

Research Paper

Applying open innovation strategies in the context of a regional innovation ecosystem: The case of Janssen Pharmaceuticals

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ABSTRACT

Open innovation strategies in large firms have been changing considerably during the last 15 years. Some multinationals are now taking a long-term, strategic approach to Open innovation, thereby actively developing a regionally bounded innovation ecosystem. This approach goes beyond the tradition of open innovation, which emphasized the opening of firms' boundaries for inbound and outbound knowledge flows. In the new approach, multinationals actively shape their innovation environment to better exploit external talent and expertise, share public infrastructure, raise funds and influence public policies - the key enablers for establishing a vibrant, world-class research and development (R&D) environment. We examine one such regionally embedded innovation ecosystem set up by Janssen Pharmaceuticals at its global R&D centre in Beerse, Belgium.

We develop a conceptual framework by integrating Open innovation, Innovation Ecosystems and Regional Economics literature streams. This combination of the three distinct theoretical approaches is required to explain the benefits and working of Janssen Pharmaceuticals' regionally embedded innovation ecosystem.

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1. Introduction

Open innovation strategies in large firms have been changing considerably during the last 15 years. Originally open innovation was defined “as the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively” [1]. Today, some large companies develop an open innovation strategy with more ambitious objectives: one of these objectives is to change the R&D sites of a company and their environment to world-class innovation hubs. The company is no longer only interested in the inbound and outbound knowledge flows, but it is actively shaping

the environment in this way creating the right conditions for unprecedented and more advanced open innovation practices.

We examine the recent open innovation practices of Janssen Pharmaceuticals, a multinational pharmaceutical company which is part of J&J and which transformed its site in Flanders/Belgium to develop a rich ecosystem for its R&D activities. The main aim of Janssen's strategy is to shape relationships with various partners by focusing on external resources and capabilities in the region. The company makes an effort to develop a strong, sustainable knowledge base at its site in Flanders. This is done by combining talent, expertise, infrastructure, policies, and funding through a variety of innovation and educational initiatives and events. Janssen's strategy fosters innovative research and an entrepreneurial spirit in the region. In the final analysis, the company is boosting its productivity by creating mutually beneficial relationships between public and private research, with investors close to the company's location. These examples show how companies benefit from local links when open innovation becomes integrated into the local/regional context. Furthermore, non-economic relationships and social exchange, as well as synergy with the regional policy, are essential

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elements in this strategy.

Janssen's regional innovation ecosystem illustrates the growing complexity of open innovation practices in large firms. It also represents a novel phenomenon in the field of open innovation research: Currently, some large firms are not only using outside knowledge but they are also creating the environment to grow the outside knowledge and facilitate the access to it. Open innovation scholars traditionally tend to focus on knowledge inflows and outflows without providing insights into the spatial organisation of open innovation. For example, Open Innovation 2.0 accounts for the complexity of innovation processes and represents a paradigm shift towards a multi-stakeholder collaboration ecosystem where civil society joins with businesses, academia, and governments to solve complex innovation challenges. Open innovation 2.0 is an interesting enrichment of the original concept of open innovation, but it still does not provide an insight into the geo-socioeconomic dimension of open innovation [2]. These aspects, overlooked by research on open innovation, can be found in other literature streams. Regionally embedded innovation ecosystems are covered in studies on Innovation Ecosystems and Regional Economics. We combine three literature streams - Open Innovation, Innovation Ecosystems, and Regional Economics - to explain Janssen's complex, regionally embedded open innovation system. We argue that although these three streams share a common focus on innovation as a collaborative activity between organisations, they approach them from another theoretical perspective. For instance, open innovation links innovation performance with purposeful flows of knowledge between organisations [1]. In innovation ecosystems, inter-organisational collaboration is considered as a process of value creation in environmentally conditioned inter-organisational networks. Regional Economics literature focuses on the public-private interface, increasingly labelling intersectoral collaborative activities as 'open innovation' and using regional innovation systems as a model for describing them. Open Innovation, Innovation Ecosystems, and Regional Economics are often positioned as different bodies of literature that cater to different communities.

Moreover, when it comes to studying regionally embedded innovation ecosystems, there coherent framework that could guide this kind of research is lacking [3]. It is not straightforward to propose such a framework when dealing with a multitude of definitions that are often difficult to reconcile and proliferate in different contexts without much cross-fertilization between domains and levels of analysis. This is certainly the case for innovation ecosystems [4].

Therefore we examine how to combine these three theoretical perspectives to enhance the effectiveness of open innovation research in dealing with the field's growing complexity. To link up the fields of Open Innovation, Innovation Ecosystems, and Regional Economics, we introduce a framework that combines the core propositions of these three theoretical perspectives. This framework should facilitate our understanding of the growing complexity of the open innovation practices in large firms: that is, the framework should explain why large firms are not only using outside knowledge but also create the right environment to boost the growth of outside knowledge and to facilitate the access to it.

The paper is organised as follows. First, we describe how the regionally embedded innovation ecosystem at Janssen was established and what the key elements of Janssen's strategy are. Next, we provide a comparative overview of the core propositions of the Open Innovation, Innovation Ecosystems, and Regional Economics literature streams. Next, we create a framework that can bridge the theoretical perspectives of these three streams of literature, grounding it in the overarching aspects related to the development of a regional innovation ecosystem. Next, we use this framework and show how novel approaches to open innovation, such as the

Janssen Pharmaceuticals case, can be explained more effectively with this new framework compared to the original one (Chesbrough 2003, 2006). Finally, we draw some conclusions and discuss the implications for innovation researchers, managers, and public policy-makers.

2. Janssen's regionally-embedded innovation ecosystem

2.1. Introducing Janssen Pharmaceuticals

Paul Janssen funded Janssen Pharmaceuticals in Belgium in 1953. Janssen was acquired by Johnson & Johnson (J&J) in 1961. J&J has three business sectors: consumer health, medical diagnostics, and the pharmaceutical sector. Janssen represents all the pharmaceutical activities of J&J companies worldwide. Janssen employs 36,000 people; it is active in 150 countries and owns 30 research institutes worldwide. It is the fifth largest company in the pharma sector. Janssen Belgium is the flagship R&D site of Janssen in Europe. Following the challenges of pharmaceutical R&D, including the waning productivity of in-house research, the company has worked with a large number of external partners using a variety of approaches to tapping external knowledge and technologies. Open innovation at Janssen has been expanding in a systematic fashion, and more traditional approaches (such as R&D alliances and licensing agreements) have been complemented with dedicated infrastructure (for instance, incubators and global innovation centres). The company needed to combine diverse open innovation activities worldwide in its search for the right partners and to acquire state-of-the-art knowledge and technology. Effective exploration and exploitation of external resources became an important source of competitive advantage at Janssen: the company successfully marketed a number of novel treatments and products that were invented and developed outside the company. Janssen organised exploration and exploitation of the resources globally by strategically locating its teams in the biggest hubs for scientific research around the world. J&J established its innovation centres at these locations: London, Boston, California, and Shanghai.

At first glance, Janssen's open innovation path seemed a safe bet yet the complex relationship between internal and external R&D also poses many challenges. For example, there are big risks of losing direct control over the intensity, nature and direction of R&D investment. All these are important factors that determine the long-term availability of useful knowledge and technology. Janssen has been focusing on developing a regional innovation ecosystem to gain more control over the development of external technology and knowledge. The main strategic goals of the ecosystem are to keep abreast of ever-changing technology and to ensure that strategic knowledge will be available whenever the company needs it. Janssen is focusing on long-term strategic activities in the ecosystem and boldly departs from the traditional firm-centric, short-term view of innovation. In a nutshell, this strategy means combining Janssen's internal capabilities with the skills of other actors in the ecosystem. These actors are important for sustaining the company's future innovativeness and competitiveness.

The establishment of the Janssen Campus in 2009 supported the strategy of creating a regional innovation ecosystem. The campus serves as part of a unique ecosystem covering the complete drug development life cycle. With state-of-the-art production facilities, the Janssen Campus in Beerse/Belgium plays a central role in ensuring the company taps a steady worldwide stream of pharmaceutical innovation and takes part in the internal competition between J&J's R&D hubs across the globe. Each of those units has the potential to give the multinational access to the regional knowledge base in its location. Therefore one of Janssen's strategic aims is to remain as the leader of a strong regional knowledge base

that is attractive enough to compete with J&J research hubs elsewhere. We detail Janssen's approach below after shortly describing the methodology applied to conduct this research.

2.2. Methodology

The current study is an exploratory analysis of a single case study. We focus on Janssen Pharmaceuticals' initiative to turn the Beerse/Belgium campus and its environment into a world-class R&D hub. We selected individual cases to warrant undiluted in-depth focus which provides an opportunity for detailed investigation of the complex phenomenon of innovation ecosystem as well as in-depth understanding of the context in which the study was located. The exploratory single-case approach is well suited for this study considering the lack of theoretical and empirical research on the phenomenon under study.

There is little empirical evidence showing how individual organisations can benefit from open innovation by proactively managing their relationship with the local innovation system. There is also virtually no academic literature about this type of advanced open innovation strategies that actively transform the firms' environment to create more knowledge that is external and improve its accessibility. Advanced open innovation means that a firm like Janssen is no longer looking at relationships with individual partners from an open innovation funnel perspective as advocated initially by Henry Chesbrough [1,5]. In the original open innovation framework, firms were looking for external technology they could use – implementing different collaboration modes with individual partners. The innovating firm had no intention to change and upgrade the scientific, technological and innovation environment. In contrast, Janssen is going way beyond the original approach: it is trying to re-shape the immediate and broader environment into the most vibrant R&D environment in pharmaceutical and medical research using a multi-dimensional approach, focusing on funding, talent, expertise, infrastructure and policies. This is a more ambitious, long-term approach where Janssen is simultaneously interacting with a variety of partners in shaping and reinvigorating the environment into an open regional innovation ecosystem.

The primary data collection method was through in-depth, semi-structured, open-ended interviews in 2017, conducted face to face with five key informants who manage innovation at Janssen. We used the semi-structured approach to make the interviews rather conversation-like to let the interviewees and interviewer discuss the phenomenon in depth and answer additional follow-up probing questions. One of the interviewees was Director of Open Innovation and Networking who was responsible for transforming the Beerse campus and the extensive interview with him (more than 2 h) was the backbone for the case study. The other interviews provided additional insights from managers at Janssen in the following functions: Head Platform Innovation & Incubator Strategy, Director Venture & Incubation Centre, and Director Campus Strategy. We also talked to a representative of the five Flemish universities, who was directly involved in the discussions with Janssen.

As the purpose of the case study was to explore the key underpinnings of Janssen's open innovation strategy for developing a vibrant innovation ecosystem in the region, we refer to Janssen's blueprint of regional innovation ecosystem as a unit of analysis.

First, we present the phenomenon under consideration by describing elements of Janssen's ecosystem architecture. The description of the different elements of the Janssen innovation ecosystem focuses not only on understanding the composition of the ecosystem but also the modes of operation. In this descriptive part of the analysis, we bring up examples of how an innovation system is organised and how it works in practice, focusing on the

relationship between structure and function.

Next, we further analysed the development of the innovation ecosystem at Janssen by searching for generic conceptual items and categorising our data into themes through an open coding procedure. Further, we reflected on the list of emerging themes using three literature streams to explore the connection between the Janssen's practice and the theory. The results of this exercise are presented in Table 1, which enumerates the elements of the three literature streams about open innovation, innovation ecosystems and regional economics that we found in Janssen's strategy.

In the last step, we aggregated the themes to identify key elements of a framework for understanding and analysing the regional innovation ecosystems. We determined that there are four dimensions which need to be looked at including organisation, co-ordination, value management and systemic context to better integrate business and (geo)socioeconomic perspectives and develop more systemic approaches for advancing open innovation strategy (Fig. 3), [6].

The quality of the data was ensured in several ways. First, the internal validity of the data was continuously checked [7]. After data collection and analysis we got regular feedback from the principal manager at Janssen. This validation process aimed to increase the reliability of the data collected. Second, construct validity was tested by triangulating data across different sources [7]. For example, similar semi-structured questions were addressed to the different managers, with the aim of understanding the actions of Janssen's approach from different, but converging angles. We further ensured the validity of this qualitative approach by integrating the info of the interviews with different official documents, PowerPoint presentations and relevant media releases. In this way, we can guarantee that the phenomenon under scrutiny is correctly represented.

2.3. What are the key elements of the regionally embedded innovation ecosystem at Janssen Pharmaceuticals?

Janssen's regionally embedded innovation ecosystem is dynamic, complex and adaptive, connecting talent, expertise, infrastructure, funding, and governmental policies. Together, these elements create the ecosystem architecture that serves as a model for defining and managing key structures, roles and relationships in the ecosystem. Focusing on these elements helps Janssen navigate its business setting and draw up strategies for tapping external resources. Innovation at Janssen is seen as something that emerges from the continuous interaction between these elements. We describe them below.

- I. **Talent:** An attractive innovation environment starts with the presence of top-talent. Janssen aims to ensure that top talent from around the world is attracted to where the company operates. Among other things, this means ensuring: competitive salaries; flexible immigration and labour policies; the availability of top universities and research labs. Most of these factors lie beyond Janssen's control, and therefore the firm's relationships with public authorities and universities are important when it comes to decision-making. The complementary activities undertaken by the company to attract and foster talent include summer courses, internships, competence building in partnerships with elementary and high schools and universities.
- II. **Expertise:** Internal and external expertise is key to building a vibrant ecosystem. Janssen is active in setting up incubators and accelerators, and in forging links between internal research groups and top external experts. Janssen Belgium has been working hard to make the company's headquarter

Table 1
Complementary perspectives on Regional Innovation Ecosystem with practical illustrations.

What elements of open innovation do we find at Janssen Pharmaceuticals?	Practical illustration	Reference to the framework (Fig. 3)
<p>Boundary Spanning</p> <ul style="list-style-type: none"> - The knowledge is widely dispersed beyond the firm. - <i>Not all smart people work for us</i> [1] <p>Outside-in Innovation</p> <ul style="list-style-type: none"> - Firms should profit from external resources <p>We should buy others' intellectual property (IP) whenever it advances our business model (Chesbrough 2003).</p> <ul style="list-style-type: none"> - The outside-in process is enriching a company's knowledge base through the integration of suppliers, customers, and external knowledge sourcing and can increase a company's innovativeness [12]. <p>Inside-out Innovation</p> <ul style="list-style-type: none"> - Firms should combine internal and external paths to market to advance the development of new technologies. - <i>We should profit from others' use of our IP</i> [1]. - The external exploitation of ideas in different markets, selling IP and multiplying technology by channelling ideas to the external environment [12]. <p>Coupled Innovation</p> <ul style="list-style-type: none"> - Firms should combine internal and external ideas. - <i>External R&D can create significant value: internal R&D is needed to claim some portion of that value</i> [1]. - <i>If we make the best use of internal and external ideas, we will win</i> [1]. <p>Linking outside-in and inside-out by working in alliances with complementary companies during which give and take are crucial for success. Consequent thinking along the whole value chain and new business models enable this core process [12].</p> <p>Business Model</p> <ul style="list-style-type: none"> - Business model innovation is more important for the firm's competitive advantage than technological innovation. <p>Innovation is aligned to a firm's business model [13,14].</p>	<ul style="list-style-type: none"> - Tapping into abundant knowledge through four globally distributed Innovation Centres and Janssen Pharmaceuticals' Campus Office in Belgium. - Products that come from elsewhere dominate Janssen Pharmaceuticals' portfolio. - The company is planning to spin-off some of the projects from the Venture & Incubation Centre. - The company is combining internal and external skills and knowledge, providing start-ups and academia with access to complementary skills and expertise. - Janssen Pharmaceuticals focuses on shifting its business model to integrated customer-centric disease management by offering transformative solutions for disease prevention, treatment and interception by working with non-traditional partners such as governments and non-profit agencies and taking initiatives such as the Venture & Incubation Centre. 	<ul style="list-style-type: none"> - O - O, VM - O, VM - O, VM - VM
<p>What elements of innovation ecosystem do we find at Janssen Pharmaceuticals?</p> <p>Multi-stakeholder collaboration</p> <ul style="list-style-type: none"> - Innovation ecosystem accounts for the complexity of the innovation process and for relationships between socioeconomic factors that are important for innovation, such as technology, knowledge, talent, expertise, education, infrastructure and policies [15]. - Pro-active relationship with the environment is used to explain differences in innovative performance, generated by interactive patterns and links between organisational, technological and environmental factors [4,16]. The innovation ecosystem thus constitutes a pro-active, inter-organisational approach to open innovation [15,17–19]. <p>Networks</p> <ul style="list-style-type: none"> - Innovation ecosystem as dynamic and purposive network of knowledge production and consumption side participants including a range of actors from academia, industry, foundations, scientific and economic organisations, and all tiers of government [8,15,20–22]. <p>Orchestration</p> <ul style="list-style-type: none"> - Hub company plays an orchestrating role in the innovation ecosystem [23]. - The orchestrating role in developing innovation ecosystems is considered an important source of long-run competitive advantage [24]. <p>Value Creation and Capturing</p> <ul style="list-style-type: none"> - The partners in a non-linear mode jointly create value, and value distribution among the partners is taken care of by the hub firm [18,25–28]. - The network of partners only dictates opportunities for value creation. It is a firms' behaviour that dictates the extent to which the possibilities for capturing the value can be realised [29]. <p>Innovation Infrastructure</p> <ul style="list-style-type: none"> - The innovation ecosystem is designed so that it provides the conditions needed for all stages of the innovation process from basic research to commercialisation [29]. <p>What elements of regional economics do we find at Janssen Pharmaceuticals?</p> <p>Spatial Proximity</p> <ul style="list-style-type: none"> - Spatial proximity fosters interactions between actors and stimulates the flow of knowledge [30–32]. 	<p>Practical illustration</p> <ul style="list-style-type: none"> - Janssen Pharmaceuticals is developing the innovation ecosystem by focusing on talent, expertise, funding, infrastructure and policies as key drivers of open innovation. - In its effort to specialise in supercomputing, Janssen Pharmaceuticals brings together industry and academia; governmental funding was used to invest in infrastructure, local universities educate experts with the relevant skills to implement and develop new technologies. - Janssen Pharmaceuticals used its leadership position to guide the development of competencies vital to innovation by unlocking the knowledge and resources from diverse actors in the ecosystem. Some examples include ExaScience Life Lab. partnership or focused regional cluster in neurodegeneration. - Janssen Pharmaceuticals develops an innovation ecosystem where various partners work together and jointly create value. The value is spread throughout the ecosystem and the role of Janssen Pharmaceuticals is to make sure that the company will be able to appropriate a portion of that value and that other actors joining the networks will also benefit from the ecosystem's value proposition. - JLINX (JLINX) has been set up in Beerse to provide incubation of early-stage companies to catalyse scientific innovation by offering start-ups flexible ways to grow and collaborate. <p>Practical illustration</p> <ul style="list-style-type: none"> - Janssen Pharmaceuticals forges many partnerships with local universities, research institutes and companies. 	<ul style="list-style-type: none"> - O, C, VM, SC - O - C, VM - VM, C - O, SC - O, SC

(continued on next page)

Table 1 (continued)

What elements of open innovation do we find at Janssen Pharmaceuticals? Practical illustration	Reference to the framework (Fig. 3)
<ul style="list-style-type: none"> - Spatial proximity favours interactions between actors, helps knowledge flow [30], and promotes common social and cultural values underpin long-term inter-organisational relationships [33]. 	<ul style="list-style-type: none"> - Janssen Pharmaceuticals Belgium selected as one of 4 supercomputing centres within J&J corporation.
<p>Local Embeddedness</p> <ul style="list-style-type: none"> - Long term, purposeful arrangements among distinct but related organisations based on co-specialization and complementarities [34–37]. - Location is important for internal competition in multinational companies [38,39]. - Region's socio-spatial embeddedness plays an important role in firms' innovation success and build-up of knowledge [40]. 	<ul style="list-style-type: none"> - A strong concentration of pharma research in Flanders and neighbouring regions, both through universities and research centres as well as companies.
<p>Governmental Institutions and Policies</p> <ul style="list-style-type: none"> - Governmental institutions and policies play an important role in supporting and incentivising innovation. The relationship between innovation policy and innovation strategies of the firms is a two-way street [41]. 	<ul style="list-style-type: none"> - Janssen Pharmaceuticals' strategy provides a robust example that companies need to take into account the impact that institutions, decision-makers and political processes have on the innovation process. - Janssen Pharmaceuticals is the biggest private investor in R&D in Flanders. This means the firm has a major impact on the regional innovation ecosystem and this boosts the company's strategic role in the region. - The Janssen Pharmaceuticals case shows that the availability of skilled workers, funding and state-of-the-art knowledge all affect the process of knowledge creation in the region.
<p>Structural Factors</p> <ul style="list-style-type: none"> - Structural factors such as education, funding, infrastructure, job markets and entrepreneurship drive innovative growth [42]. - A vibrant local socio-economic setting is key to (1) the development of a joint organisation and learning system based on regionally-embedded R&D; (2) getting access to knowledge incorporated in regional systems covering innovation, cooperation, institutions and policy patterns [43]. 	<ul style="list-style-type: none"> - Janssen Pharmaceuticals is an example of an anchoring company whose growing economic impact on employment, the development of local talent and a well-educated workforce helps shape the regional innovation ecosystem.
<p>Anchoring Company</p> <ul style="list-style-type: none"> - Orchestrating role in the regional context increases the impact on employment and education [44]. - Anchoring company operates t the critical interface between companies, workers, universities and governments [45]. 	

campus in Beerse accessible to outsiders and to enable internal research teams to reach out easily to a large network of innovation partners. The Janssen Campus Office was set up to play this role in Belgium. It plays a crucial role in linking the outside world with innovation teams within the company. This interaction is in particular important for academic scientists, who often find it hard to forge links with big companies.

III. **Infrastructure:** Modern drug discovery entails an increasing number of technologies. Many of them can only be developed using very expensive equipment. Sharing state-of-the-art technology with other entities is thus a 'must'. For instance, Janssen benefited from superfast connectivity (1 Gigabyte/sec), providing the company with global connectivity to academic institutes with a subsidy granted by the Belgian Science Policy Office (Belspo). Another important element of Janssen's ecosystem is the physical infrastructure for incubating new projects and bringing together internal and external experts from both the business and science worlds under one roof.

IV. **Funding:** New (external) ideas and technologies need suitable financing to develop into potential new products. Therefore, Janssen makes major efforts to boost initiatives in Belgium and abroad with international communities of inventors, through boot-camps, match-making events, corporate venture capital (CVC) investments, accelerators, incubators, and close collaboration with business angels and venture capitalists (VCs). The sources of funding that sustain Janssen's innovative projects depend on the maturity of the ecosystem. Developing the initial ecosystem requires Public-Private Partnerships (PPP). Once PPP initiatives reach the commercial phase, the role of private and corporate equity capital would gradually kick in to support the creation and growth of new businesses. Eventually, these new enterprises are also expected to benefit from tax incentives and the banking system's financial product portfolios.

V. **Policy:** A lot of the factors crucial to the success of the ecosystem lie beyond Janssen's control. The Flemish Government is a major decision-maker when it comes to public investment in R&D, education policy, infrastructure, safety, and so forth. Working closely together is mutually beneficial. Janssen can develop a world-class innovation ecosystem in Belgium which, in turn, will lead to more investments from its global businesses and from other actors that want to join in. For the government, this strategy puts Flanders at the cutting edge of science and technology. Public grants have a multiplier effect on the subsequent investments made by firms choosing to set up their research facilities in Flanders to take advantage of the ecosystem. This, in turn, strengthens the ecosystem and boosts its growth. Thus it is important for a large company such as Janssen to keep direct contact and to align with public authorities and regulatory agencies.

2.4. How Janssen's innovation ecosystem architecture works in practice

Recognising the role of talent, expertise, infrastructure, funding and policies for company innovativeness is crucial as Janssen's innovation ecosystem works by integrating these five building blocks. Conceptually it is represented by a roadmap that shows how to combine public and private R&D and turn the results into measurable innovative outcomes. In this case, the roadmap links the company's objective of boosting deal flows in Belgium and abroad with the overall goal of creating economic value and coming up with solutions to meet society's needs.

Janssen's strategy also shows how the company seeks to boost the ecosystem by linking the 'inside' with the 'outside' while using horizontal anchors such as PPPs and Key Enabling Technologies (KETs) defined by The European Commission as a basis for innovation in a range of products and industries (Fig. 1).

In the regional innovation ecosystem, one of the strategies for

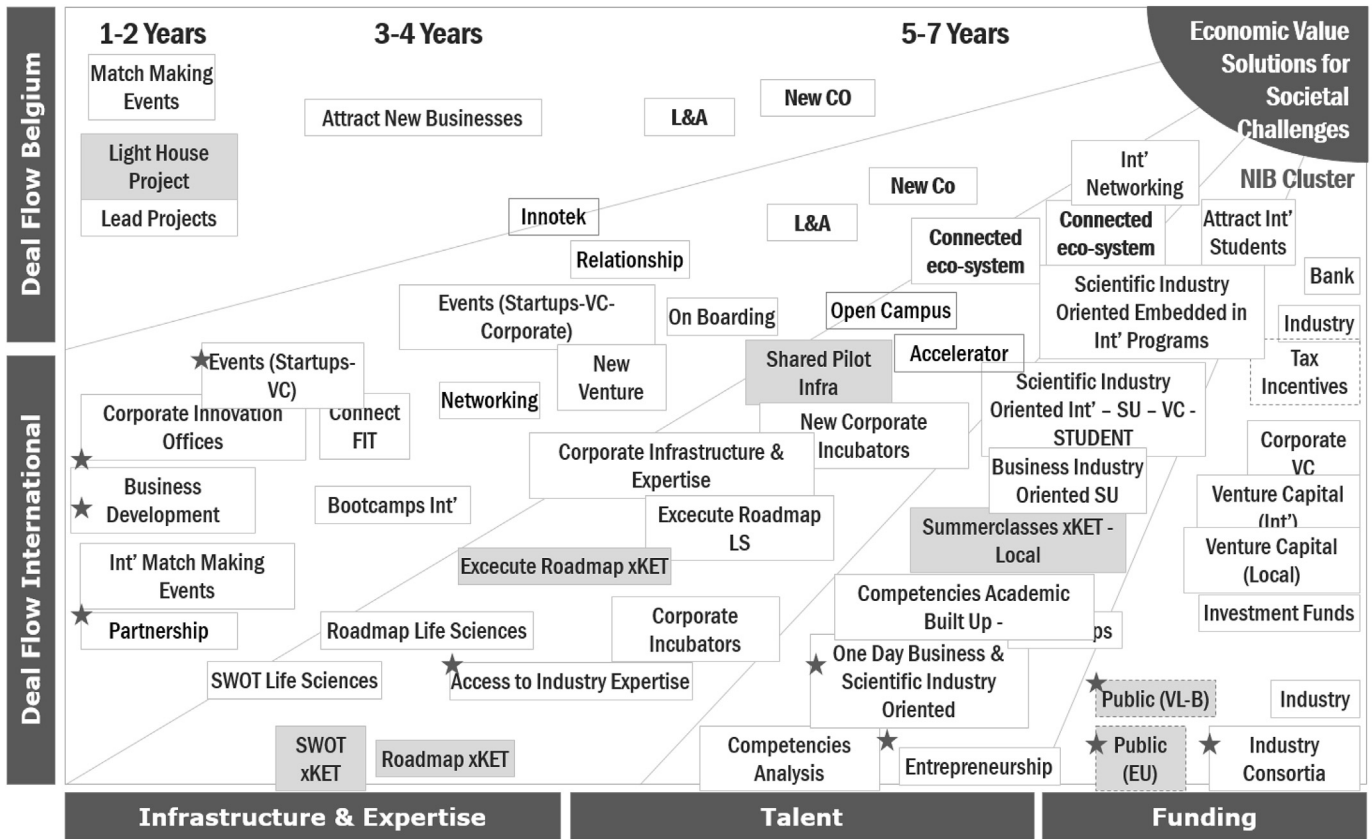


Fig. 1. Janssen's roadmap to connect the 'inside' with the 'outside'. Source: Janssen internal documents. Note: Gray boxes indicate policy-driven public-private initiatives.

boosting KETs' impact is the clustering of actors that share interest, expertise and facilities. Clusters help to organise complementary resources in the region. Janssen developed and orchestrated such a cluster to strengthen the company's strategic focus on neurodegeneration. Janssen developed this cluster together with a broad range of partners including knowledge institutes, government agencies, business and academia (each specialising in different aspects of technology development, commercialisation and value creation). For example, working in the area of neurodegeneration requires expertise and technology for brain imaging. Instead of setting up its imaging centre, Janssen partnered with Antwerp University and its University Hospital. These institutions have access to the scientific expertise and clinical research required for running a brain-imaging centre. Siemens, another partner with a great interest in the scientific and medical understanding of neuroscience, supplied the equipment needed. Fig. 2 shows the combination of knowledge, technology and expertise stemming from the various partners working together within the Janssen-orchestrated cluster.

Modular interfaces of talent, expertise, infrastructure, policy and finance also define relationships between the various stakeholders. These relationships change during the ecosystem life cycle. The stages of this life cycle are reflected by changes in the number and types of partners, in requirements for expertise and infrastructure as well as in approaches towards financing innovation (Fig. 1). For instance, in the early phases, Janssen forges links with research centres, universities and other companies to explore alternative technological solutions in a pre-competitive collaboration. After this exploratory phase, the firm forges stronger links to start-ups and new entrants to explore underlying technologies. In this transition phase, Janssen also reaches out to financial, i.e. VCs who

support investment and play an important role in determining which of the new technologies will become standards. University students are encouraged to experiment to discover the full commercial potential of their ideas by trying them out in incubators and accelerators such as JLINX launched at Janssen's Belgian Campus (more detail in section 3). Janssen's core interest is to spark an entrepreneurial spirit and spawn start-ups that offer assets, which are important for technological innovation and that, have already gained commercial value. Strategically, it creates deal flow options for Janssen that eventually lead to innovative outputs such as new products and new businesses. Janssen's ecosystem strategy is also linked to the policies, programs and projects of national, regional and local governments and their agencies within the innovation framework covered by the EU's agenda. By bringing together those diverse perspectives, the company is able to upgrade its strategic measures so that it can actively manage the intertwined factors of innovation availability and applicability instead of merely reacting to them.

2.5. How Janssen Pharmaceuticals' regional ecosystem enriches existing approaches to innovation

Janssen's innovation ecosystem shows how the company can create a dynamic innovation architecture by strategically linking the various parts of that system. Analysing the ecosystem reveals that the innovation practices of large, modern firms are embedded in a new relational context. Open innovation in large companies is no longer about only 'outside in' or 'inside out' links but also about nurturing and sustaining the ecosystem of partners and resources — something that requires long-term planning. Although the company draws on the global socioeconomic context to span

Focused regional cluster in neurodegeneration

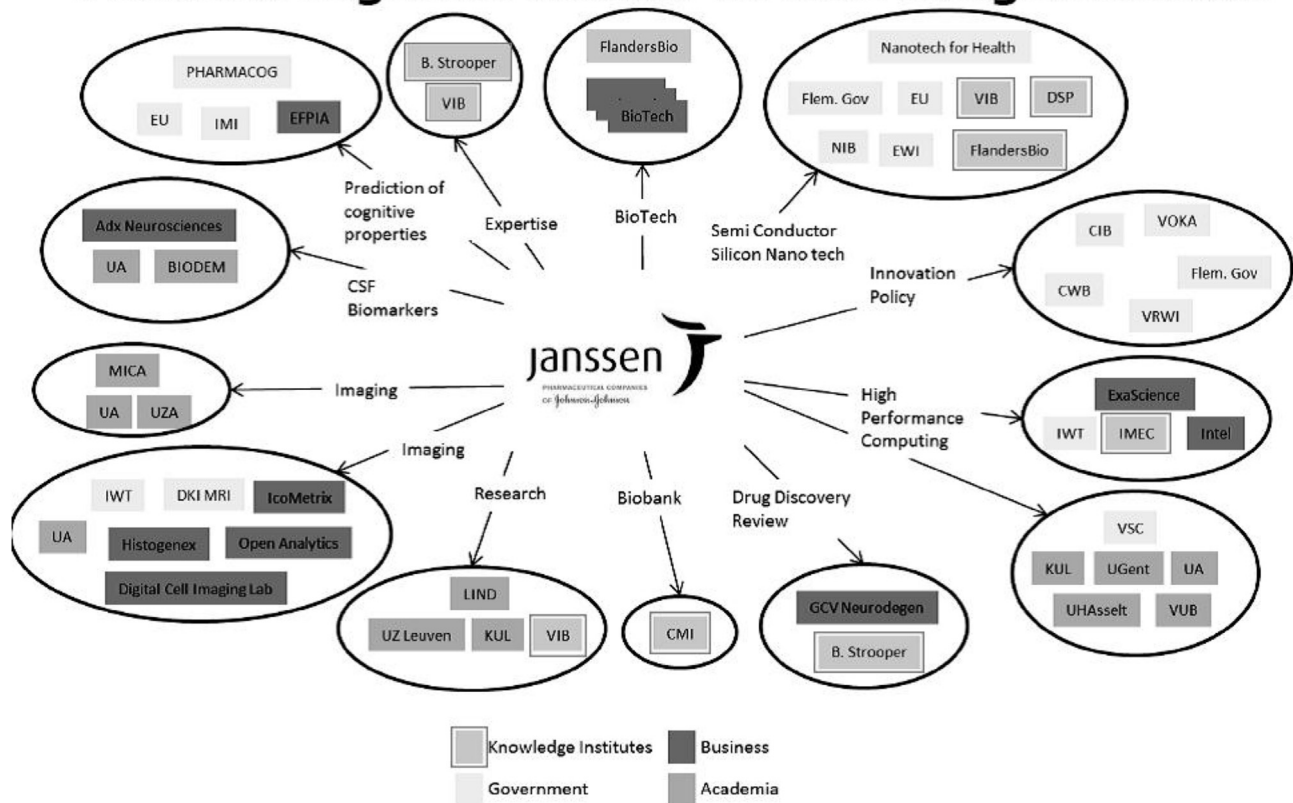


Fig. 2. Focused regional cluster in neurodegeneration. Source: Janssen internal documents.

organisational boundaries, the region has been identified as a new boundary-maintaining structure.

Focusing on external resources and relationships is a common approach for an innovation ecosystem. However, most industrial innovation ecosystems focus on developments in technological knowledge and assets as an immediate outcome. In Janssen's case, the ecosystem strategy aims at creating the right conditions for developing an external knowledge base that serves the firm's innovation strategy. What the company does is to take care of the external environment favouring developments of strategic resources. For Janssen, it is important that both present and potential partners expand their innovation base in a way that ties in with the company's vision. By working together with governments, universities, financial organisations and industry, the company fosters institutional capabilities in meeting future knowledge and R&D needs.

This approach is new to open innovation and reveals the true complexity of modern innovation practice, which spans multiple roles, processes, structures and functions. Understanding the role of a large company as a driving force in setting up such an ecosystem can, therefore, be a challenging task. It might need taking an entirely new perspective to explain how innovation can flourish through the interaction of various kinds of partners. To answer this question, we have to combine different literature streams that focus on collaborative innovation but explain it from a different perspective.

The open innovation framework [1] has mostly focused on the mechanisms for connecting technologies and markets and giving advice to individual companies on how to capitalise on internal and external knowledge by spanning organisational boundaries. Under

this approach, innovation is viewed as a function of the division of labour and global knowledge production, distribution and mobility. Large companies to cut the costs and risks entailed by innovation applied the open innovation framework initially. Implementation of open innovation resulted in a rich repertoire of tools and practices to search for partners, technologies and market opportunities. The ecosystem approach focuses on the socioeconomic aspects of collaboration, explaining the variability in innovative performance through different roles and interdependencies between actors in innovation networks. Innovation in ecosystems depends on socially-organised knowledge output represented by the system of relationships among the various partners. Managing multi-stakeholder collaboration focuses on knowledge transfer and value creation [8]. Regional Economics literature has focused on the so-called 'triple helix' and other approaches to knowledge generation and transfer within a regional innovation system [9,10]. This approach is based on a long-standing theoretical association between location and innovation. A regional perspective of innovation involves policy development and institutional arrangements such as government subsidies and allocation of resources to public and private research institutions, and the development of clusters [11].

Each stream of literature makes its contribution to our understanding of contemporary developments in innovation management but none of them explains the complex initiative we describe in the Janssen case. Bringing these three literature streams together is a fresh approach and helps one shed new light on open innovation, as we will show in the following sections. We will explore the links, complementarities and synergies between the elements defining mainstream approaches to open innovation, the

Innovation Ecosystem and Regional Economics in relation to Janssen’s ecosystem. We will then go on to propose a framework for guiding the development of innovation ecosystems and hubs.

3. Complementarity framework for developing regional innovation ecosystems

The three literature streams focus on collaborative approaches to innovation, paying particular attention to various aspects of the process such as business, socioeconomic, political and geographical perspectives. We show this in Fig. 3.

The regional innovation ecosystem developed by Janssen can be explained using the three perspectives and incorporating them within a single framework. The specific elements of the framework, i.e. the key concepts from the literature and their practical illustrations are set out in Table 1.

3.1. Organizing regional innovation ecosystem

Regional innovation ecosystem at Janssen is organised around the key principles of open innovation. First, the company recognises the potential in the outside world for solving the company’s innovative challenges [5]. The need to access the abundance of external knowledge was expressed at Janssen Pharmaceuticals through the slogan “The World is our Lab”. Following the change in the role of R&D people from knowledge generation towards knowledge acquisition, identifying and forging links with excellent science in labs around the world became a prerequisite for successful innovation [5]. Following this strategy, Janssen Pharmaceuticals works closely with global innovation centres set up by

Johnson and Johnson and strategically located in the biggest hubs for scientific research, including London, Boston, Menlo Park, and Shanghai. This made it easier for the company to scour the knowledge landscape, keep abreast of state-of-the-art research and tap useful knowledge whenever needed. Janssen Pharmaceuticals’ Campus Office plays a similar role in Belgium, where a dedicated team is fostering open innovation practices and is forging contacts with various kinds of external parties.

Open innovation at Janssen Pharmaceuticals is a blend of internal expertise and external skills and knowledge [5]. How this blending is done at Janssen Pharmaceutical is illustrated in the way the company works with academia. An interesting example is The Stellar Initiative, which is a grant scheme for sponsoring research projects and scientific exchange activities in the neurodegeneration field. This initiative encourages collaborative research between academic partners and Janssen Pharmaceuticals’ R&D to combine excellence in all aspects of translational research and developmental capabilities. This collaboration covers the various capabilities needed to address several productivity roadblocks in pharma R&D. Here, the company actively forges industry-science links by conducting joint research projects, facilitating the mobility of university staff, and sharing infrastructure.

Open innovation is a long-term endeavour in Janssen Pharmaceuticals’ strategy. It will continue to produce the expected results only if an environment conducive to open innovation supports it. How such an environment can be developed is a new topic in the open innovation field and requires strategic measures, such as external networks and ecosystems that go beyond the existing open innovation framework [25]. ExaScience Life Lab is an example how Janssen Pharmaceuticals is using a network of multilateral

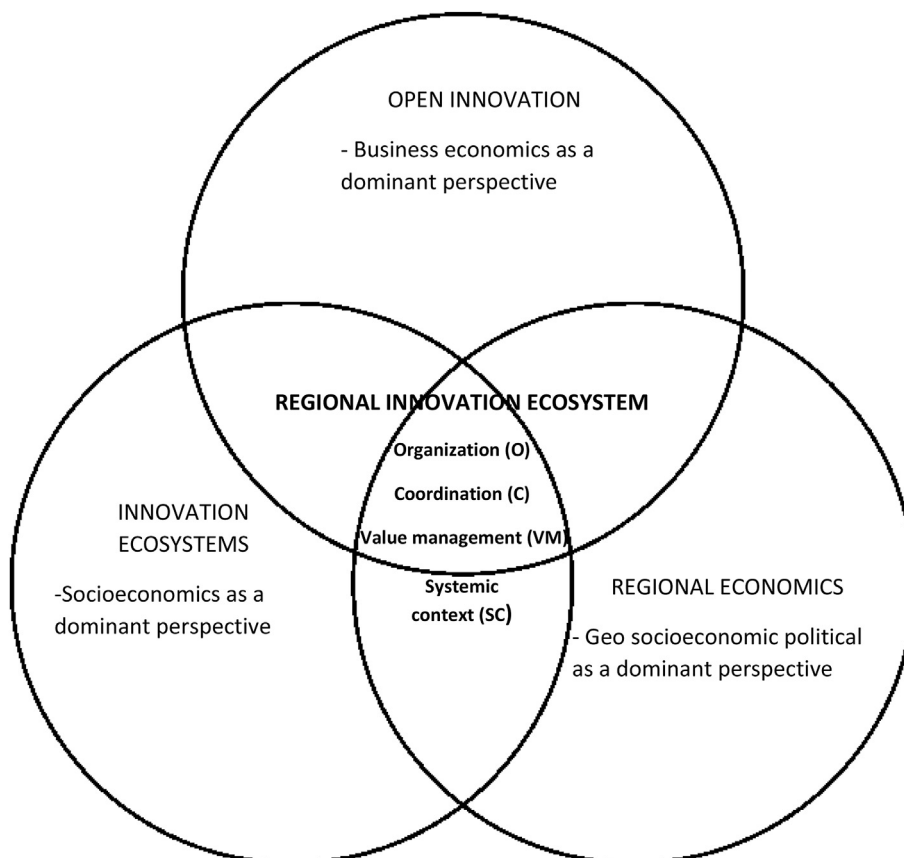


Fig. 3. Complementarity framework for developing Regional Innovation Ecosystems.

relationships in the innovation ecosystem to gain and provide access to supercomputers, which it is thought will become a strategic innovation resource in future lab research. ExaScience Life Lab is a partnership in which Intel's expertise in the field of supercomputers has been combined with the know-how of Flemish universities and research institutes in the Life Sciences and Biotechnology fields. This partnership catalyses the quest for technological innovation drawing on the fields above. Janssen Pharmaceuticals is part of this unique initiative, which harnesses both external expertise and internal know-how. The combined knowledge creates value for the company's customers and the whole ecosystem. To ensure that both Janssen Pharmaceuticals and the ecosystem benefit from the ExaScience Life Lab partnership, the company has set itself the target of turning the region into a world-class hub for supercomputing in Life Sciences. This requires collaboration with various kinds of partners, including the regional government. The latter played an important role in this task by providing funds for infrastructural investment in supercomputing. Janssen Pharmaceuticals played an active role in persuading the Flemish government to make this investment. The company managed to convince local politicians that many public and private bodies in the region would benefit from applying supercomputing to their R&D. Taking this approach, the company rationalised resource management and gained access to strategic infrastructure by implementing a fee-for-service model, thus avoiding forking out vast sums up front.

Another key feature of the innovation ecosystem is that it is designed to span all process stages from basic research to market launch. It is particularly important to identify and nurture early-stage research intense companies because of their potential to transform human health. Janssen Pharmaceuticals in Belgium is offering start-ups flexible ways to grow and collaborate across the European Life Science ecosystem. In keeping with this approach, a new company incubation model called JLINX has been launched at Janssen Pharmaceuticals' Belgian Campus and is sited in a purpose-built complex in Beerse. The Director Open Innovation and Networking at Janssen explains that "JLINX provides entrepreneurs with opportunities to share ideas and collaborate while accessing a unique combination of resources including, infrastructure, and access to all necessary internal and external scientific, technical and business expertise". The promising transformative innovations will be developed through venture investment from Janssen and external investors.

3.1.1. Coordinating regional innovation ecosystem

In the region, Janssen Pharmaceuticals acts as a hub company orchestrating the innovation ecosystem [23]. Janssen Pharmaceuticals used its leadership position to carefully shape the development of supercomputing power by unlocking knowledge and resources from various players in the ecosystem [46]. Janssen's proactive role in that process was directly linked to the company's strategic decision on where to deploy its resources and skills and where to search for external knowledge. Investments would probably have languished without a sufficient supply of expertise and talent in the Bioinformatics and Biostatistics fields. However, Flanders has an excellent supply of faculty researchers and students because the nearby-located University of Hasselt was already offering Master and Doctoral courses in Bioinformatics and Biostatistics. These disciplines provided knowledge and applied skills in database management, computer programming, and statistical techniques in response to the giant strides being made in Genomics and Proteomics research — both important specialities in pharmaceutical research. This strategic complementarity between companies and universities facilitated cooperation between industrial and academic partners (both of which stood to benefit from the external funding available in the region). In this case, the

company has been capitalising on generic links and relationships with local universities as suppliers of talent and research services. Janssen Pharmaceuticals played a strategic role by acting as an industrial partner, encouraging academia to deepen and expand knowledge in Bioinformatics and to create a new technology niche that met the company's business needs.

Janssen Pharmaceuticals' orchestrating role means that one needs to consider how partners jointly create value and how that value is distributed in the innovation ecosystem [18,25]. The company developed an innovation ecosystem in which various partners have a common objective and jointly create value. This value is created in the ecosystem by combining knowledge, technologies, assets, infrastructure, and human capital of different partners. The firm strategically navigates all these elements, ensuring partners follow the direction of the company's innovation strategy so that it can exploit some of the value created. Moreover, a number of actors (including universities, start-ups and the company's competitors) can benefit from joining the innovation ecosystem. There are several mechanisms the hub firm uses to set up the ecosystem including acquisitions, licensing agreements, non-equity alliances, joint ventures, R&D contracts, and other types of commitments that go beyond arm's-length relations. Janssen Pharmaceuticals has been using all of them.

Nevertheless, advancing science is the primary objective for Janssen when bringing industry and university together to work on fundamental research. Janssen provides sufficient freedom to scientists and does not predetermine the research outcomes, in this way creating the space for unpredictable and unexpected results. Only in the later stages of development, when the commercial value of the innovation is increasing, Janssen might be interested in acquiring the intellectual property rights from the owner. In this scenario, Janssen would position itself as a partner of choice for an exit capitalising on ongoing relational engagements with investors or start-ups. This practice, which is described in the literature as relational contracting represents a complementary approach to traditional IP strategies [47].

3.1.2. Managing value in regional innovation ecosystem

Another element of the open innovation strategy at Janssen Pharmaceuticals is the business model innovation. The company's current model is quite different from the traditional, vertically integrated one focusing on internal R&D as a key function for drug discovery and development. Janssen Pharmaceuticals complemented its internal R&D with externally available resources and set up new functions, processes and structures to support open innovation. The overall aim is to shift its business model to integrated customer-centric disease management by offering transformative solutions for disease prevention, treatment and interception. This transformation requires a multidisciplinary, cross-company, cross-industry approach to innovation. This also explains why collaboration at Janssen Pharmaceuticals is not just about R&D. The company also partners with governments and non-profit agencies on new strategies for access to medicines, affordable pricing, patient education and support. Janssen Pharmaceuticals also established a Venture & Incubation Centre (VIC) — a business incubator and venture accelerator to launch new healthcare activities around Janssen Pharmaceuticals' core business. The initiative's purpose is to foster entrepreneurial talent and build a collaborative community. VIC boosts the viability of new ventures by working closely with Janssen Pharmaceuticals, which furnishes key know-how in the finance, legal and marketing fields. The company will also manage the venture's exit: it can be integrated into one of the existing business units, or it can be spun off.

This multidisciplinary, cross-company, cross-industry approach to innovation entailed the development of a full suite of cross-

sector tools that are designed to identify access and accelerate the best science available externally. Janssen Pharmaceuticals tap into the valuable external resources using several strategies including acquisitions of assets, companies, and technologies, as well as by engaging in strategic collaborations (including joint ventures, developments, and commercial partnerships). This variety of approaches is needed to work together at every stage of the value chain, from early discovery to market launch. This integrated view on the R&D value chain also allows searching for medical breakthroughs wherever they occur, whether it be at a university, a research organisation, or at a biotech/pharmaceutical company. This strategy is working well at Janssen Pharmaceuticals. Most of the new products that the company has brought to market in recent years originated outside Janssen. In other words, the pharma firm mainly used externally sourced IP to tackle unmet medical needs and to make profits from the company's business model.

3.1.3. *Connecting to the systemic context*

The systemic interaction between education, science and business is used by Janssen Pharmaceuticals to combine public policy and private sector interests to strengthen the regional innovation ecosystem. Following lessons from Regional Economics, education is addressed in a much wider context than short-term innovation while universities are seen as a key driver in the knowledge economy and, as a consequence, higher education institutions have been encouraged to develop links with industry and business in a series of new venture partnerships. On the one hand, the quality and breadth of university faculties, opportunities for multidisciplinary studies and their openness to taking on research projects are important in getting the private sector to join development projects. On the other hand, quality provision of primary and secondary education, international multi-lingual High Schools, open universities with international degrees, schools for lifelong learning and continuous re-education are equally important to create a pool of talent and to underpin innovation in the long-term. Educational activities also complement R&D by providing high-quality programs for Master's and Doctoral students, while international Summer Schools bring students, scientists and industry experts together. Other forms of interorganizational education and learning include internships between academia and industry, and business and entrepreneurship camps. Janssen Pharmaceuticals actively engages in such initiatives.

Janssen Pharmaceuticals' strategy shows how companies need to take into account the impact that institutions, decision-makers and political processes have on the innovation process. These insights are important for better organizing innovation and for exploiting resources more efficiently. For example, Janssen Pharmaceuticals' cooperation with the Flemish government led to public investment in supercomputing facilities. Institutions provide both economic and non-economic incentives to take part in innovation processes [41]. The role of policy-makers and governmental institutions is to support education, develop the technological base and provide companies with incentives to invest in innovation. Here, one should not underestimate the role played by structural factors in driving innovative growth. These factors include such things as the availability of skilled workers, funding, and state-of-the-art knowledge, which together influence the process of knowledge creation via multiple input and feedback loops in the innovation ecosystem.

4. Discussion and conclusions

The analysis of Janssen Pharmaceuticals' innovation ecosystem at its Beerse site shows that open innovation is no longer only about project based, 'outside-in' or 'inside-out' relationships with

individual partners. Some large companies like Janssen Pharmaceuticals transformed their open innovation strategies and go for more ambitious objectives. They are no longer using external technology from partners or license out their technology for external use, but they actively transform their own R&D campus and its local environment into a regional innovation ecosystem that can be considered a world-class environment for R&D in pharmaceutical technologies and disciplines. The focus is no longer on individual relations with R&D partners, but on nurturing and sustaining a broad ecosystem of partners in the region. Long-term planning and forecasting in that direction requires broadening the scope of partners engagement in non-traditional activities, including leadership and governance in a new relational context [47–49].

The open innovation campus in Beerse also shows how innovation is driven by a number of inter-related social and economic forces that bring together industry, academia, governments, and innovation financiers such as VCs to stimulate the creation of multidisciplinary knowledge. Enhanced transfer of information, knowledge and talent leads to open innovation up to a level where many sectors overlap and multiple actors engage. In this context managing innovation become increasingly complex and it is less and less possible to come up with the compelling "blueprint" for the future ecosystem that precisely defines structures and roles in the ecosystem i.e. what value is created and for whom, who does what, who controls what and how everyone will benefit [50]. This represents a new challenge to the ecosystem champion who needs to develop an innovation strategy for managing dynamics of increasingly complex and uncertain environment.

This is why we claim that the 'classic', firm-level open innovation defined by Chesbrough [1,5] needs to be reconsidered given that large companies are not only opening their R&D labs, but are also actively creating an external innovation system in the neighborhood of their labs. This reframing helps link open innovation to other literature streams in the innovation management field — something that will be of great practical value to managers who are increasingly challenged by changes in markets, technologies, and socioeconomic forces.

From a theoretical perspective, bridging the open innovation literature to the innovation ecosystems and regional innovation systems is essential to account for the dynamic and systemic aspects of multi-stakeholder collaboration and ecosystem dynamics in open innovation projects. These dynamic aspects mostly relate to the control over the process and structure i.e. the development of innovation ecosystems and the fact that they can rarely be micro-controlled as opposed to the current open innovation literature which focuses on value capturing through IP and asset control [5,51–53]. This is why the innovation management literature most often offers guidance for ecosystem blueprints which are very prescriptive in nature, i.e. they specify the assets firms should leverage in the ecosystem and who are the right partners for doing so [15,54].

The literature does not offer much of an advice on what to do when firms do not have the clarity on ecosystem design for managing long term, strategic, open innovation based projects, in particular, those located at the "fuzzy front end" of research and development or projects with a high innovative and commercial potential. These projects are most often complex, risky and characterised by considerable ambiguity. In this situation companies may benefit from 'vision', which provides a general direction for future value creation and capture, i.e. by mobilising structural drivers and enablers of innovation (infrastructure, talent, skills, finance, and policies [50]. This way the coordinating roles in the innovation ecosystem change from orchestrating and developing resources within an ecosystem towards future-oriented "ecosystem

engineering” where the strategic role of coordination expands towards facilitating long-term resource and relationship development at the system level [55].

Our study holds several lessons for managers. Companies undertaking open innovation might find it useful to grasp the shortcomings of the concept in its current form. Large firms should no longer think in terms of inbound and outbound open innovation. Instead of just opening their boundaries, large companies can actively shape their environment to vibrant technology hotspot and build the right conditions to get optimal access to external technology. Transforming the external environment is a challenging task demanding continuous scrutiny and acting upon various external conditions. A better definition of the context will help focus on those environmentally conditioned aspects that are most important for sustaining competitive advantage. These elements should work as a holistic frame (blueprint) that allows one to focus on the main issues by turning fiendish complexities into manageable simplicities. Having these blueprints is important for squaring open innovation’s strategic aims with the tactical demands made by the business environment. For instance, Janssen’s combination of talent, expertise, funding and policy established an innovation architecture that provides the means for driving strategy through actionable results. These elements together create an evolving system that ensures alignment among changing business models, strategy, vision, stakeholder needs, product innovation and policies. Together, the five building blocks of Janssen’s ecosystem create a framework for decision-making that makes it easier to analyze problems, plan, draw up roadmaps, and to deploy multiple scenarios for transformational change. Companies need such decision frameworks, which are useful for modeling relationships at different levels (for instance, regional systems of innovation, business ecosystems, and innovation networks).

We therefore recommend that managers re-examine how they approach open innovation and tackle the issue as a long-term program that involves strategic thinking. Here, they not only need to ponder internal innovation structures and processes to boost a firm’s absorptive capacity but also think about the need to transform the environment together with external parties into a world-class innovation hub. This requires drawing on multidisciplinary approaches to socio-economic systems and the ability to synthesize separate findings from different perspectives. Our framework, which draws on Open Innovation, Innovation Ecosystems and Regional Economics, provides an example of how to do this by using key crosscutting dimensions.

Our study also has several implications for public policy-makers. Efficient policy-making for innovation is growing in importance in securing the provision of the infrastructure, human capital and financial resources needed to create a vibrant innovation environment. Public policies, together with private investors, influence the demand and supply of innovative research and new ventures. They also determine the way profits are valued and protected, and cover legal arrangements for reducing the risks arising from innovation. Together, they can better direct the resources by focusing on the areas with global market potential, high societal value and local impact. It is therefore crucial to have policies for fostering socio-economic networks in which key stakeholders (including industry leaders, research centres, universities, VCs, governmental agencies and institutions) are highly motivated and properly supported in engaging in pioneering ventures and are willing to take calculated risks. In order to effectively design incentives to these ends, innovation policies must better understand competitive and collaborative relationships between multiple actors and their roles in innovation ecosystems [56].

Policy-makers need to focus more on removing barriers to collaboration. This requires governmental agencies and political

institutions to become more open, easier to approach and more responsive to the various stakeholders (including large companies interested in making big R&D investments). Governments must therefore develop the capabilities and a culture to engage in relationships with companies and relate them to multiple players.

This paper has several limitations. We focused on different approaches towards open innovation and collaboration assuming that none of them properly tackles the growing complexity of innovation practices or reflects its systemic nature (determined by common functions and structures connecting internal and external worlds at different levels of organisation into a dynamic, evolutionary structure). We took this approach to create scope for multi-level, multi-perspective research needed to capture the complexity of distributed innovation activities. Whereas we apply an ego perspective of one multinational enterprise (MNE) to show in detail various elements of the company strategy, others have analysed ecosystem dynamics from the perspective of ecosystem coordinator at the inter-organisational level [50,55].

However, we recognize that this pioneering approach may have suffered from those arbitrary decisions we were forced to make in selecting relevant theoretical perspectives and in building a complementarity framework. Better understanding of the systemic nature of open innovation and agreeing on the dimensions to be used in analytical models is thus the main challenge for further research.

References

- [1] Henry W. Chesbrough, *Open Innovation: the New Imperative for Creating and Profiting from Technology*, Harvard Business School Press, 2003.
- [2] Martin Curley, Twelve principles for open innovation 2.0, *Nature News* 533 (314) (2016) 7603.
- [3] Ron Adner, Ecosystem as structure: an actionable construct for strategy, *J. Manag.* 43 (1) (2017) 39–58.
- [4] E. Autio, L. Thomas, Innovation ecosystems: implications for innovation management? in: M. Dodgson, D.M. Gann, N. Phillips (Eds.), *The Oxford Handbook of Innovation Management: 204–228* Oxford University Press, Oxford, UK, 2014, pp. 204–228.
- [5] Henry Chesbrough, Open innovation: a new paradigm for understanding industrial innovation, *Open innovation: Researching a New Paradigm* 400 (2006), 0–19.
- [6] Alexander Laszlo, Stanley Krippner, Systems theories: their origins, foundations, and development, *Advances in Psychology-Amsterdam* 126 (1998) 47–76.
- [7] Robert K. Yin, *Qualitative Research from Start to Finish*, Guilford Publications, 2015.
- [8] Marco Iansiti, Levien Roy, Creating value in your business ecosystem, *Harv. Bus. Rev.* 3 (2004).
- [9] Henry Etzkowitz, Research groups as ‘quasi-firms’: the invention of the entrepreneurial university, *Res. Pol.* 32 (1) (2003) 109–121.
- [10] Henry Etzkowitz, Loet Leydesdorff, The Triple Helix—University–industry–government relations: a laboratory for knowledge based economic development, *EASST review* 14 (1) (1995) 14–19.
- [11] Simona Iammarino, Philip McCann, The structure and evolution of industrial clusters: transactions, technology and knowledge spillovers, *Res. Pol.* 35 (7) (2006) 1018–1036.
- [12] Oliver Gassmann, Ellen Enkel, *Towards a Theory of Open Innovation: Three Core Process Archetypes*, 2004.
- [13] Henry Chesbrough, Richard S. Rosenbloom, The role of the business model in capturing value from innovation: evidence from Xerox Corporation’s technology spin-off companies, *Ind. Corp. Chang.* 11 (3) (2002) 529–555.
- [14] Feng Li, Jason Whalley, Deconstruction of the telecommunications industry: from value chains to value networks, *Telecommun. Pol.* 26 (9–10) (2002) 451–472.
- [15] Ron Adner, Rahul Kapoor, Value creation in innovation ecosystems: how the structure of technological interdependence affects firm performance in new technology generations, *Strat. Manag. J.* 31 (3) (2010) 306–333.
- [16] Jon-Arild Johannessen, A systemic approach to innovation: the interactive innovation model, *Kybernetes* 38 (1/2) (2009) 158–176.
- [17] Ron Adner, Match your innovation strategy to your innovation ecosystem, *Harv. Bus. Rev.* 84 (4) (2006) 98.
- [18] Ron Adner, Ecosystem as structure: an actionable construct for strategy, *J. Manag.* 43 (1) (2017) 39–58.
- [19] Jens Frelslev Christensen, Open innovation and industrial dynamics—towards a framework of business convergence, *New frontiers in open innovation* (2014) 94–114.

- [20] Robert F. Lusch, L. Stephen, Vargo, and mohan tanniru. "Service, value networks and learning, *J. Acad. Mark. Sci.* 38 (1) (2010) 19–31.
- [21] James F. Moore, Predators and prey: a new ecology of competition, *Harv. Bus. Rev.* 71 (3) (1993) 75–86.
- [22] David J. Teece, Explicating dynamic capabilities: the nature and micro-foundations of (sustainable) enterprise performance, *Strat. Manag. J.* 28 (13) (2007) 1319–1350.
- [23] Satish Nambisan, Mohanbir Sawhney, Orchestration processes in network-centric innovation: evidence from the field, *Acad. Manag. Perspect.* 25 (3) (2011) 40–57.
- [24] Ronald S. Burt, Structural holes and good ideas, *Am. J. Sociol.* 110 (2) (2004) 349–399.
- [25] Wim Vanhaverbeke, Myriam Cloudt, Open innovation in value networks. *Open Innovation: Researching a New Paradigm*, 2006, pp. 258–281.
- [26] Richard Normann, Rafael Ramirez, From value chain to value constellation: designing interactive strategy, *Harv. Bus. Rev.* 71 (4) (1993) 65–77.
- [27] Clayton M. Christensen, Richard S. Rosenbloom, Explaining the attacker's advantage: technological paradigms, organizational dynamics, and the value network, *Res. Pol.* 24 (2) (1995) 233–257.
- [28] Charles B. Stabell, Øystein D. Fjeldstad, Configuring value for competitive advantage: on chains, shops, and networks, *Strat. Manag. J.* 19 (5) (1998) 413–437.
- [29] Mathew Hughes, R. Duane Ireland, Robert E. Morgan, Stimulating dynamic value: social capital and business incubation as a pathway to competitive success, *Long. Range Plan.* 40 (2) (2007) 154–177.
- [30] Bruce Audretsch, Agglomeration and the location of innovative activity, *Oxf. Rev. Econ. Pol.* 14 (2) (1998) 18–29.
- [31] Arne Isaksen, Building regional innovation systems: is endogenous industrial development possible in the global economy? *Can. J. Reg. Sci.* 24 (1) (2001) 101–124.
- [32] Letizia Mortara, Tim Minshall, "Patterns of Implementation of OI in MNCs." *New Frontiers in Open Innovation*, 2014, pp. 242–255.
- [33] Markku Sotarauta, et al., Local or digital buzz, global or national pipelines: patterns of knowledge sourcing in intelligent machinery and digital content services in Finland, *Eur. Plann. Stud.* 19 (7) (2011) 1305–1330.
- [34] J. Carlos Jarillo, On strategic networks, *Strat. Manag. J.* 9 (1) (1988) 31–41.
- [35] James C. Anderson, Håkan Håkansson, and Jan Johanson. "Dyadic business relationships within a business network context, *J. Mark.* 58 (4) (1994) 1–15.
- [36] Ranjay Gulati, Nitin Nohria, Akbar Zaheer, Strategic networks, *Strat. Manag. J.* 21 (3) (2000) 203–215.
- [37] Allan Afuah, How much do your co-opetitors' capabilities matter in the face of technological change? *Strat. Manag. J.* 21 (3) (2000) 397–404.
- [38] Ulf Andersson, Mats Forsgren, Ulf Holm, The strategic impact of external networks: subsidiary performance and competence development in the multinational corporation, *Strat. Manag. J.* 23 (11) (2002) 979–996.
- [39] Leon Oerlemans, et al., Innovation and proximity: theoretical perspectives, in: R. McNaughton, M. Green (Eds.), *Industrial Networks and Proximity*, 2000, pp. 16–47.
- [40] Leon Oerlemans, Marius Meeus, Frans Boekema, On the spatial embeddedness of innovation networks: an exploration of the proximity effect, *Tijdschr. Econ. Soc. Geogr.* 92 (1) (2001) 60–75.
- [41] Anna Johnson, Functions in innovation system approaches, in: Nelson and Winter Conference, Aalborg, Denmark, 2001.
- [42] Mark Olszen, Michael A. Peters, Neoliberalism, higher education and the knowledge economy: from the free market to knowledge capitalism, *J. Educ. Policy* 20 (3) (2005) 313–345.
- [43] Hans-Joachim Braczyk, Martin Heidenreich, Regional governance structures in a globalized world, *Regional innovation systems* 414 (1998) 440.
- [44] James Karlsen, The role of anchor companies in thin regional innovation systems lessons from Norway, *Syst. Pract. Action Res.* 26 (1) (2013) 89–98.
- [45] Ira Richard Harkavy, Harmon Zuckerman, in: *Meds: Cities' Hidden Assets*, Brookings Institution, Center on Urban and Metropolitan Policy, 1999.
- [46] Charles Dhanaraj, Arvind Parkhe, Orchestrating innovation networks, *Acad. Manag. Rev.* 31 (3) (2006) 659–669.
- [47] Marcel Bogers, Knowledge sharing in open innovation: an overview of theoretical perspectives on collaborative innovation, *Open innovation in firms and public administrations: Technologies for value creation*. IGI global (2012) 1–14.
- [48] Dovev Lavie, The competitive advantage of interconnected firms: an extension of the resource-based view, *Acad. Manag. Rev.* 31 (3) (2006) 638–658.
- [49] Peter Moran, Structural vs. relational embeddedness: social capital and managerial performance, *Strat. Manag. J.* 26 (12) (2005) 1129–1151.
- [50] Brice Dattée, Alexy Oliver, Erkkö Autio, Maneuvering in poor visibility: how firms play the ecosystem game when uncertainty is high, *Acad. Manag. J.* 61 (2) (2018) 466–498.
- [51] David J. Teece, Profiting from technological innovation: implications for integration, collaboration, licensing and public policy, *Res. Pol.* 15 (6) (1986) 285–305.
- [52] Joel West, Wim Vanhaverbeke, Chesbrough Henry, "Open Innovation: a Research agenda." *Open Innovation: Researching a New Paradigm*, 2006, pp. 285–307.
- [53] Mattia Bianchi, et al., Organisational modes for Open Innovation in the biopharmaceutical industry: an exploratory analysis, *Technovation* 31 (1) (2011) 22–33.
- [54] A. Romme, L. Georges, A. Georges, Toward the blueprint of campus-based ecosystems for innovation, *emr* 6 (1) (2017).
- [55] L.S. Sun, V.Z. Chen, S.A. Sunny, J. Chen, Venture Capital as an Ecosystem Engineer for Regional Innovation Co-evolution in an Emerging Market. *International Business Review*, Forthcoming, 2018.
- [56] Sybille Reichert, The Role of Universities in Regional Innovation Ecosystem, *European University Association asbl*, 2019.