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Review

Exploring Mission-Oriented Innovation Ecosystems for Sustainability: Towards a Literature-Based Typology

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Abstract: With mounting sustainability challenges, policy makers have embraced the idea of transformative, mission-oriented innovation policies, to direct innovation objectives towards the 'grand challenges' in recent years. Against this backdrop, the discourse on innovation ecosystems, bringing together actors from science, industry, government and civil society for collaborative research and innovation, has increasingly gained traction. Yet, their role and architectural set-up in a sustainability context remains rather poorly understood. Complementing a systematic literature review with methods of bibliometric analysis and typology building, this paper introduces a typology of mission-oriented innovation ecosystems. It finds that, depending on the type of mission they are trying to address, ecosystems differ, with both a view to the actors involved, and the specific role taken on by them throughout the innovation process. In particular, it points to an increasingly important role of the state for realizing system-level transformations, underlines the importance of civil society involvement, and highlights research organizations' need to adapt to new requirements.

Keywords: grand challenges; innovation ecosystems; mission-oriented innovation; SDGs; sustainable innovation; systematic literature review; SLR; transformative innovation; typology

1. Introduction

How do we ensure health—both mental and physical—in an aging society? How do we improve quality of life within and beyond urbanizing spaces? How do we proceed towards a less resource-intensive circular economy? How do we arrive at net carbon zero whilst progressing towards gender equality, ending hunger and reducing global disparities? Confronted with these and other grand challenges of our time, research and innovation faces new demands by politics and society. Having been scrutinized with a view to its ability to deliver originality, prove commercially viable and thus contribute to economic growth over the last decades, research and innovation is now expected to not only provide prosperity, but also deliver solutions to society's most pressing questions. As pointed out by Schot and Steinmueller [1], this is reflected in a tremendous change in science, technology and innovation (STI) policy, from World War II to the present day. "Entering a new era of innovation policy" [2] (p. 76), policy makers, such as the European Commission (EC), are embracing the idea of 'transformative' innovation policies that direct innovation objectives at sustainability challenges. Drawing on the ideas of Mazzucato [3–5], the grand challenges, such as the United Nation's Sustainable Development Goals (SDGs), are translated into concrete, achievable steps—so-called missions, to be achieved through research and innovation. The European Union's programs 'Horizon 2020' [6] and 'Horizon Europe' [7] or Germany's 'High-Tech Strategy 2025' [8] are only three among many examples illustrating this mission-oriented turn in innovation policy making over the last years. Given their complex and often wicked nature, these missions cannot be solved by one actor—be it politics, science, industry or civil society—alone. Instead, "they require different sectors to come together in new ways" [4] (p. 3). Against this backdrop, a shift from linear, largely bilateral innovation processes to non-linear, collaborative forms, involving multiple actors can be observed [9] (p. 4). Yet, the question of how these collaborations for mission-oriented, sustainable innovation might work exactly remains underexplored and unanswered so far.

Describing and analyzing processes of joint value creation towards a common innovation objective, the innovation ecosystem literature [10–14] offers a promising frame of reference for scrutinizing these collaborations (see Section 2). Thereby, the particular focus of the innovation ecosystem perspective complements related research on mission-oriented innovation policy [3,5], sustainability transitions [15,16] and broader system perspectives therein [2,17]. However, an initial scoping review reveals that, while the discourse on innovation ecosystems has grown significantly over the last years, their role in light of today's sustainability challenges is yet to be explored [18].

Addressing said research gap, this paper is the first to systematically explore and conceptualize innovation ecosystems from a mission-oriented perspective. As suggested by Liu and Stephens [18], a systematic literature review (SLR) based on Tranfield et al. [19] is conducted for this purpose. To this end, the paper is guided by the following research questions:

1. What characterizes mission-oriented innovation ecosystems as an emerging area of research and how does it relate to similar research strands?
2. How can mission-oriented innovation ecosystems and their sub-types be conceptualized?
3. What should an agenda for future research look like to improve our understanding of mission-oriented innovation ecosystems?

To answer these questions, the remainder of this paper is structured as follows: Section 2 provides the conceptual background by defining innovation ecosystems as key frame of reference. While the Section 3 describes the methodological approach consisting of systematic literature review, bibliometric analysis and typology building, the Section 4 displays the paper's findings. In accordance with the guiding research questions, it explores the research field as such before conceptualizing mission-oriented innovation ecosystems (MOIEs) by developing a typology of sub-types. Before concluding, Section 5 discusses the paper's contribution, reflects upon its limitations, and sketches an agenda for further research.

2. Conceptual Background: Innovation Ecosystems

Aiming to conceptualize mission-oriented innovation ecosystems and analytically distinguish them from similar approaches requires examining the innovation ecosystem concept and related constructs. However, as numerous SLRs on innovation ecosystems have been conducted for precisely this purpose over the last three years [10–14,20], only a brief summary is provided.

With mounting popularity of the innovation ecosystem concept over the last years, countless—and at times contradictory—definitions have been developed. Some of these are vague and terms have been used interchangeably, however, all definitions identify joint innovation activities, collaboration towards a common goal and value co-creation as central to the innovation ecosystem concept [20]. As summarized by Suominen et al. [13] (p. 16)

> The central literature on ecosystems highlights the capability of ecosystems to create value larger than that which any single organization could create. This process of value creation requires co-evolution, where actors enhance each other's capabilities, but also governance of the dynamics of the endeavour

Drawing on Carayannis and Campbell [21], ecosystems bring together actors from different sectors, such as politics, science, industry or civil society, and are best described by the principles of co-creation, co-evolution, co-specialization and co-opetition. It is these key ideas and principles that form this paper's underlying ecosystem definition (for a more comprehensive definition, see [11]).

The innovation ecosystem concept has developed alongside a number of related concepts. A conclusive differentiation between these is difficult and inconsistent across publications, causing fragmentation and ambiguity in the research field [20,22]. Drawing on previous studies [9–14,20,23,24], this paper distinguishes between discourses on the innovation ecosystem, entrepreneurial ecosystem, innovation system, innovation network, open innovation, supply chain collaboration and public-private partnerships (see Table 1). Here, these concepts' applications in the sphere of sustainable innovation are of particular interest (see e.g., 'sustainable entrepreneurship ecosystems' [25]; 'dedicated' [17] resp. 'mission-oriented' [2] innovation systems; 'sustainable innovation networks' [26] or 'Public-Private Partnerships for Sustainable Development' [27]).

Table 1. Ecosystems and related concepts (author's own elaboration based on [9–14,20,23,24]).

Concept	Description	Analytical Focus	Authors
Innovation Ecosystem	Innovation ecosystems can be understood as collaborative multi-sector arrangements, in which organizations co-create value to achieve a shared innovation target.	▪ joint value-creation ▪ co-creation, co-evolution, co-specialization, co-opetition ▪ ecosystem orchestration and governance	▪ Adner 2006 [28] ▪ Adner/Kapoor 2010 [29] ▪ Gomes et al. 2018 [10]
Entrepreneurial Ecosystem	Centered on the entrepreneur, the concept shines a light on the environment and institutions indispensable for nurturing new ventures, hereby generating economic wealth and new jobs.	▪ entrepreneurial activity, start-up success and wealth creation ▪ necessary support structures and intermediaries to nurture new ventures	▪ Autio et al. 2014 [30] ▪ Isenberg 2010 [31] ▪ Spigel 2017 [32]
Innovation System	The systems view on innovation analyzes the different factors (political, economic, social, institutional, organizational) shaping development, diffusion and use of innovations.	▪ contextual, institutional and organizational factors influencing creation and use of innovation ▪ national, regional, sectoral or technological reference points	▪ Edquist 1997 [33] ▪ Lundvall 1992 [34] ▪ Nelson 1993 [35]
Innovation Network	Focusing on the relational ties and networks between different organizations (mostly firms), the network perspective does not look at their co-evolution.	▪ within- and across-industry collaboration of (mostly) businesses ▪ direct and indirect ties between actors	▪ DeBresson/Amesse 1991 [36] ▪ Powell et al. 1996 [37] ▪ Powell et al. 2005 [38]
Open Innovation	The open innovation concept describes the use of external knowledge sources from the perspective of a focal firm. Innovation ecosystems could be understood as a specific form of open innovation arrangements.	▪ firms incorporating external knowledge sources, e.g., users ▪ usually bilateral partnerships between a focal firm and its partners	▪ Bogers 2018 [39] ▪ Chesbrough 2003 [40] ▪ von Hippel 1986 [41]

Table 1. *Cont.*

Concept	Description	Analytical Focus	Authors
Supply Chain Collaboration	Closely related to the concept of open innovation, supply chain collaboration describes firms' cooperation with supply chain partners to improve products or optimize resource use.	▪ firms collaborating along the supply chain to refine offers or optimize resource use ▪ effectiveness vs. efficiency	▪ Cao/Zhang 2011 [42] ▪ Holweg et al. 2005 [43] ▪ Stank et al. 2001 [44]
Public-Private Partnership (PPP)	Coming from a new public management tradition, the PPP literature analyzes prospects and pitfalls of governmental collaboration with private sector partners for joint solution resp. service provision.	▪ collaboration between governments and businesses and/or NGOs ▪ effectiveness and efficiency of solution/service provision (not necessarily innovation)	▪ Bäckstrand 2006 [45] ▪ Glasbergen et al. 2007 [46] ▪ Pattberg et al. 2013 [27]

Throughout the fast-growing literature on innovation ecosystems, different research themes, pertaining to concept [11–13], life cycle [47], evaluation [48], as well as actors and roles [23,49], have emerged. However, as of now, innovation ecosystems are predominantly understood as a vehicle for technology, product or service development, and only rarely discussed within the context of mission-oriented innovation policy or the sustainability agenda [18].

3. Methodology

In accordance with the research interest, this paper builds upon a systematic literature review (SLR) [19,50,51]. To complement the analysis, it also borrows methodological approaches from bibliometric analysis [52,53] and typology building [54,55]. The next sections outline the methodological approach in detail, while its potential limitations will be resumed and discussed in this paper's discussion section.

3.1. Systematic Literature Review

Systematic reviews can be defined as "a methodology for rigorous and extensive synthesis of research findings, using transparent, explicit and replicable procedures" [56] (p. 237). Providing a detailed analysis about what is or else what is not known so far and how the existing knowledge was empirically generated [57] (p. 3), this approach is particularly appropriate in light of the research aim's exploratory nature. As suggested by Tranfield et al. [19] (pp. 214–215), as well as Arksey and O'Malley [58], an initial scoping review of existing SLRs in the field of innovation ecosystems was conducted, to ensure the planned review's feasibility and relevance. After having identified and screened 35 SLRs, 13 were reviewed in detail. While numerous authors have puzzled their heads over the conceptualization of 'standard'—commercially oriented—innovation ecosystems, particularly as distinct from similar concepts such as business and entrepreneurial ecosystems or innovation systems (see Section 2) [10,11,13,14], little systematic attention has been paid to them against the backdrop of today's mission-oriented innovation policy. Having specified and refined the research aim based on the scoping review, the actual SLR proceeded in four steps (also see Figure 1).

The first step aimed to identify all relevant papers. Following a configurative rather than an aggregative approach, as suggested by the research interest [59] (p. 63), it is not stringently required to identify every single study, but to ensure a sufficient breadth of different concepts [60] (p. 100). Nevertheless, three distinct strategies were implemented to identify relevant literature irrespective of its disciplinary background. Through a keyword-based search, four key bibliographic databases for academic literature—Scopus, Web of Science, EBSCO (among others also including the sub-database EconLit) and ProQuest—were systematically screened. Accounting for potential conceptual overlaps (as illustrated in Section 2), the two keyword blocks—innovation ecosystems and mission-oriented innovation—comprised a broad range of synonyms derived from previous studies in both fields (see Appendix A Table A1 for review protocol) [10,12,61]. The search was limited to results published from 1987 onwards, as "the idea of 'innovating for sustainability' can be traced back" [62] (p. 6) to the publication of the Brundlandt report in the same year. Establishing a base line in terms of scientific quality, only articles published in peer-reviewed scientific journals were included in the search. To complement the keyword-based database search, the ten most relevant journals, as identified by previous systematic reviews on innovation ecosystems and sustainable innovation [10,12–14,61], were screened for additional papers (see Appendix A Table A1 for details). Lastly, reference snowballing was applied throughout the review process, to further identify promising articles. The complete search was conducted in April 2020, with the manual search repeated on 15th of June 2020 to ensure the inclusion of recently published articles. After removing duplicates and cleaning the data (e.g., excluding records with central bibliographic information missing), this tripartite search strategy yielded 1984 results.

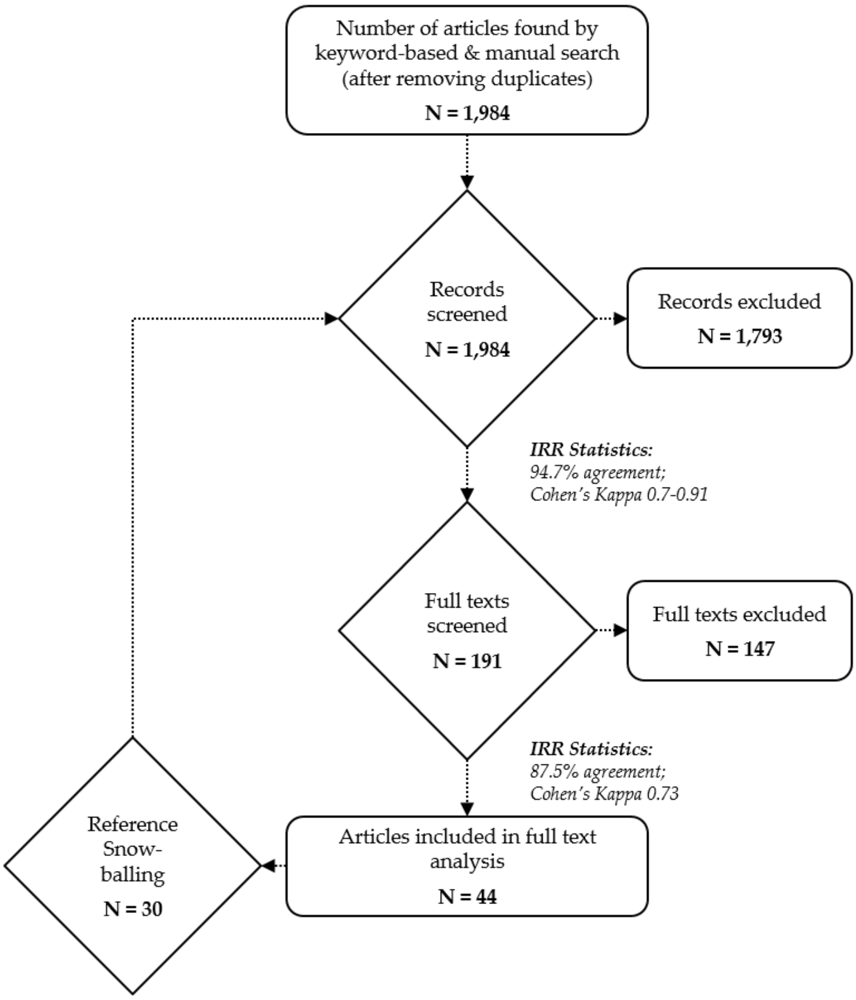

Figure 1. PRISMA flow chart of research process (author's own illustration).

In a second step, the corresponding 1984 abstracts were screened, with view to the following inclusion criteria deducted from the research interest: (a) whether the article deals with a case of mission-oriented innovation, and if yes, (b) whether a specific type of collaboration within this innovation process is scrutinized. For the latter purpose, abstracts were categorized based on their reference to innovation ecosystems or related constructs. Drawing on the conceptual considerations outlined in this paper's second section, articles either explicitly referring to innovation ecosystems or describing similar characteristics (such as a collaboration's multi-sector, co-creative nature) without using the term were included in the subsequent full text screening. The abstract screening procedure was performed by two researchers, who—after completing two training rounds with smaller samples—independently screened all 1984 abstracts. The overall agreement rate of

94.7% in their inclusion-exclusion decisions and the Kappa values of 0.70 (=substantial agreement) for articles describing innovation ecosystem-like characteristics more vaguely respectively 0.91 (=almost perfect agreement), for those explicitly using innovation ecosystem language indicate a high inter-rater reliability of the screening process [63,64]. After resolving remaining disagreements through discussion, 191 records were selected for the subsequent full text screening. While the rate of excluded articles may appear to be high initially, it may be explained by the wide and general nature of the set of keywords employed throughout the search process. Although the majority of articles was ultimately rendered irrelevant to this paper's particular research interest, this approach was necessary due to the ecosystem concept's fuzziness (see Section 2).

The systematic review's third step comprised the full text screening of the 191 remaining records against the backdrop of refined inclusion criteria, as outlined above. Again, two researchers independently conducted the screening process in parallel. After two training rounds with smaller samples, an overall agreement of 87.5% resp., a Cohen's Kappa of 0.73 (=substantial agreement) was achieved. Remaining differences were resolved through discussion. Excluding 26 articles due to technical issues (e.g., because they were not accessible or despite the English search written in another language), and 121 articles on content-related grounds, 44 articles (see Appendix B Table A2 for full list) were selected for subsequent bibliometric (see Section 3.2) and full text analyses (see Section 3.3).

3.2. Bibliometric Analysis

In order to explore and map the research landscape around the emerging field of mission-oriented innovation ecosystems, a bibliometric analysis similar to that performed on innovation ecosystems in general by Gomes et al. [10] was conducted. Coined by Pritchard [53], the term bibliometric analysis refers to the quantitative study of a certain stock of literature and its respective bibliographies. Bibliometric analyses may adopt two different foci: choosing a rather descriptive productivity count, the publication behavior of authors and journals is examined over time. On the other hand, a more evaluative usage count considers the number of citations of a certain author or journal [52].

In accordance with this paper's research aim, different techniques from bibliometric analysis were applied at two stages of the systematic literature review. Firstly, productivity counting was used to explore differences in publication behavior between different research streams, based on the categorization made during the abstract screening (n = 603 records, in which some form of collaboration for mission-oriented innovation is mentioned). Secondly, the 44 full texts eligible for content analysis were assessed both from productivity as well as usage points of view. For this purpose, their complete bibliographic datasets were retrieved from Scopus (available for 41 of the 44 articles) and analyzed using the software VOSviewer (Nees Jan van Eck and Ludo Waltman at Leiden University's Centre for Science and Technology Studies (CWTS), version 1.6.15) [65].

3.3. Content Analysis and Typology Building

Concluding the review process, those 44 papers identified as relevant throughout the rigorous procedure outlined above were analyzed in detail, incorporating elements of framework and narrative synthesis [66,67]. For this purpose, each article was read several times, in order to scrutinize its content. Using MaxQDA as a software tool for qualitative data analysis, the papers' key features were coded based on a codebook derived from the underlying research questions [68] (p. 124). Meta-data, such as information on articles' research aims, their methodological approaches or perspective, were gathered. Furthermore, studies' findings were analyzed, paying particular attention to the conceptualization of ecosystems and their characteristics, e.g., target focus, architectural set-up or collaboration formats.

Aiming to explore and ultimately systemize the differences between several forms of mission-oriented innovation ecosystems, typology building was used as methodological approach drawing on Kluge [54,55], Collier et al. [69] and Schütz [49]. In a first step, an ecosystem's sustainability focus (on one of the three dimensions people, prosperity, planet resp. an integrated understanding) and its solution approach (focus on single solutions vs. focus on system level transformation) were set as the relevant dimensions, opening up the property space. Following Kluge's [54,55] four step procedure, cases were then grouped, empirical regularities analyzed, and types constructed. Additional variables which had been coded as part of content analysis but not used for type construction were then utilized to characterize the constructed types in greater detail.

4. Findings

In line with the two-fold research interest, the systematic review's findings are presented in two separate sections. While the first section focuses on mapping the research landscape by highlighting selected descriptive statistics and results from bibliometric analysis, the subsequent section dives deeper into the content-related analysis, ultimately introducing a typology of mission-oriented innovation ecosystems.

4.1. Overview of the Research Field

Drawing on the conceptual differentiation between innovation ecosystems and related concepts outlined above, abstracts were categorized according to their reference to one of these constructs during the screening process. In total, 603 of the 1984 abstracts focus on some form of collaborative, mission-oriented resp. sustainable innovation. Throughout those articles, the leading discourses are open innovation (20.3%), supply chain (13.3%) and entrepreneurial ecosystems (11.1%). The concept of interest—innovation ecosystems—is present in 7.5% of the 603 abstracts, while remaining constructs figure at roughly 5% (see Figure 2).

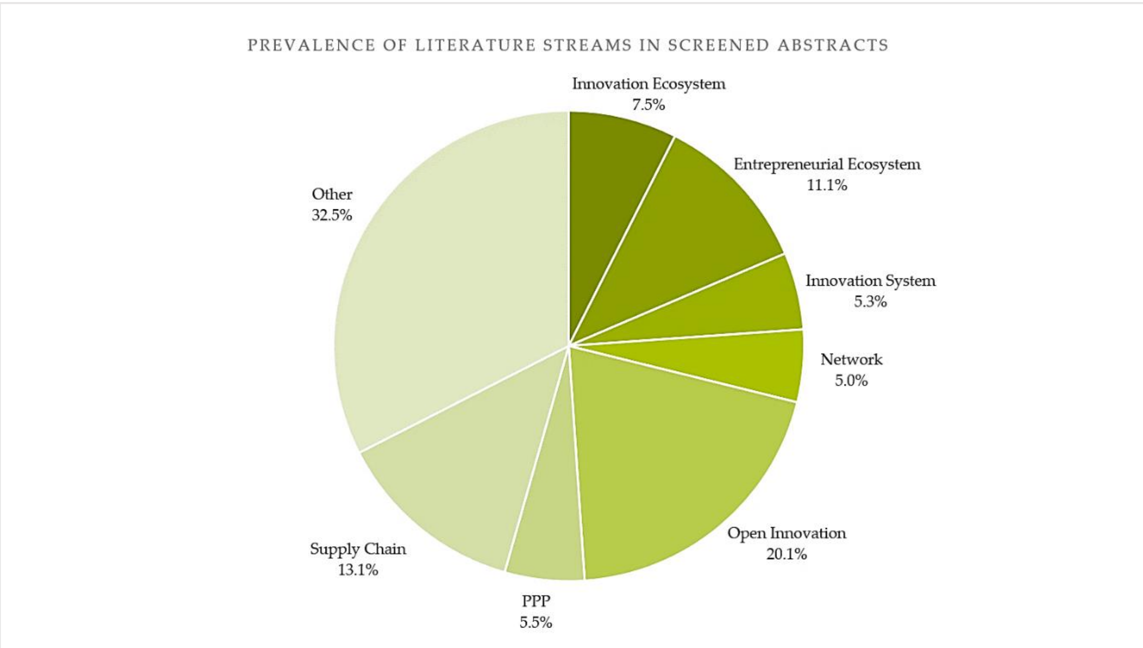

Figure 2. Prevalence of different literature streams in screened abstracts (author's own illustration).

Introducing a time axis to observe publication behavior over time, it becomes apparent that the topic of collaborative innovation for sustainability only gained momentum from 2011 onwards. The research field's growth has significantly accelerated since 2015. As visualized by Figure 3, this general trend can be observed across different streams of research. However, a certain time lag is visible with the open innovation discourse leading the field, while the supply chain and entrepreneurial ecosystem discourses followed a bit later. The prevalence of the innovation ecosystem terminology within the mission-oriented innovation discourse only gained traction from 2017 onwards, jumping up the ladder in 2019, with yearly publications more than doubling in comparison to the previous year. Although not included in Figure 3, a sneak peek into preliminary 2020 data suggests that the innovation ecosystem stream might even outpace other streams. These observations are in line with findings of previous SLRs on innovation ecosystems, pointing to a significant increase of publications in recent years, with the majority stemming from the last three years alone [12,22].

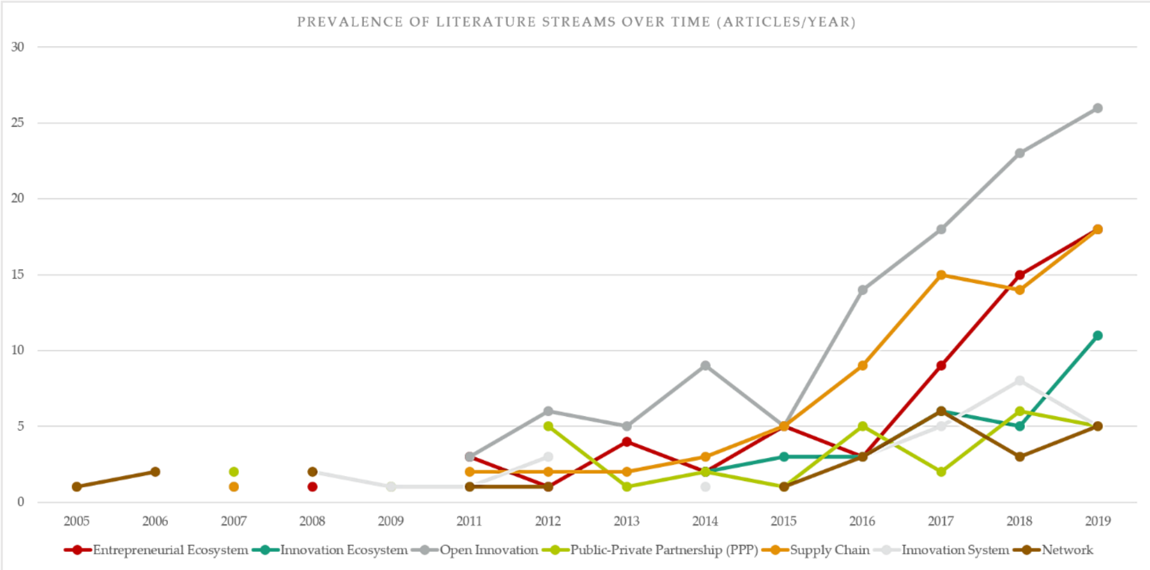

Figure 3. Prevalence of literature streams found in abstracts over time (author's own illustration).

Investigating the papers' source of publication, the impression of a scattered field emerges at first sight, with the 603 articles stemming from 328 different journals. Taking a closer look, however, the analysis reveals an uneven distribution, with two journals—*Journal of Cleaner Production* and *Sustainability*—leading the field by far with 65 resp. 50 records each, compared to just 11 publications in the third-ranked *Business Strategy and the Environment*. Differentiating between the various conceptual streams (see Section 2) shows that the former two are characterized by their broad approach, providing a platform to almost all conceptual traditions. Beyond that, each research stream is dominating one or two important journals, as is the case with *Small Business Economics* for the entrepreneurship-focused literature, the *International Journal of Production Economics* for the supply chain discourse, or *Technological Forecasting & Social Change* and *European Planning Studies* for the proponents of sustainable innovation systems. Looking specifically at the 44 articles selected for full-text analysis, the findings emphasize the importance of the *Journal of Cleaner Production* and *Sustainability* for the discourse on mission-oriented innovation ecosystems. These two journals are the only ones with more than two publications, dominating this niche from 2017 onwards (see Figure 4). Interestingly, however, these are not the journals of high relevance for the general debate on innovation ecosystems (such as *International Journal of Technology Management*, *Research Policy*, *R&D Management*, *Strategic Management Journal*, *Technovation* or *Technological Forecasting & Social Change* [10,12–14,22]), but rooted in the sustainable innovation discourse [61].

Looking beyond the journal covers, Table 2 provides an overview of the eleven most cited articles within the full text sample. Strikingly, there are no papers specifically dedicated to the phenomenon of mission-oriented innovation ecosystems included in this list. Instead, articles focus on certain sub-types, such as Carayannis and Campbell's [70] influential work on quadruple and quintuple helix structures for achieving sustainability, as well as the former author's conceptualization of social innovation ecosystems [71].

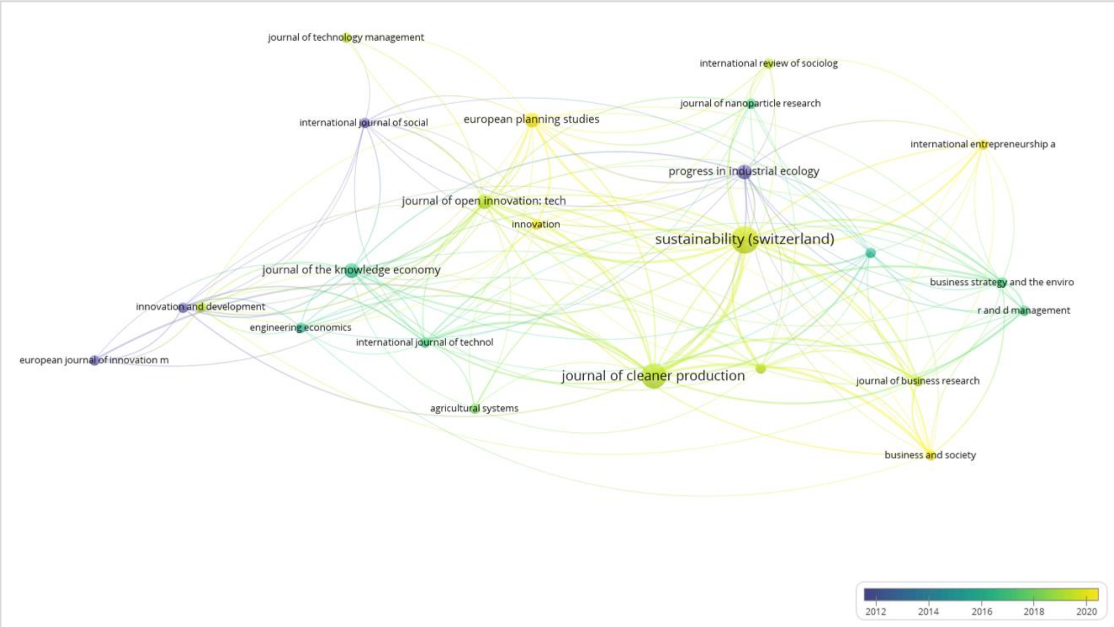

Figure 4. Development of journal importance over time (based on bibliographic coupling using VOSviewer 1.6.15).

Table 2. Overview of most-cited articles within the sample of full texts.

Rank	Authors (Year)	Title	No. of Citations
1	Carayannis and Campbell (2010) [70]	Triple Helix, Quadruple Helix and Quintuple Helix and How Do Knowledge, Innovation and the Environment Relate to Each Other?	196
2	Carayannis et al. (2019) [71]	Social Business Model Innovation: A Quadruple-/Quintuple- Helix-Based Social Innovation Ecosystem.	113
3	Pigford et al. (2018) [72]	Beyond Agricultural Innovation Systems? Exploring an Agricultural Innovation Ecosystems Approach for Niche Design and Development in Sustainability Transitions.	41
4	Goodman et al. (2017) [73]	Our Collaborative Future: Activities and Roles of Stakeholders in Sustainability-Oriented Innovation.	37
5	Yarahmadi and Higgins 2012 [74]	Motivations towards Environmental Innovation: A Conceptual Framework for Multiparty Cooperation.	30
6	Behnam et al. (2018) [75]	How should Firms Reconcile their Open Innovation Capabilities for Incorporating External Actors in Innovations Aimed at Sustainable Development?	26
7	Yun and Liu (2019) [76]	Micro- and Macro-Dynamics of Open Innovation with a QH-Model.	24
8	Brown et al. (2019) [77]	Why Do Companies Pursue Collaborative Circular Oriented Innov?	11
9	Hossain et al. (2019) [78]	A Systematic Review of Living Lab Literature.	10
9	Barrie et al. (2017) [79]	Leveraging Triple Helix and System Intermediaries to Enhance Effectiveness of Protected Spaces and Strategic Niche Management for Transitioning to Circular Economy.	10
9	Yang et al. (2012) [80]	What can Triple Helix Frameworks Offer to the Analysis of Eco-Innovation Dynamics? Theo. and Method. Considerations.	10

Against this backdrop, it is no wonder that E.G. Carayannis is also leading the ranking of the ten most important authors within the sample (see Table 3), co-authoring not only three different papers, but also having the most citations by far. Two more authors with a high publication output, pushing the research frontiers forward, are Zheng Liu and Nancy Bocken. Since their articles have been published more recently (4 in 2019; 2 in 2020), their citation count is inevitably lower—up to this point. This also highlights the more general point that citation statistics should be used with caution, specifically within a research field that is relatively young and still evolving.

Table 3. Overview of most important authors within the sample of full texts.

Rank	Author	No. of Documents within Sample	No. of Citations	Author's h-Index (Source: Google Scholar)
1	E.G. Carayannis	3	310	57
2	Z. Liu	3	31	*n.a.*
3	N. Bocken	3	13	36
4	J. Barrie	2	16	*n.a.*
5	E. João	2	16	17
6	G. Zawdie	2	16	*n.a.*
7	R. Balkenende	2	11	25
8	P. Brown	2	11	3
9	Y. Yang	2	11	*n.a.*
10	M. Grimaldi	2	1	*n.a.*

Although the research field is only just coming of age, its conceptual roots can be traced back to discourses that have been around for much longer. Running a co-citation analysis of our sample to better understand the intellectual structure of the field, six main conceptual traditions or research clusters influencing mission-oriented innovation ecosystem thinking were revealed (see Figure 5). These are: (1) the open innovation discourse around authors such as Chesbrough, Bogers and von Hippel; (2) the innovation systems and helix debates, going back to e.g., Nelson, Carayannis, Campbell or Etzkowitz; (3) the living lab concept put forward by Leminen and Schuurman; (4) the sustainable innovation literature with authors such as Bocken, Evans or Lüdeke-Freund; (5) the social innovation concept—sometimes viewed from a more sociological perspective—established by Howaldt and Terstriep, and finally, (6) the debates around sustainability transitions, transformative change and mission-oriented innovation policies, dominated by authors such as Mazzucato, Schot or Klerkx.

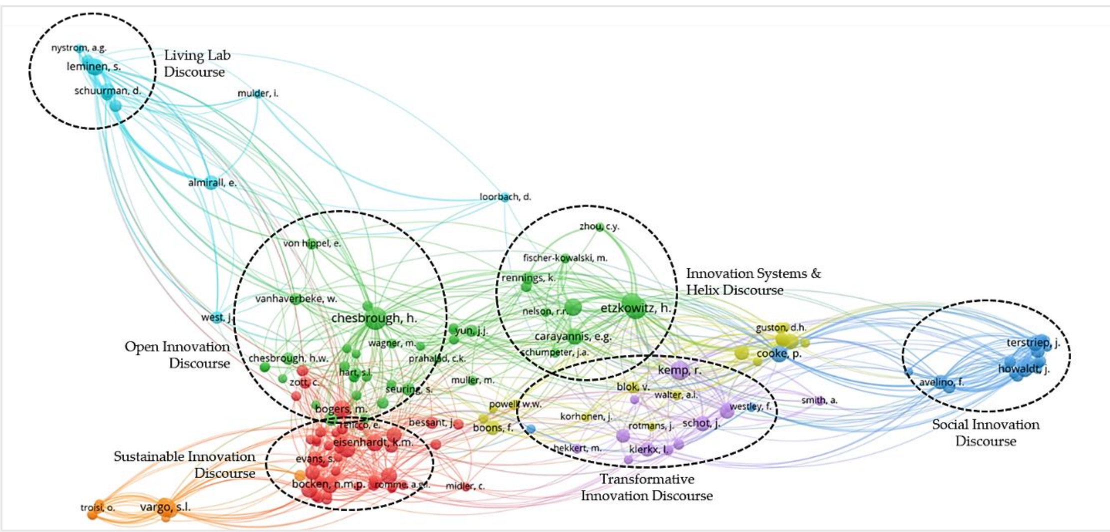

Figure 5. Conceptual roots of MOIE thinking (based on co-citation analysis using VOSviewer 1.6.15).

Building on these conceptual roots, about one third of the 44 articles are of a conceptual nature, whereas about two thirds apply an empirical approach. Zooming in, Table 4 displays that half of the empirical papers build on single case studies, while another 21.4% utilize a small-n comparative approach (2–5 cases). On the contrary, only a quarter of the empirical papers are based on the analysis of more than five cases. This lack of medium- and large-n research reinforces findings from previous SLRs on innovation ecosystems [10]. By far the most common methodological approaches are qualitative interviews (57.1% of empirical papers) and document analyses (also 57.1%). While social network analysis (SNA) is used in at least four papers, other methods are scarce.

Table 4. Overview of methodological approaches used within the sample of full texts.

Nature of Paper	No. of Studies (% Total)	Research Approach	No. of Studies (% Empirical)	Research Method * (* Note: One Study can Use Several Methods)	No. of Studies (% Empirical)
Conceptual	16 (36.4%)	—	—	—	—
Empirical	28 (63.6%)	Single Case Study	14 (50.0%)	Interviews	16 (57.1%)
		Small-N Case Study	6 (21.4%)	Document Analysis	16 (57.1%)
		Medium-N Case Study	7 (25.0%)	Social Network Analysis	4 (14.3%)
		Other	1 (3.6%)	Survey	2 (7.1%)
				Participant Observations	1 (3.6%)
				Action Research	1 (3.6%)

4.2. *Content Analysis: Towards a Typology of Mission-Oriented Innovation Ecosystems*

Having provided an overview of the research field in response to the first research question, the following section focuses on the second research question by laying out the conceptual foundations of the mission-oriented innovation ecosystem idea. As stated in the introduction and background section, a mission-oriented innovation ecosystem is characterized by its distinct target focus. As opposed to 'standard' innovation ecosystems that have been dealt with in the business strategy and innovation management literature, and predominantly aim to bring innovative technologies, products and services to the market [28,29], mission-oriented innovation ecosystem pit themselves against the grand challenges. Aiming to direct innovation towards sustainability challenges, as for example represented by the United Nation's Sustainable Development Goals (SDGs), a mission-oriented innovation ecosystem brings together all relevant actors from politics, science, industry and civil society for joint value creation. Directionality and value co-creation, as well as the principles of 'co-evolution' and 'co-specialization' [21] mark key characteristics of, and dynamics within, these ecosystems (see Figure 6).

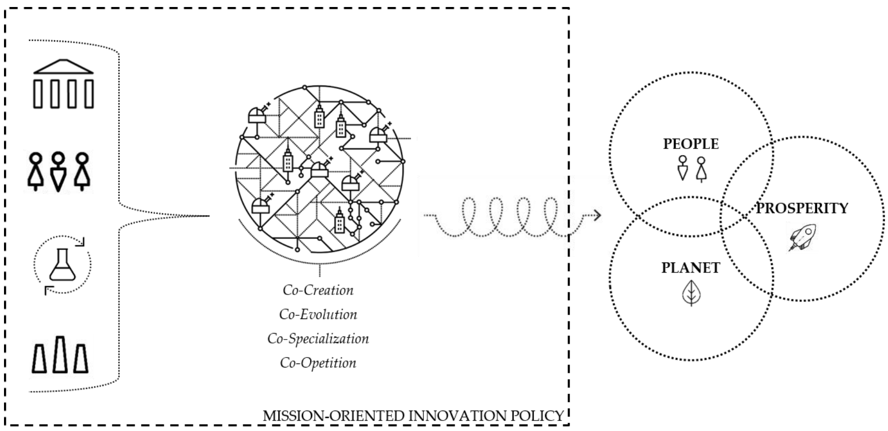

Figure 6. Mission-oriented innovation ecosystems (author's own illustration inspired by Schütz [49]).

Starting from this relatively broad definition of mission-oriented innovation ecosystems, several sub-types could be identified based on the systematic literature review. On the one hand, the 'new' missions, as defined by Mazzucato [5], equally encompass all three dimensions of sustainability—economic, social, environmental. Hence, mission-oriented innovation ecosystems could specifically target one of the three dimensions—people, prosperity, planet—or apply a more holistic understanding that aims to integrate these elements. On the other hand, mission-oriented innovation policy leaves room for two different solution approaches towards the grand challenges: Answers to pressing societal challenges can be sought at the immediate solution level (e.g., electric instead of fuel-based vehicles), or at the system level (e.g., transforming mobility systems as such). As mission-oriented innovation ecosystems could potentially emerge at the intersection of all four sustainability foci and take on either one of the two solution approaches, the typology developed as part of this article is based upon a 4 × 2 property space. Figure 7 visualizes the eight potential sub-types (of which one was not empirically found within the analyzed papers, and one is excluded based on conceptual considerations), which will be outlined in more detail in the following.

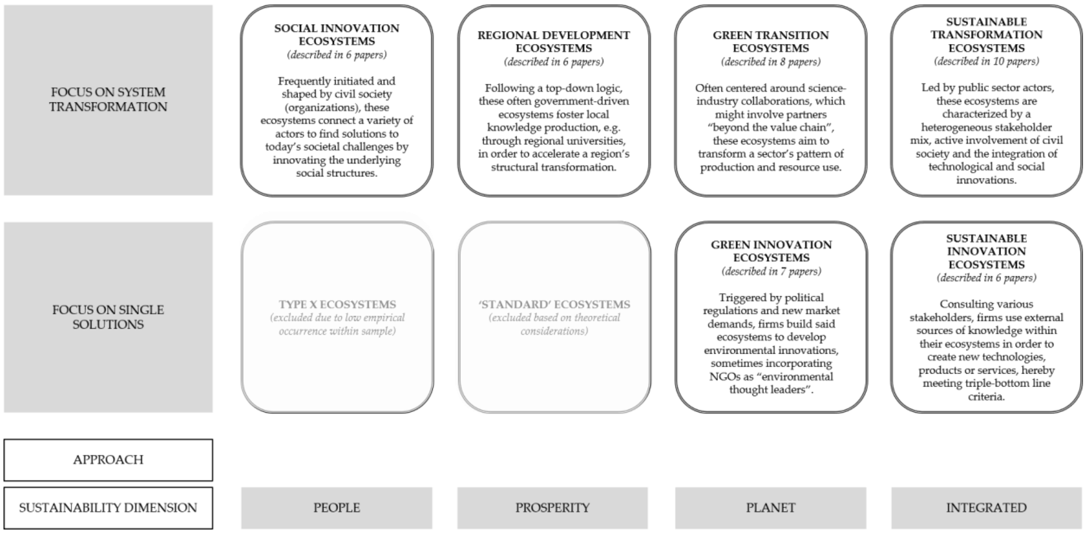

Figure 7. A typology of mission-oriented innovation ecosystems (author's own elaboration).

Social Innovation Ecosystems: The first sub-type of mission-oriented innovation ecosystems describes ecosystems which aim to give "answers [. . .] to social needs that will lead to better results for the entire society" [71] (p. 2). As such, these ecosystems focus on sustainability's 'people dimension', while trying to tackle challenges at a system level. The six papers clustered under this heading all refer to the 'social innovation ecosystem' terminology. Acknowledging the ambiguity of the term 'social innovation' [81,82], this paper uses the terminology explicitly to describe innovation ecosystems leveraging social impact. Social, in the sense of behavioral, non-technological innovation, cuts across all four different target dimensions and may—some might even say must—be part of any innovation ecosystem. With view to their architectural set-up, these innovation ecosystems are characterized by a high variety of actors [71,82,83]. All six papers are based upon a quadruple-helix perspective, and describe ecosystems as involving actors from science, industry, politics and civil society. Alcaide Lozano et al. [83] consider stakeholder variety a key success factor of social innovation ecosystems, stating that "the more heterogeneous an ecosystem is [. . .], the greater are its possibilities of gaining access to new ideas and strategies". Despite this quest for stakeholder diversity, public sector actors and civil society (organizations) in particular take on a central role in social innovation ecosystems [81,83]. In contrast, actors from science seem to play a less prominent role compared to other innovation processes [81,83,84]. As trust and relational ties are perceived to be particularly relevant to social innovation ecosystems, their local embedding is utterly important [81–83]. Still, they "are often supported in their attempts at social change through translocal, international collaborations with like-minded local initiatives" [84] (p. 5).

Regional Development Ecosystems: Within this sub-type of mission-oriented innovation ecosystems, a primary focus on economic sustainability is combined with a system level perspective. An illustrative example that features prominently in most of the six underlying papers are missions aiming at regional development and structural transformation, for instance within the context of smart specialization strategies driven forward in EU innovation policy. According to Lopes and Franco [85] (p. 278), these ecosystems' "final objective is the creation of territorial added value in the form of increased wealth, employment and well-being, leading to regional competitiveness". Five out of the six papers refer to a quadruple-helix set-up; however, the empirical findings allude to a dominance of triple-helix patterns, and a marginalized role of civil society in some cases [86]. This may be due to the often government-driven nature of regional development initiatives [87]. Although hardly an easy endeavor, combining this top-down logic with bottom-up elements and ensuring meaningful citizen participation is critical for success [87,88]. To this end, the 'social foresight lab approach' developed by Schroth et al. [89] depicts a promising methodological approach. Reflected in the particular university perspective taken by two of the six papers, a key role within regional development ecosystems is ascribed to academia, especially regional universities [88,90]. Not only do they provide a region with a highly skilled workforce, but generate new scientific knowledge, which can be transferred and commercialized through science-industry collaboration or academic spin-offs [88]. At this point, a blurring of innovation and regional development policies and a conceptual overlap with regional innovation system (RIS), cluster and entrepreneurial ecosystem discourses can be observed. Inherent to the concept is the ecosystem's highly local nature, with the geographical region as the central point of reference [85–88,91], nevertheless, aiming at global markets [86,88].

Green Transition Ecosystems: Green transition ecosystems—at the intersection of planet focus and system approach—can be defined as innovation ecosystems, with a clear focus on achieving environmental sustainability, through the transformation of the underlying patterns of production and resource use. An excellent example for these ecosystems addressed by several of the eight underlying papers [e.g., 231; 232; 901; 1953] is the circular economy. This is because the

> Transition to a circular economy can be achieved through multiple protected spaces targeted—for example, at key circular economy growth markets such as renewable energy, biorefinery, remanufacturing, sustainable mobility and the sharing economy, to co-evolve, paving the way for smooth transition within a governance framework that is capable of mitigating tensions and conflicts that are likely to arise in the transition process [79] (p. 3)

An alternative example could be the discourse around agricultural innovation ecosystems [72,92]. With view to these ecosystems' architectural set-up, it is notable that, while actors from science and industry are discussed in almost all papers, the role of governments and especially of civil society is less prominent. Throughout the analyzed papers, the leading role of industry and science and the importance of the two sectors' collaboration is emphasized [92–95]. If considered relevant by these key actors, additional partners "beyond traditional value-chains" [93] (p. 11) may be included. Although said ecosystems "may be driven by firms only", it "may often require a push from policy organizations", for example "trough financing mechanisms" [94] (p. 14), to accelerate the ecosystems' initial emergence. In some cases, these early investment costs are also borne by large keystone companies in order to nurture the emerging ecosystem [95]. The strong science-industry collaboration at the heart of green transition ecosystems is also reflected in typical collaboration formats. In contrast to some of the other ecosystem types, they predominantly focus on classical knowledge and technology transfer channels, such as patents and licenses [96], as well as the establishment of common standards [95,97,98]. Contrary to the previous two sub-types, green transition ecosystems can have a "decentralized" [79] (p. 7) nature, and do not necessarily rely on a specific geographical point of reference.

Sustainable Transformation Ecosystems: The fourth sub-type of mission-oriented innovation ecosystems distinguish itself by their holistic perspective on sustainability, seeking to integrate and balance the three dimensions people, planet and prosperity. Such an approach can, for example, be found in smart city projects, where positioning the city competitively in the region and reducing CO_2 footprints and increasing citizens' well-being may be three (among other) aims pursued at the same time. Such an integrated perspective combined with a system level approach is described in ten papers of the full text sample. While all papers refer to the three sectors politics, industry and civil society, science is mentioned once less. A heterogeneous stakeholder set-up is perceived as central to these ecosystems [78], however, taking a closer look reveals a leading role of public sector actors and the importance of active citizen participation [70,76,99]. As ensuring the latter is challenging at times, it is particularly interesting that—despite the steering role of the public sector—"there is usually an intermediary, like a design or architecture firm, taking care of the co-creative process" [99] (p. 12). While design-based methods' ability to translate between different stakeholder groups and make potential future(s) tangible is a promising pathway to ensure wider participation in innovation processes [100], citizens' preferences towards participatory approaches must be considered [101]. Besides various co-creation formats, for example in living lab environments [78,99,102], the literature highlights the important role of capacity building [102,103] and the opportunities of open government platforms for increasing government-citizen interaction [99,102]. Compared to other types of ecosystems, their aspiration to pursue different goals simultaneously, hereby adding complexity, and their heterogeneous stakeholder setting, might make sustainable transformation ecosystems especially prone to tensions, which may arise with regard to competing priorities, value creation vs. value capture mechanisms, or potential hi-jacking through interest groups [99,104].

Type X Ecosystems: Type X ecosystems focus on sustainability's people dimension, and adopt a solution level approach. A recent practice example of such ecosystems is the development of the COVID-19 tracing app in Germany, where actors from government, industry, science and civil society joined forces to make a concrete step towards the containment of the corona pandemic. However, as this sub-type was identified in only one paper, no further characterization is developed here.

Standard Innovation Ecosystems: Given the two dimensions spanning the typology's property space—sustainability focus and solution approach—there could potentially be a type of ecosystem at the intersection of prosperity focus and solution level. Based on the research aim to conceptualize mission-oriented innovation ecosystems and drawing on Mazzucato's [3–5] mission definition, this type is nevertheless excluded due to theoretical considerations. Introducing a new solution—in other words a product or service—whilst aiming at economic sustainability is what all commercial innovation ecosystems strive for. Yet, such focus does not qualify as a dedicated mission from a policy perspective. Instead, this ecosystem type can be defined as a 'standard innovation ecosystem', representing the research focus of the general innovation ecosystem discourse (see Section 2). Most of what has been written on ecosystems so far characterizes this non-mission-oriented ecosystem type.

Green Innovation Ecosystems: Described in seven papers, green innovation ecosystems are defined by their strong focus on environmental sustainability, while applying a solution level approach. For such ecosystems, numerous examples aiming at developing 'green' or 'cleaner' technologies, for instance in the areas of energy production [105,106], construction [107] or mobility [108], could be listed. Within green innovation ecosystems, firms are considered the ecosystem leaders and primary solution drivers, not least reflected by the fact that all seven papers are analyzing ecosystems from a focal firm perspective. Over the course of the innovation process, these ecosystem leaders consult and incorporate various stakeholders, for two reasons [107,108]: according to Yarahmadi and Higgins [74], they aim at leveraging external competences on the one hand, whilst trying to comply with (environmental) regulations and obtain legitimacy on the other. With regard to the latter cooperation rationale, the literature particularly highlights the importance of governments, as regulators, and in some cases of civil society organizations and NGOs, as environmental thought leaders [80,105]. On the contrary, science seems to play a less prominent role, and is only considered as an important stakeholder by three of the seven papers. More often, competency is sought within the firm's own supply chain. The open innovation and supply chain literature, as neighboring strands of research, which have already inquired this topic in detail, serve as important points of reference here. The two main motivations for collaboration within this ecosystem sub-type may also help to explain the collaboration formats, which are mentioned by the texts: While knowledge exchange among firms and the involvement of users are meant to build competencies [106,108], political lobbying and awareness campaigns are used for reasons of compliance [80].

Sustainable Innovation Ecosystems: Sustainable innovation ecosystems combine a holistic view on sustainability with a focus on the immediate solution level. Six papers apply this understanding. However, a closer look at their methodology and sampling in particular shows that some of them define sustainable innovation as "a new or significantly improved product or service whose implementation in the market solves or alleviates an environmental OR a social problem" [73] (p. 732; own accentuation). Thus, sustainable innovation ecosystems encompass both cases with a more singular people or planet focus, as well as with a more integrated approach. Therefore, the following characterization based upon the underlying texts must be viewed with caution. Generally, said ecosystems show significant similarity with green innovation ecosystems, as the former appear to be equally firm-driven and are once again analyzed from the focal firm perspective in all cases. Perceiving the grand challenges "as a potential future market" [109] (p. 5), in which a first mover advantage may still be achieved, firms try to incorporate them into their business models. Applying a 'boundary-spanning business model' [110] perspective, different stakeholders are consulted and incorporated at certain stages or for certain tasks during the innovation process [18,73,109,111].

5. Discussion and Agenda for Further Research

Having presented the SLR's findings above, the subsequent sections aim to embed them into the broader discourse to derive their theoretical and practical contribution (see Section 5.1), outline avenues for further research (see Section 5.2) and reflect upon this study's limitations (see Section 5.3).

5.1. Ecosystems in Times of Mission-Oriented Innovation Policy

The grand challenges of our time cannot be solved by one actor—be it politics, science or industry—alone. Yet, an appropriate analytical framework for conceptualizing and ultimately analyzing these processes of collaborative innovation is lacking. As argued within this paper, the innovation ecosystem construct depicts a particular promising frame of reference in this regard. For this purpose, the paper integrates two different strands of research—the discourse on mission-oriented or transformative innovation policy on the one, as well as the innovation ecosystem literature on the other hand. Following a rigorous approach of systematic literature review, this study is the first to map adjacent fields of research and conceptualize mission-oriented innovation ecosystems with view to both the scope and target of their proposed solution and the underlying structure of multi-sector, collaborative innovation.

While the question of how such mission-oriented innovation ecosystems might work remains underexplored, the SLR's content-related findings presented in Section 4.2 indicate that the overarching mission or innovation target typically implies the prioritization of one sustainability dimension over others, influencing ecosystems' strategy and architectural set-up in turn. Compared to the broader innovation ecosystem literature, where firms usually constitute the keystone players [10], the analysis of mission-oriented innovation ecosystems reveals a more central role of the public sector. Within many sub-types of mission-oriented innovation ecosystems, governments move beyond their purely regulatory role, in order to actively create and orchestrate ecosystems. This finding is in line with the general shift in the role of governments within mission-oriented innovation policy [5]. However, the sub-types social innovation ecosystem, regional development ecosystem and sustainable transformation ecosystem show that—in order to be successful, this top-down approach is in need of societal participation and bottom-up experimentation, as argued by Schot and Steinmueller [1].

Whereas single solutions are driven by firms within ecosystem set-ups, which are partly similar to 'standard' innovation ecosystems, real, system-level transformation does not only require fresh ideas and innovative solutions, but political commitment and societal acceptance. With view to the academic sector, the analysis reveals a less central role within several ecosystem types, despite mission-oriented policy's initial claim 'to solve the grand challenges with the means of research and innovation'. This observation does certainly not imply a general loss of importance, but rather points to the challenge of overcoming linear innovation processes and strategically positioning research organizations within these new forms of collaboration.

This bears important implications for mission-oriented policy practices: on the one hand, politics should realize its formative power, especially with view to system-level transformations. For this purpose, new collaboration formats, enabling the active involvement of policy makers in innovation processes beyond merely providing financial resources and setting the regulatory framework, should be tested. On the other hand, both public and private actors need to recognize that civil society involvement is indispensable with regard to system level transformations. Moving beyond the narrow 'user-centered' focus often found at the solution level, broader societal involvement is necessary. This is especially true given that for technological solutions to leverage significant effects, they must go hand in hand with social, behavioral innovations. The academic sector should accelerate these transformational processes, by not only providing the necessary contextual and specialist knowledge, but also by taking on a mediating role, enabling the co-production of knowledge and innovation as such. In order to adapt to these new roles and requirements, research organizations are advised to constantly rethink and reinvent their organizational practices, reputational mechanisms and business models [49].

5.2. Agenda for Further Research

Having conceptualized mission-oriented innovation ecosystems and explored the surrounding field(s) of research, a number of potential avenues for further inquiry emerge. Those were identified based on (a) the transfer of the general innovation ecosystem discourse based on the scoping review and (b) more than 60 open research questions raised within the analyzed full texts. While this paper does not aim to provide an exhaustive list, Table 5 groups and aggregates these questions along six broader themes: (1) concept; (2) architectural set-up, actors and roles; (3) emergence and life cycle; (4) collaboration formats; (5) success factors; (6) impact.

Table 5. Opportunities for further research (author's own elaboration).

Theme	Description	Potential Research Questions
Concept	Starting from this paper, providing a first literature-based conceptualization of MOIEs, the concept should be empirically tested and refined.	▪ How can today's mission-orientated innovation policy and sustainability issues be integrated in our understanding of innovation ecosystems? ▪ Which of the sub-types of MOIEs can be found empirically? How can they be characterized?
Architectural Set-Up, Actors and Roles	Knowing that different sub-types of MOIEs are also characterized by differences within their architectural set-up, different configurations of actors and roles should be scrutinized. The works of Dedehayir et al. [23], Jacobides et al. [112] and Schütz [49] depict particularly promising starting points.	▪ What are architectural characteristics of MOIEs? How do they differ from 'standard' innovation ecosystems? ▪ (How) do targeted mission and the ecosystem's architectural set-up interrelate? ▪ Which actors resp. which functional roles are needed to achieve certain goals? ▪ How does the role of governments change from 'standard' to mission-oriented innovation ecosystems? What are the prospects and pitfalls in this regard? ▪ How can the architectural set-up account for the transnational nature of today's sustainability challenges?

Table 5. *Cont.*

Theme	Description	Potential Research Questions
Emergence and Life Cycle	Building upon Dedehayir et al. [23], understanding emergence and evolution of MOIEs is not only an urgent question among scholars, but equally relevant for policy makers and practitioners.	▪ What are necessary conditions, resources and circumstances for MOIEs to emerge? What inspires their creation? ▪ What is the role of innovation policy and politics in the emergence of MOIEs? ▪ How do MOIEs evolve over time? Which life cycle phases do exist?
Collaboration Formats	As collaboration faces a wide range of barriers, suitable formats for overcoming these should be explored.	▪ Which collaboration formats are used by (different sub-types of) MOIEs? ▪ Which methods can facilitate the integration of sustainability goals within collaborative innovation processes?
Success Factors	Failure is inherent not only to innovation but also to innovation ecosystems. Identifying the adjusting screws is of high strategic priority for innovation managers.	▪ What are necessary and sufficient conditions for successful MOIEs? How do these factors interact? ▪ Which intra-organizational prerequisites need to be fulfilled in order to engage in MOIEs? ▪ How can mechanisms of value creation (also considering external effects) and value capture be balanced?
Impact	As measuring the performance of ecosystems has always been far from trivial [48], assessing the impact of MOIEs depicts a particular challenge.	▪ How should the impact of MOIEs be conceptualized and measured? ▪ Which KPIs could be used to evaluate MOIE's impact? ▪ How can MOIEs balance different (sometimes conflicting) targets, for example the three dimensions of sustainability?

However, the analysis also reveals that the largest, most commonly mentioned research gap is a methodological one. As shown in Section 4.1, new methods beyond single and small-n case studies and a diversified sampling are urgently needed to proceed over the course of the coming years. This is in line with the current state of general innovation ecosystem research [10].

5.3. Limitations

In order to appraise this paper's contribution to the evolving area of research around mission-oriented innovation ecosystems, its limitations must be considered as well. For this purpose, two methodological and one conceptual challenge potentially influencing results' validity shall be discussed. Firstly, although systematic reviews depict the most rigorous approach towards existing literature, not all of the previous research is necessarily covered, due to flaws within the search strategy, technically unavailable sources or language barriers [60] (p. 97). A second challenge inherent to the chosen methodological approach arises from publication bias. As not all forms of research are equally submitted to, and published in, academic journals, studies addressing the failure of innovation ecosystems might be less prevalent within the sample [60] (p. 101). In addition, one conceptual limitation should be pointed out with regard to the development of the typology in Section 4.2 of this paper. As it is the aim of typologies to reduce complexity by providing a relatively simple model of real-life phenomena, the potential loss of case-specific granularity must be acknowledged.

6. Conclusions

Collaborative innovation within innovation ecosystems is critical for proceeding towards the SDGs. Following a rigorous review approach, and supplementing it with elements from bibliometric analysis and typology building, this paper explores and conceptualizes the idea of mission-oriented innovation ecosystems. In doing so, it closes the research gap detected through the scoping analysis of previous SLRs on innovation ecosystems and similarly identified by Liu and Stephens [18]. By differentiating mission-oriented innovation ecosystems from related streams of research, such as innovation systems, entrepreneurial ecosystems or supply chain collaboration, conceptual boundaries towards similar constructs are drawn. Analyzing 44 articles in depth, and developing a typology of mission-oriented innovation ecosystem sub-types, allows for an internal sharpening of the concept. Ultimately, the study has shown that the actual mission and respectively prioritization of sustainability dimensions influence ecosystems' strategy and architectural set-up. In a next step, the concept of mission-oriented innovation ecosystems, as well as the literature-based typology, should be tested and refined through empirical studies.

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Conflicts of Interest: The author declares no conflict of interest.

Appendix A.

Table A1. Review protocol (author's own elaboration).

AIM	Objective	Exploring and conceptualizing mission-oriented innovation ecosystems by aggregating and systemizing previous research (based on scoping review and [18]). Research questions: ▪ What characterizes mission-oriented innovation ecosystems as an emerging area of research and how does it relate to similar research strands? ▪ How can mission-oriented innovation ecosystems and their sub-types be conceptualized? ▪ What should an agenda for future research look like to improve our understanding of mission-oriented innovation ecosystems?
IDENTIFICATION	Information Sources	Bibliographic databases: ▪ EBSCO (including among others EconLit) ▪ ProQuest ▪ Scopus ▪ Web of Science Manual search within 10 most important journals (based on previous SLRs [10,12–14,61]): ▪ International Journal of Sustainability ▪ International Journal of Technology Management ▪ Journal of Cleaner Production ▪ Journal of Technology Transfer ▪ R&D Management ▪ Research Policy ▪ Strategic Management Journal ▪ Sustainability ▪ Technological Forecasting and Social Change ▪ Technovation Reference checking and literature snowballing

Table A1. *Cont.*

	Key Words	Search of all possible combinations of key words in block A ("ecosystem") and key words in block B ("mission-oriented innovation"). Key words were developed based on previous SLRs in both fields [10,12,61]. Block A ("ecosystem"): ▪ alliance ▪ collaboration ▪ ecosystem ▪ helix ▪ network ▪ open innovation ▪ partnership ▪ platform Block B ("mission-oriented innovation"): ▪ circular innovation ▪ eco innovation ▪ green innovation ▪ inclusive innovation ▪ innovation AND bottom of the pyramid ▪ innovation AND triple-bottom line ▪ mission-oriented innovation ▪ responsible innovation ▪ social innovation ▪ societal innovation ▪ sustainable innovation ▪ value-based innovation
	Filter	Publication period: 1987–2020 (based on [62]) Publication type: peer-reviewed journal articles
SCREENING and ELIGIBILITY	Inclusion vs. Exclusion Criteria	Technical exclusion, if: ▪ not peer-reviewed journal article ▪ central bibliographic information, such as author, title or abstract missing ▪ article is not written in English Content-based inclusion, if: ▪ article deals with case of mission-oriented innovation ▪ article scrutinizes the underlying innovation process, hereby directly referring to ecosystem terminology or describing similar characteristics (such as a collaboration's multi-sector, co-creative nature)
PROCESSING	Data Management	The data were stored and processed using Excel (general data management and descriptive statistics), Citavi (bibliographic records), MaxQDA (coding and content analysis) and VOSViewer (bibliometric analysis).
	Data Collection Process	Abstract and full text screening were independently conducted by two researchers after two training rounds, inter-rater reliability checked and remaining differences solved through discussion. Abstract screening: ▪ overall agreement: 94.7% ▪ Cohen's Kappa: 0.70 (=substantial agreement) for articles describing innovation ecosystem-like characteristics more vaguely resp. 0.91 (=almost perfect agreement) for those explicitly using innovation ecosystem language. Full text screening: ▪ overall agreement: 87.5% ▪ Cohen's Kappa: 0.73 (=substantial agreement)

Table A1. *Cont.*

	Data Items	The following data items were coded as part of the full text analysis: Meta data: ▪ conceptual vs. empirical paper ▪ method ▪ sample ▪ perspective ▪ context ▪ further research ▪ literature snowballs Content: ▪ name ▪ definition ▪ goal ▪ regional scope ▪ actors ▪ roles ▪ motivation (for ecosystem participation) ▪ collaboration formats ▪ emergence and life cycle ▪ success factors ▪ barriers and risks
	Synthesis	Integration of elements of framework and narrative synthesis [66,67]; subsequent typology building based on Kluge [54,55], Collier et al. [69] and Schütz [49].
CHALLENGES and LIMITATIONS	Technical Issues	26 out of the 191 articles identified for full text screening were not accessible through the channels available to the researchers (portals of Fraunhofer IAO, FU Berlin, HU Berlin, TU Berlin).
	Potential Bias	Coverage: despite the broad search strategy, not all research is necessarily covered due to potential flaws in the search strategy, technically unavailable sources (see technical issues) or language barriers [60]. Publication bias: as not all forms of research are equally submitted to and published in academic journals, studies addressing the failure of innovation ecosystems might be less prevalent within the sample [60].

Appendix B.

Table A2. Overview of the 44 articles included in the full text analysis.

Author (Year)	Title	Journal
Alcaide et al. (2019) [83]	Understanding the Effects of Social Capital on Social Innovation Ecosystems in Latin America through the Lens of Social Network Approach.	International Review of Sociology
Barile et al. (2020) [111]	Technology, Value Co-Creation and Innovation in Service Ecosystems: Toward Sustainable Co-Innovation.	Sustainability
Barrie et al. (2017) [79]	Leveraging Triple Helix and System Intermediaries to Enhance Effectiveness of Protected Spaces and Strategic Niche Management for Transitioning to Circular Economy.	Int. J. of Techn. Mgm. and Sust. Development
Barrie et al. (2019) [96]	Assessing the Role of Triple Helix System Intermediaries in Nurturing an Industrial Biotechnology Innovation Network.	Journal of Cleaner Production
Behnam et al. (2018) [75]	How Should Firms Reconcile their Open Innovation Capabilities for Incorporating External Actors in Innovations Aimed at Sustainable Development?	Journal of Cleaner Production

Table A2. *Cont.*

Author (Year)	Title	Journal
Borowska/Osborne (2018) [103]	Locating the Fourth Helix: Rethinking the Role of Civil Society in Developing Smart Learning Cities.	International Review of Education
Brown et al. (2019) [77]	Why Do Companies Pursue Collaborative Circular Oriented Innovation?	Sustainability
Brown et al. (2020) [93]	How Do Companies Collaborate for Circular Oriented Innovation?	Sustainability
Callaghan/Herselman (2015) [113]	Applying a Living Lab Methodology to Support Innovation in Education at a University in South Africa.	TD—The Journal for Transdisciplinary Research in S.A.
Carayannis/Campbell (2010) [70]	Triple Helix, Quadruple Helix and Quintuple Helix and How Do Knowledge, Innovation and the Environment Relate to Each Other? A Proposed Framework for a Transdisciplinary Analysis of Sustainable Development and Social Ecology.	Int. J. of Social Ecology and Sust. Development
Carayannis/Rakhmatullin (2014) [87]	The Quadruple/Quintuple Innovation Helixes and Smart Specialisation Strategies for Sustainable and Inclusive Growth in Europe and Beyond.	Journal of the Knowledge Economy
Carayannis et al. (2019) [71]	Social Business Model Innovation: A Quadruple and Quintuple Helix-Based Social Innovation Ecosystem.	IEEE Transactions on Engineering Mgm.
Ceicyte/Petraite (2018) [109]	Networked Responsibility Approach for Responsible Innovation: Perspective of the Firm.	Sustainability
Chaminade/Randelli (2020) [92]	The Role of Territorially Embedded Innovation Ecosystems Accelerating Sustainability Transformations: A Case Study of the Transformation to Organic Wine Production in Tuscany (Italy).	Sustainability
Ciasullo et al. (2020) [102]	Multi-Level Governance for Sustainable Innovation in Smart Communities: An Ecosystems Approach.	Int. Entrepreneurship and Mgm. Journal
Domanski et al. (2020) [81]	A Comprehensive Concept of Social Innovation and its Implications for the Local Context: On the Growing Importance of Social Innovation Ecosystems and Infrastructures.	European Planning Studies
Fliaster/Kolloch (2017) [105]	Implementation of Green Innovations: The impact of Stakeholders and their Network Relations.	R&D Management
Foley/Wiek (2017) [86]	Bridgework Ahead! Innovation Ecosystems vis-à-vis Responsible Innovation.	J. of Nanoparticle Research
Goodman et al. (2017) [73]	Our Collaborative Future: Activities and Roles of Stakeholders in Sustainability-Oriented Innovation.	Business Strategy and the Environment
Hossain et al. (2019) [78]	A Systematic Review of Living Lab Literature.	Journal of Cleaner Production
Jucevicius et al. (2016) [91]	The Emerging Innovation Ecosystems and "Valley of Death": Towards the Combination of Entrepreneurial and Institutional Approaches.	Engineering Economics
Kirschten (2005) [26]	Sustainable Innovation Networks: Conceptual Framework and Institutionalisation.	Progress in Industrial Ecology
Koch-Ørvad et al. (2019) [107]	Transforming Ecosystems: Facilitating Sustainable Innovations Through the Lineage of Exploratory Projects.	Project Management Journal

Table A2. *Cont.*

Author (Year)	Title	Journal
Konietzko et al. (2020) [94]	Circular Ecosystem Innovation: An Initial Set of Principles.	Journal of Cleaner Production
Liu et al. (2019) [108]	An Investigation on Responsible Innovation in the Emerging Shared Bicycle Industry: Case Study of a Chinese Firm.	J. of Open Innovation: Technology, Market, and Complexity
Liu/Stephens (2019) [18]	Exploring Innovation Ecosystem from the Perspective of Sustainability: Towards a Conceptual Framework.	J. of Open Innovation: Technology, Market, and Complexity
Lopes/Franco (2019) [85]	Review About Regional Development Networks: An Ecosystem Model Proposal.	Journal of the Knowledge Economy
Madsen (2020) [114]	Business Model Innovation and the Global Ecosystem for Sustainable Development.	Journal of Cleaner Production
Markkula/Kune (2015) [88]	Making Smart Regions Smarter: Smart Specialization and the Role of Universities in Regional Innovation Ecosystems.	Technology Innovation Management Review
Mejia et al. (2019) [90]	A Hub-Based University Innovation Model.	Journal of Technology Mgm. and Innovation
Oskanen/Hautamäki (2015) [115]	Sustainable Innovation: A Competitive Advantage for Innovation Ecosystems.	Technology Innovation Management Review
Oskam et al. (2020) [104]	Valuing Value in Innovation Ecosystems: How Cross-Sector Actors Overcome Tensions in Collaborative Sustainable Business Model Development.	Business and Society
Parida et al. (2019) [95]	Orchestrating Industrial Ecosystem in Circular Economy: A Two-Stage Transformation Model for Large Manufacturing Companies.	Journal of Business Research
Pel et al. (2019) [84]	Unpacking the Social Innovation Ecosystem: An Empirically Grounded Typology of Empowering Network Constellations.	Innovation: The European J. of Social ScienceResearch
Pigford et al. (2018) [72]	Beyond Agricultural Innovation Systems? Exploring an Agricultural Innovation Ecosystems Approach for Niche Design and Development in Sustainability Transitions.	Agricultural Systems
Reficco et al. (2018) [110]	Collaboration Mechanisms for Sustainable Innovation.	Journal of Cleaner Production
Schuurman et al. (2016) [116]	Living Labs as Open Innovation Systems for Knowledge Exchange: Solutions for Sustainable Innovation Development.	Int. J. of Business Innovation and Research
Terstriep et al. (2020) [82]	Favourable Social Innovation Ecosystem(s)? An Explorative Approach.	European Planning Studies
Van Genuchten et al. (2019) [99]	Open Innovation Strategies for Sustainable Urban Living.	Sustainability
Walter/Scholz (2006) [117]	Sustainable Innovation Networks: An Empirical Study on Interorganisational Networks in Industrial Ecology.	Progress in Industrial Ecology
Yang et al. (2012) [80]	What Can Triple Helix Frameworks Offer to the Analysis of Eco-Innovation Dynamics? Theoretical and Methodological Considerations.	Science and Public Policy
Yang et al. (2019) [106]	Dynamics of Triple Helix Relations in the Development of Cleaner Technologies: Case of a Chinese Power Equipment Manufacturer.	Innovation and Development

Table A2. *Cont.*

Author (Year)	Title	Journal
Yarahmadi/Higgins (2012) [74]	Motivations towards Environmental Innovation: A Conceptual Framework for Multiparty Cooperation.	European Journal of Innovation Management
Yun/Liu (2019) [76]	Micro- and Macro-Dynamics of Open Innovation with a Quadruple-Helix Model.	Sustainability

References

1. Schot, J.; Steinmueller, W.E. Three frames for innovation policy: R&D, systems of innovation and transformative change. *Res. Policy* **2018**, *47*, 1554–1567. [CrossRef]
2. Hekkert, M.P.; Janssen, M.J.; Wesseling, J.H.; Negro, S.O. Mission-oriented innovation systems. *Environ. Innov. Soc. Transit.* **2020**, *34*, 76–79. [CrossRef]
3. Mazzucato, M. From market fixing to market-creating: A new framework for innovation policy. *Ind. Innov.* **2016**, *23*, 140–156. [CrossRef]
4. Mazzucato, M. Mission-Oriented Innovation Policy: Challenges and Opportunities. Available online: https://www.ucl.ac.uk/bartlett/public-purpose/publications/2017/sep/mission-oriented-innovation-policy-challenges-and-opportunities (accessed on 10 July 2020).
5. Mazzucato, M. Mission-oriented innovation policies: Challenges and opportunities. *Ind. Corp. Chang.* **2018**, *27*, 803–815. [CrossRef]
6. European Commission. Horizon. 2020. Available online: https://www.eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52011DC0808 (accessed on 3 July 2020).
7. European Commission. Implementation Strategy for Horizon Europe: Version 1.0. Available online: https://ec.europa.eu/info/sites/info/files/research_and_innovation/strategy_on_research_and_innovation/documents/ec_rtd_implementation-strategy_he.pdf (accessed on 3 July 2020).
8. Bundesministerium für Bildung und Forschung. Forschung und Innovation für die Menschen. Die Hightech-Strategie 2025. 2018. Available online: https://www.bmbf.de/upload_filestore/pub/Forschung_und_Innovation_fuer_die_Menschen.pdf (accessed on 3 July 2020).
9. Yaghmaie, P.; Vanhaverbeke, W. Identifying and describing constituents of innovation ecosystems: A systematic review of the literature. *EuroMed J. Bus.* **2019**. [CrossRef]
10. De Vasconcelos Gomes, L.A.; Facin, A.L.F.; Salerno, M.S.; Ikenami, R.K. Unpacking the innovation ecosystem construct: Evolution, gaps and trends. *Technol. Forecast. Soc. Chang.* **2018**, *136*, 30–48. [CrossRef]
11. Granstrand, O.; Holgersson, M. Innovation ecosystems: A conceptual review and a new definition. *Technovation* **2020**, *90*, 102098. [CrossRef]
12. Scaringella, L.; Radziwon, A. Innovation, entrepreneurial, knowledge, and business ecosystems: Old wine in new bottles? *Technol. Forecast. Soc. Chang.* **2018**, *136*, 59–87. [CrossRef]
13. Suominen, A.; Seppänen, M.; Dedehayir, O. A bibliometric review on innovation systems and ecosystems: A research agenda. *Eur. J. Innov. Manag.* **2019**, *22*, 335–360. [CrossRef]
14. Tsujimoto, M.; Kajikawa, Y.; Tomita, J.; Matsumoto, Y. A review of the ecosystem concept: Towards coherent ecosystem design. *Technol. Forecast. Soc. Chang.* **2018**, *136*, 49–58. [CrossRef]
15. Schot, J.; Geels, F.W. Strategic niche management and sustainable innovation journeys: Theory, findings, research agenda, and policy. *Technol. Anal. Strateg. Manag.* **2008**, *20*, 537–554. [CrossRef]
16. Schot, J.; Kanger, L. Deep transitions: Emergence, acceleration, stabilization and directionality. *Res. Policy* **2018**, *47*, 1045–1059. [CrossRef]
17. Pyka, A. Dedicated innovation systems to support the transformation towards sustainability: Creating income opportunities and employment in the knowledge-based digital bioeconomy. *J. Open Innov.* **2017**, *3*, 385. [CrossRef]
18. Liu, Z.; Stephens, V. Exploring innovation ecosystem from the perspective of sustainability: Towards a conceptual framework. *J. Open Innov. Technol. Mark. Complex.* **2019**, *5*, 48. [CrossRef]
19. Tranfield, D.; Denyer, D.; Smart, P. Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *Br. J. Manag.* **2003**, *14*, 207–222. [CrossRef]

20. Hakala, H.; O'Shea, G.; Farny, S.; Luoto, S. Re-Storying the business, innovation and entrepreneurial ecosystem concepts: The model-narrative review method. *Int. J. Manag. Rev.* **2020**, *22*, 10–32. [CrossRef]
21. Carayannis, E.G.; Campbell, D.F.J. 'Mode 3' and 'Quadruple Helix': Toward a 21st century fractal innovation ecosystem. *Int. J. Technol. Manag.* **2009**, *46*, 201–234. [CrossRef]
22. Khademi, B. Ecosystem value creation and capture: A systematic review of literature and potential research opportunities. *Technol. Innov. Manag. Rev.* **2020**, *10*, 16–34. [CrossRef]
23. Dedehayir, O.; Makinen, S.J.; Ortt, J.R. Roles during innovation ecosystem genesis: A literature review. *Technol. Forecast. Soc. Chang.* **2018**, *136*, 18–29. [CrossRef]
24. Russo-Spena, T.; Tregua, M.; Bifulco, F. Searching through the jungle of innovation conceptualisations: System, network and ecosystem perspectives. *J. Serv. Theory Pract.* **2017**, *27*, 977–1005. [CrossRef]
25. Simatupang, T.M.; Schwab, A.; Lantu, D. Introduction: Building sustainable entrepreneurship ecosystems. *Int. J. Entrep. Small Bus.* **2015**, *26*, 389–398. [CrossRef]
26. Kirschten, U. Sustainable innovation networks: Conceptual framework and institutionalisation. *Prog. Ind. Ecol.* **2005**, *2*, 132–147. [CrossRef]
27. Pattberg, P.H.; Biermann, F.; Chan, S.; Mert, A. *Public-Private Partnerships for Sustainable Development: Emergence, Influence and Legitimacy*; Pattberg, P.H., Biermann, F., Chan, S., Mert, A., Eds.; Edward Elgar: Cheltenham, UK, 2013; ISBN 1781006520.
28. Adner, R. Match your innovation strategy to your innovation ecosystem. *Harv. Bus. Rev.* **2006**, *84*, 98. [PubMed]
29. Adner, R.; Kapoor, R. Value creation in innovation ecosystems: How the structure of technological interdependence affects firm performance in new technology generations. *Strateg. Manag. J.* **2010**, *31*, 306–333. [CrossRef]
30. Autio, E.; Kenney, M.; Mustar, P.; Siegel, D.; Wright, M. Entrepreneurial innovation: The importance of context. *Res. Policy* **2014**, *43*, 1097–1108. [CrossRef]
31. Isenberg, D. The big idea: How to start an entrepreneurial revolution. *Harv. Bus. Rev.* **2010**, *88*, 40–50.
32. Spigel, B. The relational organization of entrepreneurial ecosystems. *Entrep. Theory Pract.* **2017**, *41*, 49–72. [CrossRef]
33. Edquist, C. *Systems of Innovation. Technologies, Institutions and Organizations*; Pinter Publishers/Cassell Academic: London, UK, 1997; ISBN 9781855674523.
34. Lundvall, B.A. *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*; Pinter Publishers: London, UK, 1992.
35. Nelson, R.R. *National Innovation Systems: A Comparative Analysis*; Oxford University Press: New York, NY, USA, 1993; ISBN 9781601298904.
36. De Bresson, C.; Amesse, F. Networks of innovators: A review and introduction to the issue. *Res. Policy* **1991**, *20*, 363–379. [CrossRef]
37. Powell, W.W.; Koput, K.W.; Smith-Doerr, L. Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology. *Adm. Sci. Q.* **1996**, *41*, 116. [CrossRef]
38. Powell, W.W.; White, D.R.; Koput, K.W.; Owen-Smith, J. Network dynamics and field evolution: The growth of interorganizational collaboration in the life sciences. *Am. J. Sociol.* **2005**, *110*, 1132–1205. [CrossRef]
39. Bogers, M.; Chesbrough, H.; Moedas, C. Open innovation: Research, practices, and policies. *Calif. Manag. Rev.* **2018**, *60*, 5–16. [CrossRef]
40. Chesbrough, H. *Open Innovation: The New Imperative for Creating and Profiting from Technology*; Harvard Business School Press: Boston, MA, USA, 2003.
41. Von Hippel, E. Lead users: A source of novel product concepts. *Manag. Sci.* **1986**, *32*, 791–805. [CrossRef]
42. Cao, M.; Zhang, Q. Supply chain collaboration: Impact on collaborative advantage and firm performance. *J. Oper. Manag.* **2011**, *29*, 163–180. [CrossRef]
43. Holweg, M.; Disney, S.; Holmström, J.; Småros, J. Supply chain collaboration: Making sense of the strategy Continuum. *Eur. Manag. J.* **2005**, *23*, 170–181. [CrossRef]
44. Stank, T.P.; Keller, S.B.; Daugherty, P.J. Supply chain collaboration and logistical service performance. *J. Bus. Logist.* **2001**, *22*, 29–48. [CrossRef]
45. Bäckstrand, K. Multi-stakeholder partnerships for sustainable development: Rethinking legitimacy, accountability and effectiveness. *Eur. Environ.* **2006**, *16*, 290–306. [CrossRef]

46. Glasbergen, P.; Biermann, F.; Mol, A.P.J. *Partnerships, Governance and Sustainable Development. Reflections on Theory and Practice*; Edward Elgar: Cheltenham, UK, 2007; ISBN 9781847204059.
47. Rabelo, R.J.; Bernus, P. A holistic model of building innovation ecosystems. *IFAC Pap. Online* **2015**, *48*, 2250–2257. [CrossRef]
48. Galvão, A.; Mascarenhas, C.; Gouveia Rodrigues, R.; Marques, C.S.; Leal, C.T. A quadruple helix model of entrepreneurship, innovation and stages of economic development. *Rev. Int. Bus. Strategy* **2017**, *27*, 261–282. [CrossRef]
49. Schütz, F. Das Geschäftsmodell Kollaborativer Innovation: Eine Empirische Analyse zu Funktionalen Rollen in Quadruple-Helix-Innovationsprozessen. Ph.D. Thesis, Technische Universität Berlin, Berlin, Germany, 2020.
50. Gough, D.; Oliver, S.; Thomas, J. (Eds.) *An Introduction to Systematic Reviews*, 2nd ed.; SAGE: Los Angeles, CA, USA; London, UK; New Delhi, India; Singapore; Washington, DC, USA; Melbourne, Australia, 2017; ISBN 9781473929432.
51. Petticrew, M.; Roberts, H. *Systematic Reviews in the Social Sciences. A Practical Guide*; Blackwell: Oxford, UK, 2006.
52. Osareh, F. Bibliometrics, citation analysis and co-citation analysis: A review of Literature I. *Libri* **1996**, *46*, 149–158. [CrossRef]
53. Pritchard, A. Statistical bibliography or bibliometrics? *J. Doc.* **1969**, *25*, 348–349.
54. Kluge, S. *Empirisch Begründete Typenbildung. Zur Konstruktion von Typen und Typologien in der Qualitativen Sozialforschung*; Leske+Budrich: Opladen, Germany, 1999.
55. Kluge, S. Empirically grounded construction of types and typologies in qualitative social research. *Forum Qual. Soc. Res.* **2000**, *1*. [CrossRef]
56. Langer, L.; Stewart, R. What have we learned from the application of systematic review methodology in international development: A thematic overview. *J. Dev. Eff.* **2014**, *6*, 236–248. [CrossRef]
57. Gough, D.; Oliver, S.; Thomas, J. Introducing systematic reviews. In *An Introduction to Systematic Reviews*, 2nd ed.; Gough, D., Oliver, S., Thomas, J., Eds.; SAGE: Los Angeles, CA, USA; London, UK; New Delhi, India; Singapore; Washington, DC, USA; Melbourne, Australia, 2017; pp. 1–18. ISBN 9781473929432.
58. Arksey, H.; O'Malley, L. Scoping studies: Towards a methodological framework. *Int. J. Soc. Res. Methodol.* **2005**, *8*, 19–32. [CrossRef]
59. Gough, D.; Thomas, J. Commonality and diversity in reviews. In *An Introduction to Systematic Reviews*, 2nd ed.; Gough, D., Oliver, S., Thomas, J., Eds.; SAGE: Los Angeles, CA, USA; London, UK; New Delhi, India; Singapore; Washington, DC, USA; Melbourne, Australia, 2017; pp. 43–70. ISBN 9781473929432.
60. Brunton, G.; Stansfield, C.; Caird, J.; Thomas, J. Finding relevant studies. In *An Introduction to Systematic Reviews*, 2nd ed.; Gough, D., Oliver, S., Thomas, J., Eds.; SAGE: Los Angeles, CA, USA; London, UK; New Delhi, India; Singapore; Washington, DC, USA; Melbourne, Australia, 2017; pp. 93–122. ISBN 9781473929432.
61. Cillo, V.; Petruzzelli, A.M.; Ardito, L.; Del Giudice, M. Understanding sustainable innovation: A systematic literature review. *Corp. Soc. Resp. Environ. Manag.* **2019**, *26*, 1012–1025. [CrossRef]
62. Lupova-Henry, E.; Dotti, N.F. Governance of sustainable innovation: Moving beyond the hierarchy-market-network trichotomy? A systematic literature review using the 'who-how-what' framework. *J. Clean. Prod.* **2019**, *210*, 738–748. [CrossRef]
63. Landis, J.R.; Koch, G.G. The measurement of observer agreement for categorical data. *Biometrics* **1977**, *33*, 159. [CrossRef]
64. Belur, J.; Tompson, L.; Thornton, A.; Simon, M. Interrater reliability in systematic review methodology. *Sociol. Methods Res.* **2018**. [CrossRef]
65. Van Eck, N.J.; Waltman, L. Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics* **2010**, *84*, 523–538. [CrossRef]
66. Thomas, J.; O'Mara-Eves, A.; Harden, A.; Newman, M. Synthesis methods for combining and configuring textual or mixed methods data. In *An Introduction to Systematic Reviews*, 2nd ed.; Gough, D., Oliver, S., Thomas, J., Eds.; SAGE: Los Angeles, CA, USA; London, UK; New Delhi, India; Singapore; Washington, DC, USA; Melbourne, Australia, 2017; pp. 181–210. ISBN 9781473929432.
67. Snilstveit, B.; Oliver, S.; Vojtkova, M. Narrative approaches to systematic review and synthesis of evidence for international development policy and practice. *J. Dev. Eff.* **2012**, *4*, 409–429. [CrossRef]

68. Sutcliff, K.; Oliver, S.; Richardson, M. Describing and analysing studies. In *An Introduction to Systematic Reviews*, 2nd ed.; Gough, D., Oliver, S., Thomas, J., Eds.; SAGE: Los Angeles, CA, USA; London, UK; New Delhi, India; Singapore; Washington, DC, USA; Melbourne, Australia, 2017; pp. 123–144. ISBN 9781473929432.
69. Collier, D.; LaPorte, J.; Seawright, J. Putting typologies to work: Concept formation, measurement, and analytic rigor. *Political Res. Q.* **2012**, *65*, 217–232. [CrossRef]
70. Carayannis, E.G.; Campbell, D.F.J. Triple helix, quadruple helix and quintuple helix and how do knowledge, innovation and the environment relate to each other? *Int. J. Soc. Ecol. Sustain. Dev.* **2010**, *1*, 41–69. [CrossRef]
71. Carayannis, E.G.; Grigoroudis, E.; Stamati, D.; Valvi, T. Social business model innovation: A quadruple/quintuple Helix-Based Social innovation ecosystem. *IEEE Trans. Eng. Manag.* **2019**, 1–14. [CrossRef]
72. Pigford, A.-A.E.; Hickey, G.M.; Klerkx, L. Beyond agricultural innovation systems? Exploring an agricultural innovation ecosystems approach for niche design and development in sustainability transitions. *Agric. Syst.* **2018**, *164*, 116–121. [CrossRef]
73. Goodman, J.; Korsunova, A.; Halme, M. Our collaborative future: Activities and roles of stakeholders in sustainability-oriented innovation. *Bus. Strat. Environ.* **2017**, *26*, 731–753. [CrossRef]
74. Yarahmadi, M.; Higgins, P.G. Motivations towards environmental innovation. *Eur. J. Innov. Manag.* **2012**, *15*, 400–420. [CrossRef]
75. Behnam, S.; Cagliano, R.; Grijalvo, M. How should firms reconcile their open innovation capabilities for incorporating external actors in innovations aimed at sustainable development? *J. Clean. Prod.* **2018**, *170*, 950–965. [CrossRef]
76. Yun, J.J.; Liu, Z. Micro- and Macro-Dynamics of open innovation with a Quadruple-Helix Model. *Sustainability* **2019**, *11*, 3301. [CrossRef]
77. Brown, P.; Bocken, N.; Balkenende, R. Why do companies pursue collaborative circular oriented innovation? *Sustainability* **2019**, *11*, 635. [CrossRef]
78. Hossain, M.; Leminen, S.; Westerlund, M. A systematic review of living lab literature. *J. Clean. Prod.* **2019**, *213*, 976–988. [CrossRef]
79. Barrie, J.; Zawdie, G.; João, E. Leveraging triple helix and system intermediaries to enhance effectiveness of protected spaces and strategic niche management for transitioning to circular economy. *Int. J. Technol. Manag. Sustain. Dev.* **2017**, *16*, 25–47. [CrossRef]
80. Yang, Y.; Holgaard, J.E.; Remmen, A. What can triple helix frameworks offer to the analysis of eco-innovation dynamics? Theoretical and methodological considerations. *Sci. Public Policy* **2012**, *39*, 373–385. [CrossRef]
81. Domanski, D.; Howaldt, J.; Kaletka, C. A comprehensive concept of social innovation and its implications for the local context–On the growing importance of social innovation ecosystems and infrastructures. *Eur. Plan. Stud.* **2020**, *28*, 454–474. [CrossRef]
82. Terstriep, J.; Rehfeld, D.; Kleverbeck, M. Favourable social innovation ecosystem(s)?–An explorative approach. *Eur. Plan. Stud.* **2020**, *28*, 881–905. [CrossRef]
83. Alcaide Lozano, V.; Moliner, L.A.; Murillo, D.; Buckland, H. Understanding the effects of social capital on social innovation ecosystems in Latin America through the lens of Social Network Approach. *Int. Rev. Sociol.* **2019**, *29*, 1–35. [CrossRef]
84. Pel, B.; Wittmayer, J.; Dorland, J.; Søgaard Jørgensen, M. Unpacking the social innovation ecosystem: An empirically grounded typology of empowering network constellations. *Innov. Eur. J. Soc. Sci. Res.* **2019**, *37*, 1–26. [CrossRef]
85. Lopes, J.; Franco, M. Review about regional development networks: An ecosystem model proposal. *J. Knowl. Econ.* **2019**, *10*, 275–297. [CrossRef]
86. Foley, R.; Wiek, A. Bridgework ahead! Innovation ecosystems vis-à-vis responsible innovation. *J. Nanopart. Res.* **2017**, *19*, 216. [CrossRef]
87. Carayannis, E.G.; Rakhmatullin, R. The quadruple/quintuple innovation Helixes and smart specialisation strategies for sustainable and inclusive growth in Europe and beyond. *J. Knowl. Econ.* **2014**, *5*, 212–239. [CrossRef]
88. Markkula, M.; Kune, H. Making smart regions smarter: Smart specialization and the role of universities in regional innovation ecosystems. *Technol. Innov. Manag. Rev.* **2015**, *5*, 7–15. [CrossRef]
89. Schroth, F.; Glatte, H.; Kaiser, S. Integrating civil society into regional innovation systems: A social foresight lab approach. *Int. J. Innov. Reg. Dev.* **2020**, *8*, 6.

90. Mejia, S.P.; Hincapie, J.M.M.; Giraldo, J.A.T. A Hub-based university innovation model. *J. Technol. Manag. Innov.* **2019**, *14*, 11–17. [CrossRef]
91. Jucevicius, G.; Juceviciene, R.; Gaidelys, V.; Kalman, A. The emerging innovation ecosystems and "Valley of Death": Towards the combination of entrepreneurial and institutional approaches. *Eng. Econ.* **2016**, *27*. [CrossRef]
92. Chaminade, C.; Randelli, F. The role of territorially embedded innovation ecosystems accelerating sustainability transformations: A Case study of the transformation to organic wine production in tuscany (In Italy). *Sustainability* **2020**, *12*, 4621. [CrossRef]
93. Brown, P.; Bocken, N.; Balkenende, R. How do companies collaborate for circular oriented innovation? *Sustainability* **2020**, *12*, 1648. [CrossRef]
94. Konietzko, J.; Bocken, N.; Hultink, E.J. Circular ecosystem innovation: An initial set of principles. *J. Clean. Prod.* **2020**, *253*, 119942. [CrossRef]
95. Parida, V.; Burström, T.; Visnjic, I.; Wincent, J. Orchestrating industrial ecosystem in circular economy: A two-stage transformation model for large manufacturing companies. *J. Bus. Res.* **2019**, *101*, 715–725. [CrossRef]
96. Barrie, J.; Zawdie, G.; João, E. Assessing the role of triple helix system intermediaries in nurturing an industrial biotechnology innovation network. *J. Clean. Prod.* **2019**, *214*, 209–223. [CrossRef]
97. Wurster, S.; Ladu, L. Bio-Based products in the automotive industry: The need for ecolabels, standards, and regulations. *Sustainability* **2020**, *12*, 1623. [CrossRef]
98. Majer, S.; Wurster, S.; Moosmann, D.; Ladu, L.; Sumfleth, B.; Thrän, D. Gaps and research demand for sustainability certification and standardisation in a sustainable bio-based economy in the EU. *Sustainability* **2018**, *10*, 2455. [CrossRef]
99. Van Genuchten, E.; Calderón González, A.; Mulder, I. Open innovation strategies for sustainable urban living. *Sustainability* **2019**, *11*, 3310. [CrossRef]
100. Heidingsfelder, M.; Kimpel, K.; Best, K.; Schraudner, M. Shaping future: Adapting design know-how to reorient innovation towards public preferences. *Technol. Forecast. Soc. Chang.* **2015**, *101*, 291–298. [CrossRef]
101. Schütz, F.; Heidingsfelder, M.L.; Schraudner, M. Co-shaping the future in quadruple Helix innovation systems: Uncovering public preferences toward participatory research and innovation. *J. Des. Econ. Innov.* **2019**, *5*, 128–146. [CrossRef]
102. Ciasullo, M.V.; Troisi, O.; Grimaldi, M.; Leone, D. Multi-level governance for sustainable innovation in smart communities: An ecosystems approach. *Int. Entrep. Manag. J.* **2020**, *21*, 1. [CrossRef]
103. Borkowska, K.; Osborne, M. Locating the fourth helix: Rethinking the role of civil society in developing smart learning cities. *Int. Rev. Educ.* **2018**, *64*, 355–372. [CrossRef]
104. Oskam, I.; Bossink, B.; de Man, A.-P. Valuing value in innovation ecosystems: How cross-sector actors overcome tensions in collaborative sustainable business model development. *Bus. Soc.* **2020**. [CrossRef]
105. Fliaster, A.; Kolloch, M. Implementation of green innovations: The impact of stakeholders and their network relations. *RD Manag.* **2017**, *47*, 689–700. [CrossRef]
106. Yang, Y.; Etzkowitz, H.; Yin, S.; Luo, Y. Dynamics of triple helix relations in the development of cleaner technologies: Case of a Chinese power equipment manufacturer. *Innov. Dev.* **2019**, *9*, 65–84. [CrossRef]
107. Koch-Ørvad, N.; Thuesen, C.; Koch, C.; Berker, T. Transforming ecosystems: Facilitating sustainable innovations through the lineage of exploratory projects. *Proj. Manag. J.* **2019**, *50*, 602–616. [CrossRef]
108. Liu, M.; Zhu, J. An investigation on responsible innovation in the emerging shared bicycle industry: Case study of a chinese firm. *J. Open Innov. Technol. Mark. Complex.* **2019**, *5*, 42. [CrossRef]
109. Ceicyte, J.; Petraite, M. Networked responsibility approach for responsible innovation: Perspective of the firm. *Sustainability* **2018**, *10*, 1720. [CrossRef]
110. Reficco, E.; Gutiérrez, R.; Jaén, M.H.; Auletta, N. Collaboration mechanisms for sustainable innovation. *J. Clean. Prod.* **2018**, *203*, 1170–1186. [CrossRef]
111. Barile, S.; Grimaldi, M.; Loia, F.; Sirianni, C.A. Technology, value Co-Creation and innovation in service ecosystems: Toward sustainable Co-Innovation. *Sustainability* **2020**, *12*, 2759. [CrossRef]
112. Jacobides, M.G.; Cennamo, C.; Gawer, A. Towards a theory of ecosystems. *Strateg. Manag. J.* **2018**, *39*, 2255–2276. [CrossRef]
113. Callaghan, R.; Herselman, M. Applying a living lab methodology to support innovation in education at a university in South Africa. *J. Transdiscipl. Res. S. Afr.* **2015**, *11*, 21–38. [CrossRef]

114. Madsen, H.L. Business model innovation and the global ecosystem for sustainable development. *J. Clean. Prod.* **2020**, *247*, 119102. [CrossRef]
115. Oksanen, K.; Hautamäki, A. Sustainable innovation: A competitive advantage for innovation ecosystems. *Technol. Innov. Manag. Rev.* **2015**, *5*, 24–30. [CrossRef]
116. Schuurman, D.; Baccarne, B.; Marez, L.D.; Veeckman, C.; Ballon, P. Living Labs as open innovation systems for knowledge exchange: Solutions for sustainable innovation development. *Int. J. Bus. Innov. Res.* **2016**, *10*, 322. [CrossRef]
117. Walter, A.I.; Scholz, R.W. Sustainable innovation networks: An empirical study on interorganisational networks in industrial ecology. *Prog. Ind. Ecol.* **2006**, *3*, 431. [CrossRef]