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On Technology in Innovation Systems and Innovation-Ecosystem Perspectives: A Cross-Linking Analysis

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Abstract: The purpose of this paper is to clarify the role of technology as it has been framed within Innovation System (IS) and Innovation Ecosystem (IE) literature research streams. The methodological choice is a systemic review that allows to focus on theoretical proposals by scholars and the identification of the commonalities regarding the pivotal role of technology and the differences in describing innovation-based mechanisms in both literatures. Results show that the key elements are the overall idea of technology as pivotal in driving innovation, the actors affecting technology and contributing to reach innovation-based goals, and the decisional process emerging because of technology. Furthermore, emerging features on evolution through time and knowledge-transforming mechanisms favored by technology in IE show an opportunity to learn in-depth from specific insights generated in both the literatures and to delineate a more comprehensive approach to technology related to innovation in wider interconnected contexts.

Keywords: technology; innovation system; innovation ecosystem; innovation-based mechanisms

1. Introduction

Innovation is said to take place in wider interconnected contexts more than in single firms, and scholars focusing on understanding innovation as a multiactor and collaborative-based phenomenon are growing in number as time goes by [1–3].

On one hand, large firms or institutions are unable to afford innovation alone because of rapid changes spurred by great challenges that society has to face, while on the other, opportunities that innovation produces are more useful than before, spreading into further change when innovation is open and its results are shared [4–6].

An important feature of this new complexity is that innovation is usually seen as strategically developed around a specific technology, increasingly involving a great variety of actors and networks [7–10]. Technology is one of the main drivers of innovation [11,12] that is recognized as a necessary ingredient for introducing transformational changes influencing business and economic growth, as highlighted by the diffusion of concepts like the Internet of Things (IoT), Industry 4.0, artificial intelligence (AI), and digital transformation. One of the most recent and all-embedding approaches to the role of new technologies in furthering innovation was by Ardito et al. [13]; they proposed the IoT as a technology shaping new solutions and offering additional knowledge to provide new opportunities to a multitude of actors. They recorded the beneficial effects related to businesses, policymakers, and managers towards innovative activity design.

The most known context in which the relationship between innovation and technology has been investigated in a wider and networked perspective is the literature field of Innovation

Systems (IS), especially thanks to the contributions of Freeman [14], Malerba [15], Niosi et al. [16], and Cooke et al. [17]. The IS literature looks at innovation from different perspectives: innovation systems are multilevel, as they have been analyzed as regional [17–19], national [14–16,20], and international [21] systems; moreover, IS may vary in scope and has been referred to as sectoral [22,23] or technological IS [24–26].

Within the system literature, research is ongoing [20,27,28] to define technological advancements, its role, and its features in shaping innovation systems. Moreover, Huang et al. [28] described the pivotal role played by technology in furthering governmental policies; indeed, local and central governments affect the development of a system and the deployment of innovation in it through the implementation of specific technologies; similarly, governments can encourage further technological advances after identifying the beneficial effects they can have on a system [27,28].

However, while assigning technology a central role in innovation and economic growth, the treatment of technological advances remains underdeveloped [29].

Moreover, scholars within different disciplines, such as regional studies [18], strategy and marketing [8,30], entrepreneurship [31], and social and sustainable development studies [32], move towards the system idea into Innovation Ecosystems (IE); however, this conceptualization began to proliferate with not much evidence as to how IEs are different. An IE focuses on how different actors interplay through complex and dynamic interactions to achieve innovation-driven goals, with technology playing a central role in favoring knowledge flows and integrations [8,30]. Ecosystem perspectives on innovation are mainly characterized by an interdependent approach to innovation and the way by which interactions are shaped by different actors, as one of an IE's main features is its openness.

The model of a platform ecosystem highlights the well-connected network of business, technology, and other partners producing complements and innovations around a core technological platform that performs as the real engine and core catalyst for innovation development and diffusion [30,33,34]. Möller and Halinen [35] recently stressed the need to focus on IE as a relevant add-on to the extant network studies instead of being just a new name with which to frame studies.

There has been significant overlap and even an interchange between scholars studying technological advances through both the IS and IE approaches. However, both fields of study are concerned with technology development and innovation; the former more at the macro level of institutional structures needed to take advantage of innovations for economic growth, and the latter at the industry or technological innovation level to sustain business growth. Moreover, both approaches are related to the concept of open innovation [4–6] and to the increasing importance of sustainability [36], with continuous interactions between the economy, society, and the environment [37].

The structure of an IE shapes recent advances: the crucial role played by the relationships between IE actors has been recently confirmed by Carayannis et al. [12], who defined the IE as a helix, leading to a more complete understanding of the nature and dynamics of actors shaping an IE itself; similarly, De Jager et al. [38] focused on social structure as the context hosting the main beneficiaries of the outcomes of an IE, especially in the way in which it regards knowledge. Knowledge is thought as coupled with technology to better depict how innovation can be encouraged due to a tie emerging among actors. Similarly, in helix-based models, technology acts as an innovation enabler due to the support offered to knowledge exchange, transfer, and combination [12].

Both developments in social studies [12,32] and service science [39,40] have made improved the possible contact between the two fields.

The aim of this paper is to clarify the role of technology as it has been framed within the IS and IE literature research streams; previous studies described the role of technology, but a full understanding of how technology led to the continuous evolution of the debate on IS and IE is still missing. This is mainly due to the recent development of a body of research centered on IE and even on the different backgrounds inspiring research on IS and IE.

To reach this aim, our methodological choice is a systematic review because it allows us to focus on theoretical proposals by scholars and to select the contributions we considered relevant in line with the topic we chose, namely, technology. As a consequence, we described how scholars have framed technology in both IS and IE, and how these two notions were considered in the last decade. As a result of this process, we identified commonalities regarding the pivotal role of technology in both the literatures, in order to highlight how technology partnered the debate on IS and IE as innovation contexts. Indeed, differences emerged with respect to framing and describing innovation-based mechanisms through technology. The IS perspective is centered on activities and the interactions of actors involved in innovation, with technology taking the leading role in determining the system boundaries and the way in which knowledge transfer is guaranteed to prompt and diffuse innovation. Technology issues in IE direct attention to an ecosystem's evolution over time as well as in relation to other ecosystems, and scholars paid most attention to knowledge-transforming mechanisms and the generative force of technologies.

Based on these differences, the contribution of this research is the opportunity to learn from specific insights generated in both the literatures and to allow for a more comprehensive approach to technology related to innovation in wider interconnected contexts.

We organized the remainder of this paper as follows. First, the methodology for reviewing the literature is illustrated. Then, findings from analyzing the IS and IE literature are presented. Finally, a discussion and implications are provided.

2. Research Process

The systematic review we planned to perform was based on the methodological suggestion proposed by Gough et al. [41] because the authors shaped the research process starting with the definition of the review question, then going through data collection with a specific search strategy and finally moving towards the assessment of contributions and the interpretation of the content by the researchers.

Our review question was on understanding how technology has been shaping the conceptual perspective of two innovation research streams, namely, IS and IE. Willingness and interest in performing such a review are related first to the central role played by technology in both the literature streams; additionally, our research aim stemmed from the significant attention paid by past and current scholars to achieving IS contributions, and the recentness and interest devoted to the approach to ecosystems as context-shaping innovation.

Specifically, our aims for this systematic review were to define how technology has been thought in both IS and IE in recent years; to compare the main issues related to technology in the two research streams; and to identify similarities and differences in the two innovation contexts, as proposed by Barnett-Page and Thomas [42]. To sum up, our study aims to fill a gap in a focus on technology and its role in the innovation literature based on two different theoretical contexts, namely, system and ecosystem, as stated above. We thought that a systematic review was the most suitable method to uncover all potential contributions, to depict in detail all the issues linked to technology, and to explain the role it has played in framing the IS and IE literature. In addition, other authors have already performed systematic reviews on the more general topic of innovation [43,44].

The research process started with data collection, so we performed queries on Web of Knowledge–Web of Science to acquire most IS and IE contributions; the queries we planned to perform by looking for works were based on the descriptors "innovation system*" and "innovation ecosystem*" to consider both singular and plural versions [43]. Because IE is more recent than IS, we chose to compare contributions published during the same period; thus, we selected the period between 2006 and 2017 because, in 2006, the first contribution to an ecosystem as a context for innovation arose. The first datasets we achieved were composed of 543 contributions concerning IS and 55 contributions concerning IE after having filtered query results and selected only contributions written in English and published as scientific papers or book chapters.

The authors started reading the abstracts of the contributions shaping the two datasets. In line with their search strategy to extend the sets of available contributions to be considered, they decided to add new papers by even looking at the list of references in those academic articles and book chapters, only written in English [45] and contributing to the definition of the two contexts of innovation. Due to this, the updated versions of the datasets were composed of 608 contributions related to IS and 232 contributions related to IE.

The last step of our data collection involved selecting the contributions dealing with technology, without considering the theoretical approach chosen by the author(s), the methodology used, and the linkages among proposed topics. Due to this, the final versions of the datasets we used for our analysis consisted of 334 contributions regarding IS (namely, 332 academic papers and 2 book chapters) and 92 contributions regarding IE (namely, 87 academic papers and 5 book chapters). In the following figure (Figure 1) we summed up the process described in the three steps mentioned above.

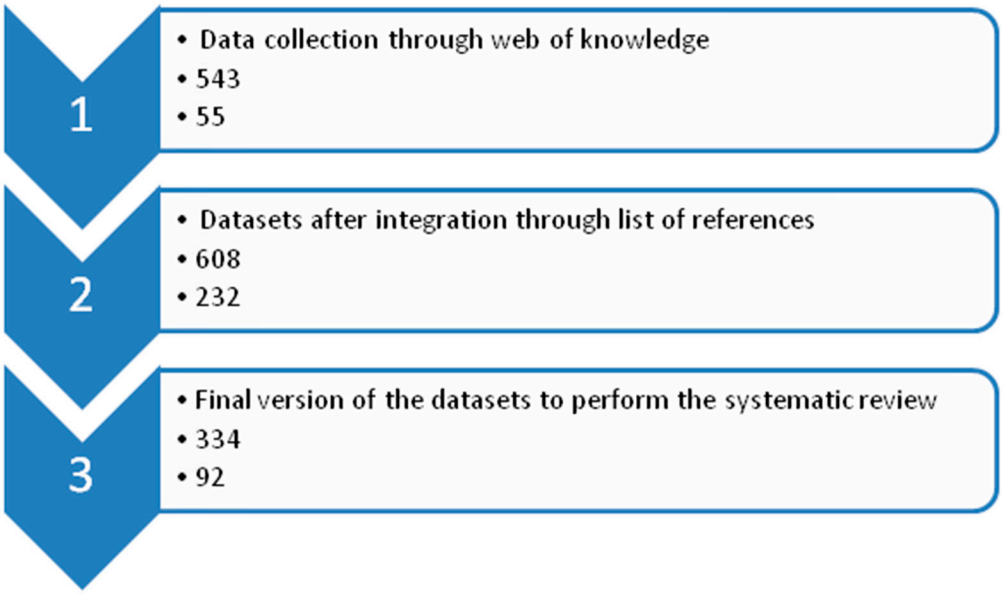

Figure 1. Research process.

Finally, the two datasets were assessed for relevance of the content of each contribution. The authors divided the two datasets among them and planned periodic comparisons of the intermediate findings achieved, doubts arisen, and the final set of issues emerged. In this way, the process was less affected by subjectivity [44] due to the sharing of ideas, analyses, and interpretations of the considered contributions.

Because the aim of our research was to combine insights into the role of technology in innovation, we tried to combine the issues that emerged on the basis of the considered core elements. In more detail, we aimed to combine contributions dealing with the same topic in relation to technology, so we coupled them on the basis of the main element shaping the academic papers or chapters. We preferred not to perform a categorization before the systematic review took place because this would affect the interpretation of the researchers, as suggested by some of the authors proposing methodological ideas on how to perform a systematic review [44,46]. Additionally, a systematic review should lead to the understanding of key scientific contributions, so a descriptive approach is more suitable than others [47], especially if compared with predefined categories.

3. Overview

Appendix A presents general information about the set of publications used. The number of contributions considered varies among the literatures due to the longer and more established tradition of IS studies.

In spite of these results, the production trend was quite similar: contributions on technology show a constant increase in both the literatures, demonstrating that the topic has attained increasing interest in different scientific communities.

Moreover, as journal analysis shows, the debate for both the literatures is intense in highly specialized journal areas, even if some differences can be registered. Specifically, scholars' contributions regarding IS are published in journals dealing with policy and economic studies of science, technology, and innovation; this is evident by looking at Research Policy, Technology Forecasting, and Social Change, and Technology Analysis and Strategic Management as top journals in this category. The IS literature is also found to be shaped by several authors grouped under the influence and primary leadership of the U.S. economist researcher community.

The debate around technology in IE studies is less concentrated due not only to the more recent origin of the IE literature but also because this literature combines many perspectives. A major part of its scientific community comes from the economics and technology tradition of IS scholars; however, the research in this field has also been prompted by the contributions of the larger community, including innovation and technology management and strategic scholars, as well as information systems and entrepreneurship researchers. This heterogeneity is also reflected in studies published in a greater variety of journals, as among the 92 analyzed contributions, the first sources, namely, Technological Forecasting and Social Change, and Technology Innovation Management Review, present fewer than 10 articles on IE.

4. Technology in IS: Main Research Areas

Technology is highlighted as a crucial issue in IS; the nature of actors, interactions, and resource diversity are some of the key useful issues in depicting how technology has been addressed in IS studies [48].

A great number of studies address the role of technology in favoring growth in IS by focusing on the geographical level as national ISs (NIS) are a suitable context for such an investigation [48,49].

The context in which technology can show the potential positive effect on IS is broad and influenced by emerging technologies, the involvement of actors from other sectors, and other conditions favoring investments [50]. The higher the number of actor firms embedded in NIS, the more developed the technology will be [51]; this effect occurs even when considering the link between science and technology, since they are mutually influencing, and additional actors are involved in providing solutions to innovation demands [52].

According to other scholars, contexts like regional innovation systems are thought of as greatly affecting technology because they embed technological innovation capabilities and knowledge, namely, the main pillars of technological development [53]. Additionally, regional contexts can offer challenges to technology to provide a breakout of a lock-in [49] favoring the characterization of national and sectoral IS [54], and the improvement of competitiveness of the whole context [55].

Technology development has been investigated mainly in terms of knowledge flow and technology transfer due to the effects played by different actors [56] even outside of a sector, leading to cross-sector research collaborations [57]. Collaborations among actors are ruled as necessary to achieve new technologies, and more positive effects take place, especially when actors are in proximity from a geographical point of view [58,59] and/or from a technology perspective [60]. These collaborations can take place in both an emerging context and in a formal set of actors challenging innovation matters [26].

Collaborations are needed even in favoring the acceptance and diffusion of new technologies in the whole IS and in larger contexts [61]. However, even other elements need to be considered, like structures and processes of the technological innovation systems [24]. Wider contexts and actors' nation-based differences are seen as more useful to leverage global–local interactions to improve and update technological capabilities [62,63]. Technology directly affects the quality of a NIS, leading technologies to be deployed across national boundaries [22,64].

The IS literature paid specific attention to one of the actors providing support to the above collaborations, such as universities [65,66] and other technology-transfer agents [67], particularly as it regards the creation and diffusion of required competencies in favoring technology transfer [68]. Knowledge-intensive businesses and R and D services [69] are helpful in providing learning opportunities to NIS [70], in favoring the development of an approach towards innovation [71], and in extending the competitiveness of territorial IS and of the innovation provided to it [72]. Technology is thought of as the process leading to the improvement of knowledge for the entirety of an IS [73], especially if knowledge is recombined and transformed through the output of technology-based activities [74].

All these effects of technology can be summed up in context as the transformative capacity of new technologies [75]; IS has been theorized as coevolving with technological change [76].

Moreover, the development of new technologies has become topical in research that gains insight into how institutional changes evolve into an IS. Linkages among technology, networks, and institutions drew most scholarly attention, especially in complex systems, because of the role played by institutions and their evolution [77]. Innovative activities are seen as complemented by the need for institutional work [78], and innovators take on the role of institutional entrepreneurs aimed at changing institutions in the best interests of their technology.

In this sense, the role of policy intervention is often presented as crucial for different reasons as it leads IS towards the development, deployment, and transfer of new technologies [79]. Coordinating mechanisms of governance in complex systems is seen as a necessity growing together with the technological level of national or regional IS [18,80]. Technology roadmaps represent one of the tools chosen by governments and policy makers to promote technological transition [81,82]; similarly, the role and relevance of policy issues is confirmed even on the dark side of NIS, when science and technology development are not supported [83]. Moreover, reaching a better understanding of governance mechanisms [84] in IS presents a main agenda item in the emerging field of sustainability transitions [85,86]. Important requirements for sustainability transitions to take place are radical technological breakthroughs which are often marked by controversies. In this regard, some studies [84,87] argued for the emergence and acceleration of technological changes through system-building activities directly intended to favor the achievement of a sustainability-oriented process in the whole system [85].

5. Technology in IE

The IE literature is quite recent and starts to be affirmed through the rise of a technology era in which the key element is considered open access to technology [88,89].

Technology is considered a critical resource at the basis of firm and business growth in different industries [8]. The integration of technologies in IE is delineated as an element that influences the emergence of relationships among the different actors, both upstream and downstream, and the development of innovation in the whole ecosystem [90]. The impact of new technologies on old ones has been intertwined into two different strategies of "racing" or "retreat" [91,92], as the introduction of disruptive technologies has been related to the strategic consequences of continually adjusting for navigating co-opetitive tensions [93].

The dynamic relationships among multiple technologies in IE have led to the identification of the roles of actors, products, and applications, and support and infrastructure [91,94], which together influence technology evolution. Moreover, technology-development analysis and the roles of technology in different innovation contexts [95,96], such as mobile-technology [97,98] and financial ecosystems, has given a growing importance to the integration of demand-side forces, namely, stakeholders' actions [99].

As a consequence, issues that underline the role of technology in IE deal especially with technology as a component to span different knowledge and research domains, and as support and infrastructure [30] that enable actors working in conjunction by adding value to the knowledge

they support [89]. In this role, information and communication technologies (ICT) and the platform that allows the collaboration of different firms are mentioned [34,100,101].

The main actors within these IE, so-called platform leaders, are strongly influenced by technologies in the design of the architecture and interfaces, and in the choices of intellectual properties that delineate the relationships with the other actors of the ecosystems that provide complements [30,102]. The link between platform leader and technology in IE, especially in the ICT industries [103,104], has been addressed in the challenges that firms need to overcome in relation to the technological uncertainty and technology life-cycle influence [90]. In this sense, the role of technology has been valued for its interoperability within platform ecosystems in which different firms, behind the platform leader, must identify the better collaboration strategy [105,106].

The importance of the contexts in which technology can be used has sometimes been related to national or regional contexts in which high-technology small and medium-sized enterprises (SMEs) create the conditions for the enactment of innovation in the form of emerging, co-adapting, and growing [107,108]; however, the interoperability of technologies has been raised as a topical issue in research that connects the Internet of Things and the Open Innovation model within smart cities that are considered as IE joining institutions, knowledge activities, and web-based applications [109,110] in a sustainable wellbeing view [111].

The role of technology as a tool to improve existing value propositions creating a new offering or reconfiguring ecosystem partners [112] has also been related with the distinction between operand resources (i.e., people and businesses) and operant resources (i.e., technology and information) [113]. Otherwise, the increasing importance of technology has led to its delineation as an operant resource, one capable of acting on other resources to create value within the so-called service (eco)system [114]. Technology emerges as both an operant and operand resource, "an outcome and a medium of value co-creation and innovation" [39,114]. The scope of technology is broadened beyond a material artifact by considering the multiple roles of technology in service ecosystems, and how it influences and is influenced by human actions (i.e., practices) and institutions (i.e., rules, norms, and practices) [39,40].

Connective institutions, either formal or informal, are necessary to bridge individual components in an ecosystem and allow free-flowing exchange and collaboration between various actors [39,115].

In many cases, research universities are the critical lynchpin tying the necessary components of a dynamic and collaborative IE together [31,38,116–118]. While it is necessary for universities to play this role, many ecosystems have different convening institutions bringing together top human capital, R and D funding, and leading private-sector actors; in addition, these ecosystems are drawn on venture capitalists and incubators playing a critical role in fueling innovation-led growth [119,120].

The focus on technology as an enabler of innovation within ecosystems has also been analyzed in terms of its link with policy where the use of a top–down approach to create a fair business environment emerges. This top–down approach is typical in developing countries where national programs aim to develop flourishing ecosystems based on technology and business incubators [121,122]. Instead, in an ecosystem where innovation is typically driven by grassroots entrepreneurship [123], technology plays a critical role as a tool allowing the enhancement of actors and different urban stakeholders' involvement in bottom–up initiatives for better quality of life [124,125].

6. Discussion

The analysis we conducted has been useful in highlighting both commonalities and differences related to technology in the two contexts of innovation. The key elements in drawing the findings are the overall idea of technology as pivotal in driving innovation in the two specific contexts in which it takes place, the actors affecting technology and contributing to the achievement of innovation-based goals, and the decisional process emerging because of technology. Our contribution is an opportunity to propose a comparison to favor co-operation among scholars investigating technology-oriented innovation.

Generally, when framing technology in IS and IE, there are similar topics emerging as the pillars of a pattern towards the achievement of innovation-based goals (namely, the actors and their relationships), but IS scholars have paid great attention even to resource diversity. One of the ways in which an innovation-driven goal is presented is growth, but a geographical context and the firms shaping it form the context in which innovation is framed by IS scholars, while industries are under focus when dealing with an IE. Additionally, the aim of technology is mainly thought of as affecting the whole context in IS, while disrupting previously available technologies in IE. As a consequence, we can state that technology is considered an enhancing mechanism along an already running pattern from the perspective of IS scholars, while it is more commonly disruptive from an ecosystem point of view.

The focus on actors is strongly similar in the two contexts of innovation, since a multitude of actors is considered as positively affecting the development of technology with reference to different businesses, diverse solutions to be achieved, and several sources of knowledge to be considered. A wider set of interactions is specifically addressed as a positive way to achieve technology improvements in the IS literature. IE scholars have even paid attention to platforms as the main instrument enabling actors' cooperation in achieving technology-based goals through the great influence played by platform leaders. One actor among others is particularly under focus in both the literatures, namely, universities, because they represent a technology-transfer agent and a competence carrier in both IS and IE; moreover, they are considered hubs for all actors contributing to the innovation processes through technology in IS.

Both IS and IE studies provide a clear and unequivocal relation between the context(s) hosting the innovation process and the technology, even if the considered contexts are different. In more detail, geographical contexts more commonly shape IS contributions, while a greater variety can be found in an ecosystem-based perspective. IS scholars propose contexts as a trigger of innovation, since the features of a geographical context provide challenges to be dealt with and capabilities to be used. In IE contributions, the contexts are seen as an enabler because they represent the physical or virtual place where actors co-operate in the achievement of innovation-driven goals.

When dealing with framing and describing innovation-based mechanisms through technology, several differences emerged in the two research streams we analyzed. System scholars focused mostly on the input–output process in terms of knowledge and technology transfer, even to stress once again the different backgrounds, in terms of both knowledge and physical location, from which act or co-operation comes. Conversely, IE studies paid most attention to the generative force of technology and its complexity, which is manifested both in artifacts (new propositions, new tools, platforms, and so on) and in the interactions between actors with different rules and perspectives. To summarize the different approaches to knowledge, system scholars are focused mostly on the ways in which technology can support the transfer of both technology itself and knowledge, while technology acts as a connector and collector of actors holding knowledge and leading towards knowledge combination through technologies (like platforms) in an ecosystem-based perspective. Finally, innovation–governance mechanisms such as policy are another element taken into account in both research streams, with a great predominance of IS due to the large number of contributions devoted to describing the role of policies and policymakers to describe IS. Policies are considered to be a way to favor the flourishing of innovation-based activities in both IS and IE; the deployment of activities oriented to a top–down approach in the system literature altered the idea of a policy in the two research streams. IS scholars consider policies to be the ways in which governments steer innovation activities in a specific context, and even to highlight the issues to be faced when intervention from a central institution is missing. In IE studies, the focus placed on incubators, entrepreneurship, and stakeholders' involvement made policy less relevant because central institutions seem to play a less relevant role than in IS. This difference is even more relevant when dealing with innovation in developing countries or industries.

In the following table (Table 1) we summed up the main results of our comparison between the two research streams and their contributions. We highlighted the most relevant topics and provided a short overview of how each of them is thought of in the IS and IE literature so as to provide an overview of the similarities and differences emerging through this systematic review.

Table 1. Summary of the main topics under investigation in the Innovation System (IS) and Innovation Ecosystem (IE) literatures.

Topics under Focus	Innovation System	Innovation Ecosystem
Context	Mainly defined as a geographical area; it is the trigger of innovation	Often meant as an industry; it is useful in collecting actors' contribution
Aim	Improving the whole context	Disrupting previous technologies
Actors	A multitude of actors favors innovation goals through technology	
University	It is both a technology carrier and a competence integrator	
Mechanisms	Knowledge as an output and technology transfer	New propositions and platforms and new relationships among actors
Policy	Policy and policy makers support the whole process	
Policy maker	It steers the innovation process as in a top–down approach	It supports entrepreneurship and stakeholders' involvement

7. Conclusions and Further Research

When interpreting the findings of our analysis, some implications arise.

As the results show, the narrative of technology deals with different sets of concepts within the IS and IE literatures.

The IS perspective is centered on activities and interactions of those actors involved in innovation, and technology takes the leading role in determining system boundaries and the ways in which knowledge transfer is guaranteed to prompt and diffuse innovation. The IS perspective provides more opportunities to take a comprehensive view of the analyses of the overall IS, and to look more in depth at the detailed dynamics of knowledge flows within the system [28].

Influencing and developing IS, however, also requires an understanding of the dynamics of the technology and knowledge in the systems; these aspects are central in the literature on IE. The technology issues in IE not only direct attention to the structures and operation of the system, but also consider its evolution through time, as well as in relation to other ecosystems [12]. Technology's role is not only seen as a question of the possibility of more knowledge resources being at the disposal of innovation, but mainly involves knowledge-transforming mechanisms; technology became critical for its ability to cross knowledge domains and innovation contexts and to produce unintended consequences through the learning processes it generates. Thus, the complexity and nonlinearity typical of interactions in the ecosystem perspective provides opportunities to further investigate technology's role in the formation of shared infrastructures to influence ecosystem stability and development.

Based on these differences, the contribution of this manuscript stands on the opportunity to learn in-depth from specific insights generated in both the literatures and allows for a more comprehensive approach to the technology related to innovation in wider interconnected contexts.

The results should help facilitate common understandings and conceptualizations of innovation across the identified literature, and, thereby, further accelerate the academic exploration of crucial questions such as antecedents, activities, and outcomes of generative technology mechanisms [3].

However, limitations that provide avenues for further research should also be taken into consideration.

First, the seven topics under focus, namely, context, aim, actors, university, mechanisms, policy, and policy makers, can represent an instrument to map how innovation is taking place in other contexts; scholars have provided different labels to describe innovation contexts, such as networks,

and new conceptualizations further describing ecosystems as innovation contexts are emerging. Thus, further research can be based on the similarities and differences emerging from some of these innovation-based contexts through the seven elements highlighted in this research.

Second, a further understanding of the innovation contexts can be achieved by grasping the ties among the seven elements highlighted before, namely, by investigating in direct touch with innovation actors if and how these seven elements can have a mutual influence, and how this phenomenon can affect the result of an innovation process.

Moreover, findings were determined by the research process, including the choice of databases, keywords, and contributions. This task was far from straightforward, as the extant innovation literature provided little continuity in its use of labels, concepts, and definitions. A number of important contributions in the respective fields may not have been included. Moreover, the notion of IE is quite recent as compared to IS; the term IE is controversial, even among experts, and knowledge and contributions in these areas are growing rapidly. Even if we focused on the years in which both the literatures existed, the different maturity stage of the studies is a limit to be considered. Further research is needed to grasp anomalies and controversial assumptions both within and across the labels that provide room for new directions and methods related to the acquisition of valid knowledge.

Author Contributions: Introduction T.R.S. Research process F.B. Findings M.T. Discussion and conclusions C.C.A.

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Appendix

Table A1. Main publications features.

Indicators	IS Literature	IE Literature
N. of contributions (1994–2017)	334	92
Trends of production	Increasing growth (Eight contributions in 2006 against 57 in 2015 and 35 until December 2017)	Increasing growth (One contribution in 2006 against 60 in 2015 and 49 until December 2017)
First sources	- Research Policy - Technology Forecasting and Social Change - Technology analysis and Strategic Management	- Technological Forecasting and Social Change - Technology Innovation Management Review - MIS Quarterly/Research Policy
Main areas of knowledge	Business (30.4%) Management (29.5%) Economics (27.5%)	Management (44.4%) Business (33.3%) Economics (5.6%)
Top three contributing countries	United States (11.37%) United Kingdom (9.48%) Netherlands (8.53%)	United States (30.93%) China (12.37%) United Kingdom (8.25%)

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