there is a scarcity of studies targeting the tertiary sector; 5) the need for alignment of CNs' business models with the SDGs; 6) a lack of studies addressing specific SDGs (6, 10, and 16); and 7) the necessity of studies demonstrating collaboration between industry and academia for systemic change. The study aids decision-makers in identifying policies that facilitate the formation of CNs aligned with the SDGs.

1. Introduction

In an era marked by complex global challenges, including the climate crisis, global conflicts, and natural disasters, the sustainable development goals (SDGs) serve as a guiding framework that unites individual and national efforts aiming for a sustainable, equitable, and prosperous future. The "2030 development agenda," with the theme "transforming our planet," was accepted by 193 member states of the United Nations (UN) in 2015 and in 2016, the SDGs were announced (Nations, 2023). The SDGs, encompass 17 goals presented in Fig. 1, aimed at addressing a wide array of global issues, from poverty eradication and gender equality to climate action and quality education. While the first 16 SDGs outline a vision, the 17th SDG outlines a strategy for achieving it, namely "partnerships for the goals" (Giannetti et al., 2020). As such, the UN strongly emphasizes collaborative action for transforming the world. To attain the SDGs, cooperative efforts involving governments, the private sector, civil society, and researchers are imperative. Consequently, these initiatives predominantly possess a multidisciplinary, inter-sectoral, and international nature.

In their systematic review, Eberling and Langkau (2024) found that two approaches coexist in SDG-based sustainability assessment: integrating the SDGs from the outset, or alternatively attributing the SDGs to sustainability studies subsequently. Sustainable development is seen as a concept that has many dimensions and different perceptions (Sala et al.,

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2015); and some authors argue that the SDGs themselves contain the word "sustainable" (Molina-Maturano et al., 2020). Eberling and Langkau (2024) reported that the SDGs are sometimes seen as complex, incorporating more than one dimension of sustainability, with distinct objectives that interact and contradict each other or imply trade-offs between them. In this review, to capture a greater number of studies, we included designations of SDGs and sustainability and sought to identify trade-offs between SDGs.

Collaborative networks (CNs) represent a comprehensive concept that includes partnerships, alliances, coalitions, and consortia established by diverse participants (Camarinha-Matos et al., 2022; Li et al., 2023), collaborating under certain coordination and collaboration protocols to obtain mutual benefits (Nof, 2007). Such collaboration is triggered when orders of the enterprises cannot be satisfied with their own capacities (Yoon and Nof, 2011), or when changing market conditions need to be explored (Yilmaz et al., 2017). These networks can encompass individuals, organizations, or entities joining resources to pursue common goals, thereby promoting the sharing of resources, knowledge, and expertise (Sadic et al., 2020; Wegner et al., 2023). In networks, formal agreements are complemented with informal mechanisms, such as "trust, reciprocity, information transfer" but also standard economic transactions, such as those found in buyer-seller relationships (Stål et al., 2023). Their collaborative approach enables them to tackle complex challenges that extend beyond the capacities of individual institutions or organizations.

Other forms of organizational collaboration in networks are (Fredrich et al., 2022): ecosystems (an alignment structure of the multilateral set of partners that interact to materialize a focal value proposition (Adner, 2017), open innovations (defined as purposive knowledge inflows and outflows to support internal innovation and expand the external use of internally generated innovation (Chesbrough and Crowther, 2006), supply chains (that involve multiple and interconnected members in a critical path that is well determined (Simchi-Levi et al., 1999), decomposable into bilateral company relationships in a flow of (collaboration) activities (Adner, 2017).

In literature, the conceptualization of (collaboration in) networks remains somewhat vague (Stål et al., 2023). Examples are the ecosystems that comprise interdependencies and share values (Adner, 2017), supply chains that are project-focused based on demand and capacity sharing, or the alliances that can only include market-based interactions (Stål et al., 2023), and even within a given field like ecosystems, an increased number of subforms exist: business ecosystems, service ecosystems, innovation ecosystems, platform ecosystems (Konietzko et al., 2020). Ecosystems and open innovations tend to need a focal (actor) company that defines partner alignment and ensures its role in a competitive ecosystem, (i.e., a strategy for value creation), but others like virtual enterprises rely on governance protocols to be more agile. In this study, the various types of collaboration will be referred to as CNs, as the generic class, according to the CN taxonomy established by Camarinha-Matos and Afsarmanesh (2008), where CNs are the "main umbrella" that encompasses diverse forms of collaboration in networks (Graça and Camarinha-Matos, 2017).

A business model (BM) describes the rationale of how an organization creates, delivers, and captures value (Osterwalder and Pigneur, 2010). A sustainable business model (SBM) explains how companies integrate and capture social, environmental, and economic value (Boons and Lüdeke-Freund, 2013). This normative concept specifies how firms effectively contribute to sustainable development (Stål et al., 2023), with focus on stakeholders broadly, not just shareholders and customers (Schaltegger et al., 2016) seeking the transformation of the consumption and production systems that embed firms (Bocken et al., 2014). To do so, the alignment of activities with other organizations in both horizontal and vertical directions is crucial (Stubbs and Cocklin, 2008), and network collaborations are a way to achieve such alignment (Bocken et al., 2014). Examples of strategies to implement SBMs are circular economy (CE) (Lüdeke-Freund et al., 2019), circular ecosystem innovation (Konietzko et al., 2020), and green practices (Huang and Mirza, 2023).

The technological innovations, along with the forms of collaboration and the BMs that govern them, have been another dimension of this transition to sustainability (Khan et al., 2021). Industry 4.0 technologies, such as the internet of things (IoT), artificial intelligence (AI), blockchain, cryptocurrencies, etc. provided the basis for the integration of different components and enabled the formation of autonomous and smart systems (Dantas et al., 2021). Digital platforms are developed to support smart systems by gathering real-time information from diverse stakeholders, facilitating collective decision-making, and providing a comprehensive view of resource utilization and operational efficiency (Scholz et al., 2018). Sustainability is also considered a primary driver of industry 4.0 (Beier et al., 2017). These platforms rely on a combination of interconnected processes and modules to fulfill their various functions. Effective digital platforms play a pivotal role in supporting network collaboration, empowering them with real-time data-sharing, automation, communication, and data analytics (Dantas et al., 2021; Fantke et al., 2021; Sadic et al., 2020).

In this review, CNs encompass these three dimensions: organizational form, BM, and the technological innovation that supports them.

Although CNs provide the necessary interdisciplinary and unified

SUSTAINABLE DEVELOPMENT GOALS

- SDG 1: No Poverty
- SDG 2: Zero Hunger
- SDG 3: Good Health and Well-being
- SDG 4: Quality Education
- SDG 5: Gender Equality
- SDG 6: Clean Water and Sanitation
- SDG 7: Affordable and Clean Energy
- SDG 8: Decent Work and Economic Growth
- SDG 9: Industry, Innovation and Infrastructure
- SDG 10: Reduced Inequalities
- SDG 11: Sustainable Cities and Communities
- SDG 12: Responsible Consumption and Production
- SDG 13: Climate Action
- SDG 14: Life below Water
- SDG 15: Life on Land
- SDG 16: Peace, Justice, and Strong Institutions
- SDG 17: Partnerships for the Goals

Fig. 1. UN sustainable development goals.

infrastructure for the realization of the SDGs, some points need to be further clarified:

1) CNs are formed and characterized differently across numerous sectors and goals. Collaborative efforts within and between organizations vary significantly in terms of their approach to data integration and real-time data sharing. While some entities embrace full data integration, leveraging digital platforms for their operations, others adhere to traditional, non-digital methods. Notably, there is a transformative trend where companies, once strictly customers or suppliers of one another, are dissolving sectoral boundaries, paving the way for cross-sectoral collaborations (Stål et al., 2022; van Hille et al., 2020).
2) The practical applications and scope of the CN innovative concepts remain rather elusive. The realm of CNs has witnessed the introduction of numerous innovative concepts, including product innovation, BM design, digital BMs, and CE BMs (Zucchella and Previtali, 2019). These elusive concepts contribute to the complexity of understanding collaboration content and characteristics across various sectors.
3) The semantic ambiguity of the terminology used appears to be somewhat interchangeable, with keywords like "smart," "digital," "circular," "sustainable," and "green" often used interchangeably. This semantic ambiguity adds to the challenge of comprehending the multifaceted nature of CNs within academia, industry, and managerial contexts.
4) The relationship between CNs and the SDGs is an open research area. While some articles have concentrated on the social components of the issue, others have dug into the technological aspects. Whilst few writers investigated the relationship between "partnerships or CNs" and "SDGs", none presented a comprehensive review of the research. As Stott and Murphy (2020) emphasize the importance of partnerships for SDGs and propose a more inclusive approach centered on relationships; Leal Filho et al. (2022) investigate the importance of partnerships in SDG implementation and investigate the barriers to their execution. The relationship between technology, CNs and SDGs is also a fruitful research field. Di Vaio et al. (2020) explore the literature on AI's role in SBMs and its connection to SDGs. Dantas et al. (2021) investigate the interaction between CE and industry 4.0 in accomplishing the SDGs. Giannetti et al. (2020) also studies the topic of cleaner production for achieving the SDGs, by explaining the concepts and listing some contributions.
5) The role of stakeholders in achieving particular SDGs needs further attention. In their literature review, Chauhan et al. (2022) concluded that network collaboration involved various stakeholders such as companies, consumers, governments, and society at large, and that stakeholders' pressure is one driver of the SDGs.

This study aims to help clarify the aforementioned points by developing a holistic framework that encapsulates the content, methodologies, and contributions of the extensive literature produced on this subject. This article builds upon existing research in several significant ways, addressing the pivotal question: "how do CNs contribute to the SDGs?" In doing so, it aims to bridge a noticeable gap in the current literature by creating a unified and comprehensive framework that harmonizes scattered and fragmented research in the field of CNs, sustainable development, and the SDGs. The overall objective is to create a holistic conceptual framework based on a systematic literature review (SLR) that draws the typology of the related literature, offering a well-rounded understanding of CNs' multifaceted role in advancing the SDGs. The results of the SLR are developed and presented following the logic of the context-interventions-mechanisms-outcomes (CIMO) framework adopted as part of the SLR approach.

The organization of the present study is as follows. Section 1 outlined the introduction. Section 2 underscores the research methodology. Section 3 highlights the findings of CIMO typological framework elements. Section 4 presents the developed conceptual framework. Section 5 discusses the results and Section 7 presents the conclusions.

2. Research methodology

We conducted an SLR using the CIMO methodology as guided by Denyer and Tranfield (2009). Since the purpose of this study is to develop a framework for CNs in the context of the SDGs, we employ the CIMO methodology to systematize the literature on the SDGs adoption process in CNs in the form of prescriptive design proposition frameworks. This approach considers the characteristics of CNs studied as context, the factors influencing the nature of the research, and the models developed as the interventions, the BMs, decision support systems (DSSs), and information and communication technology (ICT) platforms used as mechanisms, and the results of CNs in terms of SDGs as outcomes. This methodology aligns with our research purpose as it elucidates the logic of causality and implementation: "If you want to achieve outcome (O) in context (C), then use intervention (I) through the use of mechanism (M), allowing the production of prescription rules.

The search strategy in this SLR is designed following the preferred reporting items for systematic reviews and meta-analyses (PRISMA). The SLR aims to answer the following research question: "How do CNs contribute to SDGs?". Data collection is carried out in Scopus and Web of Science (WoS) through the following search string terms in TITLE or ABSTRACT or KEYWORDS:

a) "collaborative business model*" "sustainable development" OR
b) "collaborative business model*" "SDG*" OR
c) collaboration "supply chain*" "sustainable development" OR
d) collaboration "supply chain*" "SDG*" OR
e) collaboration "business model*" "sustainable development" OR
f) collaboration "business model*" "SDG*" OR
g) "collaborative network*" "sustainable development" OR
h) "collaborative network*" "SDG*"

The search was carried out in 2023 and the cut-off date was 2022. The searches resulted in 364 studies from Scopus, and 199 from WoS. Publications other than full-text articles written in English language are excluded from the search results.

In the screening phase, the studies are qualitatively evaluated based on the inclusion criteria: 1) papers contributing to SDG literature, 2) papers providing real-life applications or proposed BMs of CNs, and 3) papers with developed technical infrastructures or digital platforms to support CN functions.

A two-stage screening (initially titles and abstracts, and subsequently the full text) is conducted in duplicate and independently by two reviewers (SS and ED). A data screening form is created at the full-text stage to verify study eligibility and extract data on study characteristics and outcomes. In case of disagreement, the reviewers meet to discuss the data and reach a consensus.

In total, 448 studies are eligible after excluding duplicates. Accordingly, 331 of the screened articles are excluded for irrelevancy after applying the aforementioned inclusion criteria. Moreover, 37 out of the 117 eligible articles are excluded, since they were published before 2017 given that SDGs were only announced in 2016. Finally, 6 of the records are also removed for lacking direct relevance to the topic. Moreover, 3 relevant articles reached through the research are also added. Therefore, the total number of articles included in this review is 77. Fig. 2 shows the PRISMA flow diagram of this study. The final spreadsheet for each study includes the following data in the final review: name of the first author, year published, name of the journal, research topic, SDG mentioned or nexus identified, type of research, sustainability dimension, focus of the research, ICT platform, technology adopted, DSS development, methodologies used, SBM archetypes, CN designation, and industry.

The CIMO framework is used to guide literature research and to produce a synthesis of the results; in this sense, the framework is adapted

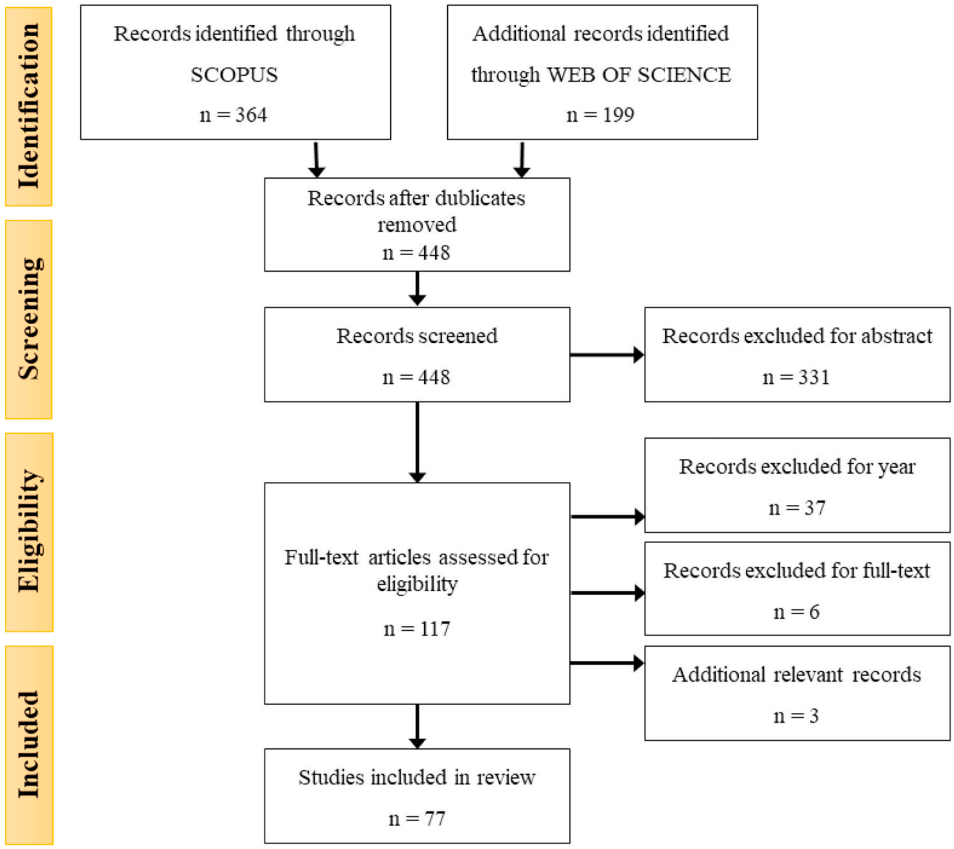


Fig. 2. PRISMA flow diagram.

to the research question "How do CNs contribute to SDGs?", divided into sub-questions according to the phases of the framework, as shown in Fig. 3. The CIMO framework serves as a tool for understanding how current CNs contribute to SDGs, it follows a mechanistic approach, as it analyzes how each component of the structure operates and interacts to produce specific results, in our case, the SDGs. The CIMO typology is particularly useful in fields where there is a need to integrate diverse research efforts, organize terminology, and understand complex interactions (Denyer and Tranfield, 2009). It helps researchers identify the key elements of a study, the changes introduced, the processes through which these changes occur, and the resulting impacts. For instance, in supply chain management literature, the CIMO framework adds value in connecting various social and organizational factors, enhancing the understanding of intricate supply chain dynamics (Khan et al., 2019; Kochan and Nowicki, 2018; Pilbeam et al., 2012). Additionally, the framework's systematic structure makes it suitable for exploring multifaceted and interdisciplinary subjects, like CNs, where multiple factors and relationships come into play.

3. CIMO typology findings

3.1. Context

To understand under which terminology, the CNs function; **the designations** of all supply chains and BMs mentioned in the articles are analyzed. The examined BMs all seek collaborative decision-making possibilities and there is variety in their given names and designations. Appendix A presents the full list of designations attributed to the studied CNs. The following keywords are repetitively used in naming CNs: sustainable (20), collaborative (20), circular (11), open innovation-based (4), ecosystem (3), smart (3), green (3), sharing (3), regional (2), product club (2), reverse logistics (2), cluster (2), industrial symbiosis (2). Other keywords used only once include resilient, associative, peer-to-peer, cross-sectoral, earth market, global, industrial ecology, virtual

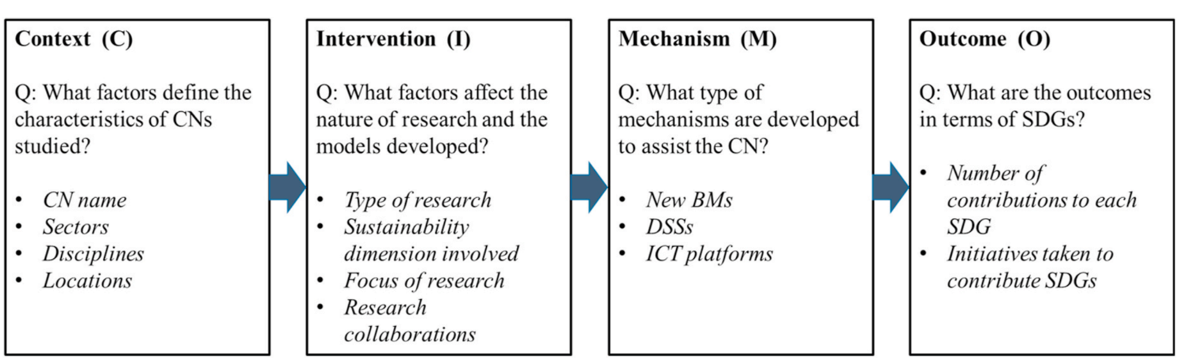


Fig. 3. The CIMO typology.

factory, virtual enterprise, social enterprise. The CN designations listed emphasize the current industrial transition, by highlighting their sustainable, collaborative, circular and smart nature.

The sector in which the CN operates is another differentiating characteristic of CNs. Appendix B provides the list of sectors grouped according to the five sectors of the economy. Fig. 4 also displays the distribution of sectors throughout the chosen literature. Each sector has its own distinct features and business requirements which influence the CN characteristics.

Primary industry, specifically food and agriculture industries, frequently mentioned as agri-food industry, garners the most attention which proves their significance in advancing sustainable development. Noteworthy approaches to this end include reducing food waste (Ciccullo et al., 2021; Moggi et al., 2018; Somlai, 2022; Zucchella and Previtali, 2019), minimizing environmental impact (Carballo-Penela et al., 2018), fostering innovative CNs and SBMs (Ammirato et al., 2021; Gallo et al., 2018; Giagnocavo et al., 2018; Hatipoglu and Inelmen, 2021; Krishnan et al., 2021; Peng and Wu, 2021; Picciotti, 2017), and enhancing sustainable packaging practices (Bogers et al., 2020).

33 articles include applications from the secondary sector, with construction receiving the highest attention. Contents of the related articles include environmental performance evaluation (Goyal et al., 2018; Kumar et al., 2022), SBM design (Ding et al., 2018; Moshood et al., 2022; Picciotti, 2017), circularity transitions (Brown et al., 2021; Franco, 2017; Hossain et al., 2020; Leising et al., 2018; Stewart and Niero, 2018; Wijewickrama et al., 2021), industrial transitions for sustainability (Balasubramanian et al., 2022; Erickson et al., 2021; Fantke et al., 2021; Marconi et al., 2017; Rappuoli and Hanon, 2018), resource and process optimization (Calmon and Graves, 2017; Hao et al., 2018; Kuo et al., 2021; Liu et al., 2022), partnerships and ecosystems for sustainability (Baldassarre et al., 2019; Larsson and Larsson, 2020; Santos et al., 2021; Toppinen et al., 2019), and innovation for sustainable materials (de Vargas Mores et al., 2018). Given that these sectors have relatively more complex supply chains, their overall performance can benefit from collaborative action facilitated by digital technologies.

Articles studying the tertiary sector explore content such as waste reduction in services (Buczacki et al., 2021), the development of new SBMs and circularity transitions (Baldassarre et al., 2019; Brown et al., 2021; De Martino, 2021; Pan et al., 2019; Picciotti, 2017; Ribarić and Stipanović, 2019; Vargas et al., 2020), and the integration of sustainability principles in operations (Aloui et al., 2021b; Gazzola et al., 2018). On the other hand, articles investigating the quaternary sector study collaboration and open innovation in education (Espada-Chavarria et al., 2021; Jirapong et al., 2021), collaborations including academy (Brown et al., 2021) and new platforms for collaborative consumption (Ertz and Leblanc-Proulx, 2018; Sinthupundaja et al., 2020). Finally, the quinary sector applications include municipal solid waste management (Fei et al., 2021), smart city design (Leu et al., 2021; Sharma et al., 2021; Stål et al., 2022) and partnerships for humanitarian purposes (Moreno-Serna et al., 2021).

Regarding the stakeholders involved in the studies, we found that companies (producers) are predominant in topics related to partner selection in networks, supply chains, CE, or in defining BMs (64 out of 77 studies). Additionally, there are 4 studies involving social communities (Ertz and Leblanc-Proulx, 2018; Hatipoglu and Inelmen, 2021; Picciotti, 2017; Sinthupundaja et al., 2020), 3 studies involving academia (Brown

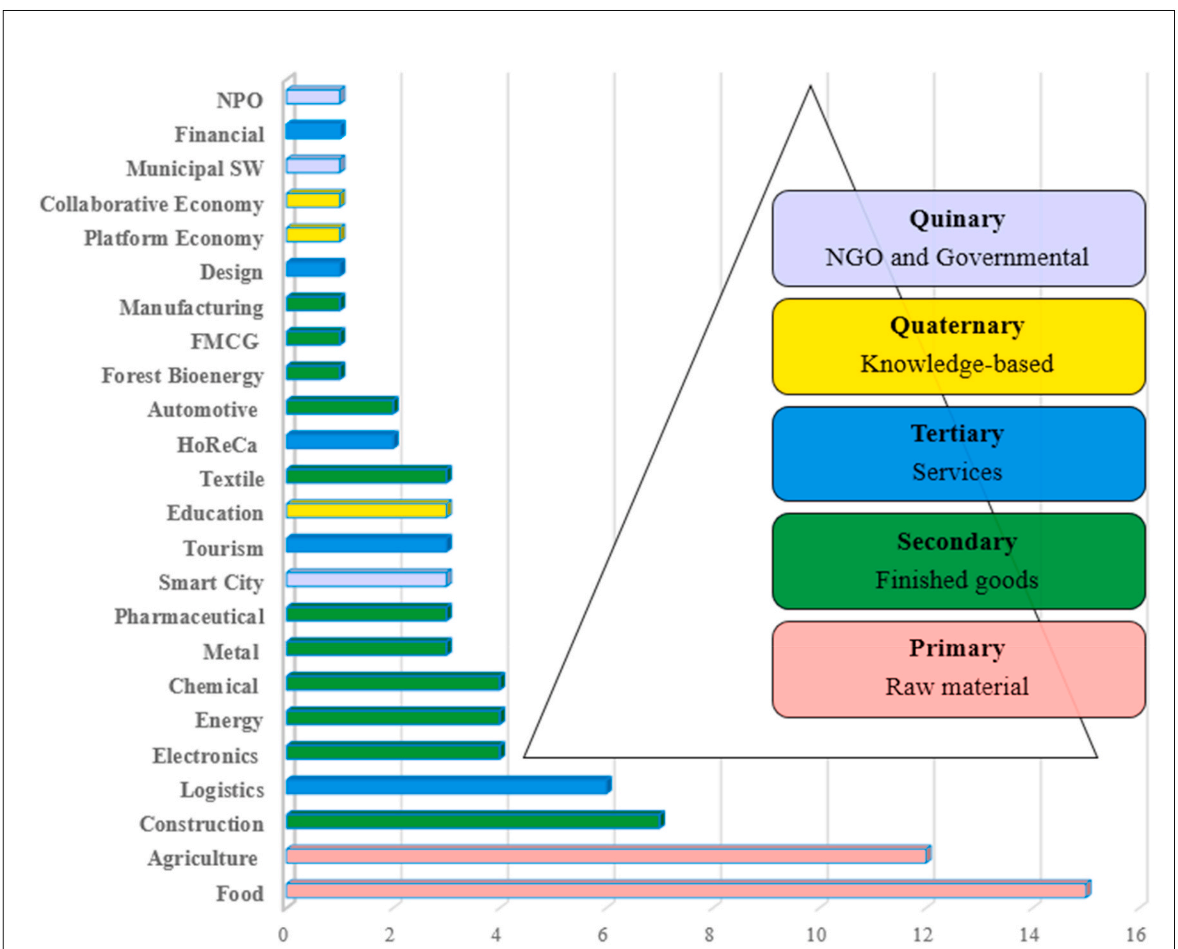


Fig. 4. Five sectors of the economy model and distribution of sectors within the selected literature.

et al., 2021; Espada-Chavarria et al., 2021; Jirapong et al., 2021), 2 studies involving government (Bruckman et al., 2018; Fei et al., 2021), 1 study involving nonprofit organizations (NPOs) (van Hille et al., 2020), 1 involving the general population (Leu et al., 2021), 1 involving both government and companies (De Martino, 2021), and 1 involving academia and companies (Alvarez-Meaza et al., 2020). Studies involving multiple stakeholders are rare and their role in achieving the SDGs has not been explored.

Multidisciplinary engagement is common in the research papers, particularly with two disciplines (22) and three disciplines (20). Single-discipline articles (25) are also noticeable. Therefore, 68 % of the 77 articles are products of multidisciplinary research. The authors come from a wide range of departments as well as multidisciplinary research centers and corporate and governmental organizations (Fig. 5). The following disciplines have the highest contribution to the research field: management (50), engineering (47), business (25), economics (22), industrial (19), technology (16), development (13), innovation (12) manufacturing (9), administration (8), and sustainability (8).

The multi-disciplinary research centers to which the authors with papers included in this review belong are quite diverse, which in some way demonstrates the interdisciplinary nature of CNs as a research area (Table 1). The areas of study include sustainability and ecology, technology with a focus on innovation and AI, operations management and supply chain, food waste and consumption, sustainable engineering, CE, eco-design, and social ecology.

By carefully analyzing each article, the location of the given case study or application is listed. Therefore, Table 2 summarizes these locations, which are mentioned as CN locations, in terms of countries and

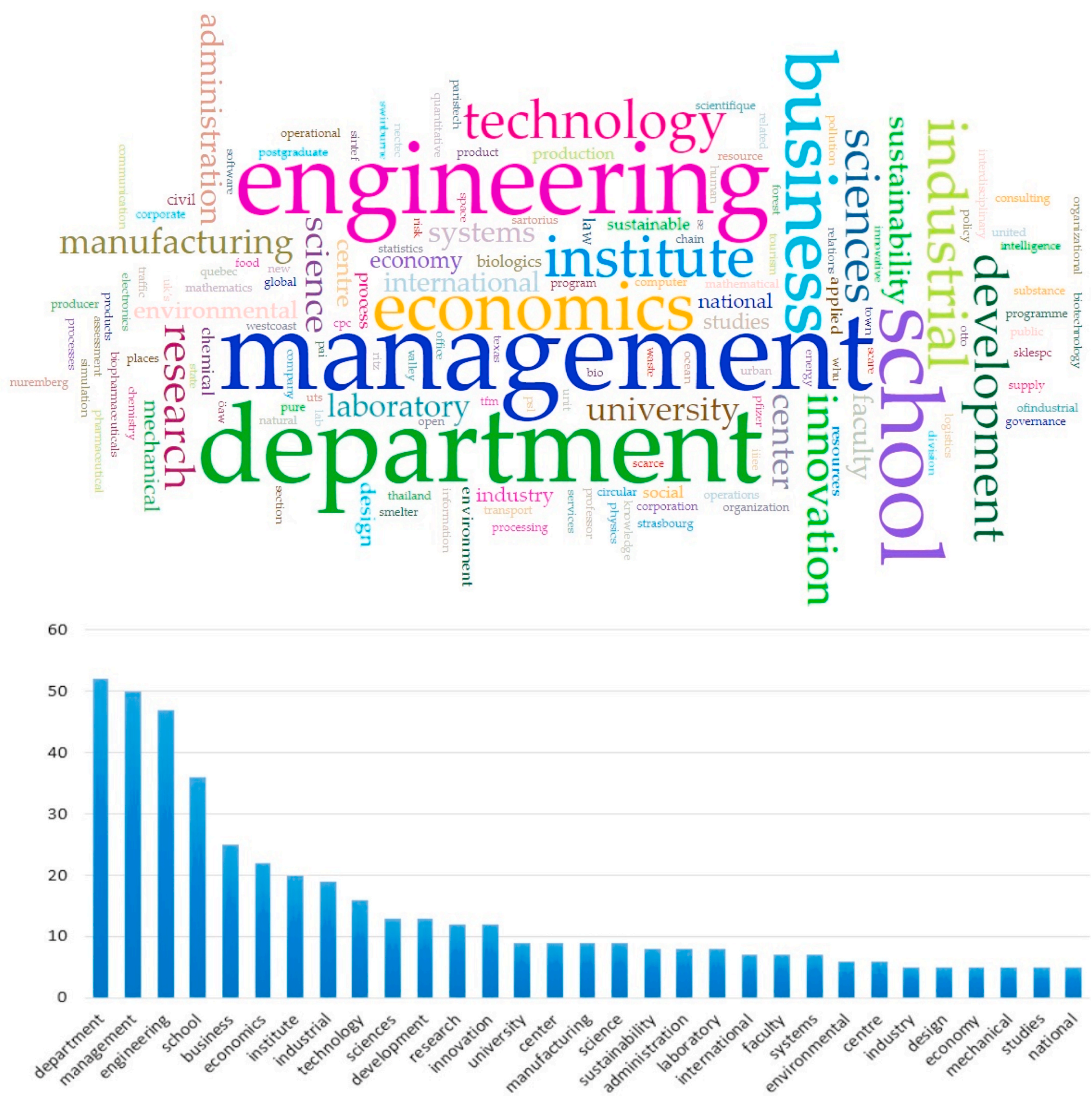


Fig. 5. Visualization of keywords in the disciplines.

Table 1
List of multi-disciplinary research centers engaged.

Research Center	Article
Artificial Intelligence for Operations Management Research Center	Kuo et al. (2021)
Center for Innovation in Technology for Human Development	Moreno-Serna et al. (2021)
Center for Sustainable Supply Chain Engineering	Govindan et al. (2019)
Center of Expertise Urban Governance and Social Innovation	van Hille et al. (2020)
Center for Sustainability Management	Schaltegger et al. (2018)
Circular Economy and Scare Resources (ScaRCE)	Wijewickrama et al. (2021)
Commission for Interdisciplinary Ecological Studies	Bruckman et al. (2018)
Corporate Sustainability Management	Schaltegger et al. (2018)
Department of Bio-Industry Communication and Development	Peng and Wu (2021)
Department of Design For a Circular Economy	Brown et al. (2021)
Department of Food and Resource Economics	Bogers et al. (2020)
Division for Quantitative Sustainability Assessment	Stewart and Niero (2018)
Fight Food Waste Cooperative Research Center	Somlai (2022)
Institute for Research on Innovation and Services for Development	De Martino (2021)
Institute for Sustainability Leadership	Fantke et al. (2021)
Institute of Social Ecology	Bruckman et al. (2018)
Institute of Sustainability Science	Toppinen et al. (2019)
Institute of Sustainable Development	van der Heijden and Cramer (2017)
Sustainability Institute	(Brown et al., 2021; van der Heijden and Cramer, 2017)
Interdisciplinary Research Laboratory on Sustainable Engineering and Ecodesign	Hossain et al. (2020)
International Sustainable Chemistry Collaborative Center	Fantke et al. (2021)
Laboratory of Environment Simulation and Pollution Control	Fei et al. (2021)
Laboratory of Innovative Technology	Aloui et al. (2021a)
New Forms of Consumption Lab	Ertz and Leblanc-Proulx (2018)
Quantitative Sustainability Assessment Department	Fantke et al. (2021)
The International Institute for Industrial Environmental Economics (IIIEE)	(Baldassarre et al., 2019; Leising et al., 2018)

their respective economic blocks: EU, BRICS, USA, UK, global, and others.

EU is the block with the maximum number of CNs. Multiple articles studied CNs located in Italy, Spain, and the Netherlands, aligning with the EU sustainability agenda. Moreover, some research is conducted in the BRICS locations, Brazil, India, and China which aligns economic growth with sustainability. The USA and UK also have a significant number of studies. The global cluster includes applications in interregional locations and others cluster refer to individual efforts of some countries. Collectively, the results reflect the interconnectedness of sustainability applications on a global scale.

3.2. Interventions

Regarding the analysis of adopted research methodologies, the articles were classified into the following five **types of research**: case studies, conceptual papers, technical papers, perspective papers, and literature reviews (Table 3). Case studies are the most frequently employed research type, with 36 papers, emphasizing the tendency for researching real-world applications of CNs for sustainability. Technical papers are the second most frequently seen research type with 19 papers, which develop tools, models, or procedures to aid decision-making. The majority of technical articles also apply their developed tools to real-world cases, demonstrating the need for decision support in industries. Other types of research also include literature reviews, conceptual articles, and perspective papers that seek to describe the research environment and comprehend the dynamics. Perspective papers provide the experiences and insights of industry specialists on a given topic to promote ongoing industrial transformations.

Table 2
List of CN locations.

Block (% of total)	Country	Articles
European Union (45%)	Italy	(Gazzola et al., 2018; Marconi et al., 2017; Moggi et al., 2018; Picciotti, 2017; Postacchini et al., 2018; Zucchella and Previtali, 2019)
	Spain	(Alvarez-Meaza et al., 2020; Carballo-Penela et al., 2018; Espada-Chavarria et al., 2021; Giagnocavo et al., 2018)
	Netherlands	(Baldassarre et al., 2019; Leising et al., 2018; van der Heijden and Cramer, 2017; van Hille et al., 2020)
	Sweden	(Larsson and Larsson, 2020; Stål et al., 2022)
	Czech Republic	Spicka (2022)
	Austria	Melkonyan et al. (2020)
	Denmark	Bogers et al. (2020)
	France	(Aloui et al., 2021a; Pan et al., 2019)
	Finland	Toppinen et al. (2019)
	Germany	Jirapong et al. (2021)
	Croatia, Slovenia	Ribarić and Stipanović (2019)
	Austria, Switzerland, Germany, Italy	Franco (2017)
	Netherlands, Germany, Latvia, Finland	Brown et al. (2021)
	Northwest Europe	Allaoui et al. (2019)
BRICS (18%)	Brazil	(de Vargas Mores et al., 2018; Oliveira Silva and Morais, 2021)
	India	(Govindan et al., 2019; Goyal et al., 2018; Krishnan et al., 2021; Kumar et al., 2022)
	China	(Ding et al., 2018; Fei et al., 2021; Liu et al., 2022; Zhao et al., 2021)
	South Africa	Trollip et al. (2022)
USA (5%)		(Erickson et al., 2021; Marusak et al., 2021; Veleva and Bodkin, 2018)
UK (5%)		(Georgiou et al., 2018; Saad and Bahadori, 2019; Vargas et al., 2020)
Global (15%)	Italy, USA, UK	Ciccullo et al. (2021)
	UK, Spain, Netherlands, Canada, Denmark, Japan, Taiwan, Belgium	Hossain et al. (2020)
	Caribbean island of Grenada, Ecuador, UK, USA	Gallo et al. (2018)
	Italy (mostly) and 13 more countries	Hatipoglu and Inelmen (2021)
	Ethiopia, Spain	Moreno-Serna et al. (2021)
	North America, Europe, Asia	Lechler et al. (2019)
	Global	(Calmon and Graves, 2017; Stewart and Niero, 2018)
	Indochina (Cambodia, Laos, Myanmar, Thailand, and Vietnam)	Bruckman et al. (2018)
Others (10%)	Taiwan	(Kuo et al., 2021; Leu et al., 2021; Peng and Wu, 2021)
	Thailand	Sinthupundaja et al. (2020)
	Colombia	Reficco et al. (2018)
	UAE	Balasubramanian et al. (2022)

The majority of articles focus on all three **sustainability dimensions** together. Table 4 presents the distribution of sustainability dimensions addressed in articles. Regarding combinations of two dimensions, only the environmental and economic dimensions encompass studies. At the individual level, the social dimension is the least studied. The economic dimension is only studied through technical and perspective papers. Regarding the joint economic and environmental

Table 3
Type of research classification.

Type of research (% of total)	Article
Case study (47%)	(Alvarez-Meaza et al., 2020; Balasubramanian et al., 2022; Baldassarre et al., 2019; Bogers et al., 2020; Bruckman et al., 2018; Carballo-Penela et al., 2018; Ciccullo et al., 2021; de Vargas Mores et al., 2018; Espada-Chavarria et al., 2021; Franco, 2017; Gallo et al., 2018; Gazzola et al., 2018; Giagnocavo et al., 2018; Hatipoglu and Inelmen, 2021; Krishnan et al., 2021; Larsson and Larsson, 2020; Lechler et al., 2019; Leising et al., 2018; Leu et al., 2021; Marconi et al., 2017; Marusak et al., 2021; Moggi et al., 2018; Moreno-Serna et al., 2021; Peng and Wu, 2021; Picciotti, 2017; Reficco et al., 2018; Ribarić and Stipanović, 2019; Sinthupundaja et al., 2020; Spicka, 2022; Stål et al., 2022; Toppinen et al., 2019; van der Heijden and Cramer, 2017; van Hille et al., 2020; Veleva and Bodkin, 2018; Zhao et al., 2021; Zucchella and Previtali, 2019)
Technical paper (25%)	(Allaoui et al., 2019; Aloui et al., 2021a; Calmon and Graves, 2017; Ding et al., 2018; Fei et al., 2021; Georgiou et al., 2018; Govindan et al., 2019; Goyal et al., 2018; Hao et al., 2018; Kumar et al., 2022; Kuo et al., 2021; Liu et al., 2022; Melkonyan et al., 2020; Moshood et al., 2022; Oliveira Silva and Morais, 2021; Postacchini et al., 2018; Saad and Bahadori, 2019; Santos et al., 2021; Vargas et al., 2020)
Literature review (14%)	(Adams et al., 2021; Aloui et al., 2021b; Ammirato et al., 2021; Buczacki et al., 2021; Ertz and Leblanc-Proulx, 2018; Hossain et al., 2020; Sánchez-Teba et al., 2021; Somlai, 2022; Stewart and Niero, 2018; Vazquez-Brust et al., 2020; Wijewickrama et al., 2021)
Conceptual paper (8%)	(Brown et al., 2021; Erickson et al., 2021; Jirapong et al., 2021; Pan et al., 2019; Schaltegger et al., 2018; Trollip et al., 2022)
Perspective paper (6%)	(De Martino, 2021; Fantke et al., 2021; Moghaddam and Nof, 2017; Rappuoli and Hanon, 2018; Sharma et al., 2021)

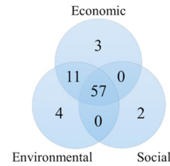
dimensions, the majority of studies (8 out of 11) are technical, with the remaining 3 being case studies (Aloui et al., 2021a; Moggi et al., 2018; Peng and Wu, 2021).

Selected publications are assessed based on their **focus and content**, and 7 distinct clusters are identified: *CE and waste management, food loss and waste management, BMs for sustainability, framework design and industrial transitions to sustainability, technology and innovation, sustainable supply chain, collaboration and partnerships* (Table 5). These clusters provide an overview of the main themes and research streams in a variety of sectors. The findings within each cluster are presented as follows, with the techniques and strategies employed.

CE and waste management: This cluster comprises 9 articles with case studies and reviews. The challenges (Hossain et al., 2020), dynamics (Veleva and Bodkin, 2018), and factors (Stewart and Niero, 2018) associated with the transition are explored and the foundation of information brokerage for CE in the construction industry is studied (Wijewickrama et al., 2021). Moreover, industrial symbiosis is examined from CE and industrial ecology perspectives (Baldassarre et al., 2019) and practices (Fei et al., 2021; Sharma et al., 2021) on reducing waste generation, and increasing sustainability are proposed. Some authors also develop methods for assisting CE transition, such as a tool for supporting CE formation in the construction industry (Leising et al., 2018) and a technique for collaborative circular proposition design (Brown et al., 2021).

Food loss and waste management: This cluster encompasses 6 papers with literature reviews and case studies that examine the causes and impacts of food loss and waste (Buczacki et al., 2021; Moggi et al., 2018; Sánchez-Teba et al., 2021), as well as BMs (Zucchella and Previtali, 2019), decision support tools (Somlai, 2022) and technologies (Cicculo et al., 2021) to prevent or minimize it. This cluster addresses issues related to food waste reduction, recovery, redistribution, and sustainable food systems.

Table 4
Distribution of the sustainability dimensions addressed.

Venn diagram	Sustainability Dimension	Articles
	Economic	(Calmon and Graves, 2017; Hao et al., 2018; Rappuoli and Hanon, 2018)
	Environmental	(Carballo-Penela et al., 2018; Goyal et al., 2018; Postacchini et al., 2018; Toppinen et al., 2019)
	Social	(Espada-Chavarria et al., 2021; Moreno-Serna et al., 2021)
	Economic, Environmental	(Brown et al., 2021; Ding et al., 2018; Georgiou et al., 2018; Kuo et al., 2021; Leising et al., 2018; Marconi et al., 2017; Moshood et al., 2022; Saad and Bahadori, 2019; van der Heijden and Cramer, 2017; Vargas et al., 2020; Veleva and Bodkin, 2018)
	Economic, Social	N/A
	Environmental, Social	N/A
	Economic, Environmental, Social (Triple bottom line)	(Adams et al., 2021; Allaoui et al., 2019; Aloui et al., 2021a, 2021b; Alvarez-Meaza et al., 2020; Ammirato et al., 2021; Balasubramanian et al., 2022; Baldassarre et al., 2019; Bogers et al., 2020; Bruckman et al., 2018; Buczacki et al., 2021; Cicculo et al., 2021; De Martino, 2021; de Vargas Mores et al., 2018; Erickson et al., 2021; Ertz and Leblanc-Proulx, 2018; Fantke et al., 2021; Fei et al., 2021; Franco, 2017; Gallo et al., 2018; Gazzola et al., 2018; Giagnocavo et al., 2018; Govindan et al., 2019; Hatipoglu and Inelmen, 2021; Hossain et al., 2020; Jirapong et al., 2021; Krishnan et al., 2021; Kumar et al., 2022; Larsson and Larsson, 2020; Lechler et al., 2019; Leu et al., 2021; Liu et al., 2022; Marusak et al., 2021; Melkonyan et al., 2020; Moggi et al., 2018; Moghaddam and Nof, 2017; Oliveira Silva and Morais, 2021; Pan et al., 2019; Peng and Wu, 2021; Picciotti, 2017; Reficco et al., 2018; Ribarić and Stipanović, 2019; Sánchez-Teba et al., 2021; Santos et al., 2021; Schaltegger et al., 2018; Sharma et al., 2021; Sinthupundaja et al., 2020; Somlai, 2022; Spicka, 2022; Stål et al., 2022; Stewart and Niero, 2018; Trollip et al., 2022; van Hille et al., 2020; Vazquez-Brust et al., 2020; Wijewickrama et al., 2021; Zhao et al., 2021; Zucchella and Previtali, 2019)

BMs for sustainability: This cluster covers 10 publications that look at the link between BM innovation and sustainability (Sinthupundaja et al., 2020; Trollip et al., 2022), new BMs for sustainability (De Martino, 2021), and case studies with innovative SBMs (Ding et al., 2018; Gallo et al., 2018; Hatipoglu and Inelmen, 2021; Lechler et al., 2019; Moshood et al., 2022; Picciotti, 2017; Reficco et al., 2018). These empirical research papers and case studies demonstrate the ways organizations

Table 5
Distribution of the focus of the research.

Focus of Research	Articles
CE and waste management	(Baldassarre et al., 2019; Brown et al., 2021; Fei et al., 2021; Hossain et al., 2020; Leising et al., 2018; Sharma et al., 2021; Stewart and Niero, 2018; Veleva and Bodkin, 2018; Wijewickrama et al., 2021)
Food loss and waste management	(Buczacki et al., 2021; Cicculo et al., 2021; Moggi et al., 2018; Sánchez-Teba et al., 2021; Somlai, 2022; Zucchella and Previtali, 2019)
BMs for sustainability	(De Martino, 2021; Ding et al., 2018; Gallo et al., 2018; Hatipoglu and Inelmen, 2021; Lechler et al., 2019; Moshood et al., 2022; Picciotti, 2017; Reficco et al., 2018; Sinthupundaja et al., 2020; Trollip et al., 2022)
Framework design and industrial transitions to sustainability	(Balasubramanian et al., 2022; Erickson et al., 2021; Fantke et al., 2021; Franco, 2017; Moghaddam and Nof, 2017; Oliveira Silva and Morais, 2021; Rappuoli and Hanon, 2018)
Technology and innovation	(Allaoui et al., 2019; Bogers et al., 2020; de Vargas Mores et al., 2018; Georgiou et al., 2018; Hao et al., 2018; Kuo et al., 2021; Leu et al., 2021; Liu et al., 2022; Pan et al., 2019; Vargas et al., 2020)
Sustainable supply chain	(Adams et al., 2021; Aloui et al., 2021a; Calmon and Graves, 2017; Carballo-Penela et al., 2018; Govindan et al., 2019; Goyal et al., 2018; Kumar et al., 2022; Marconi et al., 2017; Marusak et al., 2021; Melkonyan et al., 2020; Postacchini et al., 2018; Saad and Bahadori, 2019; van der Heijden and Cramer, 2017)
Collaboration and partnerships	(Aloui et al., 2021b; Alvarez-Meaza et al., 2020; Ammirato et al., 2021; Bruckman et al., 2018; Ertz and Leblanc-Proulx, 2018; Espada-Chavarria et al., 2021; Gazzola et al., 2018; Giagnocavo et al., 2018; Jirapong et al., 2021; Krishnan et al., 2021; Larsson and Larsson, 2020; Moreno-Serna et al., 2021; Peng and Wu, 2021; Ribarić and Stipanović, 2019; Santos et al., 2021; Schaltegger et al., 2018; Spicka, 2022; Stål et al., 2022; Toppinen et al., 2019; van Hille et al., 2020; Vazquez-Brust et al., 2020; Zhao et al., 2021)

integrate sustainability principles into their operations, products, and services. This cluster introduces innovative BMs such as earth market (Hatipoglu and Inelmen, 2021), social enterprise (Picciotti, 2017) and assessment-sharing strategic alliances (Lechler et al., 2019), as well as industry-wide collaborations for sustainability like "the collaboration between a coal power plant and a green service provider" (Ding et al., 2018), and "the industrial synergy of microalgae cultivation in biodiesel production" (Moshood et al., 2022). These novel BMs seek economic success while fostering environmental and social well-being. The methodologies presented in this cluster offer examples of bottom-up transformations towards sustainable industries.

Framework design and industrial transitions: Numerous studies develop frameworks to lead diverse industries in their sustainability transitions. The subjects addressed in the frameworks encompass various sectors and topics including; the integration of industry 4.0 technologies in the construction sector for sustainable transitions (Balasubramanian et al., 2022), a framework for collaborative factory of the future (Moghaddam and Nof, 2017), sustainable vaccine development process and collaborative approaches (Rappuoli and Hanon, 2018), the transformation of the chemical sector to a circular and sustainable state (Fantke et al., 2021), challenges and factors in circular transitions within the textile industry (Franco, 2017), collaborative frameworks for solid waste management towards a CE (Oliveira Silva and Morais, 2021), and a strategic collaboration in the biopharmaceutical industry focusing on technology, flexibility, and sustainability (Erickson et al., 2021). This cluster offers top-down, strategic, and collaborative methodologies for transforming sectors toward sustainability.

Technology and innovation: This cluster focuses on smart systems essential for sustainability transformations and innovative solutions to particular challenges across the supply chain. The smart and technology-based approaches include designing or developing several modules and systems such as; the smart cities in Taiwan with applications (Leu et al., 2021), the intelligent manufacturing system in the non-ferrous metal industry (Liu et al., 2022), smart product-service system towards seamless intelligent interoperable logistics (Pan et al., 2019), collaborative planning tools and ICT platforms for sustainable supply chain management (Allaoui et al., 2019), information system to support virtual factory BM (Hao et al., 2018), collaborative operational planning, and a gain sharing module for horizontal collaboration in freight logistics (Vargas et al., 2020), and smart material resource management and allocation approach (Kuo et al., 2021). The innovative solutions proposed encompass the green fiber bottle (Bogers et al., 2020), the green plastic innovation process from a supply chain perspective (de Vargas Mores et al., 2018), and the tool to measure energy requirements in glasshouse food production (Georgiou et al., 2018).

Sustainable supply chain: Integrating sustainability into supply chain design and decision-making is a major practice in the literature. Among the key topics within this cluster are sustainability performance evaluation, sustainable supply chain design, and case studies with sustainability practices. Some articles address sustainability performance measurement, such as the selection of sustainable supply chain indicators for SDGs (Kumar et al., 2022), an approach for tracing and measuring the environmental performance of supply chains with a case study from leather shoe industry (Marconi et al., 2017), redesign of a logistic network and its sustainability assessment (Melkonyan et al., 2020), redesign of a honey supply chain with life cycle assessment (LCA) (Postacchini et al., 2018), and environmental performance evaluation in Indian steel industry (Goyal et al., 2018). Additionally, some papers propose strategies for integrating sustainability into supply chains, including a framework for dynamically improving distribution network sustainability in food retail supply chains (Saad and Bahadori, 2019), a multi-objective model for sustainable collaborative transportation planning with a case study from agri-food industry (Aloui et al., 2021a), a framework with sustainable attributes for partner selection in reverse supply chains (Govindan et al., 2019), and an inventory optimization model for the consumer electronics sector reverse supply chain (Calmon and Graves, 2017). Finally, some of the articles review the literature and explore the dynamics. While Adams et al. (2021) provide a review of food supply chain sustainability strategies, others present case studies (Carballo-Penela et al., 2018; Marusak et al., 2021; van der Heijden and Cramer, 2017). These case studies include resilient regional food supply chains in the USA and their impact on SDGs (Marusak et al., 2021), collaborative strategies to reduce carbon footprint in the Spanish food sector (Carballo-Penela et al., 2018), and the role of change agents in fostering sustainable supply chain collaboration within the Dutch pig farming sector (van der Heijden and Cramer, 2017).

Collaboration and partnerships: This cluster has the highest number of articles emphasizing the importance of collaboration and partnerships in achieving sustainability goals. It includes research articles and case studies that examine collaboration practices for innovation, cross-sectoral partnership examples, CNs from various industries for sustainability objectives, and finally the link between collaboration and sustainability. Collaboration plays a crucial role in driving innovation by bringing diverse perspectives together, and fostering collective problem-solving. This relationship is explored, by highlighting the open innovation (Alvarez-Meaza et al., 2020; Espada-Chavarria et al., 2021) and innovation ecosystem (Spicka, 2022) concepts. An innovation ecosystem encompasses a network of stakeholders that support and foster creativity across numerous organizations, in contrast to open innovation, which focuses on using external ideas and cooperation to promote innovation within a single organization. While Alvarez-Meaza et al. (2020) examine Iberdrola's R&D and sustainability strategy in an open innovation environment, Espada-Chavarria et al. (2021) present an open innovation initiative to encourage internships for students with disabilities. Spicka (2022) presents an innovation ecosystem from the Czech hemp cluster, to explore how collaboration and partnerships drive innovation. The inclusive entrepreneurial ecosystem framework design is studied with a case study from China (Zhao et al., 2021). Finally, Krishnan et al. (2021) explore the link between collaboration and innovation in the food supply chain. Cross-sectoral partnership refers to joint efforts of different sectors to address common goals and challenges. It is a common practice in diverse industries, including construction which is characterized by innovation and project management. The sectors covered in the literature are automotive (Santos et al., 2021), construction (Larsson and Larsson, 2020; Stål et al., 2022; Toppinen et al., 2019), non-profit sector (van Hille et al., 2020), refugee response (Moreno-Serna et al., 2021), regional collaboration for forest development (Bruckman et al., 2018), and university-startup collaboration (Jirapong et al., 2021). Larsson and Larsson (2020) explore partnerships in sustainable project management, while Stål et al. (2022) present a case study of cross-sectoral collaboration between construction and real estate. Also, Santos et al. (2021) propose a framework for partner selection in CNs along with a case study on the development of an electric vehicle. Toppinen et al. (2019) highlight collaborative BMs and ecosystem dynamics in the Finnish wooden multistory construction industry, emphasizing sustainability. Van Hille et al. (2020) explore an NPO forming cross-sector partnerships to achieve sustainability objectives. Subsequently, the dynamics of a multi-stakeholder partnership in Spain for refugee response are examined (Moreno-Serna et al., 2021). Additionally, Bruckman et al. (2018) investigate the regional collaboration of Indochina countries for sustainable forest development. Finally, Jirapong et al. (2021) study the impact of university startup collaboration on SDGs. CNs are formed worldwide for various contexts to achieve sustainability objectives. While Gazzola et al. (2018) study the impact of cycle tourism on sustainable development in Italy, Aloui et al. (2021b) investigate collaboration and sustainability in freight transportation. Ribarić and Stipanović (2019) introduce a CN, the tourism product club, through the Parenzana product club. Moreover, a CN from rice production in Taiwan to explore transition to eco-agriculture is presented (Peng and Wu, 2021) and a framework is proposed for designing CNs for agri food sector (Ammirato et al., 2021). Further, the role of cooperatives as a coordination mechanism in promoting sustainable practices is examined (Giagnocavo et al., 2018). The link between collaboration and sustainable development is also studied. Schaltegger et al. (2018) address collaborative entrepreneurship and implications for sustainable development, whereas Vazquez-Brust et al. (2020) submit a review and framework on collaborative governance and sustainability performance. The role of collaborative economy in sustainability is also investigated (Ertz and Leblanc-Proulx, 2018).

Regarding **research collaborations**, out of the 77 papers, 29 are products of international collaborations. USA stands out with 11 international research partners, followed by France with 9, Denmark with 7, and China with 7. The UK has 6 and Germany has 5 while Italy, Japan, and Thailand each have 4 collaborations. A comprehensive list of these international research partnerships is available in Table 6. Alongside these international collaborations, 49 of the papers also emerge from partnerships within the same country. Therefore, Italy (7), Spain (6), USA (4), India (3), and the UK (3) have a significant number of intra-national collaborations in this particular field. This topic is not only multidisciplinary but also multiregional.

Table 6
Summary of research collaborations.

International collaboration	Countries collaborated
USA	France (2), China, Taiwan, Denmark, Italy, Finland, Thailand, Japan, Austria, Spain
France	USA (2), China (2), South Africa, Denmark, Germany, UK, Netherlands
Denmark	Germany (2), Italy, France, USA, India, UK
China	France (2), USA, Sweden, Hong Kong, Finland, UK
UK	China, France, Brazil, UAE, Denmark, Germany
Germany	Denmark (2), France, India, UK
Italy	Denmark, USA, Belgium, Switzerland
Japan	Thailand (2), USA, Austria
Austria	USA, Thailand, Japan
Hong Kong	France, China, Canada
Colombia	Mexico, Venezuela
Australia	India, Turkey
Netherlands	Sweden (2)
Malaysia	Nigeria
Norway	Poland
Intra-national Collaboration	Italy (7), Spain (6), USA (4), India (3), UK (3), Australia (3), Netherlands (3), Brazil (2), China (2), Finland (2), Germany (2), Sweden (2), Taiwan (2), France, Canada, Portugal, Croatia, Czech Republic, Denmark, France, Switzerland

3.3. Mechanisms

This section summarizes the mechanisms of the CIMO framework, by identifying the methodologies developed in the literature to assist CNs. These mechanisms are new BMs, DSSs with the methodology used, and new platforms to assist CNs with the technology involved.

In relation to new BMs, SBMs are identified in 51 out of 77 articles and classified using the **SBM archetypes** (Bocken et al., 2014). The work of Sinthupundaja et al. (2020) presents 2 SBM types. The 8 main SBM archetypes are *maximizing material and energy efficiency, creating value from waste, substituting with renewables and natural processes, delivering functionality rather than ownership, adopting a stewardship role, encouraging sufficiency, repurposing the business for society/environment, and developing scale-up solutions*. While each archetype is used at least once, some of them come forward as top-used archetypes in SBM design. Table 7 presents the list of SBM archetypes utilized in the articles. Develop scale-up solutions (21 articles of 51), create value from waste (15), and repurpose for society (9) are the most frequently used SBM archetypes. Develop scale-up solutions archetype comprises of looking at the resources and processes at a large scale to find more sustainable ways of solving problems. Collaborative approaches (16) and open innovation (3) are examples of this archetype used in practice. While collaborative approaches improve sustainability performance by resource pooling and holistic problem solving, open innovation benefits from group thinking and creativity. Waste management is frequently enhanced by innovative collaborative BMs. Numerous applications of the create value from waste archetype is found in the selected literature. CE (7), industrial symbiosis (4), sharing assets (2), and reuse, recycle, and re-manufacture (2) are among the most encountered examples. Repurpose for society or environment emphasizes the transformation of business activities to contribute to societal well-being and environmental sustainability. Hybrid businesses, social enterprise (for profit) (4), alternative ownership: cooperative, mutual collectives (3), and not-for-profit (2) are its most common examples. Through these SBMs, businesses can aim for a positive impact beyond financial gains. These archetypes provide a structure for the classification of SBMs and serve as a mechanism to facilitate SBM design. They can also inspire the design of innovative SBMs.

A **DSS** is a software application that aids intra- or inter-company decision-making. Table 8 summarizes the DSSs found in the articles (16 out of 77), along with the methodology used. These DSSs are clustered as follows: *collaborative planning, network formation, operational planning, sustainability performance measurement*, and *others*. While collaborative planning DSSs enable joint decision-making in CNs, the network formation DSSs facilitate supply chain design and partner selection decisions with sustainability concerns. Operational planning DSSs integrate and optimize processes within a single company. In addition, new DSSs are also being developed for *sustainability performance measurement*. Optimization and simulation approaches are

Table 7
SBM archetypes utilized.

New BMs Developed	Content	Articles
1. Maximize material and energy efficiency:	1.1 Low-carbon manufacturing solutions	Saad and Bahadori (2019)
2. Create value from waste	2.1. Industrial symbiosis	(Baldassarre et al., 2019; Fei et al., 2021; Moshood et al., 2022; Spicka, 2022)
	2.2. CE, closed loop	(Brown et al., 2021; Franco, 2017; Leising et al., 2018; Sharma et al., 2021; Veleva and Bodkin, 2018; Wijewickrama et al., 2021; Zucchella and Previtali, 2019)
	2.3. Sharing assets (shared ownership and collaborative consumption)	(Ertz and Leblanc-Proulx, 2018; Sinthupundaja et al., 2020)
	2.4. Reuse, recycle, re-manufacture	(Calmon and Graves, 2017; Postacchini et al., 2018)
3. Substitute with renewables	3.1. Zero emissions initiative	Ding et al. (2018)
4. Deliver functionality rather than ownership	4.1. Use oriented, product service system (PSS), rental, lease, shared	Pan et al. (2019)
5. Adopt a stewardship role	5.1. Radical transparency about environmental or social impacts	Lechler et al. (2019)
	5.2. Resource stewardship	van der Heijden and Cramer (2017)
6. Encourage sufficiency	6.1. Slow food	Hatipoglu and Inelmen (2021)
7. Repurpose for society or environment	7.1. Hybrid businesses, social enterprise (for profit)	(Leu et al., 2021; Picciotti, 2017; Reficco et al., 2018; Sinthupundaja et al., 2020)
	7.2. Alternative ownership: cooperative, mutual collectives	(Giagnocavo et al., 2018; Krishnan et al., 2021; Moggi et al., 2018)
	7.3. Not for profit	(Moreno-Serna et al., 2021; van Hille et al., 2020)
8. Develop scale-up solutions	8.1. Collaborative approaches (sourcing, production, lobbying)	(Allaoui et al., 2019; De Martino, 2021; Erickson et al., 2021; Gallo et al., 2018; Hao et al., 2018; Larsson and Larsson, 2020; Liu et al., 2022; Marusak et al., 2021; Melkonyan et al., 2020; Moghaddam and Nof, 2017; Peng and Wu, 2021; Rappuoli and Hanon, 2018; Ribarić and Stipanović, 2019; Stål et al., 2022; Toppinen et al., 2019; Vargas et al., 2020)
	8.2. Open innovation	(Alvarez-Meaza et al., 2020; Espada-Chavarria et al., 2021; Fantke et al., 2021)
	8.3. Incubators and entrepreneur support models	(Jirapong et al., 2021; Zhao et al., 2021)

frequently used in DSSs for data analysis and modeling. The selected articles employ the following approaches: multi-criteria decision-making (MCDM) (Allaoui et al., 2019; Govindan et al., 2019; Kumar et al., 2022; Melkonyan et al., 2020; Oliveira Silva and Morais, 2021; Santos et al., 2021), optimization models (Allaoui et al., 2019; Aloui et al., 2021a; Ding et al., 2018; Vargas et al., 2020), heuristics (Aloui et al., 2021a; Saad and Bahadori, 2019) and simulation (Melkonyan et al., 2020). *Collaborative planning* DSSs employ optimization and MCDM to facilitate effective cooperation and resource optimization among partners in the following domains: collaborative optimization, vehicle routing, collaborative routing, profit allotment, incentive sharing, and activity and cost allocation. These DSSs are enablers of effective CNs and

Table 8
Decision support systems developed.

DSS clusters	Article	DSS function	Methodology used
Collaborative planning	Vargas et al. (2020)	Share cluster assignment and collaborative optimization	Share-cluster assignment algorithm, collaborative optimization algorithm
	Saad and Bahadori (2019)	Green vehicle routing	Integer linear programming model, simulated annealing
	Allaoui et al. (2019)	Supply chain design, collaborative planning, sustainability performance evaluation, collaborative routing	Analytic hierarchy process (AHP), ordered weighted averaging (OWA) aggregation, multi-objective mixed integer linear programming (MILP) model
	Ding et al. (2018)	Profit allotment and incentive sharing between coal power plant and pollutant reduction	Optimization models
	Oliveira Silva and Morais (2021)	Activity and cost allocation to decision-makers in solid waste management transition	Flexible and interactive tradeoff (FITradeoff) MCDM
	Aloui et al. (2021a)	Sustainable freight transportation planning for collaborative logistics	Optimization model, heuristics, multi-objective integer programming, k-means clustering, genetic algorithms
Network formation	Melkonyan et al. (2020)	Logistic network design and sustainability performance assessment	System dynamic simulation, PROMETHEE
	Govindan et al. (2019)	Sustainable collaborative partner selection	COPRAS method and best worst method (BWM)
	Postacchini et al. (2018)	Supply chain reconfiguration and performance measurement	LCA
	Santos et al. (2021)	Partner selection for CNs with sustainability considerations	MCDM, fuzzy inference system, multi-attribute value theory
Operational planning	Kuo et al. (2021)	Smart material management system	Mathematical model and material resource allocation algorithm
	Calmon and Graves (2017)	Inventory optimization	Mathematical modeling (stochastic optimization), solution algorithm
Sustainability performance measurement	Kumar et al. (2022)	Sustainability performance measurement	Fuzzy TOPSIS
	Goyal et al. (2018)	Environmental sustainability performance measurement	Graph theoretic approach (GTA)
	Marconi et al. (2017)	Supply chain traceability approach with additional environmental measures	Data analysis
Others	Georgiou et al. (2018)	Energy requirements quantification in glasshouse food production	Analytic model

CE transitions. *Network formation* DSSs utilize system dynamic simulation, LCA, and MCDM approaches. They assist in the design and evaluation of supply networks in the following areas: logistic network design, sustainability performance evaluation, sustainable partner selection, and supply chain reconfiguration. These systems emphasize sustainability in decision-making. *Operational planning* DSSs use mathematical modeling and solution algorithms for aiding intra-company processes such as smart material management and inventory management. These DSSs target operational effectiveness and sustainable decision-making. *Sustainability performance measurement* is essential to quantify sustainability progress. The selected DSSs adopt fuzzy TOPSIS and graph theoretic approach in their modeling. Collaborative planning or network formation DSSs may also include sustainability performance measurement approaches for evaluating their sustainability performance (Allaoui et al., 2019; Marconi et al., 2017; Melkonyan et al., 2020; Postacchini et al., 2018). Apart from these clusters, DSSs can support other functions. For example, the quantification of energy requirements in glasshouse food production is assessed with a DSS, where analytic models are implemented (Georgiou et al., 2018).

Technology and digitalization are enablers of collaboration and sustainability. As social media and digital technologies advance, platform-based BMs become more prevalent. ICT systems equipped with optimization tools and real-time data sharing can strictly improve decision-making in such BMs. These platforms may act as frameworks that encapsulate various DSSs and support order commitment, data storage, collaborative planning, and order processing functions. Only 8 articles out of 77 present or refer to ICT platforms functioning in numerous industries (Table 9).

These platforms are listed as online marketplaces (Marusak et al., 2021), service-based ecosystem platform (Krishnan et al., 2021), logistic network integration platform (Melkonyan et al., 2020), gain sharing BM platform (Vargas et al., 2020), PI platform (Pan et al., 2019), collaborative planning platform (Allaoui et al., 2019), virtual factory platform (Hao et al., 2018), and farmer producer organization collaboration platform (Krishnan et al., 2021). These platforms exhibit a varied range of technological adoption. Certain platforms utilize social media and websites to aggregate and access users (Krishnan et al., 2021; Marusak et al., 2021). On the other hand, some platforms integrate digital twins, AI, IoT, blockchain, and cloud data storage into their operations to enable automation (Hao et al., 2018; Liu et al., 2022; Pan et al., 2019). Nevertheless, ICT platforms automate cooperation and coordination in inter-organizational and intra-organizational levels. Industry 4.0 technologies digital twin, big data, AI, IoT, blockchain, cloud data storage, and service-oriented architecture can be implemented innovatively to design platforms that automate and optimize BM processes and functions.

Table 9
ICT platforms.

Articles	ICT platform	Technology used
Marusak et al. (2021)	Profound Microfarms (direct-to-consumer retail model), Snackshare (online marketplace), farmers market Riceville (virtual marketplace), Good apple online ordering platform	N/A
Krishnan et al. (2021)	Farmer producer organization electronic database of farmer members, social media platform for customer orders	N/A
Liu et al. (2022)	Service-based ecosystem platform	Digital twin, big data, AI
Melkonyan et al. (2020)	Existing electronic platform for food networks integration with logistics	N/A
Vargas et al. (2020)	Digital collaboration platform supporting gain-sharing BM	N/A
Pan et al. (2019)	ICT platform for assisting physical internet (PI) hubs	ICT, databases, IoT, platforms, blockchain, APIs, supply chain digital twin, electronic product code information services
Allaoui et al. (2019)	Collaboration planning tool (CPT) web-based software system	N/A
Hao et al. (2018)	Virtual factory platform with three-layer architecture, cloud-based data storage, dashboard prototype, and service-oriented architecture	Cloud data storage (MySQL, MongoDB, Amazon S3, Sesame), XML or JSON, dashboard prototype, service-oriented architecture

3.4. Outcomes: SDGs contributed

Regarding papers contributions to SDGs, only few (10 out of 77) mention the SDGs they address. However, in Fig. 6, we present a count of the effort of identification and association for the SDGs grouped into four dimensions: economy, environment, society, and collaboration. Among these 10 studies, 35 SDGs in total were mentioned. The most frequently mentioned SDGs in the text is SDG 9 and 12, followed by SDG 17, SDG 2, and SDG 3. In 6 (out of 10), more than one SDG was mentioned: Van Hille et al. (2020) present a case study about the importance of a broker or a broker organization in coffee NPO partnerships with impact in SDGs 1, 2, 3, 5, 6, 12, 15, and 17; Sánchez-Teba et al. (2021) present a review concerning food waste reduction with impact in SDGs 2 and SDG 12; Marusak et al. (2021) present 7 case studies in regional food supply system in US during COVID19 with impact in SDGs 2, 3, 8, 11 and 12; Moreno-Serna et al. (2021) present a case study creation and development of multi-stakeholder partnerships can maximize the collaboration for refugee response with impact in SDGs 7 and SDG 17; and Sharma et al. (2021) present a literature review in construction waste and the role of CE with major impact in SDG 9, SDG 11 and SDG 12 but also in SDGs 1, 2, 3, 4, 5, 7, 8, 13, 14, 15, and 17. The existing studies that encompass more than one SDG are very vague and do not allow assessing the dimension of the impact on the SDGs or the trade-offs that can be established between them. Notably, SDG 10 and SDG 16 were not mentioned in any of the articles.

When identifying the SDGs in articles that do not explicitly mention them, we take into account the SDGs and their specific targets. This analysis may introduce some bias in interpretation and can result in a different classification compared to the authors' own claims. For instance, while many articles mention the reduction of food waste as a contribution to SDG 2, SDG 12 aligns better with the context, specifically Target 12.3, which aims to "halve global per capita food waste". Furthermore, we only assigned a single SDG to the study with the exception to the studies of Alvarez-Meaza et al. (2020), Giagnocavo et al. (2018), Hao et al. (2018), and Rappuoli and Hanon (2018).

Based on our assessment, the most commonly contributed SDGs are SDG 9, SDG 12, SDG 11, SDG 8, SDG 7, and SDG 17. SDG 9 involves building resilient infrastructures through innovation and technology. SDG 12 focuses on transforming production and consumption patterns toward circular and sustainable practices, with particular attention to waste recycling and the sharing economy. SDG 11 and SDG 7 emphasize building sustainable and smart cities powered by clean energy. Economic growth with decent work opportunities (SDG 8) and fostering change through partnerships and collaboration (SDG 17) are also significant goals. SDGs 1, 5, 10, and 16 are not the primary focus of the selected literature. These goals address complex societal challenges that are challenging to model and directly address. Moreover, the environment-related SDGs are not the primary targets in the articles. However, many of the articles contribute to environmental sustainability, as a side benefit of their other contributions. Table 10 offers an overview of SDGs, their corresponding targets, and the initiatives related to them. The SDG CN Nexus is listed for each article in Appendix C.

SDG 9 is the most often targeted, addressing industrial innovation

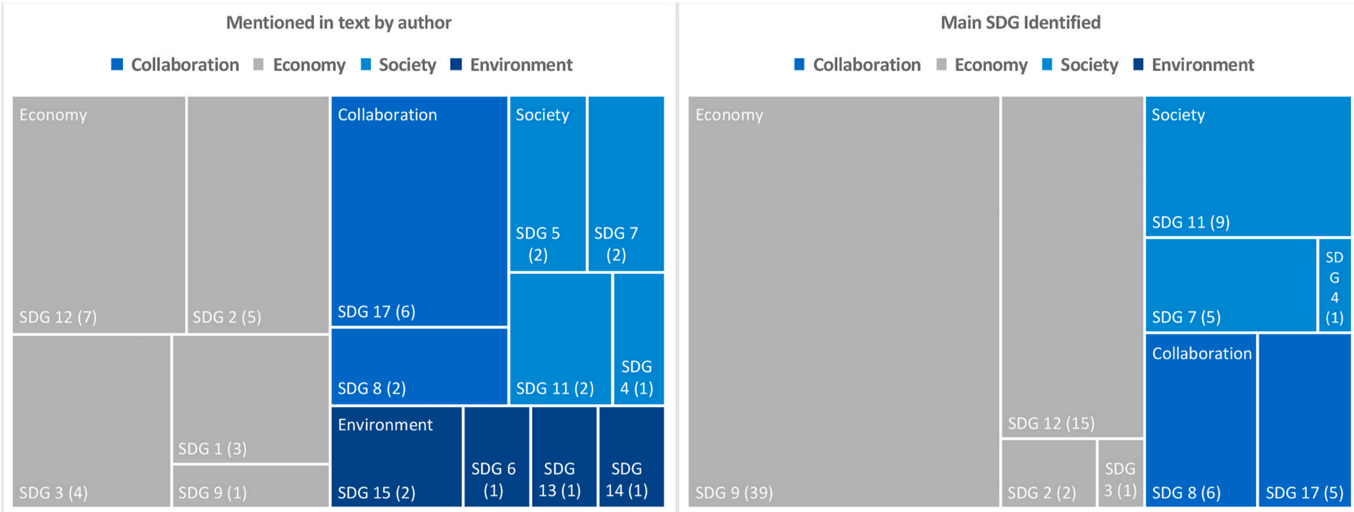


Fig. 6. Total (in parenthesis) of the SDG contributions.

Table 10
SDG Targets and corresponding initiatives.

SDG	Target	Initiatives
1	Target 1.2	Construction sector
2	Target 2.4	Farming sector
3	Target 3.b	Vaccine development
4	Target 4.5	Innovative approaches to education
5	Target 5.a	Construction sector
7	Target 7.2	Decarbonization and pollution reduction of the energy systems
	Target 7.2	New BMs for clean energy
	Target 7.a	Partnerships for clean energy
8	Target 8.3	New BMs for SMEs
	Target 8.9	Collaborative entrepreneurship for sustainability
9	Target 9.1	Partnerships for industry transitions
	Target 9.4	New BMs for sustainability (digital, collaborative)
	Target 9.4	ICT platforms and digital tools for new BMs
	Target 9.4	Industry innovations for sustainability
	Target 9.4	Smart systems (optimization for efficient resource use)
	Target 9.4	Supply chain design for sustainability
11	Target 11.2	New BMs for sustainable transportation (digital, collaborative)
	Target 11.2	ICT platforms and digital tools for sustainable transportation
	Target 11.3	Smart city applications
	Target 11.3	Sustainable construction industry
	Target 11.6	Municipal waste management
12	Target 12.1	BMs for sustainable and collaborative consumption (sharing economy)
	Target 12.2, 12.5	Frameworks for industrial transitions to CE
	Target 12.2, 12.5	New BMs for CE
	Target 12.3	DSS and strategies for food waste minimization
	Target 12.4	Minimum waste innovation ecosystems and waste management frameworks
13	Target 13.2	Construction sector
14	Target 14.5	Construction sector
15	Target 15.9	Construction sector
17	Target 17.6	Strategic regional collaboration for sustainable energy
	Target 17.6	Multi-stakeholder partnership for humanitarian purposes
	Target 17.11	Cross-sectoral partnership for international sustainable trade
	Target 17.16	Collaboration for entrepreneurship and sustainability
	Target 17.17	Collaborative governance for SDGs

and infrastructure. SDG 9 aims to build resilient infrastructures by promoting inclusive and sustainable industrialization and fostering innovation. Target 9.1 and Target 9.4 strive to develop resilient and sustainable new infrastructures and upgrade the old ones. Contributions to SDG 9 were achieved through, forming partnerships for industry transition, designing new digital and collaborative BMs for sustainability, developing ICT platforms and digital tools to support the BMs, developing innovative technologies and tools for sustainability, implementing smart systems, employing optimization for efficient resource use and redesigning supply chains for sustainability.

SDG 12 serves to ensure sustainable consumption and production patterns. It promotes the efficient use of natural resources by reducing waste on both the production and consumption side. Targets 12.1, 12.2, 12.3 (reduce food waste), and Target 12.4 (integrate waste management and sustainability into industry) and Target 12.5 (reduce waste generation) are among its emphasized targets. The authors' contributions to SDG 12 encompassed various aspects, including frameworks for industrial transitions to a CE, new BMs for circular practices, waste reduction through innovation ecosystems and waste management strategies, DSS and strategies to minimize food waste, and BMs to promote sustainable and collaborative consumption within the sharing economy.

The fundamental agenda of SDG 11 is to make cities and human settlements more inclusive, safe, resilient, and sustainable. The articles mostly focus on Target 11.2 (safe and sustainable transportation systems), Target 11.3 (sustainable urbanization), and Target 11.6 (reducing the environmental effect of cities and waste management). Researchers have worked on a variety of initiatives to contribute SDG 11, including new BMs for sustainable transport, ICT platforms and digital tools for sustainable transport, smart city applications, municipal waste management, and sustainable construction industry.

SDG 7 focuses on providing access to affordable, reliable, sustainable, and modern energy. Many articles aim for Target 7.2, which pursuits increasing the proportion of renewable energy in the global energy mix and Target 7.a which aims upgrading technology for sustainable energy. SDG 7 is supported by decarbonization and reduction of pollution in energy systems, new BMs for clean energy, and partnerships to advance clean energy initiatives. SDG 8 strives for inclusive and sustainable economic growth and decent work. Key targets of SDG 8 are supporting SMEs (Target 8.3) and promoting sustainable tourism (Target 8.9). Authors have contributed to SDG 8 through new BMs for SMEs and collaborative entrepreneurship for sustainability.

SDG 17 aims to strengthen the tools for achieving sustainable development and renew global partnerships. Targets 17.6 (enhance regional collaboration), 17.11 (increase exports of developing countries), 17.16 (partnerships for knowledge), 17.17 (promote public partnerships) are the means of contributing to SDG 17. The authors contribute to SDG 17 in the following ways: strategic regional collaboration for sustainable energy, multi-stakeholder partnerships for humanitarian purposes, collaboration at the intersection of entrepreneurship and sustainability, and cross-sectoral partnerships to support international sustainable trade. Therefore, global challenges require global partnerships.

SDG 2 focuses on ending hunger and promoting sustainable agriculture. Several articles contribute to SDG 2 through Target 2.4 which aims for resilient and sustainable farming practices. SDG 3 ensures healthy lives and promotes well-being. Target 3.b, which supports vaccine and medicine development is a way to contribute SDG 3, in the selected articles. SDG 4 strives to provide inclusive and quality education for all via Target 4.5. This is made possible through collaborations that introduce innovative approaches to education.

4. CIMO framework for CNs to achieve SDGs

The CIMO framework depicts a summary of context, interventions, mechanisms, and outcomes derived from the literature (Fig. 7). Context summarizes the important characteristics of the studied CNs, including CN names, sectors, disciplines, and locations. Sustainable, collaborative, and circular are the most frequently used keywords in the CN names. We also detect that secondary (construction, electronics, chemical, energy) and primary (food and agriculture) sectors mostly build CNs to contribute to SDGs. These CNs are most commonly designed or studied by management, engineering, business, economics, and industrial professionals. Moreover, the EU has the maximum number of CNs, followed by BRICS.

In terms of interventions, the majority of articles are case studies and technical papers. In literature reviews and conceptual papers, all three sustainability dimensions are present. When considered individually or in pairs, only articles reporting case studies and technical papers exist. Regarding the research focus, the domains of collaboration and partnerships, sustainable supply chain, technology and innovation, and BMs for sustainability stand out as the most popular research fields. It is important to emphasize that when the focus is on CE, framework design, and food loss and waste management, there are only studies that encompass all three dimensions of sustainability (Fig. 8). When research collaborations are analyzed in terms of being international or intranational, the USA has the highest number of international collaborations, followed by France, Denmark, and China. Moreover, Italy and Spain have the highest number of intra-national collaborations.

New BMs, DSSs, and ICT platforms developed to assist the CNs are listed in the mechanisms of the CIMO framework. When the studied BMs are matched to SBM archetypes, develop scale-up solutions, create value from waste, and repurpose for society or environment are found as the most frequently used SBM archetypes respectively. Upon clustering the proposed DSSs, it is revealed that they are mostly developed to assist collaborative planning and network formation functions. The ICT platforms are examined regarding their functions and technological base. It is found that their functions and technological structure vary considerably for industry and BM requirements.

If the intended outcome to be studied is SDG 12, the referenced mechanism used for all interventions, with the exception of intervention *technology and innovation*, is *create value from waste*. A gap identified is the omission of the mechanism used to implement each intervention, hindering understanding the purpose of all identified interventions: waste management, collaboration and partnerships, framework design, technology and innovation, BMs, and sustainable supply chain with an impact on SDGs 9, 12, 11, 17, and 2.

In terms of the studied SDGs, it is noteworthy that there is limited research for SDGs 1, 3, 5, 13, 14, 15, and none detected for SDG 10 and SDG 16 from the perspective of CNs. These goals aim at complex societal challenges that are difficult to model and address. All observed rules/paths are in Appendix D.

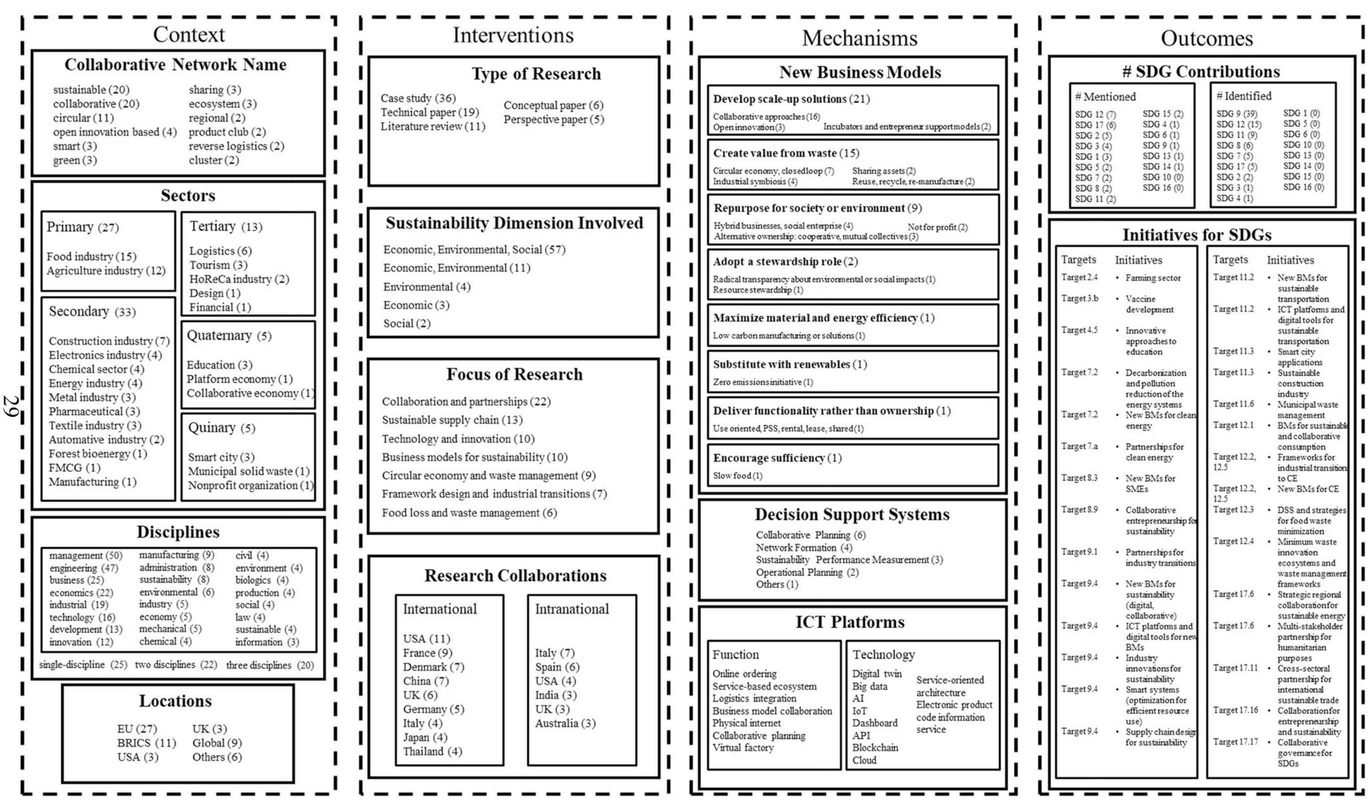


Fig. 7. CIMO synthesis.

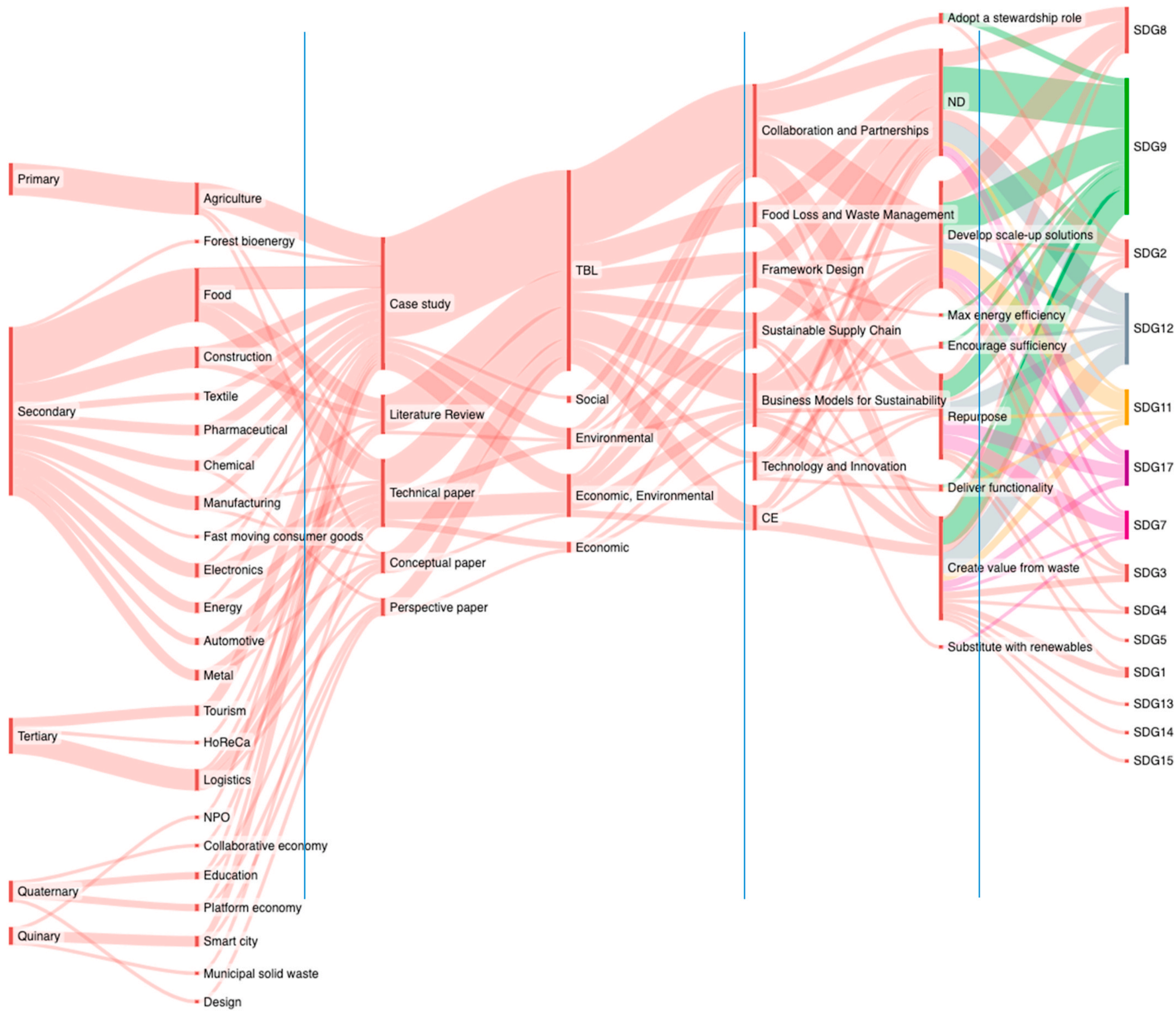


Fig. 8. Flow of articles through the different phases of CIMO *(ND-not disclosed)*.

5. Discussion and findings

5.1. What is emerging from the literature?

CNs are complex entities from various industries and countries that act as tools to accomplish SDGs. The majority of CNs are located in the EU as aligned with its sustainability targets, followed by BRICS countries. Efforts of other regions may fasten the sustainability transitions.

The number of studies per SDG is quite limited. The exceptions are the studies focusing on SDG 9 and SDG 12. Nevertheless, the norm is to concentrate on a single SDG per study. 2 papers focus on the social dimension: Target 4.5 (Espada-Chavarria et al., 2021) and Target 7.a (Moreno-Serna et al., 2021). Given the emphasis of numerous SDGs on the social dimension (SDGs 1, 2, 3, 4, 5, 8, 10, 16), it is surprising how few studies actually address these aspects. The literature does not address the potential trade-offs that can be established between the SDGs, preferring to highlight the complementarity that some strategies and practices have in achieving various SDGs. Examples of this complementarity include: CE practices in solid waste management and job creation (Sharma et al., 2021), biowaste treatment and job creation (Fei et al., 2021), smart city initiatives and their impact on the environment and quality of life (Leu et al., 2021), collaboration for sustainable consumption coupled with innovation (Fantke et al., 2021), collaboration for achieving zero hunger (Sánchez-Teba et al., 2021), collaboration for education, zero hunger, and innovation (Gallo et al., 2018), and addressing inequalities and promoting decent work (Espada-Chavarria et al., 2021). Moreover, 10 out of the 77 articles, declaring the SDGs under analysis, none of them carry out a proper assessment of the SDGs, nor have identified key performance indicators to measure their impact on the SDGs. Fei et al. (2021), is the only article that, despite not explicitly stating the SDGs, mentions and extrapolates values for waste reduction (tons and currency) and (number of) job creation with the establishment of a CN at the level of biowaste in China.

Very few studies examine the issue from a negative perspective, such as food loss (Sánchez-Teba et al., 2021) or conflicts of interest and power dynamics that may limit collaboration (Stål et al., 2022).

New SBMs are related: 1) to the development of scale-up solutions in secondary industries (pharmaceutical, (Rappuoli and Hanon, 2018), energy (Alvarez-Meaza et al., 2020), chemical (Fantke et al., 2021), construction (Balasubramanian et al., 2022), but also in the tertiary sector, namely in logistics (De Martino, 2021) and in the primary sector in agriculture (Gallo et al., 2018); 2) to the development of repurpose for society or environment solutions observed in chemical (Reficco et al., 2018), metal (Trollip et al., 2022) and collaborative economy (Sinthupundaja et al., 2020); 3) in energy industry, to the creation of value from waste (Moshood et al., 2022), and with the substitution with renewables (Ding et al., 2018); and 4) in food industry with the encouragement of sufficiency (Hatipoglu and Inelmen, 2021).

The new CE BMs are related: 1) with the creation of value from waste observed in the context of the cities (Fei et al., 2021; Sharma et al., 2021); 2) with industrial transitions to sustainability in textile (Franco, 2017); and 3) with repurpose for society or environment in food industry (van Hille et al., 2020).

New sustainable supply chains were observed in food: 1) related to the creation of value from waste (Postacchini et al., 2018); 2) the optimization of material and energy efficiency (Saad and Bahadori, 2019); and 3) the development of scale-up solutions (Allaoui et al., 2019). In the automotive industry, Kumar et al. (2022) also study new sustainable supply chains for the development of scale-up solutions. Different supply chain solutions were proposed in electronics, namely: 1) smart supply chain (Kuo et al., 2021); 2) reverse supply chain (Calmon and Graves, 2017; Govindan et al., 2019); and 3) in metal the green supply chain (Goyal et al., 2018).

ICT platforms were used to develop scale-up solutions in new SBM in metal industry (Liu et al., 2022) and for planning industrial transitions to sustainability in new CE BM in food industry (Oliveira Silva and Morais, 2021). ICT platforms were also used to develop scale-up solutions in new sustainable supply chains in agriculture (Marusak et al., 2021) and food industry (Allaoui et al., 2019). Only 3 studies identified information technology: 1) cloud data storage, dashboard prototype, and service-oriented architecture (Hao et al., 2018); 2) digital twin, big data, and AI (Liu et al., 2022); and 3) IoT, blockchain, APIs, supply chain digital twin, electronic product code information services (Pan et al., 2019). Only 8 studies mention ICT platforms: 1) collaboration planning tool (Allaoui et al., 2019); 2) virtual factory platform (Hao et al., 2018); 3) farmer producer organizations' electronic database of farmer members and social media platform for customer orders (Krishnan et al., 2021); 4) service-based ecosystem platform (Liu et al., 2022); 5) Profound Microfarms (direct-to-consumer retail model), Snackshare (online marketplace), farmers market Riceville (virtual marketplace), Good apple online ordering platform (Marusak et al., 2021); 6) existing electronic platform for food networks' integration with logistics (Melkonyan et al., 2020); 7) ICT platform for assisting PI hubs (Pan et al., 2019); and 8) digital collaboration platform supporting gain-sharing BM (Vargas et al., 2020).

3 studies were related with technology and innovation solutions: in agriculture (Georgiou et al., 2018), food (Bogers et al., 2020), and chemical industries (de Vargas Mores et al., 2018), to develop scale-up solutions based on new products development.

Few quantitative studies were proposed, namely analytic models for energy quantification (Georgiou et al., 2018), and sustainability performance measurement (Kumar et al., 2022) in automotive with MCDM methods (Govindan et al., 2019), allocation algorithms (Kuo et al., 2021), and optimization algorithms (Calmon and Graves, 2017) in electronics.

The evidence show that ongoing research do not include any concern funding aspects.

5.2. What is missing?

These findings highlight the current state of the art in CN and SDG literature and they can assist the researchers and executives in designing new BMs and CNs while contributing to SDGs. Nevertheless, from the articles analyzed, we observed a lack of studies in the following directions: 1) with focus on various SDGs (1, 2, 3, 4, 5, 6, 10, 13, 14, 15, 16); 2) with focus on ICT platforms as the preferable way to operationalize CNs; 3) with detailed SBM archetypes and their purposes in the various industries; 4) with efforts in specific industries like healthcare with huge impact in several SDGs; 5) with a focus on methods to assist the CN formation and control; 6) methods in other economic sectors (all are related with secondary sector plus the study of Vargas et al. (2020) in logistics); 7) with focus on social dimension since it is related with many SDGs (1, 2, 3, 4, 5, 10, 16); 8) no methods were developed for social dimension; 9) with efforts that show how societal objectives may gain indirectly from achievements in economic SDGs; 10) that explores funding sources for network collaborations (e.g., Horizon Europe); and 11) studies that assess the impact of the CNs on specific SDGs.

5.3. Where can we go from there?

From the identification of literature gaps, we propose the following studies as a research agenda: 1) studies on the transitions towards collaborative, sustainable, and circular structures across various sectors; 2) studies that compare the SBM proposed and somehow categorized them by industry and SDGs to create a set of benchmarking BM archetypes; 3) studies that analyze the alignment and trade-offs that occur between SDGs; 4) the use of theoretical ground in organization theories to help explaining CNs formation and existence; 5) development of conceptual frameworks with appropriate ICT platforms and information management that improves the current reported decision processes based on practice; 6) the development of DSS as modules to be incorporated in platforms with real-time data exchange; 7) studies that consider subjective but important topics in CNs' formation like trust and privacy; 8) studies that demonstrate how economic SDGs contribute to societal objectives; 9) studies based on methods with different approaches: CN formation and assessment (e.g., development of DSS based on MCDM techniques or LCA approach), CN optimization (e.g., assignment or distribution with heuristics and exact algorithms), CN simulation (e.g., discrete simulation or system dynamics), and CN negotiation (e.g., game theory); 10) studies that report the collaboration between industry and academy professionals as vital for this transformative process; and 11) studies about new supply chain-wide solutions to accomplish the SDGs.

6. Conclusion and further study

In 2016, the UN announced 17 SDGs as part of the 2030 Agenda. CNs can be one of the key instruments to achieve the partnerships necessary for these goals. Although the link between CNs and sustainable development is frequently mentioned, no study in the literature investigates the connection between CNs and the SDGs. This up-to-date review of CNs' research within the SDGs establishes a foundation for future research in the field. The design of a conceptual framework for research on CNs within the SDGs, based on the CIMO methodology, allows us to observe the paths used to achieve a specific SDG in a given context. It achieves this goal through a type of intervention by using a set of mechanisms expressed by a BM, DSS or ICT platform. From this point, it is possible to outline a research agenda. This review has two important contributions: conceptually, we synthesized concepts, frameworks, and models that contribute to theory development; on the managerial side, we identified case studies that provide evidence-based insights. The fact that only 10 out of 77 reviewed studies explicitly mention the SDGs as objectives shows that this research field, despite its importance for sustainability, has been neglected. The reason for this may stem from the lack of consensus in the numerous designations of what constitutes a CN and the varied research focus used to achieve the SDGs. SDG 9 and SDG 12 were the most studied. The main limitation of this review stemmed from the difficulty in selecting the final set of articles due to the overlap of various research areas (BMs, types of collaboration, sustainable development, SDGs). In this regard, we aimed to have comprehensive search strings and then used inclusion criteria to obtain the final set.

Finally, there is a need for more studies in SDGs from the perspective of CNs, either explicitly or implicitly.

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CRediT authorship contribution statement

Senay Sadic: Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Data curation, Conceptualization. **Emre Demir:** Writing – review & editing, Writing – original draft, Methodology, Data curation, Conceptualization. **José Crispim:** Writing – review & editing, Methodology, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

José Crispim reports that funding was provided by FCT Portuguese Foundation for Science and Technology within the project No. UIDB/03182/2020. Other authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jclepro.2024.142726.

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