Uncovering value creation in innovation ecosystems: paths towards shared value

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Abstract

Purpose – Although innovation ecosystems (IEs) are generally considered capable of creating shared value (SV), this potentiality has often been taken for granted and not deeply analysed, yet. As a result, in the literature, there is not a framework that defines the process of SV creation in IEs or which aspects should be considered for understanding it. Moving from these considerations, this paper aims to propose a conceptual model of how IEs can create SV, identifying the main building blocks of the process and the aspects that characterize these building blocks.

Design/methodology/approach – The authors reviewed the literature on IEs and value creation over the last 15 years, by structurally analysing 120 articles. On the basis of such review, the authors identified main dimensions of analysis focusing on the conceptualization of SV in IEs.

Findings – First, the authors developed a conceptual model relying on a process-based logic and framing the SV creation in terms of inputs, here intended as four key characteristics (actors, structure, governance and relations), internal processes (strategies and internal mechanisms) and outputs (the value created). Second, each element of value creation is explored, highlighting the main evidence emerging from prior studies in connection to each block.

Originality/value – This paper drives the identification of some relevant relationships that connect the characteristics of the IEs, the strategies and the internal mechanisms to the output of the process, i.e. the SV created.

Keywords Innovation ecosystem, Heterogeneity, Process-based logic, Shared value

Paper type Conceptual paper

1. Introduction

Since its first formulation (Adner, 2006), the term *Innovation ecosystem* (IE) has been adopted to describe *structures of interconnected entities, that, thanks to dynamic horizontal relations, support new grounding, exchange and strengthening of dispersed competences and resources to create innovations and value* (Gomes *et al.*, 2018; Jacobides *et al.*, 2018; Russell and Smorodinskaya, 2018). The importance of such structures is growing (Bassis and Armellini, 2018; Baloutsos *et al.*, 2020) due to a paradigm shift, that is moving the innovation processes outside the boundaries of a single organization (Moore, 1993; Chesbrough *et al.*, 2006; Von Hippel, 2007; Usman and Vahnaverbeke, 2017), with the engagement and the collaboration of different entities (Schuh and Woelk, 2017; D'Auria *et al.*, 2016; Russo-Spena *et al.*, 2017).

IEs are generally considered inherently capable of creating socio-economic benefits for multiple stakeholders (Liu *et al.*, 2016; Benz and Seebacher, 2018; Alberti and Belfanti, 2019; Huang *et al.*, 2019; Knockaert *et al.*, 2019) or, in Porter and Kramer's terminology, shared value (SV; Porter and Kramer, 2011) [1]. Therefore, it is widely accepted that actors within an IE can both improve their own results (Knockaert *et al.*, 2019) and generate collective impacts for the

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system as a whole (Adner, 2006; Adner and Kapoor, 2010; Russell and Smorodinskaya, 2018) and the society at large (Guerrero *et al.*, 2016; Radziwon *et al.*, 2017; Del Vecchio *et al.*, 2017; Lopes and Farinha, 2018; Audretsch *et al.*, 2019).

However, the relationship between IEs and SV has been studied in a highly fragmented way (Liu and Stephens, 2019; Oskam *et al.*, 2021). Indeed, prior contributions focused on specific aspects, episodic cases or peculiar settings (Liu *et al.*, 2016; Alberti and Belfanti, 2019; Huang *et al.*, 2019), while a deep analysis of the processes of value creation in IEs is still lacking (Ritala and Almpanopoulou, 2017; Gomes *et al.*, 2018; Alberti and Belfanti, 2019; Suominen *et al.*, 2019), even if they are crucial for a more efficient leverage of SV potentialities.

The paper aims to fill this gap, by focusing on the following research questions: which are the elements/building blocks that characterize the process of SV creation in IEs? To what extent are these elements connected to each other's?

To this aim, the paper revises the articles published in the last 15 years, dealing at a different extent with the creation of SV within IEs. Based on such prior literature, the paper proposes a conceptual model that represents the process of SV creation within IEs, outlining its outputs, the internal processes (strategic and operational) and inputs. Such model helps to provide a systemic picture of the state of the art literature in connection to each element of the process of SV creation and supports the identification of some relationships amongst different building blocks. This analysis suggests that the value created by IEs is relevantly influenced by a few main elements of heterogeneity in the inputs – i.e. the internal characteristics of the IEs – and by the strategies and mechanisms that are put in place.

The paper is organized in five further sections. Section 2 presents the literature review performed, Section 3 introduces the conceptual blocks of the model, and Section 4 the exploration of such blocks. Section 5 discusses main relations amongst these blocks, specifically proposing relations that outputs have, on the one hand, with inputs and, on the other hand, with strategies and mechanisms. Conclusions are in Section 6.

2. Research methodology

To explore the creation of SV within IEs, the paper relies on a thorough literature review of the articles published on this topic in the last 15 years. In these years, indeed, the concept of IEs, seen as key for value creation, has been widely adopted and studied (Baloutsos *et al.*, 2020). The literature review was conducted through a developmental approach (Templier and Paré, 2015), as the aim was to propose a conceptualization of SV creation in IEs. The search of studies to be included in the review was done with a replicable, scientific, transparent process (Petticrew and Roberts, 2006), balanced in terms of specificity and sensitivity. It stemmed from the research question, formulated including key subjects (IEs), interests (SV creation) and outcome (conceptualization and building blocks). Papers not meeting these requirements were excluded (complementarities) [2].

In line with this approach, at first, we identified keywords related to the RQs: "*innovation ecosystem**" AND "*shared value*". However, the first query formulated only with these keywords was too specific: indeed, many relevant articles were left out because they were not explicitly mentioning SV but synonyms or paraphrases referring to the same concept. Thus, we enriched the search with terms in "OR" adopted by Porter and Kramer (2011) and their synonyms – *collective impact, local cluster* and *socio economic (or socio-economic, or socioeconomic) impact* (Table 1).

On Scopus, the query found 211 contributions. We did not filter for type of publication, also keeping proceedings and book chapters, so to have in the sample all diverse kinds of updated contributions. Filters were applied to include documents published from 2006 [3], in English, in the research fields of interest (*Business, Management and Accounting, Social Sciences, Economics, Econometrics and Finance*) [4]. Titles, abstracts and keywords of the

Search on Scopus	Detail	Number of articles
QUERY	(TITLE-ABS-KEY("innovation ecosystem*") OR TITLE-ABS-KEY("*local cluster**")) AND (("*shared value*") OR ("socio-economic impact") OR ("*collective impact*") OR ("value creation") OR ("socioeconomic impact") OR ("socio economic impact"))	211
FILTER on years	From 2006 (in 2006 there is the first conceptualization of SV (Porter and Kramer, 2006) and of IEs (Adner, 2006)	206
FILTER on language	Only articles in English	199
FILTER on the field	Business management and accounting, economics, econometrics and finance, and social sciences	164
ELIGIBILITY CRITERIA (exclusion)	Contributions in the IT or in the biology/ecology research fields. Studies that analyse IEs from the inside of an organization; studies focused only on IEs and patents	120

Table 1.
Search for studies

remaining 164 articles were read to include only contributions aligned with the aims of our analysis: three exclusion criteria were applied. First, we dismissed contributions in fields that are disconnected from business, social sciences, management and economics (such as papers leveraging IEs as objects to experiment algorithms/programmes as well as articles on biological ecosystems, populations and communities). Second, we excluded papers analysing the organizational and strategic behaviours of companies dealing with open innovation transitions, adopting an internal company perspective and not a systemic one. Third, we ruled out those articles focused only on university (and knowledge) ecosystems and their patenting processes.

This process led to the selection of 120 "core articles", classified according to the dimensions provided in Appendix: reference and reading day, details on the search process (keywords, filters and databases), synthesis of the problem, research questions, methodology, and other information linked to the object of analysis and paradigm. Amongst the dimensions of analysis, we also considered the quality of the article (critical analysis) and the relevance for the present research.

Half of these 120 papers were published in the last years proving the growing interest in this topic. The selected papers were analysed based on a thematic reading (Paterson *et al.*, 2001), which enabled the individuation of building blocks to be considered as the key elements for conceptualizing the process of SV creation in IEs. This phase was conducted through a continuous confrontation amongst the authors, which independently worked on the conceptualization and then shared their impressions and insights, to support the development of the framework that is presented in the following section.

3. Conceptualizing SV creation in IEs: a process-based view

SV creation in IEs is inherently complex: it requires continuous exchanges and circular loops of relations amongst the multiple stakeholders of the system. Indeed, both SV and IEs have a multi-level and multistakeholder nature. Hence, conceptualizing SV creation in IEs requires to balance the need of simplifying the reality to structure and study it, and the possibility of capturing this complexity and fuzziness.

For this reason, we identified some building blocks for representing the process in a simplified way but underlying the relevance of identifying relations, interlinkages and loops amongst them for being able to study the issue.

In particular, the process of SV creation in IEs can be represented based on four main building blocks: the *outputs,* intended as the results of the process of value creation, the

modalities through which these results can be reached (namely the *strategies* adopted), the instruments supporting these strategies (internal *mechanisms)* and the key characteristics of the IEs that represent a sort of input (or starting point) of the process itself (Reypens *et al.*, 2016) (see Figure 1). Thus, the individuated building blocks and relations in Figure 1 represent a simplification of the complex reality of SV creation in IEs useful to structurally study the research questions posed.

Based on the literature review, we have identified some dimensions of analysis that characterize these four building blocks. These dimensions do not aim to be exhaustive, but they represent recurrent issues that emerge from the literature in connection to our building blocks and that appear relevant for explaining SV creation in IEs. Table 2 provides an overview of these main aspects that are then detailed below.

The *outputs* of the process are represented by the value that is created. For defining outputs, different aspects should be taken into account, including the *type of objectives considered* (Fulgencio, 2017; Surie, 2017; Lopes and Farinha, 2018; Audretsch *et al.*, 2019), their *prioritization* (Nambisan and Baron, 2013; Mantovani and Ruiz-Aliseda, 2018; Kwak *et al.*, 2018; De Silva *et al.*, 2018) and the *related performance* (Adner and Kapoor, 2010; Tsujimoto *et al.*, 2018; Audretsch *et al.*, 2019; Alberti and Belfanti, 2019).

Objectives are defined by considering spheres in line with the Triple Bottom Line (TBL: social, economic, environmental; Elkington, 1997). This is consistent with characteristics both of SV and IEs, which entail multi-stakeholder and multi-actor settings, creating diverse benefits (De Silva *et al.*, 2018). A fourth sphere can be extrapolated, which is fundamental for the object of analysis (IE): the one of innovation (Reypens *et al.*, 2016; Audretsch *et al.*, 2019).

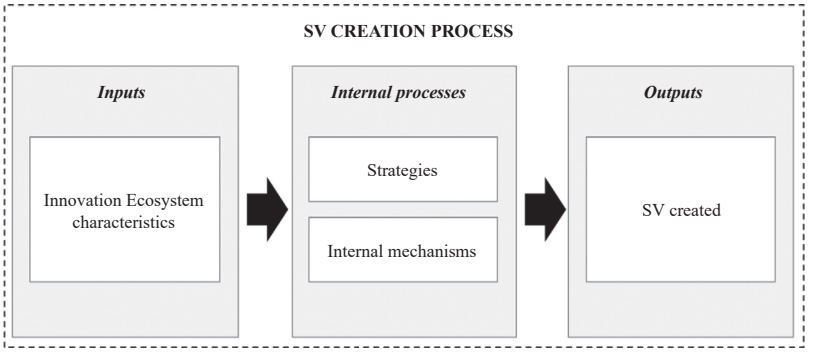

Figure 1.
Building blocks of the research, shaped through a process based logic

Dimensions	Key aspects
Outputs	Output spheres: economic, environmental, social and innovation
	Prioritization of spheres
	Performances: resilience, rapidity and intensity
Strategies	Collaboration and competition
	Internal alignment and external viability
Internal Mechanisms	Formal versus informal
	Level of openness
Inputs (IE characteristics)	Actors
	Structure
	Relations
	Governance

Table 2.
Dimensions considered in the analysis and key aspects

The innovation sphere includes outputs related to patents, new products-processes-services, R&D spending (Liu *et al.*, 2016), collaborative projects and innovative job positions (Lopez and Farinha, 2018) (Figure 2).

The performance of the outputs can be expressed in terms of rapidity of creation of SV (Liu *et al.*, 2016; Schuelke-Leech, 2018), intensity (Surie, 2017; Datteé *et al.*, 2018) and resilience (Tsujimoto *et al.*, 2018; Fukuda, 2019).

Concerning IE *strategies* for SV creation, some macro-strands can be individuated as particularly relevant to explain the relations between SV and IEs. These aspects relate to alignment and coopetition [5], both crucial and debated in IE contexts. First, alignment can be intended both as internal (amongst IE members) and external (between the IE and outer levels) (Al Mamun, 2018): the former (internal alignment) focuses on strategies enacted by actors constituting the network and requires the definition and acceptance of overarching goals and value propositions (Lopes and Farinha, 2018; Talmar *et al.*, 2018). The latter (external alignment) is important to avoid lock ins of inner looking systems (Boschma, 2005; Ben Letaifa and Rabeau, 2013) and for enhancing viability in the outer socio-technical regime (Walrave *et al.*, 2018).

Second, coopetition (Nalebuff and Brandenburger, 1997) well applies to systemic contexts (and thus to IEs), where actors are independent players that may compete while aiming at collaborating to cocreate (Benz and Seebacher, 2018; Wegmann *et al.*, 2018). Collaboration is key so to enhance knowledge exchange and generation (Boschma, 2005; Ben Letaifa and Rabeau, 2013) amongst actors which complement each other's in a non-generic way (Jacobides *et al.*, 2018). Competition is also precious, as it enhances the stimulus to continuously improve and innovate (Desrochers, 2001). In this connection, identifying the level of strategic collaboration (in the spectrum of coopetition) helps in understanding and designing SV creation strategies, characterized by diverse levels of riskiness and efficiency (Bosch-Sijtsema and Bosch, 2014; Planko *et al.*, 2019).

Competition and cooperation can occur simultaneously in coopetitive strategies, but they are also partially in contrast one with the other. Cooperation and collaboration, indeed, need a certain level of trust and the sharing of resources, data and information, which might be complex in a competitive environment.

Then, concerning *internal mechanisms*, they can be tools, systems, platforms (Gawer, 2014; Kwack *et al.*, 2018), ways to reinforce personal relations and intangible flows (Prokopenko *et al.*, 2014; Planko *et al.*, 2019). Their heterogeneity can be articulated

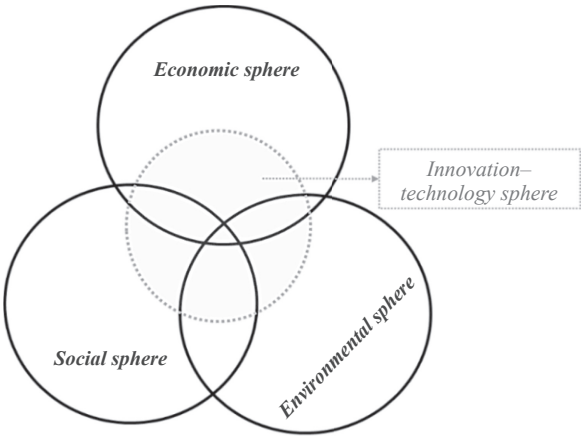

Figure 2.
The four output spheres

considering their level of formality and openness. The former requires understanding whether internal mechanisms are formally defined (databases, platforms, measurement and reporting tools, balanced scorecards) or whether they are informal (personal relations, communication, participation to events . . . Witte *et al.*, 2018). The latter requires focusing on the level of openness they favour/are designed with (Mantovani and Ruiz-Aliseda, 2018). On the one hand, openness is fundamental to create and disseminate innovation and value (Ferdinand and Meyer, 2017). On the other hand, it implies sharing competitive resources, tacit knowledge and risks.

Last, also the characteristics of IEs (*inputs* of the process) are relevant when analysing SV creation (Reypens *et al.*, 2016). In particular, four elements emerge from the literature as they can contribute to explain the heterogeneity in SV creation: *actors* (Fulgencio, 2017; Suseno *et al.*, 2018; Baloutsos *et al.*, 2020), *structure* of the IE (Surie, 2017), *relations* and *governance* (Majava *et al.*, 2016).

Starting from the actors, IEs are (Jacobides *et al.*, 2018) composed by entities of diverse nature (as firms, individuals, organizations, agents and universities) and roles like orchestrators (Still *et al.*, 2014; Linde *et al.*, 2021), brokers (Lin, 2018) components and complementors (Adner, 2006), and intermediaries (as Technology Transfer Offices; Sinell *et al.*, 2018). Actors are independent but interdependent and have numerous relations that are indeed a second key characteristic explaining heterogeneity in SV creation process. Relations amongst actors have been modelled as helixes of continuous and dynamic interactions amongst industry, academia, public institutions (Etzkowitz and Leydesdorff, 2000) and the civil society (Carayannis and Campbell, 2009). Relations can be internal to the ecosystem or with outer levels, more or less intense and strong and support in this way value creation (Gomes *et al.*, 2018). SV creation is a complex task demanding the support of institutions, as governance structures (Granstrand and Holgersson, 2020), which can be top-down, bottom-up or absent as in complex adaptive systems (Jucevicius *et al.*, 2014), composed by diverse leading bodies. A last characteristic of IE affecting SV creation relates to the system structure: the ecosystems' width (proximity) and sectors in focus appear as relevant for understanding and managing value creation. Indeed, according to Ritala and Almpanopoulou (2017), identifying the proper "boundaries" of an IE is crucial for uncovering value creation modalities.

4. Exploring the building blocks

Relying on the process-based view introduced above, we analysed the sampled papers to understand which is the main evidence that emerges from the literature in connection to each building block (outputs, strategies, mechanisms and inputs). In this section, each building block is explored.

4.1 Outputs

Value created in ecosystems can be referred to the four above identified spheres: economic, environmental, social and innovation (Audtretsch *et al.*, 2019).

In the literature, the first sphere is associated with tracking IEs' economic results in terms of profit/shareholder value (Lopes and Farinha, 2018) and market share/product value (Fulgencio, 2017). IEs are considered capable of affecting the environmental outputs as well, in terms of energy efficiency and circularity. Outputs belonging to the environmental sphere are framed in the literature as: energy security, emission reduction (Ding and Wu, 2018), waste treatment, improved habitat (Surie, 2017) and enhancement of circularity (Whicher *et al.*, 2018). According to the analysed literature, IEs entail diverse social benefits for communities and external stakeholders, too. The multi-stakeholder nature of IEs supports the

recognition of relevant societal needs (Siqueira *et al.*, 2014) and the improvement of the well-being and quality of life of entire territories: this incentivises the attraction of talented figures (Surie, 2017) the creation of high-quality jobs (Surie, 2017; Huang *et al.*, 2019), skills (Shrotriya *et al.*, 2018) and knowledge (Prokopenko *et al.*, 2014). Last, the innovation sphere, which strongly relates to the other ones, is traced in terms of increased IP investments (Chaudhuri, 2012) – required when inventions are sustained by collaborating actors – spillovers of inventions, new start-ups (Siqueira *et al.*, 2014), synergic contaminations fuelling continuously improved innovative services, products and processes (Lopes and Farinha, 2018).

The second dimension of analysis concerns the performance of the IEs – i.e. how outputs are reached in terms of resilience, rapidity and intensity. Performing resiliently in IEs is crucial for sustaining value creation: authors recognize that this is not automatic and that only IEs capable of self-adapting can sustain SV creation in the long term (Russell and Smorodinskaya, 2018).

Concerning rapidity, from the literature it emerges that economic outputs are reached faster than the ones in the other spheres, since economic outputs are usually more short-term oriented. Conversely, objectives in the social and environmental spheres require wider time windows to be reached (Jelinek *et al.*, 2012; Del Vecchio *et al.*, 2017; Suseno *et al.*, 2018): authors assess the need of simultaneously tackling short- and long-term objectives (Russell and Smorodinskaya, 2018).

The analysis of the literature pinpointed that there are also some debated elements concerning outputs.

The first one is the existence of trade-offs amongst the four spheres (Mantovani and Ruiz-Aliseda, 2018; Russell and Smorodinskaya, 2018; Hong *et al.*, 2019), whose prioritization is not univocal. The four spheres are in trade-off (Mantovani and Ruiz-Aliseda, 2018; Hong *et al.*, 2019; Oskam *et al.*, 2021), for instance, when firms are asked to accept a diminished individual short-term profitability (economic sphere) to increase the quality of the system and social/environmental effects (Mantovani and Ruiz Aliseda, 2018). Conversely, others state that all spheres can coexist and that the objectives can be simultaneously tackled (Russell and Smorodinskaya, 2018; Audretsch *et al.*, 2019). This second strand of contributions assesses that innovation, environmental and social values complement the economic one (Surie, 2017) in creating a sort of hybrid value (Suseno *et al.*, 2018). Hybrid value can simultaneously strengthen innovation performances of single actors and of the system as a whole (Song, 2016).

From articles a possible trade-off between rapidity and resilience emerges: in case an IE wants to foster rapidity and, with it, short-termism, it might neglect resilience, which needs a long-term view and might require giving up some rapidity to construct solid, sustainable and flexible basis of the ecosystem.

4.2 Strategies

IEs are structures of interdependent and independent participants (Jacobides *et al.*, 2018) that leverage on their complementarities (Kukk *et al.*, 2015; Xu *et al.*, 2018) and dynamic capabilities (Liu *et al.*, 2016; Feng *et al.*, 2019; Linde *et al.*, 2021) in a non-contractually defined setting (Jacobides *et al.*, 2018; Thomas and Autio, 2019). Therefore, SV creation in IEs always experiences a coexistence of cooperation and competition, which thus affects strategic choices (Planko *et al.*, 2019). To be successful, cooperation must effectively align actors' goals, to grant equal and proper power distribution and a collective advantage (Mantovani and Ruiz-Aliseda, 2018; Liu *et al.*, 2018). Overall, collaboration can be driven by the focal firm (Bosch-Sijtsema and Bosch, 2014) or be based on group cycling or dyads (Gupta *et al.*, 2019). For instance, according to Bosch-Sijtsema and Bosch (2014), the "*benevolent orchestrator*" is a collaborative ecosystem strategy for internally driven innovation, which protects mainly the

interests of the core firm: in this case, only once the innovation is determined, the orchestrator decides to collaborate with the selected partners of the ecosystem. A less "centrally controlled" collaborative strategy is the "*thousand flowers*" one that consists in the involvement of multiple entities that aim at finding coherent and interesting customer facing solutions. Conversely, firms adopting competitive approaches tend to consider the ecosystem only as an antenna for spotting new trends and developments, *("let them compete")* or accept to selectively cooperate following specific rules, i.e. on patents ("*play inside the box strategy*") (Bosch-Sijtsema and Bosch, 2014).

Concerning alignment, authors agree that a shared purpose of value creation, a coherent ecosystem model shaped around SV proposition, a unique mission and an overarching goal (Walrave *et al.*, 2018; Russell and Smorodinskaya, 2018; Benz and Seebacher, 2018) are relevant for internal alignment. Then, a balance between internal alignment and external viability should be found while shaping strategies at IE level (Kukk *et al.*, 2015; Radziwon *et al.*, 2017; Walrave *et al.*, 2018). This is achieved through, for instance, ambidextrous approaches, establishing dual business units in firms participating to an IE (Zeng *et al.*, 2017) or sustaining multi-directional flows.

The analysis of the literature focused on the strategy dimension identified some differences on how IEs can create SV. First, strategies can present a different balance between cooperation and competition (that occurs when there is more than one actor in each role, Walrave *et al.*, 2018) for supporting internally and externally driven innovations. Such balance is defined considering both the individual competitive advantage of focal firms and the risk of unacceptance (i.e. of defining value propositions and reaching objectives then not accepted by all key stakeholders) as well as of uncertainty around actors' behaviours. Indeed, while single entities prefer avoiding collaborating with competitors, both unacceptance and uncertainty are expected to decrease within collaborative strategies. When such strategies are *ex ante* structured, they can enhance trust and legitimation, decreasing future disputes and misalignments (Hannah, 2018; Kolloch and Dellermann, 2018), and increasing resilience, intensity and rapidity of output generation. The assumption that collaborative strategies can enhance output performances is debated, too: indeed, some contributions highlight that uncertainty increases when numerous and diverse actors are involved in coopetition (Brusoni and Prencipe, 2013).

Further debates emerge in connection to internal and external alignment. First, alignment between priorities of single entities and of the IE can be achieved, on the one hand, by leveraging on "uncontrolled developments" (Jucevičius and Grumadaitė, 2014) of self-regulatory processes (Nambisan and Baron, 2013), or, on the other hand, by looking for an orchestrator, capable of driving developments (Kukk *et al.*, 2015: Linde *et al.*, 2021). A second difference concerns the emphasis given to external alignment. This issue is perceived as urgent when dealing with path breaking innovations linked to the discovery of new niches and possible disruptions of socio-technical systems (Walrave *et al.*, 2018), but less when incremental improvements are tackled. This relates to how the external context is perceived: in path breaking innovations, the socio-technical system is perceived as an external contextual element to be included in the analysis (even as a constraint), while other contributions assume that the external environment (context) is part of the ecosystem itself, as a source of stimuli (Schuh and Woelk, 2017).

4.3 Internal mechanisms

Moving from the first aspect – the level of formality – the analysed papers confirm that IEs adopt both formal and informal mechanisms. Amongst formal ones, there are scorecards and control systems enriched by the inclusion of ad hoc perspectives (as network collaboration, economic, social and environmental; Lopes and Farinha, 2018) key for roadmapping and preempting (Elia *et al.*, 2016; Dattée *et al.*, 2018). They can support a more

transparent and safer collaboration by introducing detailed knowledge and risk sharing mechanisms, rules, platforms (Gawer, 2014; Planko *et al.*, 2019), institution of Technology Transfer Offices (TTOs; Sinell *et al.*, 2018), with a continuous focus on trust, common vision, alignment and equal power distribution.

The second aspect characterizing mechanisms is the level of openness, intended as the extent to which mechanisms favour the sharing of resources (especially data and knowledge) (Benz and Seebacher, 2018). The level of openness should be carefully "designed": it can be supported by the implementation of interconnected and flexible infrastructure (physical and virtual).

The analysis of the adoption of internal mechanisms individuated case-specific differences. The first one links to the type and competitive nature of the resources that flow amongst actors: the more the resources are tangible, the more formal are the mechanisms in place (i.e. monetary and goods exchanges are contractually defined and traced). Mechanisms can evolve from more to less informal (Ritala *et al.*, 2013) throughout the IE lifecycle: when IEs are in their birth phase, both formal and informal mechanisms are key. When the maturity of the IE increases, usually with its dimension and complexity, mechanisms tend to be formalized and managed by dedicated functions at IE level (Annanperä *et al.*, 2015; Su *et al.*, 2018). or by independent actors. Then, the analysed literature highlights the existence of diverse degrees of openness, which appears as particularly relevant when dealing with intangible flows of knowledge or data. In IEs knowledge or data can be fully shared, cumulated (through addition) or just integrated. To achieve this result (integration), IEs rely on interaction and platforms that can be open, based on common interfaces and on innovative transparent communication (Prokopenko *et al.*, 2014; Ferdinand and Meyer, 2017). In other cases, platforms ground on closed interfaces (Mantovani and Ruiz-Aliseda, 2018) to protect ownership and competitive advantage. Infrastructure can be dedicated and developed at IE level for value appropriation (Kwak *et al.*, 2018) or be driven by specific entities, aiming at sharing resources for enhancing systemic value.

4.4 Inputs: characteristics of IE

Actors, structure, relations and governance are aspects that can determine the nature of different IEs. Actors composing an IE can be diverse in type (industry, academia, public institution, society . . .), size, proximity (social, personal and cognitive) and number (Khademi, 2020). Some authors, taking a structural perspective, highlight the role of hubs, components and complementors in creating value (Adner, 2006). Others stress more the diverse nature of actors and their dynamic relations (Carayannis and Campbell, 2009).

Relations amongst actors are dynamic and build the network itself (Usman and Vahnarbeke, 2017); they can be more or less intense, strong, mainly internal to the IE or linked to outer levels (Lin, 2018). These relations enable the flow and bundle of diverse resources, even strategic. To manage these bundle and interactions, IEs are characterized by top-down or bottom-up governance structures, led by orchestrators (Linde *et al.*, 2021) or characterized by power distribution (Russell and Smorodinskaja, 2018). In this connection, some contributions suggest IEs' leaders should structure control mechanisms and asymmetric relations to sustain cooperative innovation performance (Song, 2016). Others recommend leaving IEs to completely self-adapt (Russell and Smorodinskaya, 2018) or introducing pull-based systems (Fukuda, 2019), taken, for instance, in the Japanese 5.0 STI (Science, Technology and Innovation) system [6].

Last, concerning structure, IEs can be glocal (Jelinek, 2012) and very diffused or localized at a smart-city level (Ritala and Almpanopoulou, 2017). It is difficult assessing the size, width and boundaries of an ecosystem (Ritala and Almpanopoulou, 2017), but it is important to properly manage and enhance value creation.

5. Discussing relations of inputs and processes with outputs

After having introduced the building blocks in Section 4, in this section, we discuss some relationships that are starting to emerge from the literature between the outputs (i.e. SV created) on the one hand and the inputs (the characteristics of the IE) or the internal processes (mechanisms and strategies) on the other hand (see Table 3).

5.1 Relations between inputs and outputs

First, the literature review provides some preliminary evidence about how different characteristics of the IE (input) influence SV creation (output).

IEs' *actors* influence SV outputs in diverse ways. A proper selection of collaborators (Witte *et al.*, 2018) is key, first, in favouring the sharing of tacit knowledge (Audretsch *et al.*, 1998), necessary for innovating and growing (Sinell *et al.*, 2018). Second, in supporting a sustainable and intense creation of innovation: actors bring in the ecosystem diverse complementary resources and this enables reaching intense and diversified outputs (Lin, 2018).

Thus, actors' type and number affect prioritization of output spheres, rapidity and resilience. Specifically, when IEs are designed around a focal firm and are populated mainly by companies (commercial entities) as upstream components and downstream complementors (Adner, 2006), there is a large emphasis on objectives related to innovation and creation of economic value (Adner and Kapoor, 2010, 2016; Dedehayir *et al.*, 2017; Suseno *et al.*, 2018). The other spheres usually gain an increased relevance when diverse players (universities, community representatives, public institutions, research institutes and funding agencies) affect the value proposition (Russo-Spena *et al.*, 2017; Xu *et al.*, 2018; Planko *et al.*, 2019), resulting in larger emphasis on social objectives (Del Vecchio *et al.*, 2017; Audretsch *et al.*, 2019). Thus, the social sphere gains importance in IEs populated by numerous actors of diverse nature, including NGOs and governmental institutions (Lund-Thomsen and Nadvi, 2010).

Differences in actors and their organization/management impact performances of IEs (Baloutsos *et al.*, 2020). Actors can affect output rapidity and resilience: when diverse actors are involved, rapidity is mined, as the diversity of needs, objectives, values to be

Table 3.
Relations between outputs and the other building blocks

Building block	Elements	Connection with output
INPUT (IE characteristics)	*Actors*	Type and number impact *rapidity and resilience* and drive *prioritization*
	Structure	*Prioritization of spheres* is related to geographical width and sectors
	Relations	Strong flows and the presence of relations both inside and with the outside of IEs improve *rapidity*
	Governance	Type of structure affects *performances* Type of structure and power balance affect *prioritization*
STRATEGY	*Coopetition*	Coopetition requires time, but, if effective, it improves *resilience and intensity*
	Alignment (internal)	Internal alignment supports *rapidity and resilience* in reaching outputs, as well as a *clear prioritization of spheres*
	External viability	External viability supports *intensity* of outputs reached
MECHANISMS	*Formalization*	Formal mechanisms require time to be put in place and this may hinder initial *rapidity*. However, they then support *intensity* and *resilience*. Informal mechanisms are key for *resilience*
	Openness	Openness enhances *intensity* and *resilience,* if well structured. If well managed, it supports reaching *diverse spheres*

simultaneously managed and aligned increases (Walrave *et al.*, 2018), thus slowing down the process of value creation. Once all these diverse actors are properly involved, the system is considered more resilient (Russell and Smorodinskaya, 2018), thanks to the IEs' "*social groups and economic activities that coexist within them*" (Alberti, 2016, p. 11).

The second characteristic relates to the *structure,* which may affect outputs in terms of prioritization and performances. For instance, localized IEs – as living labs or Science Parks (Del Vecchio *et al.*, 2017; Fulgencio, 2017) – can strengthen relationships with communities, which typically lead to the recognition of environmental and social inclusion as key outputs (Valkokari *et al.*, 2017; Fulgencio *et al.*, 2017; Camboim *et al.*, 2019). Moreover, in line with literature on agglomerations and proximity (Boschma, 2005), the exploitation of synergies is considered easier in local systems (Capello, 2009). Conversely, less localized IEs tend to be characterized by weaker and less controllable trust and ties, resulting in less effective settings. However, there is not full consensus on the effects of localization: some authors argue that spatial proximity is not enough for granting proper collaborations (Boschma, 2005; Capello, 2009) for value creation and that it can even hinder them (Ben Letaifa and Rabeau, 2013; Witte *et al.*, 2018). This happens when competitors acting closely in ecosystems might not be prone to collaborate for SV creation. A too high spatial proximity may bring risks of lock-ins or opportunism (Boschma, 2005), which lead towards delays and less intense outputs. Big and global IEs (as virtual laboratories of the future; Jelinek, 2012), with low spatial proximity, are expected to impact many levels even outside the IE itself (Fulgencio, 2017), as they act as multipliers of relations, thus potentially expanding effects and reaching challenging targets.

IEs' sectors and localization affect *output spheres and prioritization*, too: for instance, environmental impacts are core when the IE acts in energy-related industries (as the IE for renewable energy in India; Surie, 2017, or the one for circular economy in Scotland, Whicher *et al.*, 2018), catch-up countries (Huang *et al.*, 2019) or place-based IEs with a strong participation of Corporate Social Responsibility (CSR)-oriented firms (Lund-Thomsen and Nadvi, 2010).

Concerning the third IE characteristic, diversity in *relations* determines heterogeneity in outputs, which are reached faster when relations are strong, persistent and multi-directional, as more resources can be bundled, networks built and entities impacted. The presence of intense and stable relations sustains the creation of synergies that enrich the bundle of available resources (Adner and Kapoor, 2010), enhances acceptance (Kolloch and Dellermann, 2018) and, therefore, positively affects resilience of outputs reached. The existence of connections with the outside impacts on the intensity, too, as the more the connections firms have, the more the innovation created (Lin, 2018). This happens for instance, in the Boston Uijma IE defined as a "community-controlled open innovation ecosystem", which, thanks to the connections with the outer levels, integrates internal and external knowledge, opening paths for sustainable innovations (Bevilacqua and Ou, 2018).

Last, *governance* affects definition and prioritization of objectives and impacts on rapidity and resilience. Governance structures applying top-down control mechanisms can support reaching outputs more rapidly, but they present possible disadvantages in terms of resilience, as the case study analysis of Witte *et al.* (2018) shows: they study two different start-up IEs in port cities (Rotterdam and Montréal) and show that top-down governance brings the risk of losing acceptance and engagement. However, top-down structures can timely react to changes, since decision-making processes are usually well defined and more rapid than the ones in decentralized systems. The presence of leading bodies and orchestrators decreases possible risks linked to uncontrolled collaborations and enhances rapidity, as these leaders are key in structuring the process through which objectives are identified and aligned with IE goals (Cunningham *et al.*, 2015; Dattée *et al.*, 2018). However, they risk being detached from the everyday life of IEs, thus displaying a poor capacity of adapting to changes (Russell and

Smorodinskaya, 2018), which is actually more natural in bottom-up governed IEs. In bottom-up governed and, even more, in self-adapting IEs with no leading actors (as the health and life science ecosystem in San Diego; Majava *et al.*, 2016), there is no "imposed" prioritization of objectives, which may mine rapidity; in this sense, IEs can evolve with no pre-defined direction, being driven by changes in power balance of actors and contingencies, thus presenting resilience. In this situation, objectives may be reached more slowly but maintained more resiliently (Russell and Smorodinskaya, 2018).

5.2 Relations between internal processes and outputs

The SV creation (output) depends not only on the characteristics of the IEs but also on the processual elements that are put in place: strategies and mechanisms.

Concerning *strategies,* first, it emerges that collaboration, if efficient and effective, improves resilience and intensity and helps in considering and reaching simultaneously outputs pertaining to diverse spheres. However, the more the collaborating actors, the higher the initial negotiation efforts, and the adoption of opportunistic behaviours due to potential power imbalances. They decrease, respectively, rapidity of output generation and resilience.

Second, internal alignment is more structured and efficient when leading bodies at IE level involve managers of the key entities (Dedehayir and Seppänen, 2015). Indeed, their participation provides legitimation and guidelines based on experience and knowledge of the available resources. Such level of involvement and alignment (shared vision and goals) may take time, but, when in place, it supports rapidity and resilience, as well as a proper prioritization of output spheres. External viability relates to output performances, too: intensity benefits from a high number of "connection points" and feedback loops (Walrave *et al.*, 2018), from bundling resources and enhancing acceptance and agreements.

Also, *internal mechanisms* affect the outputs reached. First, a too high level of formality might slow down the innovation processes, thus affecting rapidity. Then, less formalized mechanisms, usually sustained by independent bottom-up structures of symbiotic relations (Still *et al.*, 2014), can support resilience in IEs, in terms of sustainable creation of value at ecosystem level.

Concerning openness of internal mechanisms, it depends on the strategic nature of the resources flowing: strategic resources are preferably bundled through semi-controlled flows, permitting integration but not full sharing, to preserve competitive advantage. Even if complex and not always feasible, openness and sharing are key to enhance the intensity of outputs reached, as bundling resources can support value creation through open innovation (Chesbrough *et al.*, 2006). Given the fact that diverse resources and capabilities are shared, multiple outputs can be reached, even simultaneously. Partnerships composed by actors with balanced power distribution enable bundling such synergic resources (Annanperä *et al.*, 2015), thus supporting mutual processes of value co-creation and sharing (Russo-Spena *et al.*, 2017), which are sometimes difficult to be set. The implementation of open platforms at IE level supports sharing, too and are facilitated by the formulation of dedicated policies.

6. Conclusion

The present study embraced a process-based logic to identify and relate dimensions of analysis key to shed light on SV creation in IEs.

Relevant articles published in the last 15 years on IEs and value creation have been structurally analysed keeping the above-mentioned process-based logic. This supported the individuation of building blocks in terms of inputs (characteristics of IEs), internal mechanisms, strategies, outputs, as well as their sub-dimensions. These aspects have been explored considering the contributions of prior literature, embracing a developmental approach: the analysis outlined not only points on which the literature agrees upon but also controversies. Debated issues concerning outputs, strategies, mechanisms emerge, as well as elements of heterogeneity pertaining the inputs (IE characteristics).

Elaborating on these results, the discussion uncovered relations between outputs, on the one hand, inputs, strategies and mechanisms, on the other hand. This reasoning helps to identify key open issues to be tackled, as (1) the effect of heterogeneity and complexity of IE on collaboration and alignment, (2) the role of proximity in determining SV output, and (3) governance structures and output performances.

The major theoretical contribution of this work is the conceptualization of SV creation in IEs, which required a complex task of systematizing a quite fuzzy literature on IEs (Suominen *et al.*, 2019; Baloutsos *et al.*, 2020), where SV creation was not studied but often taken for granted. A new conceptualization of SV creation in IEs is here provided – based on previous literature contributions – and explored. Being able to identify and relate building blocks helps better delineating the object of analysis and understanding SV modalities, providing a starting point for further empirical and theoretical analysis in diverse contexts.

Concerning practical implications, policymakers can get insights on their role and choices (i.e. in terms of prioritization of objectives, incentives for cooperation and regulations for internal mechanisms) to enhance SV at IE level. Managers are provided with a panel of main dimensions of analysis and elements to be considered while framing strategies aligned with the IE they belong to.

Some limitations are acknowledged. First, the complexity of the issue required simplifications, which have implications: the conceptual model organized in building blocks might seem linear or suggest a deterministic view of SV creation, which is characterized by loops and interdependences. The proposed model and building blocks are useful to structure the analysis, as they enable capturing the main constituents of the SV creation process as well as interdependences emerging amongst them. Indeed, the building blocks are not simple, closed and detached elements, but inherently complex dimensions (and sub-dimensions) that have identifiable interlinkages. Indeed, as shown in the analysis, exploring the building blocks enables understanding also which relations arise amongst dimensions and sub-dimensions (i.e. how inputs affect outputs, how strategies and mechanisms can impact outputs, how diverse choices under these dimensions can impact SV creation . . .). This also supports the individuation and analysis of feedback loops. Despite its usefulness, the introduced conceptual model should be adopted always acknowledging that it represents a simplification of a concept/a reality.

Moreover, although our approach was structured, subjectivity could have been introduced in paper selection (especially as it was not conducted independently by the multiple authors): this issue, however, is not central in developmental reviews, which focus more on the identification of a new conceptualization than on the systematic nature of search for studies. It is important also to acknowledge that filters have been applied during the search for studies, for instance excluding articles not in English: this was done to avoid misinterpretations due to translations, but it should be pointed out that a few papers have been excluded.

A last limitation relates to the lack of an empirical exploration. The identified dimensions have not been illustrated nor explored empirically: this could be very beneficial for validating, modifying, integrating the model and thus we suggest it to be the starting point for future research, aimed at providing an empirical analysis of SV creation in diverse IEs based on the conceptualized dimensions. Longitudinal studies might be of interest, as well, to understand how elements evolve throughout the IE lifecycle, affecting SV processes.

Notes

1. Introduced by Porter and Kramer (2006) and then refined in 2011, shared value is created thanks to "policies and operating practices that enhance the competitiveness of a company while simultaneously advancing the economic and social conditions in the communities in which it operates" (Porter and Kramer, 2011, p. 66). It assumes (1) markets are defined by societal needs and (2) social harms increase internal costs for firms.

2. These are the four core elements (PICO) required by The Cochrane Collaboration (2017) for scientific systematic reviews: People (the key subject), Interests (aspect included in the analysis), Complementarities (what is not included) and Outcome. They are here adapted to a social science field.
3. Year 2006 was chosen as starting point, since it is the moment when, for the first time, both the terms IEs and SV were uniquely adopted in the literature (Adner, 2006; Porter and Kramer, 2006).
4. These research fields are directly provided in Scopus and include, amongst others, publications on innovation and entrepreneurship.
5. These sub-dimensions do not want to be exhaustive and are intended to be macro areas where diverse strategies (and strategic processes) can insert, in a continuum of possible choices.
6. This pull approach moves away from a system where solutions to problems are addressed by internal actors following an explicit demand towards one which explicitly aims to *ex ante* "facilitate value creation for Society" (Fukuda, 2019, p. 13).

References

Adner, R. and Kapoor, R. (2010), "Value creation in innovation ecosystems: how the structure of technological interdependence affects firm performance in new Technology generations", *Strategic Management Journal*, Vol. 31, pp. 306-333, doi: 10.1002/smj.821.

Adner, R. and Kapoor, R. (2016), "Innovation ecosystems and the pace of substitution: re-examining technology S-curves", *Strategic Management Journal*, Vol. 37, pp. 625-648, doi: 10.1002/smj.2363.

Adner, R. (2006), "Match your innovation strategy to your innovation ecosystem", *Harvard Business Review*, Vol. 84 No. 4, pp. 98-107.

Al Mamun, A. (2018), "Diffusion of Innovation among Malaysian manufacturing SMEs", *European Journal of Innovation Management*, Vol. 21 No. 1, pp. 113-141, doi: 10.1108/EJIM-02-2017-0017.

Alberti, F.G. and Belfanti, F. (2019), "Creating shared value and clusters. The case of an Italian cluster initiative in food waste prevention", *Competitiveness Review An International Business Journal Incorporating Journal of Global Competitiveness*, Vol. 29 No. 2, doi: 10.1108/CR-01-2017-0008.

Alberti, M. (2016), *Cities that Think like Planets: Complexity, Resilience, and Innovation in Hybrid Ecosystems*, University of Washington Press, Seattle, London.

Annanperä, E., Liukkonen, K. and Markkula, J. (2015), "Innovation in evolving business ecosystem: a case study of information technology-based future health and exercise service", *International Journal of Innovation and Technology Management*, Vol. 12 No. 4, pp. 1-19, doi: 10.1142/S0219877015500157.

Audretsch, D.B., Cunningham, J.A., Kuratko, D.F., Lehmann, E.E. and Menter, M. (2019), "Entrepreneurial ecosystems: economic, technological, and societal impacts", *The Journal of Technology Transfer*, Vol. 44, pp. 313-321, doi: 10.1007/s10961-018-9690-4.

Audretsch, D.B. (1998), "Agglomeration and the Location of innovative activity", *Oxford Review of Economic Policy*, Vol. 14 No. 2, Oxford University Press and The Oxford Review of Economic Policy Limited.

Baloutsos, S., Karaggiannaki, A. and Pramatari, K. (2020), "Identifying contradictions in an incumbent–startup ecosystem–an activity theory approach", *European Journal of Innovation Management*, Vol. ahead-of-print No. ahead-of-print, in press, doi: 10.1108/EJIM-04-2020-0114.

Bassis, N.F. and Armellini, F. (2018), "Systems of innovation and innovation ecosystems: a literature review in search of complementarities", *Journal of Evolutionary Economics*, Vol. 28, pp. 1053-1080, doi: 10.1007/s00191-018-0600-6.

Ben Letaifa, S. and Rabeau, Y. (2013), "Too close to collaborate? How geographical proximity could impede entrepreneurship and innovation", *Journal of Business Research*, Vol. 66, pp. 2071-2078.

Benz, C. and Seebacher, S. (2018), "Open innovation in ecosystems – a service science perspective on open innovation", in Satzger, G., Patrício, L., Zaki, M., Kühl, N. and Hottum, P. (Eds), *Exploring Service Science. IESS 2018. Lecture Notes in Business Information Processing*, Springer, Cham, Vol. 331. doi: 10.1007/978-3-030-00713-3_9.

Bevilacqua, C. and Ou, Y. (2018), "Place, relationships, and community-controlled capital: on ecosystem-based innovation towards an equitable competitive advantages distribution: the Boston Ujima project case", *International Journal of Sustainable Development and Planning*, Vol. 13 No. 8, pp. 1072-1089, doi: 10.2495/SDP-V13-N8-1072-1089.

Boschma, R. (2005), "Proximity and innovation: a critical assessment", *Regional Studies*, Vol. 39 No. 1, pp. 61-74, doi: 10.1080/0034340052000320887.

Bosch-Sijtsema, P.M. and Bosch, J. (2014), "Aligning innovation ecosystem strategies with internal R&D", *Proceedings IEEE 2014 ICMIT, 7th International Conference on Management of Innovation and Technology*, Singapore, September, pp. 424-430.

Brusoni, S. and Prencipe, A. (2013), "The organization of innovation in ecosystems: problem framing, problem solving and patterns of coupling", *Advances in Strategic Management*, Vol. 30, pp. 167-194.

Camboim, G.F., Zawislak, P.A. and Pufal, N.A. (2019), "Driving elements to make cities smarter: evidences from European projects", *Technological Forecasting and Social Change*, Vol. 142 No. C, pp. 154-167, doi: 10.1016/j.techfore.2018.09.014.

Capello, R. (2009), "Indivisibilities, Synergy and Proximity: the need for an integrated approach to agglomeration economies", *Tijdschrift voor Economische en Sociale Geografie*, Vol. 100 No. 2, pp. 145-159, © 2009 by the Royal Dutch Geographical Society KNAG Published by Blackwell Publishing Ltd., 9600 Garsington Road, Oxford OX4 2DQ, UK and 350 Main Street, Malden, MA 02148, USA.

Carayannis, E. and Campbell, D. (2009), "'Mode 3' and 'Quadruple Helix': toward a 21s century fractal innovation ecosystem", *International Journal of Technology Management*, Vol. 46 Nos 3/4, pp. 201-234.

Chaudhuri, A. (2012), "Creeping tiger, soaring dragon: India, China and competition in information technologies", *China and World Economy*, Vol. 20 No. 6, pp. 1-28, doi: 10.1111/j.1749-124X.2012.12000.x.

Chesbrough, H., Vanhaverbeke, V. and West, J. (2006), *Open Innovation: Researching a New Paradigm*, Oxford University Press, Oxford, GBR. ProQuest ebrary.

Cunningham, P., Cunningham, M. and Ekenberg, L. (2015), "Assessment of potential ICT-related collaboration and innovation capacity in East Africa", *IEEE (2015), Global Humanitarian Technology Conference*, Seattle WA, USA, doi: 10.1109/GHTC.2015.7343961.

Dattée, B., Alexy, O. and Autio, E. (2018), "Maneuvering in poor visibility: how firms play the ecosystem game when uncertainty is high", *Academy of Management Journal*, Vol. 61 No. 2, pp. 466-498, doi: 10.5465/amj.2015.0869.

D'Auria, A., Tregua, M., Russo Spena, T. and Bifulco, F. (2016), "Exploring innovation contexts: system, network and ecosystem innovation", *International Journal of Management and Enterprise Development*, Vol. 15 Nos 2-3, pp. 127-146, doi: 10.1504/IJMED.2016.078206.

De Silva, M., Howells, J. and Meyer, M. (2018), "Innovation intermediaries and collaboration: knowledge–based practices and internal value creation", *Research Policy*, Vol. 47, pp. 70-87, doi: 10.1016/j.respol.2017.09.011.

Dedehayir, O. and Seppänen, M. (2015), "Birth and expansion of innovation ecosystem: a case study of copper production", *Journal of Technology Management Innovation*, Vol. 10 No. 2, pp. 145-154, doi: 10.4067/S0718-27242015000200010.

Dedehayir, O., Ortt, R. and Seppänen, M. (2017), "Disruptive change and the reconfiguration of innovation ecosystems", *Journal of Technology Management Innovation*, Vol. 12 No. 3, pp. 9-31, doi: 10.4067/S0718-27242017000300002.

Del Vecchio, P., Elia, G., Ndou, V., Secundo, G. and Specchia, F. (2017), "Living lab as an approach to activate dynamic innovation ecosystems and networks: an empirical study", *International Journal of Innovation and Technology Management*, Vol. 14 No. 5, pp. 1-17, doi: 10.1142/S0219877017500249.

Desrochers, P. (2001), "Geographical Proximity and the transmission of tacit knowledge", *The Review of Australian Economics*, Vol. 14 No. 1, pp. 25-46.

Ding, L. and Wu, J. (2018), "Innovation ecosystem of CNG vehicles: a case study of its cultivation and characteristics in Sichuan, China", *Sustainability*, Vol. 10 No. 39, pp. 1-16, doi: 10.3390/su10010039.

Elia, G., Margherita, A. and Petti, C. (2016), "An operational model to develop Technology entrepreneurship 'EGO-system'", *International Journal of Innovation and Technology Management*, Vol. 13 No. 5, pp. 1-23.

Elkington, J. (1997), *Cannibals with Forks: the Triple Bottom Line of 21st Century Business*, Capstone, Oxford.

Etzkowitz, H. and Leydesdorff, L. (2000), "The dynamics of innovation: from national systems and 'Mode 2' to a Triple Helix of university-industry-government relations", *Research Policy*, Vol. 9 No. 2, pp. 109-123.

Feng, Y., Wu, J. and He, P. (2019), "Global M&A and the development of the IC industry ecosystem in China: what can we learn from the case of Tsinghua unigroup?", *Sustainability*, Vol. 11 No. 1, p. 106, doi: 10.3390/su11010106.

Ferdinand, J.-P. and Meyer, U. (2017), "The social dynamics of heterogeneous innovation ecosystems: effects of openness on community–firm relations", *International Journal of Engineering Business Management*, Vol. 9, pp. 1-16, doi: 10.1177/1847979017721617.

Fukuda, Y. (2019), "Science, Technology and innovation ecosystem transformation toward society 5.0", *International Journal of Production Economics*, Vol. 220, doi: 10.1016/j.ijpe.2019.07.033.

Fulgencio, H. (2017), "Social value of an innovation ecosystem: the case of Leiden bioscience park, The Netherlands", *International Journal of Innovation Science*, Vol. 4, pp. 355-373, doi: 10.1108/IJIS-09-2017-0098.

Gawer, A. (2014), "Bridging differing perspectives on technological platforms: toward an integrative framework", *Research Policy*, Vol. 43 No. 7, pp. 1239-1349, doi: 10.1016/j.respol.2014.03.006.

Gomes, L., Facin, A., Salerno, M. and Ikenami, R. (2018), "Unpacking the innovation ecosystem construct: evolutions, gaps and trends", *Technological Forecasting and Social Change*, Vol. 136, pp. 30-48, doi: 10.1016/j.techfore.2016.11.009.

Granstrand, O. and Holgersson, M. (2020), "Innovation ecosystems: a conceptual review and a new definition", *Technovation*, Vol. 90-91, pp. 1-12.

Guerrero, M., Urbano, D., Fayolle, A., Klofsten, M. and Mian, S. (2016), "Entrepreneurial universities: emerging models in the new social and economic landscape", *Small Business Economy*, Vol. 47, pp. 551-563, doi: 10.1007/s11187-016-9755-4.

Gupta, R., Mejia, C. and Kajikawa, Y. (2019), "Business, innovation and digital ecosystems landscape survey and knowledge cross-sharing", *Technological Forecasting and Social Change*, Vol. 147, pp. 100-109, doi: 10.1016/j.techfore.2019.07.004.

Hannah, D.P. (2018), "Collaborative strategy and value capture in innovation ecosystems", in *78th Annual Meeting of the Academy of Management*, AOM, doi: 10.5465/AMBPP.2018.196.

Hong, J., Zhu, R., Hou, B. and Wang, H. (2019), "Academia industry collaboration and regional innovation convergence in China", *Knowledge Management Research and Practice*, Vol. 17 No. 4, pp. 396-407, doi: 10.1080/14778238.2019.1589394.

Huang, H., Cheng, J., Yu, F. and Zhu, Z. (2019), "Establishing the enterprises' innovation ecosystem based on dynamics core competence—the case of China's high-speed railway", *Emerging Market Finance and Trade*, Vol. 55 No. 4, pp. 843-862, doi: 10.1080/1540496X.2018.1518216.

Jacobides, M.G., Cennamo, C. and Gawer, A. (2018), "Towards a theory of ecosystems", *Strategic Management Journal*, Vol. 39, pp. 2255-2276, doi: 10.1002/smj.2904.

Jelinek, M., Bean, A.S., Antcliff, R., Wahlen-Pedersen, E. and Cantwell, A. (2012), "21st-Century R&D", *Research-Technology Management*, Vol. 50 No. 1, pp. 16-26.

Jucevičius, G. and Grumadaitė, J. (2014), "Smart development of innovation ecosystems", *Procedia - Social and Behavioral Sciences*, Vol. 156, pp. 125-129, doi: 10.1016/j.sbspro.2014.11.133.

Khademi, B. (2020), "Ecosystem value creation and capture: a systematic review of literature and potential research opportunities", *Technology Innovation Management Review*, Vol. 10 No. 1, pp. 16-34.

Knockaert, M., Deschryvere, M. and Lecluyse, L. (2019), "The relationship between organizational interdependence and additionality obtained from innovation ecosystem participation", *Science and Public Policy*, Vol. 46 No. 4, pp. 490-503, doi: 10.1093/scipol/scz002.

Kolloch, M. and Dellermann, D. (2018), "Digital innovation in the energy industry: the impact of controversies on the evolution of innovation ecosystems", *Technological Forecasting and Social Change*, Vol. 136, pp. 254-264, doi: 10.1016/j.techfore.2017.03.033.

Kukk, P., Moors, E.H.M. and Hekkert, M.P. (2015), "The complexities in system building strategies - the case of personalized cancer medicine in England", *Technological Forecasting and Social Change*, Vol. 98, pp. 47-59, doi: 10.1016/j.techfore.2015.05.019.

Kwak, K., Kim, W. and Park, K. (2018), "Complementary multiplatforms in the growing innovation ecosystem: evidence from 3D printing Technology", *Technological Forecasting and Social Change*, Vol. 136, pp. 192-207, doi: 10.1016/j.techfore.2017.06.022.

Lin, S. (2018), "The structural characteristics of innovation ecosystem: a fashion case", *European Journal of Innovation Management*, Vol. 21 No. 4, pp. 620-635, doi: 10.1108/EJIM-09-2017-0115.

Liu, X., Hu, Y. and Chen, J. (2016), "Establishing a CoPs-based innovation ecosystem to enhance competence – the case of CGN in China", *International Journal of Technology Management*, Vol. 72 Nos 1/2/3, pp. 144-170.

Linde, L., Sjödin, D., Parida, V. and Wincent, J. (2021), "Dynamic capabilities for ecosystem orchestration A capability-based framework for smart city innovation initiatives", *Technological Forecasting and Social Change*, Vol. 166, pp. 1-12.

Liu, X., Dong, C., Gao, Y. and Wang, D. (2018), "Effects of the Relative Power Imbalance in the Ecosystem of Innovation". *TEMS-ISIE 2018 - 1st Annual International Symposium on Innovation and Entrepreneurship of the IEEE Technology and Engineering Management Society*.

Liu, Z. and Stephens, V. (2019), "Exploring innovation ecosystems from the perspective of sustainability: towards a conceptual framework", *Journal of Open Innovation Technology, Market and Complexity*, Vol. 5 No. 48, doi: 10.3390/joitmc5030048.

Lopes, J.N.M. and Farinha, L. (2018), "Measuring the performance of innovation and entrepreneurship network", *Journal of the Knowledge Economy*, Vol. 9 No. 2, pp. 402-423, doi: 10.1007/s13132-017-0487-8.

Lund-Thomsen, P. and Nadvi, K. (2010), "Clusters, chains and compliance: corporate social responsibility and compliance in football manufacturing in South Asia", *Journal of Business Ethics*, Vol. 93 No. 2, pp. 201-222, doi: 10.1007/s10551-010-0561-7.

Majava, J., Leviäkangas, P., Kinnunen, T., Kess, P. and Foit, D. (2016), "Spatial health and life sciences business ecosystem: a case study of San Diego", *European Journal of Innovation Management*, Vol. 19 No. 1, pp. 26-46, doi: 10.1108/EJIM-01-2015-0003.

Mantovani, A. and Ruiz-Aliseda, F. (2018), "Equilibrium innovation ecosystems: the dark side of collaborating with complementors", *Management Science*, Vol. 62 No. 2, pp. 534-549, doi: 10.1287/mnsc.2014.2140.

Moore, J.F. (1993), "Predators and prey: a new ecology of competition", *Harvard Business Review*, Vol. 71 No. 3, pp. 75-86.

Nalebuff, B.J. and Brandenburger, A.M. (1997), "Co-opetition: competitive and cooperative business strategies for the digital economy", *Strategy and Leadership*, Vol. 25 No. 6, pp. 28-33, doi: 10.1108/eb054655.

Nambisan, S. and Baron, S. (2013), "Entrepreneurship in innovation ecosystems: entrepreneurs' self-regulatory processes and their implications for new venture success", *Entrepreneurship Theory and Practice*, Vol. 37 No. 5, pp. 1071-1097, doi: 10.1111/j.1540-6520.2012.00519.x.

Oskam, I., Bossink, B. and de Man, A.P. (2021), "Valuing-value in innovation ecosystems: how cross-sector actors overcome tensions in collaborative sustainable business model development", *Business and Society*, Vol. 60 No. 5, pp. 1056-1091.

Paterson, B., Thorne, S., Canam, C. and Jillings, C. (2001), *Meta-Study of Qualitative Health Research: A Practical Guide to Meta-Analysis and Meta-Synthesis*, Sage, Thousand Oaks, CA.

Petticrew, M. and Roberts, H. (2006), *Systematic Reviews in the Social Sciences: A Practical Guide*, 1st ed., Blackwell Publishing, MAUSA.

Planko, J., Chappin, M.M.H., Cramer, J. and Hekkert, M.P. (2019), "Coping with coopetition—facing dilemmas in cooperation for sustainable development: the case of the Dutch smart grid industry", *Business Strategy and the Environment*, Vol. 28, pp. 665-674, doi: 10.1002/bse.2271.

Porter, M.E. and Kramer, M. (2006), "Strategy and society: the link between competitive advantage and corporate social responsibility", *Harvard Business Review*, Vol. 84, pp. 78-92.

Porter, M.E. and Kramer, M. (2011), "The big idea: creating shared value: how to reinvent capitalism – and unleash a wave of innovation and growth", *Harvard Business Review*, Vol. 89, pp. 62-77.

Prokopenko, O., Eremenko, Y. and Omelyanenko, V. (2014), "Role of international factor in innovation ecosystem formation", *World Economy and International Economic Relations*, Vols 3-4 No. 2, pp. 4-7.

Radziwon, A., Bogers, M. and Bilberg, A. (2017), "Creating and capturing value in a regional innovation ecosystem: a study of how manufacturing SMEs develop collaborative solutions", *International Journal of Technology Management*, Vol. 75 Nos 1/4, pp. 73-96, doi: 10.1504/IJTM.2017.085694.

Reypens, C., Lievens, A. and Blazevic, V. (2016), "Leveraging value in multi-stakeholder innovation networks: a process framework for value co-creation and capture", *Industrial Marketing Management*, Vol. 56, pp. 40-50.

Ritala, P. and Almanopoulou, A. (2017), "In defense of "eco" in innovation ecosystem", *Technovation*, Vols 60-61, pp. 39-42, doi: 10.1016/j.technovation.2017.01.004.

Ritala, P., Agouridas, V., Assimakoupoulos, D. and Gies, O. (2013), "Value creation and capture mechanisms in innovation ecosystems: a comparative case study", *International Journal of Technology Management*, Vol. 63 Nos 3/4, pp. 244-267, doi: 10.1504/IJTM.2013.056900.

Russell, M.G. and Smorodinskaya, N.V. (2018), "Leveraging complexity for ecosystemic innovation", *Technological Forecasting and Social Change*, Vol. 136, pp. 114-131.

Russo-Spena, T., Tregua, M. and Bifulco, F. (2017), "Searching through the jungle of innovation conceptualisations: system, network and ecosystem perspectives", *Journal of Service Theory and Practice*, Vol. 27 No. 5, pp. 997-1005.

Schuelke-Leech, B.A. (2018), "A model for understanding the orders of magnitude of disruptive technologies", *Technological Forecasting and Social Change*, Vol. 129, pp. 261-274.

Schuh, G. and Woelk, S. (2017), "Design framework of an ecosystem for network based innovation", s.l, in *Proceedings of PICMET '17: Technology Management for Interconnected World*. doi: 10.23919/PICMET.2017.8125260.

Shrotriya, S., Dhir, S. and Sushil (2018), "Innovation driven ecosystem for quality skill development in India", *Benchmarking: An International Journal*, Vol. 25 No. 8, pp. 2997-3020, doi: 10.1108/BIJ-11-2017-0320.

Sinell, A., Iffländer, V. and Muschner, A. (2018), "Uncovering transfer – a cross-national comparative analysis", *European Journal of Innovation Management*, Vol. 21 No. 1, pp. 70-95, doi: 10.1108/EJIM-01-2017-0006.

Siqueira, A.C.O., Monzoni, M.P., Mariano, S.H.R., Moraes, J., Branco, P.D. and Coelho, A.M. (2014), "Innovation ecosystems in Brazil: promoting social entrepreneurship and sustainability", in Pate, C.W.L. (Ed.), *Emerging Research Directions in Social Entrepreneurship. s.l.*, Springer Science Business Media, Dordrecht, pp. 124-142.

Song, J. (2016), "Innovation ecosystem: impact of interactive patterns, member location and member heterogeneity on cooperative innovation performance", *Innovation Management, Policy and Practices*, Vol. 18 No. 1, pp. 13-29, doi: 10.1080/14479338.2016.1165624.

Still, K., Huhtamäki, J., Russell, M. and Rubens, N. (2014), "Insights for orchestrating innovation ecosystems: the case of EIT ICT labs and data-driven network", *International Journal of Technology Management*, Vol. 66 Nos 2/3, pp. 243-265, doi: 10.1504/IJTM.2014.064606.

Su, Y.S., Zheng, Z.X. and Chen, J. (2018), "A multi-platform collaboration innovation ecosystem: the case of China", *Management Decision*, Vol. 5 No. 1, pp. 125-142, doi: 10.1108/MD-04-2017-0386.

Suominen, A., Seppänen, M. and Dedehayir, O. (2019), "A bibliometric review on innovation systems and ecosystems: a research agenda", *European Journal of Innovation Management*, Vol. 22 No. 2, pp. 335-360, doi: 10.1108/EJIM-12-2017-0188.

Surie, G. (2017), "Creating the innovation ecosystem for renewable energy via social entrepreneurship: insights from India", *Technological Forecasting and Social Change*, Vol. 121, pp. 184-195, doi: 10.1016/j.techfore.2017.03.006.

Suseno, Y., Laurell, C. and Sick, N. (2018), "Assessing value creation in digital innovation ecosystems: a Social Media Analytics approach", *Journal of Strategic Information Systems*, Vol. 27, pp. 335-349, available at: http://hdl.handle.net/10453/130130.

Talmar, M., Walrave, B., Podoynitsyna, K.S., Holmström, J. and Romme, A.G.L. (2018), "Mapping, analyzing and designing innovation ecosystems: the ecosystem pie model", *Long Range Planning*, In press, doi: 10.1016/j.lrp.2018.09.002.

Templier, M. and Paré, G. (2015), "A framework for guiding and evaluating literature reviews", *Communications of the Association for Information Systems*, Vol. 37 No. 6, pp. 112-137, doi: 10.17705/1CAIS.03706.

The Cochrane Collaboration (2017), Published by John Wiley & Sons.

Thomas, L.D.V. and Autio, E. (2019), "Innovation ecosystems", in Aldag, R. (Ed.), *Oxford Research Encyclopedia of Business and Management*, Oxford University Press.

Tsujimoto, M., Kajikawa, Y., Tomita, J. and Matsumoto, Y. (2018), "A review of the ecosystem concept — towards coherent ecosystem design", *Technological Forecasting and Social Change*, Vol. 136, pp. 49-58, doi: 10.1016/j.techfore.2017.06.032.

Usman, M. and Vahnaverbeke, W. (2017), "How start-ups successfully organize and manage open innovation with large companies", *European Journal of Innovation Management*, Vol. 20 No. 1, pp. 171-186, doi: 10.1108/EJIM-07-2016-0066.

Valkokari, K., Seppänen, M., Maentylae, M. and Jylhae-Ollila, S. (2017), "Orchestrating innovation ecosystems: a qualitative analysis of ecosystem positioning strategies", *Technology Innovation Management Review*, Vol. 7 No. 3, pp. 12-24.

Von Hippel, E. (2007), "Horizontal innovation networks – by and for users", *Industrial and Corporate Change*, Vol. 16 No. 2, pp. 293-315, doi: 10.1093/icc/dtm005.

Walrave, B., Talmar, M., Podoynitsyna, K.S., Georges, A., Romme, L. and Verbong, G.P.J. (2018), "A multi-level perspective on innovation ecosystems for path-breaking innovation", *Technological Forecasting and Social Change*, Vol. 136, pp. 103-113, doi: 10.1016/j.techfore.2017.04.011.

Wegmann, A., Ritala, P., Tapandjieva, G. and Golnam, A. (2018), "Coopetition and ecosystems: the case of Amazon.com", in Fernandez, A.-S., Chiambaretto, P. and Czakon, W. (Eds), *The Routledge Companion to Coopetition Strategies*, 7 September, Routledge, Abingdon.

Whicher, A., Harris, C., Beverley, K. and Swiatek, P. (2018), "Design for circular economy: developing an action plan for Scotland", *Journal of Cleaner Production*, Vol. 172, pp. 3237-3248.

Witte, P., Slack, B., Keesman, M., Jugie, J.-H. and Wiegmans, B. (2018), "Facilitating start-ups in port-city innovation ecosystems: a case study of Montréal and Rotterdam", *Journal of Transportation Geography*, Vol. 71, pp. 224-234.

Xu, G., Wu, Y., Minshall, T. and Zhou, Y. (2018), "Exploring innovation ecosystems across science, Technology and business: a case of 3D printing in China", *Technological Forecasting and Social Change*, Vol. 136, pp. 208-221, doi: 10.1016/j.techfore.2017.06.030.

Zeng, D., Hu, J. and Ouyang, T. (2017), "Managing innovation paradox in the sustainable innovation ecosystem: a case study of ambidextrous capability in a focal firm", *Sustainability*, Vol. 9, pp. 1-15, doi: 10.3390/su9112091.

Appendix

The table shows the structure of the Excel sheet used for analysing the 120 core articles

Table A1

Table A1.
Details on the paper analysis

Preliminary	Reading day
	Reference
Search data	Database
	Keyword
	Filters
Preliminary analysis	Theories
	Perspective
	Methodology
	Data collection
	Problem
	Research question
	Framework
	Interesting case studied/cited
	Main answers
	Contributions
	Limitations
	Future research
Description of the object of analysis: IE	Definition of IE
	Characteristics of IEs
	Borders (how they are described)
	SV creation
	Model to study IEs
	Alternative labels (network, clusters . . .)
Deep dive on the structure of IE	Boundaries: material, value and knowledge flows explicit/implicit/na
	Borders: national/regional/local + national sector/global sector explicit/implicit/na
	Infrastructure
Citations and theoretical background	Seminal works
	Theoretical streams
	Models to study IE
	Main references cited
Synthetic overview	Critical analysis
	Relevance of the article in relation to the present research

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