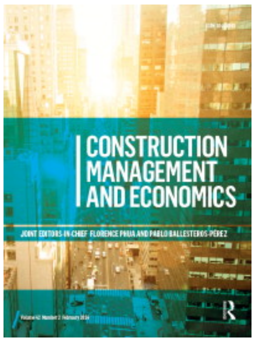

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Ecosystems in construction management and urban development: a comprehensive review of conceptualizations and contributions

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ABSTRACT
To solve grand challenges, the collaboration between construction management and urban development professionals is essential. This article proposes that ecosystem conceptualizations can enhance our understanding of collaboration, but how these concepts contribute to this field is unclear. Therefore, a literature review is presented on how ecosystem concepts are operationalized in construction management and urban development research. The article classifies conceptualizations into seven categories and analyzes their potential for contributions to ecosystem theorizing. An ecosystem research agenda is developed, arguing that it can serve as a theoretical bridge between these disciplines. The article also highlights how research on ecosystems in the built environment sector can contribute to management and organization research fields more broadly. Notably, conceptualizations of ecosystems as project-based or location-based are valuable contributions to ecosystem research.

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Introduction

Today's societies are facing several grand challenges, including those outlined in the United Nations' Sustainable Development Goals (SDG; United Nations 2022). These challenges are simultaneous, complex, and interdependent, with climate change acting as a "crisis multiplier" towards other Goals (United Nations 2022, p. 2). Given their complexity, these grand challenges are considered wicked problems (Churchman 1967), requiring a holistic approach that considers various system-level effects. Addressing these challenges necessitates collaboration between actors and areas of expertise.

To fully understand and address the grand challenges faced by society, it is important to consider the unique characteristics of different industries. In the built environment sector, addressing challenges (SDGs) such as climate action; good health and well-being; clean water and sanitation; affordable and clean energy; industry, innovation, infrastructure; and sustainable cities requires considering the fragmented nature of the industry (Dubois and Gadde 2002) and the resulting challenges of cooperation. Thomson *et al.* (2021) argue that more integrated development approaches are needed and that urban professionals such as planners and designers must work closely with the construction industry to respond to these challenges (p. 874). This requires extensive coordination and orchestration between several actors and processes.

Developing a comprehensive understanding of how actors can effectively collaborate with each other is not only a practical problem faced by managers but also a theoretical problem, as any understanding is influenced by the thinker's frame of reference. The management and organization research field provides a wealth of theories and concepts that aim to explain coordination between different actors and processes. These theories and concepts include institutional theory (DiMaggio and Powell 1983), value chain (Porter 1985), industrial clusters (Porter 1990), national and regional innovation systems (Freeman 1987, Lundvall 1992), sectoral innovation systems (Breschi and Malerba 1997), techno-economic networks (Callon *et al.* 1992), technological systems (Carlsson and Stankiewicz 1991, Bergek *et al.* 2008), interorganizational structures (Powell *et al.* 1996, Gulati *et al.* 2012), industrial ecology (Ehrenfeld 2000), open innovation (Chesbrough 2003), and business ecosystems (Moore 1993).

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While the potential merits of comparing these theories or their applications in the context of built environment research are acknowledged, it is beyond the scope of this article. Instead, the article focuses on exploring the potential of ecosystem conceptualizations in construction management and urban development research. The use of ecosystem conceptualizations has seen a significant rise in recent years, with over 1400 research articles from over 100 research fields utilizing this approach (Vigren 2022). The diversity of theoretical and methodological approaches used to employ ecosystem concepts has been rich. The primary value of ecosystem concepts lies in their ability to analyze the system-level effects of competition and collaboration between various actors (Eriksson *et al*. 2019, Thomas and Autio 2020), as well as to identify complementarities and interdependence between actors (Jacobides *et al*. 2018). Moreover, ecosystem conceptualizations offer analytical tools that can transcend established industrial, contractual, or regional boundaries (Tsujimoto *et al*. 2018). Thus, ecosystem thinking has the potential to bridge different communities of expertise, such as construction management and urban development researchers, by providing a common language and framework for analysis (Thomson *et al*. 2021).

The purpose of the article is to *increase an understanding of this emerging theoretical approach: this article presents a review of how ecosystem concepts are operationalized in construction management and urban development research and analyzes the potential for contributions based on ecosystem theorizing.*

The first section introduces the frame of reference and key concepts that serve as the basis for the research. The subsequent section presents the method of structured literature review, which identifies and analyzes existing research that applies ecosystem concepts in the built environment research literature. The following section presents the analysis of the literature, followed by a discussion section that presents a research agenda for ecosystem research in construction management and urban development research, highlighting potential areas for contribution in management and organization research fields based on ecosystem theorizing. Finally, the conclusion section summarizes the main arguments and limitations of the study.

Business ecosystems

The concept of the business ecosystem was (re)introduced to the management research literature by Moore in 1993 in a Harvard Business Review article, in which he proposes that (1) a company should be viewed "not as a member of a single industry but as part of a business ecosystem that crosses a variety of industries", (2) that in a business ecosystem, "companies coevolve capabilities around a new innovation", and (3) that "every business ecosystem develops in four distinct stages: birth, expansion, leadership, and self-renewal — or, if not self-renewal, death" (Moore 1993, p. 76). Since 1993, several authors have applied, refined, extended, and criticized these central ideas. Notably, the concept of the business ecosystem has been extended to describe different types of interorganizational logics and contexts, giving rise to related ecosystem-concepts. Examples are entrepreneurial ecosystem (e.g. Stam and Spigel 2017), innovation ecosystem (e.g. Adner 2006), platform ecosystem (e.g. Gawer and Cusumano 2014), knowledge ecosystem (e.g. Clarysse *et al*. 2014), and industrial ecosystem (e.g. Tsvetkova and Gustafsson 2012), among others. It's not the aim to introduce all the possible ecosystem conceptualizations that have been presented in previous literature, but to focus on the architypes.

Entrepreneurial ecosystems can be defined as "a set of interdependent actors and factors coordinated in such a way that they enable productive entrepreneurship within a particular territory" (Stam and Spigel 2017, p. 1). Therefore, the focus of the concept is on entrepreneurship within a determined geographical region, which differentiates entrepreneurial ecosystems from business ecosystems. A common example of an entrepreneurial ecosystem is Silicon Valley.

Innovation ecosystems can be defined as "the collaborative arrangements through which firms combine their individual offerings into a coherent, customer-facing solution" (Adner 2006, p. 2). Therefore, the concept focuses on joint innovation of products and services. On the other hand, as innovation can be a business objective of any business, the concepts of innovation and business ecosystems overlap significantly (Moore 1993; de Vasconcelos Gomes *et al*. 2018). The examples of innovation ecosystems by Adner (2006) were mainly from manufacturing sectors, such as high-definition televisions.

Platform ecosystems can be defined based on industry platforms that "act as a foundation upon which external innovators, organized as an innovative business ecosystem, can develop their own complementary products, technologies, or services" (Gawer and Cusumano 2014, p. 417). Furthermore, industry platforms are a set of products, services, or technologies that are broadly used in an industry, which differentiates them from company or product platforms that are mainly developed for the business purposes of individual companies (Gawer and Cusumano 2014). Therefore, platform ecosystems are business ecosystems in which platforms have a central role. Common examples of platform ecosystems are from the software industry, in which firms such as Apple rely on multiple complementors in platform development.

Knowledge ecosystems are characterized by the primary activity of generating new knowledge and by being centered around knowledge hubs (e.g. Clarysse *et al*. 2014). Knowledge ecosystems differ from business ecosystems in that the knowledge is not necessarily used in business activities, and therefore the value creation processes in knowledge and business ecosystems are fundamentally different (Clarysse *et al*. 2014). Examples of knowledge ecosystems are knowledge hubs around universities and other research institutions.

The concept of industrial ecosystems originates from studies of industrial processes (Frosch and Gallopoulos 1989), and the concept has been associated with the concepts of industrial metabolism and industrial ecology (Erkman 1997), albeit analysis of the connections between these concepts are limited (Tsujimoto *et al*. 2018). A distinctive feature of the industrial ecosystem concept is that it focuses on resource flows (e.g. materials, energy, or money; Tsujimoto *et al*. 2018), and the system-level that is an outcome from these flows (Eriksson *et al*. 2019).

These mentioned concepts are not an exhaustive list of all conceptualizations in literature, but they represent the common ecosystem archetypes. Although there are differences between the concepts, it is noteworthy that with the shared origins and similar theoretical statements, the ecosystem conceptualizations represent a common, even if sometimes contradictory, system of ideas (Jacobides *et al*. 2018, Thomas and Autio 2020, Autio 2022, Thomas and Ritala 2022, Vigren 2022). Clarification of concepts has indeed been an important part of ecosystem research and numerous review articles have been published on the subject (Valkokari 2015, Oh *et al*. 2016, Alvedalen and Boschma 2017, Seppänen *et al*. 2017, Dedehayir *et al*. 2018, de Vasconcelos Gomes *et al*. 2018, Ferasso *et al*. 2018, Scaringella and Radziwon 2018, Tsujimoto *et al*. 2018, Cavallo *et al*. 2019, Gupta *et al*. 2019, Granstrand and Holgersson 2020, Yin *et al*. 2020, Mohammadi and Karimi 2021). This article differs from these earlier reviews by focusing on the operationalizations of ecosystem concepts in the built environment sector.

In conclusion, by today the loose metaphorical connection to ecological ecosystems has largely been abandoned, and a common perception of the concept has emerged among scholars. In general, ecosystems are communities of hierarchically independent yet interdependent heterogeneous actors that contribute to system-level value creation (Thomas and Autio 2020). Furthermore, collaboration and competition between the actors is an important system-creating and modifying process. This perspective highlights that ecosystem researchers have been interested in (1) individual actors, mostly organizations, that differ from each other (heterogeneous), (2) interdependencies between the actors (hierarchical independence, but interdependent though system-level value creation), (3) actors' contributions to system-level value creation, (4) and the system-level outcomes of collaboration. Moreover, research has contextualized these ideas in many research fields, which has generated a rich set of theoretical statements about the nature of ecosystems in different contexts. For example, which actors and processes are important in ecosystems and what value is created in ecosystems is context-dependent.

Methodology

This section presents the rationale for the method choice and application of the methods used.

Approach to the literature review

This article presents a review of how ecosystem concepts are operationalized in construction management and urban development research and analyzes the potential for contributions based on ecosystem theorizing. First, the review is a structured literature review and follows the PRISMA guidelines (Moher *et al*. 2009), to the extent that the review shows step-by-step how the literature sample is searched, selected, and analyzed.

Second, the review is a confirmatory and concept-centric review (Webster and Watson 2002), meaning that the review confirms how concepts are used in literature. Confirmatory reviews can bring clarity to the use of concepts by focusing on the chosen conceptualizations, i.e. operationalizations, and the context in which concepts are used. A focus on conceptualizations represents a view in which concepts are considered as entities themselves. The latter view, a dispositional view of concepts (Baldwin 2008), emphasizes the meaning of concepts in use. Awareness of this distinction is relevant as the application of concepts vary in different research fields and borrowing of concepts from one context to another requires an understanding of both the concepts and the contexts of use. This is to say that theoretical concepts have an origin, and that application of concepts may change the meaning of concepts. Furthermore, a confirmatory review on an emerging research topic can help to consolidate knowledge and therefore create a solid foundation for further research (e.g. Webster and Watson 2002, Snyder 2019, Granstrand and Holgersson 2020).

Third, the literature sample is designed to be fit for satisfying the purpose of the review. Booth *et al.* (2016) argue that a completely exhaustive review on any topic is not necessary to achieve a purpose of a review, and it would not practically be possible, as, for example, any combination of keywords and selection of scientific databases limits a review. Webster and Watson (2002, p. 16) also state that an author should accumulate a "relatively complete census of relevant literature". With the iterative testing of multiple data sources and keywords, and the selection of the keywords considered to be the most suitable, the literature sample in this article is extensive, but not exhaustive. Fourth, coding of the conceptualizations and theorizing, which is an integral part of the coding process, follows an approach by Gioia *et al.* (2013). The following sections clarifies how literature was searched, selected, and analyzed.

Literature search and selection

The process was initiated by selecting databases for the literature search. Searches were carried out in the Scopus, Web of Science Core Collection, and Google Scholar databases. Various keyword combinations were experimented with, and the outcomes of the searches were examined thoroughly. The Web of Science Core Collection database was chosen as the source from which the literature sample was derived, as the results aligned with the topic of the review. Additionally, the obtained results covered relevant journals in the field of construction management and urban development, as well as journals from other disciplines.

To present a comprehensive review on various conceptualizations of ecosystems in construction management and urban development, an attempt has been made to capture as many articles as possible on ecosystems from the literature through the utilization of multiple search terms. Keyword combinations were selected (Figure 1) that capture a multitude of articles on the topic. The final keyword choice was informed by previous search results, reading of the literature, and reviewer comments. The following search term was used: [("built environment" OR "real estate" OR "construction" OR "building" OR "facility management" OR "architecture" OR "facilities management" OR "property management" OR "city" OR "cities" OR "urban" OR "urban development" OR "habitat" OR "milieu") AND ("business ecosystem" OR "innovation ecosystem" OR "entrepreneurial ecosystem" OR "entrepreneurship ecosystem" OR "platform ecosystem" OR "industrial ecosystem" OR "software ecosystem" OR "ecosystem theory" OR "knowledge ecosystem")]. The first 14 terms cover a wide range of terms related to the field of construction management and urban development, and the following 9 terms, separated from the first set with an "AND"-operator, cover ecosystem terminology discussed in the previous section. The search was on the title, abstract and keywords of the article. The search resulted in 885 articles that were exported to Excel.

To refine the sample, articles that were published elsewhere than in peer-reviewed scientific journals were first removed (272 articles removed). This choice was made to focus on conceptualizations that have already passed the test of peer-review. Subsequently, articles published in other than the English language were removed (18 articles removed). Additionally, articles lacking an abstract or publication year in the database were also removed (54 articles removed).

As a final exclusion criterion, the abstracts were reviewed, and articles that clearly relate to ecosystems and construction management or urban development as activities associated with city planning, land use, district or building development, or related operations were included. Articles that did not directly address these topics were excluded (499 articles). Therefore, the research does not encompass, for instance, the subjects of economic development, social structures, technology policies, or other similar topics broadly situated in urban, regional, or ecosystem contexts. This type of research could also benefit from the utilization of ecosystem concepts provided that the conceptual relationship between an ecosystem and its context is well-defined. Nonetheless, in a significant portion of the research, the term "ecosystem" is employed as a label with minimal significance. Furthermore, articles concerning natural ecosystems or other biological systems, or those in other fields such as agriculture, computer science applications, or manufacturing, were

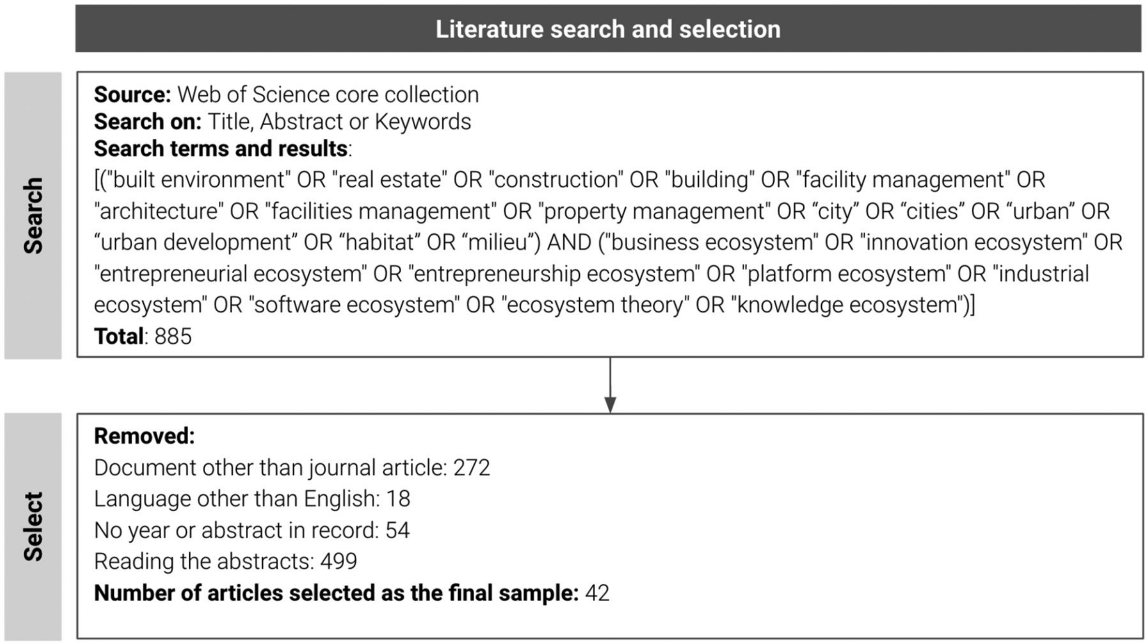

Figure 1. Literature search and selection.

eliminated. In conclusion, the final sample consisted of 42 selected articles.

Methods of literature analysis

The sample of 42 articles was analyzed in two stages. Initially, article meta-data was analyzed through the application of descriptive statistics and bibliometric analysis, the outcomes of which are presented in Table 1 and Figure 2. Table 1 displays that the 42 articles were published in 31 different journals. It should be noted that the ecosystem is a niche theoretical concept in built environment research. On one hand, ecosystem articles have reached a wide range of readership, but on the other hand, the dispersion of articles in many journals may slow down the adoption of ecosystem perspectives as scholarly communities focusing on these perspectives remain small. Figure 2 further shows the number of articles per year of publication. Notably, the number of articles has grown rapidly in recent years, as more than half of the publications are published between 2020 and 2022.

Secondly, the articles were read, and excerpts were collected from them through an open coding process. These excerpts are sentences in which the authors explain what they mean by ecosystems. For example, Säynäjoki *et al*. (2017, p. 9), develop a "platform ecosystem model for the Internet of Buildings", and Kangas *et al*. (2018, p. 4) develop a framework of "integrated energy service companies functions and impacts on customer's building". Excerpts were collected from all 42 articles, with each article containing one to three excerpts. The decision was made not to present all excerpts as part of the findings, considering the extensive size of the coding tables. Instead, the focus was directed towards presenting the higher-order conceptualizations (Figure 3), similarly as in Gioia *et al*. (2013, p. 7, see Figure on "Data structure").

The collection of the excerpts is a confirmatory analysis (Webster and Watson 2002) as it views how authors have conceptualized ecosystems in the literature. The analysis focuses on excerpts from the literature and contains little interpretation by the reviewer. The review is also concept-centric, as it focuses on ecosystem conceptualizations. In practice, this is realized in that the selected excerpts are sentences in which the authors have described how they understand the concept of ecosystem or have used the concept in their research. The sample of excerpts is therefore narrow and does not focus on all the possible themes in the literature.

Excerpts were subsequently combined in an axial coding procedure, involving the identification of similarities and differences among the conceptualizations. For example, both statements by Säynäjoki *et al*. (2017, p. 9) and Kangas *et al*. (2018, p. 4) view ecosystems to be formed around smart buildings. These excerpts were labeled as a conceptualization titled "Ecosystems are formed around buildings." Similarly, excerpts in which ecosystems were seen to be formed within and around cities were combined into one ecosystem conceptualization. In total, a count of 29 categories was reached (Figure 3).

Table 1. Sources: 42 articles in 31 journals.

Journal title	Nr. of articles
Journal of Cleaner Production	5
Sustainability	5
Technological Forecasting and Social Change	3
Buildings	2
Administrative Sciences	1
Business Strategy and the Environment	1
Cities	1
Civil Engineering Journal-Tehran	1
Complexity	1
Construction Management and Economics	1
Electronics	1
Energies	1
Energy Policy	1
Energy Research & Social Science	1
Engineering Construction and Architectural Management	1
Facilities	1
Frontiers of Engineering Management	1
International Entrepreneurship and Management Journal	1
International Journal of Innovation and Learning	1
Journal of Asian Architecture and Building Engineering	1
Journal of Business Research	1
Journal of Coastal Research	1
Journal of the Knowledge Economy	1
Landscape Ecology	1
Nanotechnologies in Construction-A Scientific Internet-Journal	1
Open House International	1
Project Management Journal	1
Revista De Administracao Publica	1
Transportation Research Part A-Policy and Practice	1
Urban Studies	1
Wood Material Science & Engineering	1
Total	**42**

Finally, these categories were combined into higher-order conceptualizations through a selective coding process. As Gioia *et al*. (2013, p. 6) point out, these higher-order conceptualizations are emergent theoretical categories that answer the question "What's going on here?" theoretically. The higher-order conceptualizations were categorized based on the type of theoretical work carried out by the conceptualizations. Gioia *et al*. (2013, p. 7) call this level of abstraction "aggregate dimensions".

This categorization is not purely confirmatory, as it relies on interpretation of, and theorization based on the excerpts. This interpretative approach is however necessary and a natural part in any theory-building process.

Limitations

The focus on the conceptualizations is intentional, and the aim is not to ask how the authors have justified the choice of these conceptualizations in relation to the existing literature. Making such further analysis is methodologically and theoretically challenging and beyond the scope of this article, as the number of possible comparable theories or streams of literature is vast (see Introduction for a list of comparable theories). This is thus a limitation of this literature review.

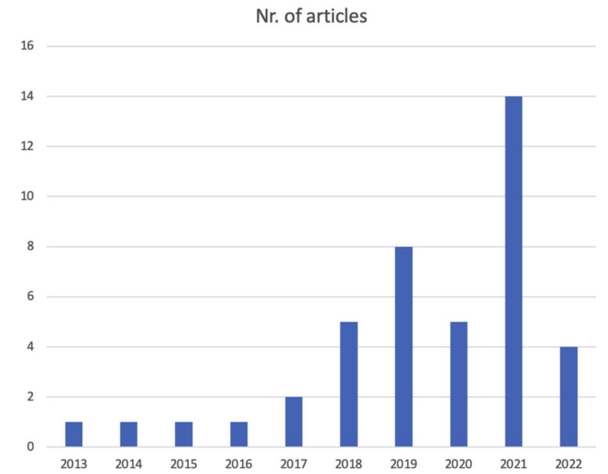

Figure 2. Number of articles per year published.

Furthermore, it should also be noted that ecosystem concepts are often theoretically vague and diverse in the literature, which is characteristic of any emergent theoretical concept. As this review uses excerpts from the literature as sources of analysis, the problem is also reflected in the analysis. On the other hand, the contribution of this review is to build a structure for understanding ecosystem theories and future theorizing in the field of construction management and urban development. This is realized in that the article makes a synthesis of the existing conceptualizations in construction management and urban development and brings out contributions and research directions related to this research. Further research can extend this analysis e.g. by analyzing other literature samples or by comparing ecosystem conceptualizations with other theoretical concepts in construction management and urban development research.

Findings

The results of reading and analyzing the 42 articles are summarized in Figure 3, which presents *ecosystem conceptualizations* in the literature (the left-hand column; 29 categories), *higher-order conceptualizations* (the column in the middle; 7 categories) that capture the essence of ecosystem theorizing in construction management and urban development research fields, and the *type of theoretical work that the conceptualizations perform* (the right-hand column; 3 categories). This section is structured according to the type of theoretical work the ecosystem conceptualizations perform: what ecosystems are, what they achieve, and how they function? Each section provides illustrations

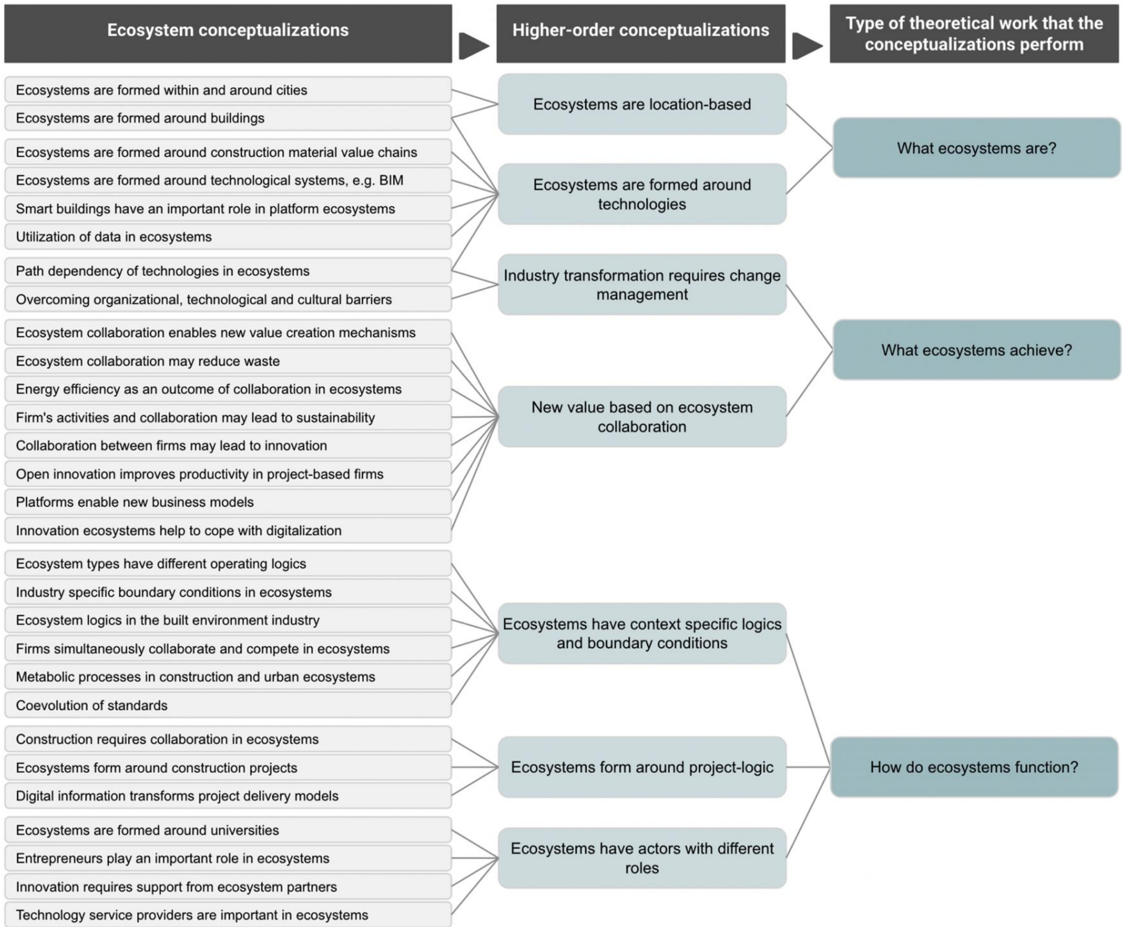

Figure 3. Data structure: ecosystem conceptualizations.

of higher-order conceptualizations and examples of more specific ecosystem conceptualizations.

What ecosystems are?

Ecosystems are location-based

The literature on ecosystems indicates that they are frequently perceived as location-based ecosystems (Figure 4), which develop around buildings and within cities. In these conceptualizations, the construction, use, or maintenance of buildings effectively link various organizational actors to a specific location, or the positioning of actors in a particular place profoundly impacts the ecosystem's functioning.

This perspective is most prominent in urban development and smart city research. For instance, Liu *et al.* (2021, p. 2) propose that urban innovation ecosystems are complex adaptive systems that evolve and grow "through the metabolism of innovation elements" in cities. Similarly, Zhang *et al.* (2018, p. 428) theorize on "an industrial ecosystem level metabolism framework", while Jiang and Zheng (2021) view cities as central hubs of innovation ecosystems. Additionally, Jo *et al.* (2021) explore industrial ecosystems within smart cities, Zygiaris (2013) focuses on innovation ecosystem characteristics in smart cities, and Gorelova *et al.* (2021) examine the role of entrepreneurship in the development of smart cities.

Another perspective that underscores the location-specific characteristics of ecosystems is the notion that ecosystems emerge around buildings. This perspective is more commonly represented in the literature on construction management, yet examples of platform-based services also extend to the broader domain of urban development. For instance, Kangas *et al.* (2018) examine the Finnish energy services ecosystem that provides energy-related services to the existing building stock. They write, "we employ the concept of an 'ecosystem' to have a brief look at how the barriers [to energy efficiency] are caused by or affect other actors besides energy service companies" (square brackets added; Kangas *et al.* 2018, p. 3). Likewise, Säynäjoki *et al.* (2017) propose a platform ecosystem model comprising users, complementors, platform owners, and data derived from smart buildings. Analogous views are echoed in Andion *et al.* (2020),

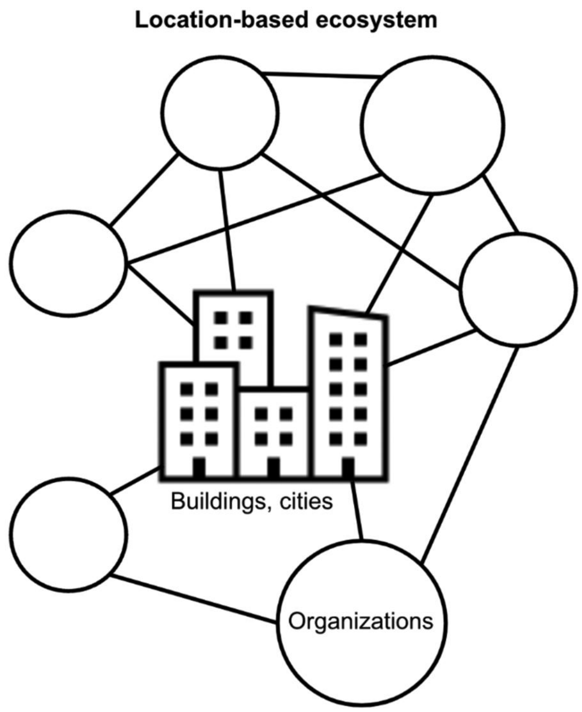

Figure 4. Illustration of location-based ecosystems: organizations are linked to each other and to a specific location.

Zygiaris (2013), Han *et al.* (2021), and Xu *et al.* (2019). This literature further interrelates buildings, actors (e.g. building owners and tenants), and other ecosystem components with the concept of smart cities (cf. Han *et al.* 2021). This comprehensive, multilevel, and hierarchical vantage point has the potential to bridge construction management and urban development in forthcoming research.

Furthermore, the literature on smart cities, industries, and ecosystems commonly establishes interlinkages among these concepts. However, there is a lack of consensus regarding their definitions, as highlighted by Zygiaris (2013), and their interconnections. Additionally, the articles vary in terms of how they perceive the level of analysis between these concepts. For example, some argue that smart cities are ecosystems themselves, while others suggest that they host multiple ecosystems. As a result, discussions on smart city and ecosystem policy and governance, including those concerning sustainability challenges at the local level, are theoretically inconsistent across the literature. This theoretical inconsistency presents a challenge for researchers and policymakers seeking to develop a comprehensive understanding of the relationships between these concepts and to formulate effective policies for smart city and ecosystem governance.

Finally, the conceptualization of ecosystems formed around buildings intersects with the common view that ecosystems are formed around technological systems, such as digital platforms. However, while technologies play a central role in both perspectives, the nature of the technologies differs significantly. In the case of ecosystems formed around buildings, the materiality and location of an ecosystem, as well as the locations of technologies and actors within the ecosystem, are critical for its overall functioning.

Ecosystems are formed around technologies

The literature on ecosystems highlights a prevalent theme of viewing ecosystems as formed around technologies or material value chains (Figure 5). In these conceptualizations, technologies, digital platforms, or material value chains effectively link various organizational actors in the wider built environment sector.

Examples of technologies and material value chains include Building Information Modeling (BIM), as seen in studies by Aksenova *et al.* (2019) and Yang *et al.* (2020), artificial intelligence (AI) in works by Lammers *et al.* (2021) and Xu *et al.* (2019), and platforms, such as those examined by Kim and Kim (2021), Xu *et al.* (2019), Yang *et al.* (2020), Rajakallio *et al.* (2018), and Säynäjoki *et al.* (2017). Other examples of materials and technologies around which ecosystems have emerged include concrete, as investigated by Kang (2022), nanomaterials in the study by Shayakhmetov *et al.* (2021), smart grid in the work by Planko *et al.* (2019), integrated solutions in the article by Whyte (2019), and wood as studied by Viholainen *et al.* (2021) and Toppinen *et al.* (2019). Across this literature, technologies or materials are consistently viewed as central components of ecosystems, with the ecosystem metaphor proving useful for describing actor constellations, interdependencies between actors, and challenges in industry transformation.

This literature draws on sociotechnical systems perspectives, which have a long tradition in construction management and urban development research (e.g. Sackey *et al.* 2015; cf. Bostrom *et al.* 2009). For instance, Aksenova *et al.* (2019) found that while individual firms have adopted BIM, systemic change in the Finnish built environment business ecosystems has been limited. Yang *et al.* (2020, p. 11) similarly concludes "there is a long way to go before the BIM-based project network in China transforms to be a self-updating, self-organizing, and highly efficient ecosystem". Lammers *et al.* (2021) and Xu *et al.* (2019) provide similar views, with Lammers *et al.* (2021) focusing on the evolution of AI knowledge practices in entrepreneurial ecosystems and Xu *et al.* (2019) focusing on platform-oriented business models based

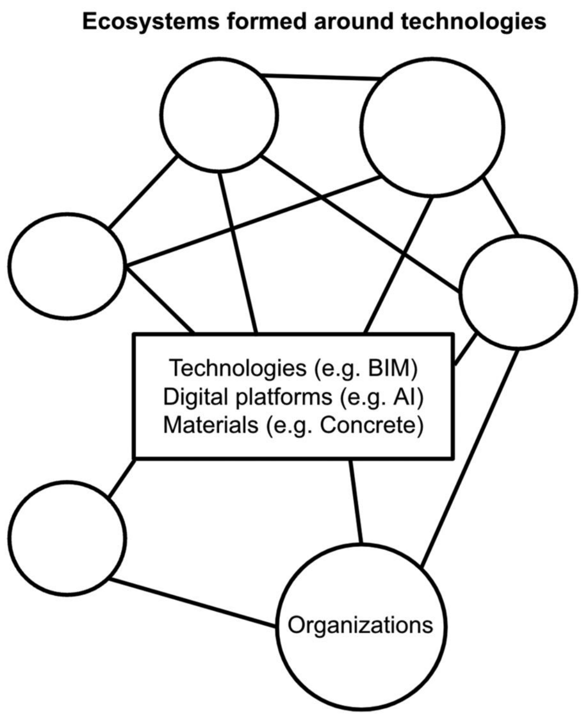

Figure 5. Illustration of ecosystems formed around technologies: organizations are linked to each other and to a specific technology, a digital platform or a material value chain.

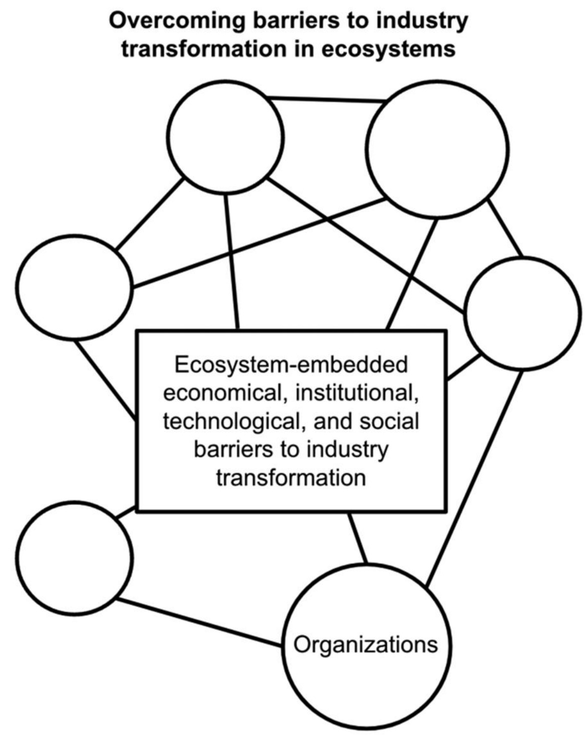

Figure 6. Illustration of industry transformation through an ecosystem lens.

on ecosystem thinking. Lammers *et al*. (2021) suggest that understanding the dynamic processes in entrepreneurial ecosystems can help to form policies, while Xu *et al*. (2019, p. 1) argue that ecosystem thinking can help overcome “a traditional, closed, and product-oriented approach” to the development of AI applications.

What ecosystems achieve?

Industry transformation requires change management

The literature not only defines what ecosystems are, but also provides various conceptualizations of what ecosystems achieve. One such prevalent theme is the use of ecosystem concepts to understand industry transformation and change management (Figure 6).

Kim and Ha (2021), for example, examine the challenges facing the implementation of building energy management technologies in the built environment industry. They identify economic, institutional, technological, and social systems-related barriers and suggest that factors such as payback period, electricity pricing schemes, upfront costs, energy consumption and CO2 emission reduction, and government support systems require industry transformation and change management in ecosystems. Similarly, Kangas *et al*. (2018) conduct a study on integrated energy service companies and their associated ecosystems of actors. They identify supply-side barriers such as economic and market, behavioral, organizational, and institutional barriers to achieving energy efficiency in the built environment sector. The authors emphasize the lack of technical skills, disinterest in energy efficiency improvements, and non-functional regulation as the most significant hindering factors and discuss different ecosystem actor roles in addressing these challenges.

Scholars have also examined technological path dependencies within ecosystems. Yang *et al*. (2020, p. 1) argue that “ecosystem theory provides a new perspective for studying the development of the architecture engineering and construction (AEC) industry”. Specifically, they suggest that analyzing path dependencies in BIM innovation ecosystems can shed light on the interdependencies and symbiosis among ecosystem participants. Similarly, Liu *et al*. (2021) contend that urban innovation ecosystems are also path dependent. They identify five key factors for Beijing’s innovation ecosystem: talent, innovation subjects, resources, innovation environment, and innovation network, and they stress the importance of creating a supportive environment and culture for innovation. Lastly, Jo *et al*. (2021) investigate the structural changes within Korea’s smart city industrial ecosystems over the past 60 years. From labor-intensive manufacturing to emerging high-tech industries and services in smart cities, they argue that smart cities represent a new industrial paradigm that integrates the built environment and ICTs.

Common to this literature is that ecosystem conceptualizations are used to understand organizational, technological, and cultural barriers to change. Analyses of barriers have led to proposals for policy and change management. This view is prevalent in the literature on urban development.

New value based on ecosystem collaboration

The literature explores the mechanisms of value creation within ecosystems and examines the results of collaborative efforts within these ecosystems. It underscores the crucial role of collaboration for value creation and highlights that value is generated at the ecosystem level (Eriksson *et al.* 2019) (Figure 7).

Many authors have theorized on the value creation mechanisms in ecosystems, including Säynäjoki *et al.* (2017), Rajakallio *et al.* (2018), Toppinen *et al.* (2019), Xu *et al.* (2019), and Kim and Kim (2021). For instance, Viholainen *et al.* (2021, p. 1) note that the construction industry has “a strong path dependency towards applying well-established construction materials and methods, as well as partnerships”, and argue that a mindset shift is necessary to develop sustainability-driven logic and create value for consumers. Similarly, Säynäjoki *et al.* (2017) focus on the more effective use of data from smart buildings and digitalization for value creation.

Another valuable perspective in ecosystem research is to examine the outcomes of ecosystem collaborations, with a particular focus on value creation. For instance, Zhang *et al.* (2018) investigated construction and demolition waste generation in Shanghai from 2004 to 2014, while several other studies have examined energy efficiency (Groesser 2014, Kangas *et al.* 2018, Lazarevic *et al.* 2019, Peltokorpi *et al.* 2019, Kim and Ha 2021). Additionally, various authors have conceptualized other sustainability-related outcomes of ecosystem collaborations (Zygiaris, 2013, Toppinen *et al.* 2019, Planko *et al.* 2019, Andion *et al.* 2020, Jo *et al.* 2021, Lammers *et al.* 2021, Viholainen *et al.* 2021). Moreover, several authors provide explanations on how ecosystem collaboration may foster innovation (Planko *et al.* 2019, Chen *et al.* 2020, Al-Gasim *et al.* 2021, Greco *et al.* 2021), while Xu *et al.* (2019), Toppinen *et al.* (2019), and Rajakallio *et al.* (2018) argue that platforms can facilitate the emergence of new business models within ecosystems.

In summary, the literature reviewed highlights diverse value-creation mechanisms and outcomes resulting from ecosystem collaboration. What unites these works is the recognition that new industry practices are essential for value creation, and that collaboration is a key enabler of this process. The ecosystem perspective offers a valuable lens for identifying value-creation opportunities in the fragmented sector.

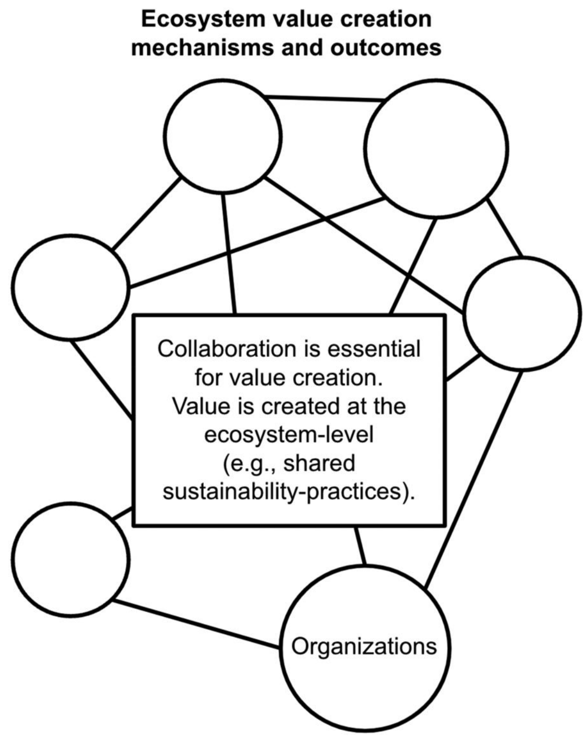

Figure 7. Illustration of ecosystem-level value creation.

How do ecosystems function?

Ecosystems have context specific logics and boundary conditions

The literature on ecosystems also considers the internal logics of ecosystems, such as their processes, boundary conditions, and context-specific logics (Figure 8).

Many of the reviewed articles differentiate between the types of ecosystems they study, which defines ecosystem boundary conditions. For example, Kangas *et al.* (2018), Yang and Tang (2018), Lazarevic *et al.* (2019), Toppinen *et al.* (2019), Kim and Kim (2021), and Viholainen *et al.* (2021) focus on various forms of business ecosystems, where the main logics revolve around business performance and innovation in the built environment. For example, Lazarevic *et al.* (2019, p. 1) state that “we present two critical case studies analysing the emergence of business ecosystems around companies offering integrated-solutions at the intersection of building and energy regimes in

Finland", which clarifies conceptual, structural, and temporal dimensions of their ecosystem conceptualization (cf. Phillips and Ritala, 2019).

In contrast, Zhang *et al*. (2018), Han *et al*. (2021), Jo *et al*. (2021), Kim and Ha (2021), and Kang (2022) define ecosystems as industrial ecosystems. Han *et al*. (2021) operationalize the concept of industrial ecosystems by studying "the spatiotemporal patterns of industry mix between and within office buildings in Sydney". Additionally, other studies focus on urban innovation ecosystems (Zygiaris 2013, Liu *et al*. 2021), digital entrepreneurial ecosystems (Gorelova *et al*. 2021), entrepreneurial ecosystems (Mack and Mayer 2016, Lammers *et al*. 2021), and social innovation ecosystems (Andion *et al*. 2020).

Furthermore, some authors, such as Rajakallio *et al*. (2018), have not only borrowed existing theories from organization and management research fields, but have also reconceptualized, tested, and developed these theories to fit the context-specific logics of ecosystems. For example, Rajakallio *et al*. (2018) first examined the constructs of modularity, interdependence, and technical flexibility from platform ecosystem theory literature outside the built environment research context, and then redefined them to fit the context of construction management and urban development. In doing so, they crafted theoretical instruments that were better suited to their purpose. They state, "The literature review conducted and the empirical results both confirm that the approach [use of platform ecosystem conceptualizations] has a good potential fit within an urban development context, and the operationalization of the necessary boundary conditions for a platform ecosystem's success makes it possible to identify key areas for improvement within the current process" (square brackets added; Rajakallio *et al*. 2018, p. 101). As a result, they were able to extend urban development theories and contribute to the platform ecosystem literature.

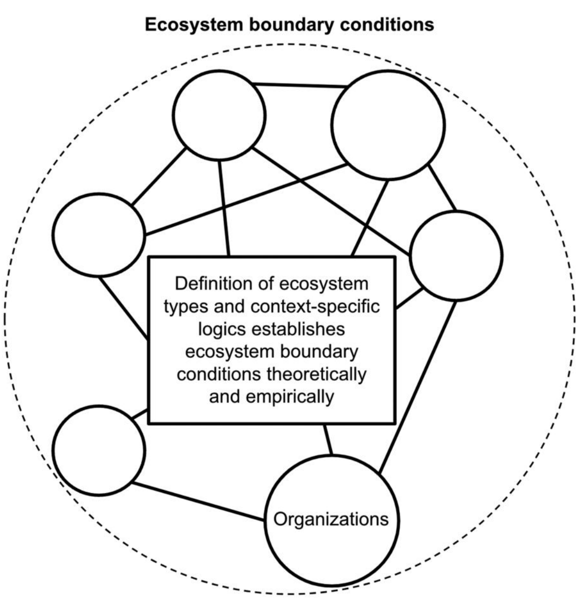

Figure 8. Illustration of ecosystem boundary conditions: context-specific logics and ecosystem types specify boundary conditions of ecosystems.

Another approach to theory development in ecosystem research is to describe context-specific ecosystem logics in the built environment industry. Aksenova *et al*. (2019) provide a rich description of the context-specific ecosystem logics in their study of the Finnish architecture, engineering, and construction industry. Others have focused on specific theoretical concepts within the ecosystem research literature, such as coopetition (Planko *et al*. 2019), urban metabolism (Zhang *et al*. 2018), or co-evolution of standards (Groesser 2014).

In summary, authors in the literature tend to specify different types of ecosystems based on their research interests, which also serves to signal their target audience. Although the choice of ecosystem concept is primarily driven by the dominant organizing logics, it can have implications for the positioning of the work within a particular research literature. Additionally, ecosystem concepts are frequently used superficially in ecosystem research, raising concerns about their value (Vigren 2022). Nevertheless, articles that prioritize conceptual clarity illustrate how ecosystem concepts can advance our understanding of construction management and urban development.

Ecosystems form around project-logic

A recurring motif in this literature is the notion that ecosystems revolve around project-based organizing (Figure 9). While this perspective is prevalent in construction management research, the ecosystem lens offers the potential to broaden its scope from solely construction activities to encompass a broader range of actor constellations within the sector and its institutional framework.

Examples of research that view ecosystems as formed around project-based organizing include Whyte's (2019) and Chen *et al*.'s (2020) articles, which focus on ecosystems that form around megaprojects. Whyte (2019, p. 178) writes: "This approach [a process perspective to articulate the direction and set of transitions] is taken here in a study of the evolving digital innovation ecosystem in the London megaproject ecology, focusing on 15 years of industry/government initiatives, the experience of digital delivery in megaprojects, and the growing links across the ecosystem" (square brackets added). Similarly, Chen *et al*. (2020) examine how ecosystem captains build and operate a megaproject innovation ecosystem. Other studies have explored ecosystem collaboration related to construction projects, such as those by Planko *et al*. (2019), Toppinen *et al*. (2019), Al-Gasim *et al*. (2021), and Viholainen *et al*. (2021). However, this view of ecosystems formed around project-logic is more common in construction management literature, less common in urban development literature, and marginal in ecosystem research outside of the built environment context.

Ecosystems have actors with complementary roles

A distinctive feature of the ecosystem literature is its focus on the complementary roles played by actors (Figure 10), as well as their non-hierarchical relationships. While this has been of interest in both construction management and urban development research, the specific actor groups studied differ between these fields.

One example of a study that explores actor roles in smart building ecosystems is Xu *et al*. (2019), where the authors discuss the roles of customers, facility managers, and real estate operators in the transition towards increased use of AI in smart building ecosystems. Similarly, Säynäjoki *et al*. (2017) identify actor roles related to the commercialization of data from smart buildings and extend the analysis from ecosystem description to foresight by asking interviewees to generate ideas of new business models and new modes of interaction. They highlight the importance of recognizing suitable roles for specific real estate and construction sector stakeholders and suggest that this area warrants further research. Another example is the study by Andion *et al*. (2020), which identifies actor roles and interactions in the social innovation ecosystem in the city of Florianopolis.

A second group of researchers have examined actor roles in project-based ecosystems. For instance, Rajakallio *et al*. (2018) investigated the roles of municipalities and private-sector actors in urban development and discovered that developers played a crucial role in pursuing project complementarities, acting as centralized ecosystem coordinators and system integrators. Similarly, Viholainen *et al*. (2021) utilized ecosystem conceptualizations to analyze actor roles in a construction business ecosystem throughout the design, construction, and use phases of wooden multi-story buildings. Other examples include Chen *et al*. (2020), who focused on the role of "ecosystem captains" in megaproject innovation ecosystems, and Planko *et al*. (2019), who studied actor roles and interactions in Dutch smart grid development.

The third context that emerges from the literature concerns wider industry transformation, particularly the adoption of Building Information Modeling (BIM). For instance, Aksenova *et al*. (2019) investigate the roles of government actors, public agencies, industry players,

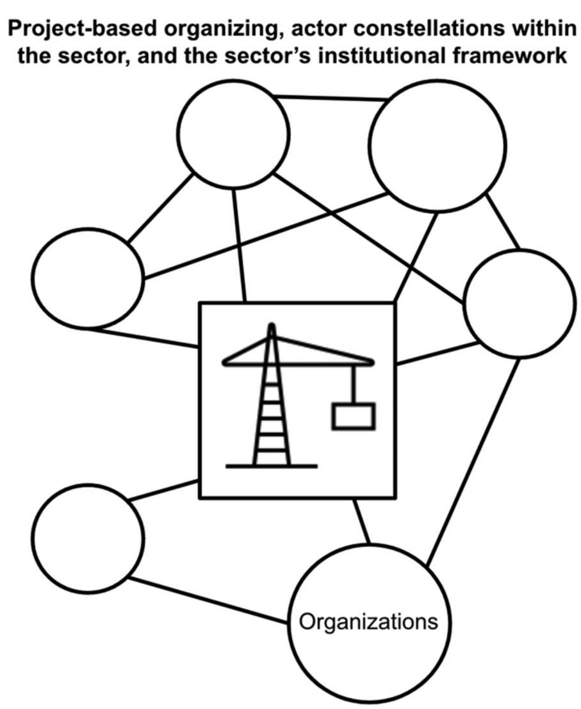

Figure 9. Illustration of ecosystems formed around project-logic.

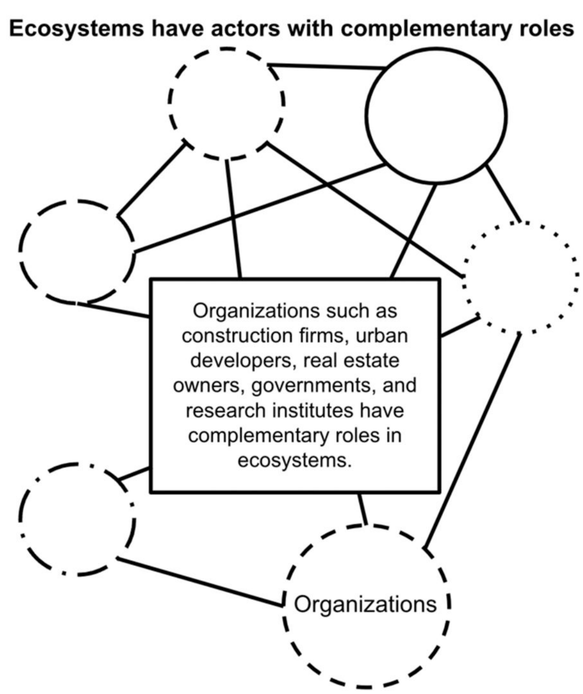

Figure 10. Illustration of complementary roles of ecosystem actors.

and academics in the introduction of BIM in the construction sector's business ecosystems, while Yang *et al.* (2020) analyze the roles of government agencies, research institutes, owners, and various firms (design, construction, consulting, and software) in BIM implementation in China. Other scholars have examined the roles of entrepreneurs in ecosystems (Gorelova *et al.* 2021; Lammers *et al.* 2021; Shayakhmetov *et al.* 2021), technology service providers (PropTech; Kim and Kim 2021), and universities (Ardito *et al.* 2019; Al-Gasim *et al.* 2021; Shayakhmetov *et al.* 2021).

To summarize, this literature has demonstrated that the conceptualizations of ecosystems and actor roles have been valuable in helping to make sense of the complex issues related to smart buildings, construction projects, and wider industry transformation in the built environment sector. These conceptualizations have been used to identify the various actor roles involved in these processes, including customers, facility managers, real estate operators, municipalities, private-sector actors, ecosystem captains, entrepreneurs, technology service providers, and universities. By examining these actor roles, researchers have gained insights into the ways in which different actors interact and collaborate within these ecosystems, as well as the challenges and opportunities that arise in the context of these collaborations. Ultimately, this literature has highlighted the importance of understanding the roles and interactions of actors in built environment ecosystems, and the potential of ecosystem conceptualizations to facilitate this understanding.

Towards an ecosystem research agenda

Although ecosystem remains a niche theoretical concept in construction management and urban development research, its usage is growing rapidly, and existing research has demonstrated the utility of ecosystem concepts in these research fields. This section will focus on the implications of ecosystem conceptualizations in construction management and urban development research, as well as management and organization research more broadly.

The potential of ecosystem theorizing in construction management and urban development research

Location-based ecosystems

Recognizing buildings or construction sites as defining features in ecosystems represents a natural progression in construction management theorization. Such ecosystems comprise actors who contribute to the construction of buildings and related services, leading to system-level value creation (Eriksson *et al.* 2019). The interdependence of actors in these ecosystems is evident through construction activities, location, buildings, common goals, and complementarities (Jacobides *et al.* 2018; Thomas and Autio 2020). However, the actors are also independent of one another, given that construction involves a wide range of heterogeneous companies and stakeholders.

The location-based ecosystem perspective in urban development research considers cities as ecosystems or hosts of ecosystems. This view aligns closely with entrepreneurial ecosystem conceptualizations, which focus on actors contributing to value creation within a specific territory (Stam and Spigel 2017). However, future research should not be limited to this loose conceptualization. A more productive approach would be to define the actors and processes that operate within location-based ecosystems, such as smart cities, and investigate how urban planning and design can guide them towards desired outcomes. Additionally, ecosystem conceptualizations can inform policy formulation by providing descriptive tools that aid in understanding the context of implementation.

One potential way to bridge the gap between construction management and urban development research would be to adopt a life cycle perspective, which considers the entire life span of a building, from design and construction to use, maintenance, and disposal. Research could explore how ecosystems influence the various phases of the building life cycle, and how the actors involved in these ecosystems contribute to system-level value creation over time. For example, researchers could examine how urban planning and design decisions affect the value creation processes in construction management, or how different actors are connected to each other at the ecosystem level beyond the disciplinary boundaries.

Technology-based ecosystems

The existing research in construction management has utilized ecosystem theory to understand how ecosystems are formed around technologies or material value chains. This approach has helped to identify system-level value creation, which can manifest as innovation, efficiency, or new services. While technology-focused ecosystem research in urban development is relatively scarce, it has the potential to serve as a theoretical link between the built environment disciplines. However, it is important to avoid limiting the theorization to specific groups to fully capitalize on the potential of ecosystem conceptualizations in this area.

Future research in construction management and urban development could benefit from exploring the potential of industry platforms and platform ecosystems (Gawer and Cusumano 2014), which have been shown to enable the creation of innovative services in the built environment sector. Prominent examples of such technologies include operating systems for buildings and tenant-experience platforms. Industry platforms are broadly used across industry, enabling them to be a valuable tool for crossing disciplinary and regional boundaries. With the ongoing development of new data sources and platforms, future research could focus on exploring the opportunities and challenges associated with these ventures.

Similar sociotechnical systems perspectives have been extensively used in construction management and urban development research, as seen in studies by Sackey *et al*. (2015) and Bostrom *et al*. (2009). However, the introduction of ecosystem metaphors in such theorization adds a new dimension to the literature, potentially leading to fresh insights into the interdependence of technical and social aspects. As Ritala and Almpanopoulou (2017, p. 40) suggest, there are other ecological analogies that shape our understanding of the underlying phenomena in technology and management literature. These analogies include evolutionary economics (Nelson and Winter 1982), project ecology (Grabher 2002; Hedborg and Karrbom Gustavsson 2020), ambidexterity (Liu *et al*. 2012; O'Reilly and Tushman 2013), and metabolism (Zhang *et al*. 2018). Further research that incorporates these conceptualizations could lead to a more nuanced understanding of the complex relationships between technical and social aspects in construction management and urban development research.

Industry transformation and change management

Ecosystem concepts have proven valuable in addressing the challenges of industry transformation and change management within the built environment sector. Specifically, perspectives on path dependency in socio-technical systems and overcoming organizational, technological, and cultural barriers are relevant for driving systemic change in the industry. These studies transcend the boundaries of construction management and urban development research, as they focus on broad systemic changes in the built environment industry.

The literature on ecosystem conceptualizations has been applied to understand organizational, technological, and cultural barriers to change in the built environment sector. While similar analyses have been conducted in previous research, the ecosystem perspective offers new opportunities for theorizing how different analytical categories, such as economic, institutional, technological, and social systems, relate to each other. This approach has been particularly prevalent in urban development literature, where ecosystem conceptualizations have led to proposals for policy and change management.

However, this literature does not clearly differentiate between the concepts of industry and ecosystems, which can lead to theoretical inconsistencies in discussions about the implications of the findings. To address this issue, industries could be specified based on the types of actors and outputs, while ecosystems could be seen to cross industrial boundaries, as they focus on system-level value creation (Eriksson *et al*. 2019). Without such definitions, there is a risk that vague theories produce implications whose boundary conditions are not clear. Therefore, it is important for future research to clarify these concepts and their relationships to avoid confusion and ensure theoretical coherence.

Opportunities for future research in ecosystem concepts in built environment transformation relate to identifying the needs for change, the actors involved, and the processes required to facilitate change. Ecosystem mapping, which involves identifying actor roles, responsibilities, and workflows, can be a useful tool for this purpose. Additionally, addressing bottlenecks in workflows, governance structures, and conducting transformative, action-oriented research in business studies could play a critical role in supporting industry transformation (Provan and Kenis 2008; Gustafsson and Tsvetkova 2017; Eriksson *et al*. 2019).

Processes of value creation and ecosystem collaboration

While construction management and urban development have different value-creation processes by nature, research on ecosystem concepts may reveal commonalities between these two fields. Ecosystem research in both fields highlights the importance of collaboration in enabling new mechanisms for value creation such as reducing waste, promoting innovation and sustainability, and facilitating new business models through platforms. Thus, the application of ecosystem theories in both disciplines is similar.

However, differences arise from the distinct actor constellations, processes, and outcomes of value-creating activities in each field. For instance, construction management may involve a more hierarchical organizational structure with a focus on project completion within budget and timeline constraints, while urban development may involve a broader stakeholder network and a more long-term perspective on sustainable urban growth.

Construction management and urban development require collaboration among numerous actors. Research in the built environment sector has long been interested in collaboration models, and ecosystem conceptualizations could provide new insights into how to orchestrate ecosystem activities among non-hierarchically governed actors (Thomas and Autio 2020). Future research could explore how roles and orchestration are theorized in relation to the technological, economic, institutional, and behavioral layers of ecosystem orchestration (Autio 2022). Additionally, the research could explore the emergence of ecosystems (e.g. Thomas and Ritala 2022) and how this impacts roles and orchestration. Currently, these aspects are under-theorized in the literature, indicating the need for further research in this area.

The sharing of data to industry platforms and the resulting cooperation and competition among actors are interesting topics for future research (Rajakallio *et al*. 2018). To investigate these issues, researchers could draw on concepts such as digital platform architectures (Tiwana *et al*. 2010) and network effects (Gawer and Cusumano 2014). These perspectives have the potential to enrich the existing research on BIM and to open up new research streams related to platform ecosystems.

Context specific logics and boundary conditions

Ecosystem research in the built environment has made significant strides in recent years, with studies testing the applicability of ecosystem concepts in various research contexts (Pulkka *et al*. 2016, Rajakallio *et al*. 2018, Toppinen *et al*. 2019, Vosman *et al*. 2021, Vigren *et al*. 2022). These studies provide evidence that the ecosystem concept is highly relevant in the built environment sector and holds the potential for further contributions.

In the fields of construction management and urban development, ecosystem research has mainly focused on the application of ecosystem concepts to understand value creation, collaboration, and platform-based business models. However, there are still many research gaps to be addressed, including the study of different types of ecosystems.

For instance, knowledge ecosystems (Clarysse *et al*. 2014, Aksenova *et al*. 2019), have received little attention in the built environment sector, despite their potential role in driving innovation and competitiveness. Future research could explore how knowledge is generated, transferred, and applied in different business ecosystems, and how this affects the development of new products, services, and processes.

Moreover, the emergence of entrepreneurial ecosystems, such as PropTech and ConTech, raises important questions about their relations with other business ecosystems in the sector. Investigating these relations could shed light on how digital technologies are changing the industry landscape and creating new opportunities for value creation and collaboration.

To fully leverage the potential of ecosystem conceptualizations in the built environment, it is also important to define the different components of ecosystems, including actors, relationships, activities, assets, and outcomes. By adopting a more comprehensive ecosystem perspective, researchers can develop more nuanced and context-specific insights into the dynamics of the industry and the challenges of transformation and innovation.

Finally, it is important to acknowledge the specificity of contexts and clearly define ecosystem boundary conditions (Phillips and Ritala 2019) as quality criteria for ecosystem research. This aspect is often neglected, both in general ecosystem literature and in the built environment ecosystem research. As Autio (2022) points out, the term "ecosystem" has been used to describe a wide range of organizational collectives. Articles that demonstrate high conceptual clarity and provide clear definitions of ecosystem boundary conditions can advance our understanding of construction management and urban development. Furthermore, adopting a context-specific approach to ecosystem research can help identify and address unique challenges and opportunities in different settings.

Project-logic in ecosystems

The view of the ecosystem as formed around project-based organizing is widely accepted in construction management literature, as the construction industry is largely project-based. This makes the ecosystem concept valuable for describing groups of actors formed around projects, such as megaprojects (Whyte 2019, Chen *et al*. 2020), and the relationships between those actors between projects. Thus, the ecosystem concept may complement the literature on temporary organizing (Packendorff *et al*. 1987, Söderlund *et al*. 2014, Bakker *et al*. 2016) and project ecology (Grabher, 2002, Hedborg and Karrbom Gustavsson 2020), providing a broader and more comprehensive analysis of construction industry ecosystems.

Additionally, the ecosystem approach could enhance the understanding between construction management and urban development by expanding the analysis from projects to the level of actors and system-level value creation. For example, research could use ecosystem conceptualizations to examine the impact of construction projects on physical appearance, functionality, and livability of urban areas, or impacts on employment opportunities in local communities.

Actors and roles

The existing literature on ecosystems in the built environment identifies various actors and their roles, such as universities, entrepreneurs, and technology service providers, among others. Although the description of actors and their roles is context-bound, there is no theoretical distinction made between construction management and urban development. However, establishing such a theoretical connection could facilitate more integrated development approaches in research on construction management and urban development (Thomson *et al*. 2021). Furthermore, future research could consider new actor types. For instance, building users, service providers (e.g. banks, financiers, architects, engineers, consultants, and construction workers), and public administration are underrepresented in the literature.

In contrast, ecosystem literature outside of the built environment research context offers a rich description of actor types, such as central actors (Zahra and Nambisan 2012), complementary actors (Kapoor and Lee 2013), individuals (Williamson and De Meyer 2012), intermediaries (Stam and van de Ven 2021), users (Mäkinen *et al*. 2014), catalysts (Brusoni and Prencipe 2013), and other partners (Adner and Kapoor 2010). By considering these actor types in the built environment context, future research could provide more integrated development approaches in construction management and urban development.

Potential for contribution in management and organization research field

Developing and applying theories has been a longstanding subject of debate and criticism among scholars in both construction management and urban development (Betts and Lansley 1993, Seymour *et al*. 1997, Seymour *et al*. 1998, Runeson 1997, olde Scholtenhuis and Dorée 2014, Leiringer and Dainty 2017, Volker 2019, Chan 2020). These debates on the style of theorizing are common across various research fields (Abend 2008), and they have remained relevant as these fields have matured. In this regard, Leiringer and Dainty (2017, p. 2) advocate for "theoretical diversity," while Chan (2020) argues for the construction management field to have a strong theoretical grounding and suggests the proposal of new models or metaphors to better understand phenomena. Ecosystem conceptualizations align with this tradition of borrowing ideas from other fields and addressing the need for new concepts and metaphors. On the other hand, to ensure the development and recognition of construction management and urban development research, scholars such as Leiringer and Dainty (2017), Styre (2017), and Bresnen (2017) emphasize the importance of this research contributing to other research fields.

The ecosystem theorizing presented in this review offers numerous opportunities for such contributions.

- First, location-based conceptualizations of ecosystems contribute to mainstream ecosystem research by emphasizing materiality and location, which have been under-theorized themes in ecosystem research.
- Second, the focus on technologies such as BIM and buildings complements platform ecosystem research by highlighting the materiality and location of technologies — which is not necessarily the case in other types of platform ecosystems.
- Third, research on industry transformation and change management can complement ecosystem research by studying the actors that need to complement each other for system-level value creation to emerge.
- Fourth, the fragmented nature of the built environment sector provides an interesting context for research on value creation and ecosystem collaboration.
- Fifth, the built environment sector provides a unique context for testing and developing ecosystem concepts that originate from high-tech sectors.
- Sixth, project-based ecosystem research can increase the understanding of ecosystem dynamics and is a contribution to mainstream ecosystem research that traditionally focused on other features of ecosystems. Moreover, although ecosystems are acknowledged to be dynamic, they have often been studied as static systems. Here, project-based ecosystem research could increase the understanding of ecosystem dynamics.

- Seventh, the unique characteristics of the built environment sector result in different ecosystem actors and roles, making it distinct from ecosystems in other contexts.

To ensure the wider dissemination of these contributions beyond construction management and urban development research fields, future research needs to make them more explicit. Additionally, as these conceptualizations are still in their early stages, they require further testing and critique to fully understand their potential contribution to ecosystem research.

Conclusion

In the context of solving grand challenges in construction management and urban development, Thomson *et al*. (2021, p. 874) argue that an integrated approach between the two professions is essential. To achieve this, there needs to be an understanding of the ways in which actors need to collaborate in order to solve grand challenges through system-level value creation. The article proposes that ecosystem conceptualizations can increase understanding of collaboration in these fields, as ecosystems are communities of actors that contribute to system-level value creation (Thomas and Autio 2020), and collaboration between actors plays a crucial role in creating and modifying ecosystems, as well as in achieving system-level goals (Eriksson *et al*. 2019), such as sustainable development goals.

A structured review of 42 articles identifies seven conceptualizations of what ecosystems are, what they achieve and how they function, including location-based, project-based and technology-centered ecosystems. The article develops an ecosystem research agenda for the construction management and urban development fields, suggesting that the ecosystem concept can act as a theoretical bridge between the disciplines. Additionally, the article highlights the potential contributions of construction management and urban development research to the broader field of ecosystem research. The main limitation of the article is that it does not compare ecosystem conceptualizations with other theories or their application in the context of built environment research. The article contributes to the debate on a theory-driven understanding of collaboration for overcoming grand challenges in these fields.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Data availability statement

The data that support the findings of this study are available in Web of Science Core collection at [https://clarivate.com/].

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