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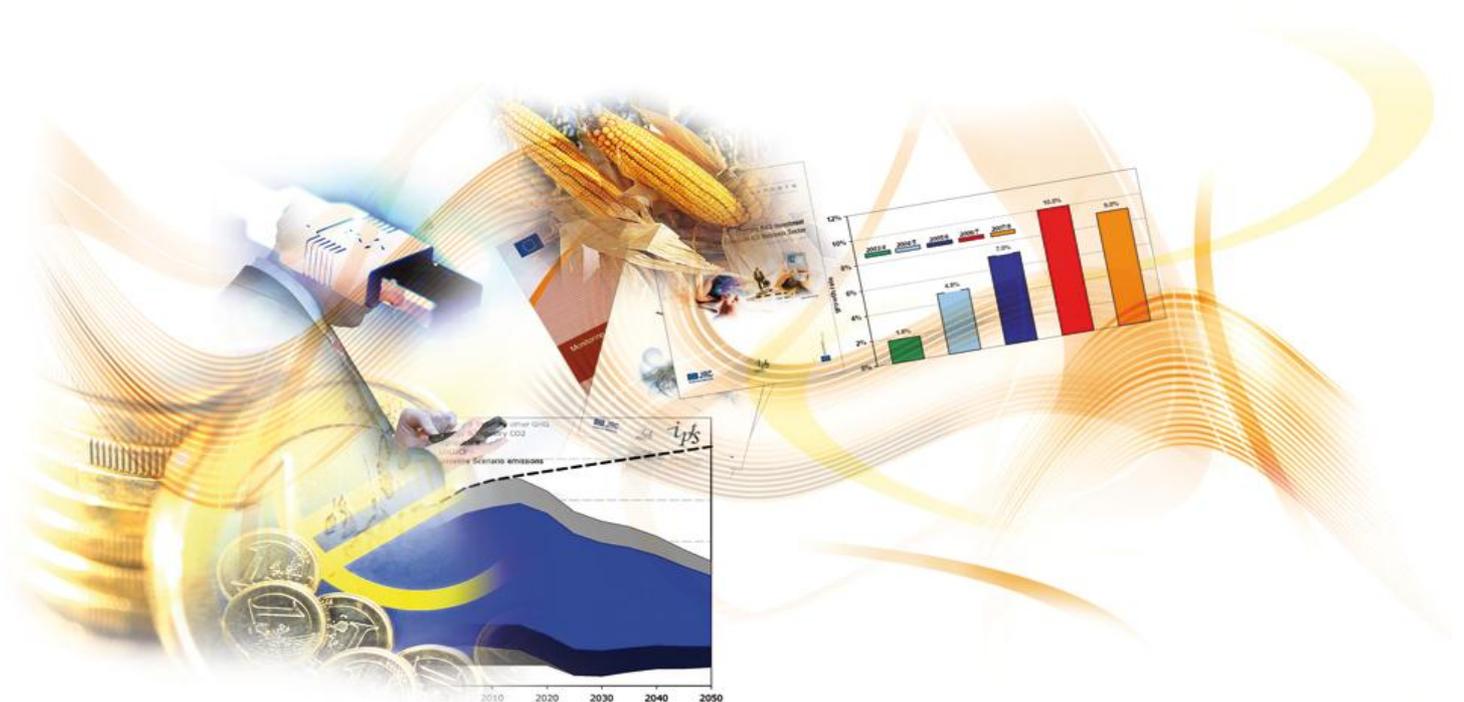
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An Overview of Models of Distributed Innovation

*Open Innovation, User
Innovation
and Social Innovation*

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Abstract

This report discusses models of distributed innovation and how they differ in their nature, effects, and origins. Starting from Open Innovation, the paper analyses its methodological evolution, some of its applications, and the opportunities to apply it in a social context. Open Innovation has gained traction in the last ten years and because of this popularity, Open Innovation has been endowed with numerous meanings. This paper dives into the large literature associated with Open Innovation. First, this paper describes Open Innovation. Second, it explains how Open Innovation has evolved from a linear model of innovation to a model that includes feedback loops. Third, it describes the parallel evolution of Open Innovation and User Innovation, where users are actively involved. This new perspective on the user involvement further contributes to the evolution of Open Innovation into Open Innovation 2.0. Finally, the paper considers the role of Open Innovation in tackling societal challenges and how and if this new innovation process could help Social Innovation to find ways to scale up and reproduce successful results.

Acknowledgements

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Preface

This report was prepared in the context of the three-year research project on European Innovation Policies for the Digital Shift (EURIPIDIS), jointly launched in 2013 by JRC-IPTS and DG CONNECT of the European Commission. Euripidis aims to improve understanding of innovation in the ICT sector and of ICT-enabled innovation in the rest of the economy.²

The project's objective is to provide evidence-based support to the policies, instruments and measurement needs of DG CONNECT for enhancing ICT Innovation in Europe, in the context of the Digital Agenda for Europe and of the ICT priority of Horizon 2020. It focuses on the improvement of the transfer of best research ideas to the market.

EURIPIDIS aims:

1. to better understand how ICT innovation works, at the level of actors such as firms, and also of the ICT "innovation system" in the EU;
2. to assess the EU's current ICT innovation performance, by attempting to measure ICT innovation in Europe and by measuring the impact of existing policies and instruments (such as FP7 and Horizon 2020); and
3. to explore and suggest how policy makers could make ICT innovation in the EU work better.

The present report contributes to the first bullet point, and looks at innovation systems. The project analyses the development of the 'Open Innovation' concept. Current definitions of this term in the literature show that, since it was first coined, it has evolved in many directions.

The growing literature on Open Innovation makes the study of this concept unavoidable in the search for the means to boost innovation. This paper aims to explore the evolution of Open Innovation, its many offshoots and other concepts that developed around the same period. Some contemporary concepts resemble or borrow from Open Innovation and require further description, which can help us understand how each concept may be applied in different situations.

² For more information, see the project web site:
<http://is.jrc.ec.europa.eu/pages/ISG/EURIPIDIS/EURIPIDIS.index.html>

Executive Summary

This report discusses models of distributed innovation and how their nature, effects, and origins differ. Starting with Open Innovation, the report analyses its methodological evolution and some of its applications. It also looks at how it differs from User Innovation and how it can be applied in a social context.

The report starts with Chesbrough's definition of Open Innovation (2003) and analyses how it impacts on the traditional innovation chain and related business models. Looking at the different organizational models and taking into account both pecuniary and non-pecuniary mechanisms, the report contrasts the emerging open business models with the traditional closed innovation ones.

A key characteristic of open business models is that they include in the innovation process interactive co-creation outside the boundaries of the firm. This characteristic of Open innovation is shared with models of User Innovation. This report describes the two contemporary research streams of Open Innovation and User Innovation, highlighting the shared precepts as well as the key differences in values and assumptions about the phenomenon studied.

In both Open Innovation and User Innovation, users may play a role in the definition of the innovation strategy. However, how users are involved in these two models may differ. The centrality of users in the innovation process suggests the possible introduction of these new innovation models in non-profit and public organizations. The report also briefly introduces Social Innovation and discusses how Open Innovation and User Innovation could be used in the non-profit and public organization value creation process.

Latest developments on Open Innovation introduce the concept of Open Innovation 2.0 that encompasses the main precepts of Open Innovation, User Innovation, and Social Innovation.

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1. Introduction

The concept of Innovation System highlights the fact that innovation processes no longer take place within the boundaries of a single organisation. They now involve complex relationships among several players, both private and public, some of which are competitive, while others are collaborative. In this context, information and communication technology (ICT) becomes critical in all aspects of innovation – from product–service innovation, to business model innovation, through to management innovation. Innovation processes are moving towards a more widespread adoption of the Open Innovation paradigm: i.e. they are becoming more open and collaborative. They now involve a diverse global network of partners, customers, and other stakeholders, making ICT a critical enabler of distributed innovation and Innovation Systems.

In this report, we consider the two streams of research on the innovation process that focus on the role of external knowledge: Open Innovation and Open User Innovation. Chesbrough³ defines Open Innovation as *"the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively."*⁴ In other words, the Open Innovation process combines ideas and knowledge internal and external to the firm in order to capture value from the outside. The business model based on this process establishes internal mechanisms to garner this value.⁵ von Hippel defines Open User Innovation (hereafter User Innovation) as models of innovation where *"economically important innovations are developed by users and other agents who divide up the tasks and cost of innovation development and then freely reveal their results."*⁶ Thus, he emphasises the importance of users in the creation of value and its dissemination as free information.

Open Innovation and User Innovation have both overlapping and diverging characteristics. We first discuss a taxonomy⁷ for the two research streams, and then distinguish between Chesbrough's definition of Open Innovation and von Hippel's definition of User Innovation. Specifically, we present how these models differ with respect to how they define the motives for innovation, the innovation process and the commercialisation phase, and the role played by firms in the innovation process.

The report is organised in six sections. First, Section 2 describes Open Innovation and compares it to traditional models of innovation. It analyses how companies adopt Open Innovation (OI) and how OI impacts on the creation of new business models and new approaches to innovation. It explains how OI has evolved from a linear model of innovation to include feedback loops.

³ Chesbrough has been attributed with coining the term Open Innovation but has not been attributed with discovering the method. (Giannopoulou, Ystrom, Ollila, Fredberg, & Elmquist, 2010). However, a study of the origin of the concept by (Dahlander & Gann, 2010) attributes the concept earlier research of von Hippel in 1988. See also Hartmann & Trott (2009) highlight that the method is not new as most of the example predate.

⁴ (Chesbrough et al., 2006)

⁵ (Chesbrough, Vanhaverbeke, & West, Forthcoming Fall 2014) In Chapter 3, Chesbrough and Vanhaverbeke discuss the distinction between the open innovation process and the open business model. They argue that the open business model lives along a continuum and companies may bring in different level of information and innovation from the outside to benefit their value creation.

⁶ (von Hippel, 2005).

⁷ (Scrohll A., 2014) <http://www.open-innovation.net/open-innovation/129-about-the-dispute-between-open-and-user-innovation> and (Duarte V. and Sarkar S., 2011).

Section 3 explains User Innovation models where users become central to the innovation process and how they differ from OI. It also looks at the evolution of innovation communities (e.g. drupal, linux, etc.). Section 4 analyses the role of OI as a tool to enable community participation with a social purpose. OI helps scale up and reproduce successful innovations. Section 5 describes the new concept of Open Innovation 2.0. Section 6 offers conclusions.

2. Open Innovation in the Business Innovation Literature

In his seminal book (2003), Chesbrough contrasts the Open Innovation model with the Closed Innovation model. In the Closed Innovation world, all the stages that lead to an innovation occur within the boundaries of the firm. It is, in fact, a single-company linear model (pipeline from pure scientific research to commercial application). In contrast, Open Innovation allows external ideas to enter the firm's stream of innovation at any stage – external resources (e.g. ideas, patents, etc.) receive the same importance as internal ideas. Similarly, internal ideas can be sent outside the boundaries of the firm, especially if they cannot be exploited inside.

In a forthcoming book (Chesbrough, Vanhaverbeke, & West, Forthcoming Fall 2014), Chesbrough and Bogers underline the importance of using the term Open Innovation precisely. Chesbrough defines *open* as *flowing and unrestrained exchange of knowledge* from one entity to another. *Open* can also mean *free* as in *gratuitous*, however, Open Innovation often coexists with market transactions such as licensing fees.

In the OI context, ideas flow freely to and from an entity without hindrance. While the flow is unhindered, OI always involve multiple actors. One or more actors distribute their research to one or more different actors, who absorb it. However, the process may occur without explicit collaboration between these entities: an entity can integrate, on its own, freely available resources to reach a solution. If the process involves interactions between two entities going back and forth, they can explicitly collaborate (in a two-way coupled process).⁸ In other words, OI does not necessarily imply explicit collaboration, cooperation, and co-creation – though if one company absorbs knowledge or ideas, another entity must have produced them.

Sections 2.1 and 2.2 focus on the development of the OI model. Section 2.3 discusses the different forms of openness. Section 2.4 discusses how OI also affects the service industry and smaller businesses.

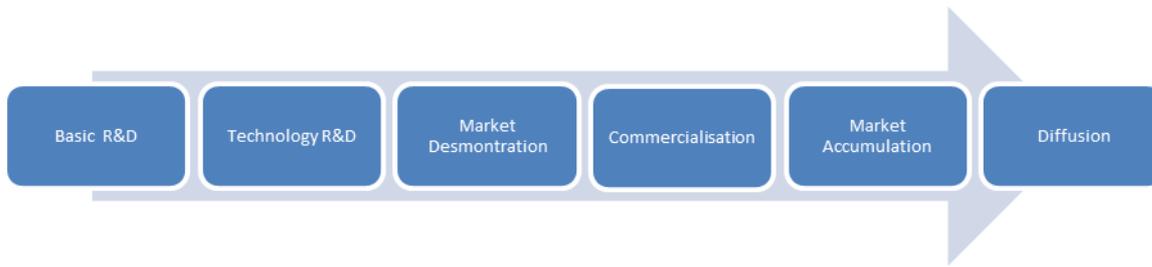
2.1 Closed versus Open Innovation

This section first defines the stages of the innovation process and then introduces how Chesbrough defines Open Innovation in contrast to the Closed Innovation model.

The sequential stages of innovation can be defined as: basic research and development; technology research and development; market demonstration; commercialization; market accumulation; diffusion. Grubb (2004) proposes a sequential six-stage innovation chain, see Figure 1:

⁸ (West & Bogers, 2014).

Figure 1: Steps in the Technological Innovation Process



Source: Wiesenthal et al (2009) citing Grubb (2004)

These stages of innovation have numerous variances in the literature. In the OI context, Hartmann & Trott (2009) use a four-stage innovation model to describe Chesbrough's OI model: the firm (1) discovers, (2) develops, (3) produces, and (4) ships products. West & Bogers (2014) also use a four-stage innovation model to describe the OI model developed by Chesbrough and following models. However, they use different stages: obtaining innovations from external sources, integrating innovation, commercializing innovations, and interaction mechanisms.

This report continues along the same path as Chesbrough and his followers, and uses a four-stage model to develop OI: i) research and development (which includes scientific exploration and technological research); ii) product/services development; iii) marketing; and vi) distribution. Chesbrough focuses his definition of OI on the initial two stages, however, following models discuss how *openness* may affect any of these four stages.⁹

Chesbrough defines OI in two steps: first, he defines Closed Innovation; second, he describes the dichotomy between Closed Innovation and Open Innovation. Closed Innovation assumes a closed vertical integrated process of innovation. The OI concept focuses on firms cooperating across boundaries to create and commercialise innovations and was developed with profit maximization in mind.

Figure 2 illustrates the Closed Innovation model, where all these stages of innovation take place in-house and under the guidance of the firm. The firm is sealed to ideas and influences from the outside and keeps all its own ideas inside. The Nuclear and Military Industries have been used as examples of completely closed industries where "*non-proliferation of technology and protection remain important.*"¹⁰ The closed innovation model thrived in a number of research-driven industries.¹¹

⁹ (Lee, Park, Byungun, & Park, 2010) discuss how Open Innovation may come into play at any level: the R&D, Marketing, Distribution, and inclusion of Component.

¹⁰ (Gassman, 2006) p. 224.

¹¹ For instance, Chesbrough cites General Electric as a firm that followed the closed innovation model, developed their own technologies and products without outside influence. (Chesbrough H. , The Era of Open Innovation, 2003). Others cite Bell Labs/Lucent, Texas Instrument (George, Works, & Watson-Hemphill, 2005) pp. 94-95 or Google Wave as a closed project within a usually open innovative firm (Savoia & Copeland, 2011).

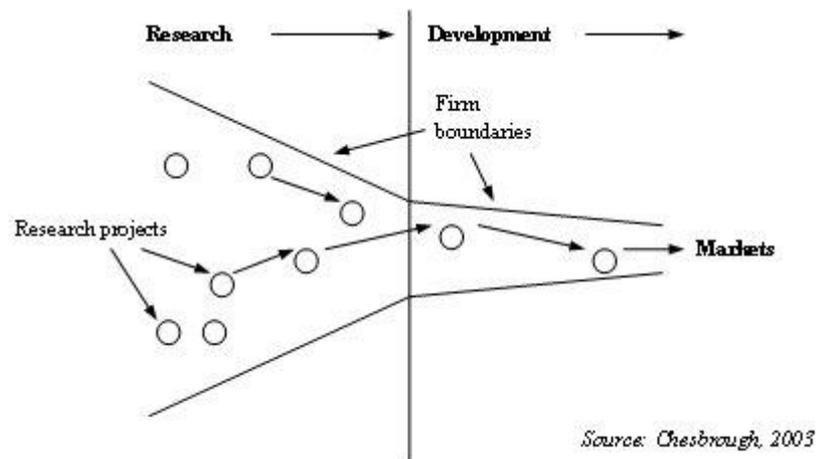


Figure 2: Sequential Closed Innovation

In Open Innovation, ideas and influences from the outside can come in during research and development stages to influence the process. As shown in Figure 3, ideas can also leave the firm during these stages and may be taken up by outside entities.

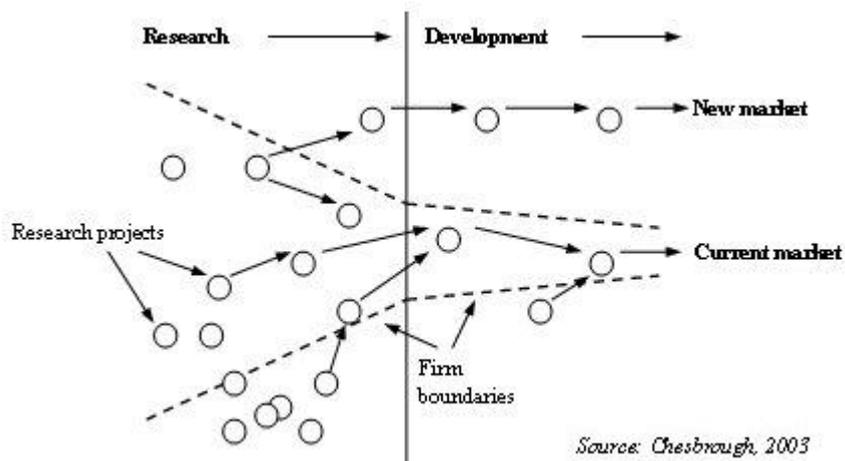


Figure 3: Sequential Open Innovation

In original OI discussion, the sources of ideas and knowledge are universities or research centres, industry participants (such as competitors, customers, suppliers), government entities, and users. See Section 3.2 and Section 5 for a deeper discussion of the involvement of users.

In the third chapter of their book, Chesbrough and Vanhaverbeke (2014) highlight the fact that open and closed innovation are the two extremes of a spectrum along which most business models can be found. The spectrum they describe is a function of how the in-house research and development is involved in product development.

2.2 Subsequent Literature Addition: Beyond R&D, Feedback Loops, and Users.

Following Chesbrough's book, other researchers have furthered the principles of Open Innovation. This section focuses on how subsequent works on Open Innovation have gone

beyond a linear innovation model to introduce different entry points for ideas, feedback loops, and users.

Giannopoulou, Ystrom, Ollila, Fredberg, & Elmquist (2010) argue in their literature review that models of innovation evolve over time through four phases (attributed to Rothwell (1992)):

1. a linear model;
2. interactions between elements and feedback loops;
3. parallel line model (upstream and downstream movement);
4. systems integration and extensive network, and customized responses.

Chesbrough's OI model evolved through these four evolutionary phases. Chesbrough originally defines "Open Innovation [as] a sequential, linear model"¹² looking primarily at research and development (R&D) processes. In this original model depicted in Figure 3, the stages of innovation come sequentially, one after the other, and with solely downward interactions. Later works soon started to integrate loops between the stages of the innovation process, include movement along the supply chain, and embrace users and network effects.

Though West & Bogers (2014) agreed that the OI model followed the above four phases; they suggested however, that this did not necessarily happen in a defined order. West and Bogers researched 291 published papers for "Open Innovation" in the title, keywords, or abstract of the papers. They further narrowed their analysis to articles from the *Financial Times* top 45 research journals. They highlighted the fact that OI changes in the literature from a stylized sequential linear model to incorporate feedback and interaction mechanisms (with influences from external sources at any phase of the innovation process – and not merely at the R&D phase).

The growing academic interest in Open Innovation has led to additions being made to the original OI model. **Figure 4** represents the most recent way Chesbrough has depicted OI. The model remains linear from upstream to downstream; however it now has a number of new elements. It includes four stages of innovation (research, development, manufacturing, marketing) where openness matters, instead of only two (research and development). It also includes coupled processes instead of a unilateral process.

¹² (West & Bogers, 2014).

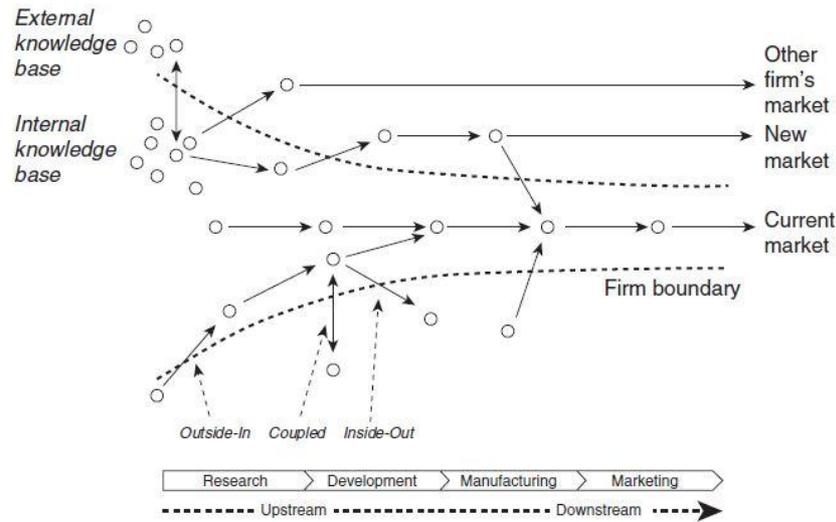


Figure 4: Chesbrough's Latest Definition of Open Innovation
 (source: Chesbrough and Bogers (2014) in Chesbrough, Vanhaverbeke, & West (2014))

Figure 4 shows that though Chesbrough still sees OI as a linear model, this latest version has included feedback from each stage of the innovation process. Figure 5 shows OI including feedback and conversations between all four stages of innovation through the overlap between these stages.

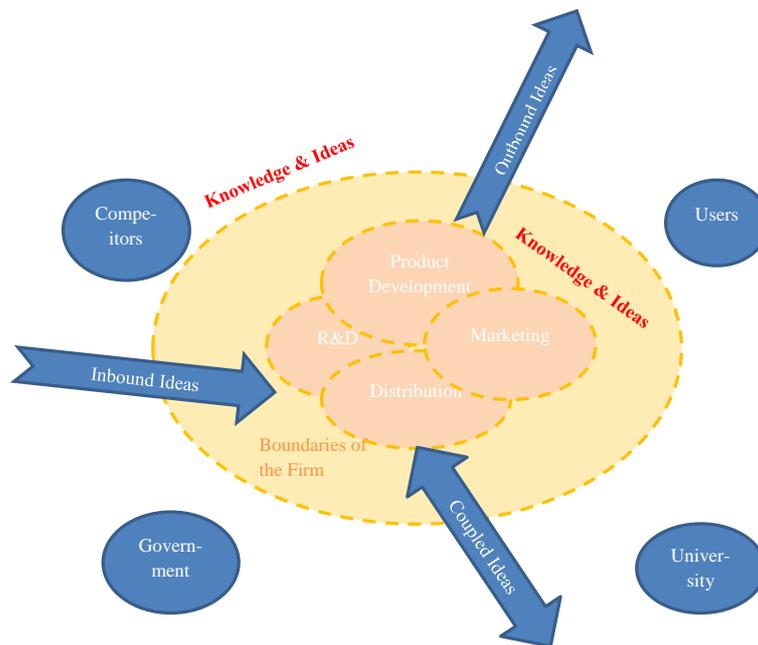


Figure 5: Open Innovation with Feedback¹³

Figure 3 and Figure 5, side-by-side, show the evolution of OI from a sequential, linear process to one including feedback loops, introduction of ideas at any stages of innovation,

¹³ This is a generalization of the model described by Wim Vanhaverbeke, Jingshu Du, Bart Leten, and Ferrie Aalders in Figure 6.1 of Chapter 6 *Exploring Open Innovation at the Level of R&D Projects* from *New Frontiers in Open Innovation* (2014).

and user inclusion. The firm boundaries remain important to ensure that the companies capture the value of the process.

Ideas come in and affect the innovation process at any of the nodes. The different stages of the innovation process interact when the companies allow for feedback loops. Government, universities, competitors, suppliers, and also users come and offer feedback and ideas as well. In this model with feedback, users may be actively involved in the creation process (which is the overlapping characteristic with the User Innovation model discussed in Section 3), although the innovation nucleus remains inside the firm.

2.3 Transfers of Ideas: Different Forms of Openness

Open Innovation allows the "use of sources outside of the entity or group to generate, develop and implement ideas"¹⁴ (outside-in process or inbound innovation). OI also distributes internal resources outside the entity or group to generate, develop and implement ideas outside the entity or group (inside-out process or outbound innovation).¹⁵ When both processes occur together, these entities co-create through alliance, cooperation, and joint ventures (coupled-process). The outside-in process, the inside-out process and the coupled-process represent different forms of openness.

Dahlander & Gann (2010) analysed 150 papers in the Thomson's ISI Web of Knowledge published before September 2009 and catalogued these papers under the four forms of openness detailed below:

	Inbound Innovation	Outbound Innovation
Pecuniary	Acquiring	Selling
Non-Pecuniary	Sourcing	Revealing

Table 1: Different Forms of Openness (Source: Dahlander and Gann (2010)).

Each form of openness has its own advantages and drawbacks. First, **revealing** (non-pecuniary outbound innovation) occurs when firms can reveal their internal research to the external environmental. This revealing helps firms to gain legitimacy in their environment and it also helps to increase the stream of incremental innovations and cumulative advancements. However, companies may struggle to capture revenues.

Second, **selling** (pecuniary outbound innovation) occurs when firms commercialize some of their research either by selling their internal resources or licensing them. This selling benefits firms which gain from commercializing their resources. However, firms have found selling more difficult than expected. They fear disclosing research results will destroy their value and they struggle to assess the value of research. Purchasers fear being locked-in and becoming vulnerable to the selling firm. In addition, negotiations may stumble on transaction costs. Intermediaries such as license-pooling organisations can facilitate transactions between participants and lower the associated transaction costs.¹⁶

¹⁴ As defined by Crowdsourcing.org at: <http://www.crowdsourcing.org/community/open-innovation/1>

¹⁵ (Enkel, Gassman, & Chesbrough, 2009).

¹⁶ (Giannopoulou, Ystrom, Ollila, Fredberg, & Elmquist, 2010).

Third, **sourcing** (non-pecuniary inbound innovation) occurs when firms can use and access external resources after they scan and search the repertoire of available external knowledge. These external resources constitute an important factor of innovation. Yet, firms struggle to search amongst the various knowledge repertoires because they may fail to identify the solution to their problem or if they do not find a solution, they may not recognize when to stop searching. Once they have found relevant external knowledge, they must also have enough absorptive capacity to assimilate this information.¹⁷ Therefore, sourcing (as well as acquiring) does not completely substitute internal research. Firms must create synergy between their internal process and available external knowledge.

Fourth, **acquiring** (pecuniary inbound innovation) occurs when firms can also access resources through the market place. Firms can obtain licenses or acquire expertise from outside. Much like sourcing, firms in this situation must be able to assess the value of solutions offered to them. Thus, they must still have internal expertise. However, they may struggle to select the appropriate outside resource and at the same time maintain a working relationship with the source of their resources.

These four forms of openness and their use also indicate how each company positions itself within the Open-Closed Innovation spectrum. Each form of openness may be used with different intensity. Breadth of openness describes the number of resources searched for and used to produce the innovation. Depth of openness describes the extent or intensity with which each resource is used.¹⁸

Researchers have paid more attention to studying the inbound movement of resources than the outbound.¹⁹ The number of studies on outbound flows of ideas remains limited.²⁰ However, for external research to be absorbed by one entity, it must have moved out from its original source (other firms, academic and government institutions) at some point, making these topics intertwined.

2.4 Open Innovation in Services and Small and Medium-sized Enterprises

Open Innovation was originally conceived as a paradigm shift for large manufacturing companies. These companies were also among the first to adopt Open Innovation as part

¹⁷ "Absorptive capacity amplifies the benefits of external innovation sourcing both on innovativeness and financial performance." (Giannopoulou, Ystrom, Ollila, Fredberg, & Elmquist, 2010).

¹⁸ (Bloch, Ebersberger, & Hersta, 2012) empirically investigate these four forms of openness, described in Table 1: Different Forms of Openness (Source: Dahlander and Gann (2010)). They find the breadth of openness (or extent of the network created through OI) has a statistically significant positive impact upon the probability of creating a new product more than the depth of openness. These results hide that most of the breadth effect upon the probability of creating an invention comes from intellectual property protection. In other words, companies that file intellectual property right protections are more likely to create a new product. Filing an intellectual property right can facilitate licensing or selling of this right – hence a sign of openness; but it also excludes others from using this research – a sign of closure. Whether property right encourages open innovation or forecloses future innovation cannot be extracted from their data and should be further investigated.

¹⁹ (West & Bogers, 2014) find that 36 published papers address Outbound whereas 115 do not. See e.g. (Laursen & Salter, 2006) (empirically investigating, finding a positive impact with diminishing marginal rate of returns, but enable to identify whether information from different sources affect the effectiveness of open innovation).

²⁰ (Bianchi, Cavaliere, Chiaroni, Frattini, & Chiesa, 2011) discuss how pharmaceutical companies commonly use inbound and outbound innovation.

of their innovation strategy.²¹ However, OI has also extended to the service industry²² and Small and Medium-Sized Enterprises (SME).²³

Services differ from manufacturing because they innovate in different ways.²⁴ They involve more consumer interaction from the start, in a process that is not as linear as the manufacturing innovation processes. Indeed, unlike manufacturing, services do not deliver a take-it-or-leave-it product, as service providers tacitly elicit consumers' knowledge and integrate it into their service value web.²⁵ Figure 6 depicts how OI and external ideas affect the service development process.

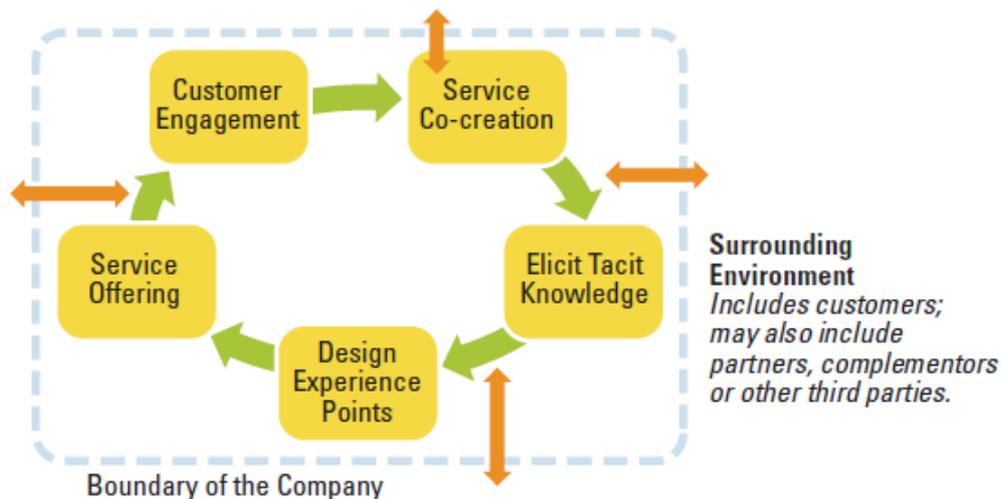


Figure 6: Open Innovation in Services

(Source: Chesbrough (2011) *Creating the Customer's Experience: A Service Value Web*).

Mina, Bascavusoglu-Moreau, and Hughes (2013) empirically estimated how manufacturers and services have employed OI in the United Kingdom. Using a sample of 819 business, of which 67% were manufacturers and 33% were from the service industry, they found that service companies are statistically significantly more likely to engage in OI. They also found that company size has a positive statistically significant impact on business engagement in OI, which is discussed next.

Lack of resources may push SMEs to search for solutions outside the firm earlier than larger companies. However, their size limits the implementation of OI because collaboration with outside firms often means new risks and increased transaction costs.

This explains why Mina et al. (2013) found that larger businesses are statistically significantly more likely to employ Open Innovation measures. Many authors have addressed the lack of adaptability of the Open Innovation model to Small and Medium-sized Enterprises (SMEs).²⁶ For instance, Lee, Park, Byungun, & Park, (2010) investigated the role played by intermediaries in enabling SMEs to achieve the same efficiencies as

²¹ (Chesbrough, H. W., Vanhaverbeke, W., & West, J., Forthcoming Fall 2014). *New Frontiers in Open Innovation*. Oxford University Publishing.

²² "[O]pen innovation has been changing the way many companies think about developing products. But open innovation can – and should – apply to services, too." (Chesbrough H. , *Bringing Open Innovation to Services*, 2011)

²³ See e.g. (Spithoven, Vanhaverbeke, & Roijackers, 2012) using CIS data to investigate and compare the impact of Open Innovation on SMEs and large multinationals.

²⁴ (Mina, Bascavusoglu-Moreau, & Hughes, 2013)

²⁵ (Chesbrough H. , *Bringing Open Innovation to Services*, 2011)

²⁶ (Lee, Park, Byungun, & Park, 2010); (Idota, Bunno, & Tsuji, 2012); (Hutter, Hautz, Repke, & Matzler, 2013).

large firms in applying Open Innovation and information sharing/gathering. Intermediaries act as brokers and alleviate some transaction costs associated with selling and acquiring. They also alleviate some risks because they diminish costly disclosures.²⁷

3. Distributed Model of Innovation: Contrasting Open Innovation and User Innovation

The previous section shows that often innovation no longer takes place within the boundaries of a single organisation. Quite the opposite, innovation tends to be distributed across many stakeholders interacting in a network. As described in Section 2, the Chesbrough paradigm of Open Innovation challenges the traditional model of vertical integration and introduces a distributed perspective on the industrial innovation process. In the same period, von Hippel²⁸ talked about distributed innovation when he contrasted the "producer model" of innovation to the openly-shared "user innovation model." Both authors present models of distributed innovation - that is they agree that knowledge relevant for innovation is widely distributed - and consider the role of users as a source of innovation. However, these authors differ with respect to how they define the motives for innovation, the process of innovation, its commercialisation, and the role played by firms in the innovation process.

Chesbrough's paradigm of Open Innovation is specifically concerned with the economic implications, focusing on exploiting external sources of innovation and commercialisation of innovation. This view of OI does not, however, take into account the value created by bottom-up grassroots communities which focus on the sharing of knowledge for non-profit purposes. This practice is widespread among internet-based communities - not only but mostly in the development of free and open source software.

The limitations arising from the revenue-generating focus and the firm-centric perspective of Open Innovation prompted Chesbrough and those who followed to draw a map of the areas that require further investigation.²⁹ They proposed nine different perspectives³⁰ and suggested developing Open Innovation research, including structural R&D processes of innovation, user and supplier involvement and institutional and cultural issues. In the analysis presented in their forthcoming book,³¹ Chesbrough and co-authors further extend the topics of research to new issues such as Open Innovation in SMEs, high-tech and low-tech industries, no-profit organisations and Open Innovation in public policy. Furthermore, they identify the need to analyse Open Innovation at different levels beyond the firm level.

²⁷ They use the example of the Korean Integrated Contract Manufacturing Service and how their services have helped close this SME-Large-Firm OI gap: these intermediaries help SMEs collaborate; they collect data about members; they provide consulting services during collaboration; and they open markets for SMEs.

²⁸ (von Hippel, 2005).

²⁹ (Gassmann, Enkel, & Chesbrough, 2010).

³⁰ The nine perspectives include: 1) spatial perspective; 2) structural perspective; 3) user perspective; 4) supplier perspective; 5) leveraging perspective; 6) process perspective; 7) tool perspective, 8) institutional perspective and 9) cultural perspective.

³¹ (Chesbrough & Bogers, Explicating Open Innovation: Clarifying an Emerging Paradigm for Understanding Innovation, Forthcoming Fall 2014).

In their latest work,³² Chesbrough and his co-authors further developed the conceptualization of Open Innovation, which they define as "*a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organization's business model*". They also clarify how it overlaps with User Innovation and how it differs. Both Open and User Innovation have an overlapping interest in the role of users in a distributed process of innovation. The involvement of user knowledge in the innovation process requires firms to cooperate beyond their own boundaries. However, in the Open Innovation model, the locus of innovation production remains the firms, while the User Innovation model advocates a decentralization of innovation that changes the locus of innovation from firms to users and leads to the "democratisation of innovation".

The following sections introduce the User Innovation paradigm where user communities (those who get together to create ex-novo or improve a product or service to satisfy a common need) are taken into account. Section 3.2 describes the User Innovation model defined originally by von Hippel and the concept of *democratisation* of innovation, presenting the practical example of Linux innovation communities. Section 3.1 presents the evolution from a Triple to a Quadruple Helix model and introduces the concept of *Open Innovation 2.0*.

3.1 User Innovation

The User Innovation model differs from Chesbrough's firm-centric approach in that it explores user motives for innovation. In the User Innovation model, innovation results from a collaborative and co-creation process, where users share tasks and the cost of developing innovative products and services, and then users freely reveal their results. In other words, the motivation for innovation revolves around the concept of user utility gains rather than pecuniary returns.

According to von Hippel (2013), users are firms or individuals that "*expect to benefit from using a product or a service, in contrast to manufacturers that expect to benefit from selling a product or a service*." Therefore, users who contribute to the development of the innovative product or service (users-innovators) will adapt the innovation to their specific needs. The user-innovators, although they freely reveal the innovation, will receive greater utility from the use of this innovation than free-riders,³³ as the innovation may not completely fulfil the needs of the latter.

The reason for supporting customization of innovations instead of purchasing innovation is that user needs are heterogeneous and therefore may not be fully satisfied by manufactured innovations. Hence, users are willing to develop innovations. In addition, in an efficient innovation system, other users may adopt and further improve the innovation and make it more valuable. This process generates an incentive to freely diffuse innovative products.³⁴ von Hippel and von Krogh define this model of innovation as the

³² (Chesbrough & Bogers, Explicating Open Innovation: Clarifying an Emerging Paradigm for Understanding Innovation, Forthcoming Fall 2014).

³³ "A person who chooses to receive the benefits of a public good or a positive externality without contributing to paying the costs of producing those benefits"

http://www.auburn.edu/~johnspm/gloss/free_rider

³⁴ (von Hippel and von Krogh, 2003).

"private-collective" model that contains elements of both private investment and collective action models.³⁵

The promulgation of the user innovation paradigm has been driven by both the augmented user-friendly design capabilities of new technologies³⁶ and increased efficiency in the use of social media. Internet allows the creation of network systems that lead to a "democratization"³⁷ of innovation, where users can themselves create innovative products and services thanks to user-friendly technologies. The democratization of innovation does not only apply to information products, such as software, but also to physical products.³⁸ As shown by the empirical literature, users largely contribute to the development and modification of commercially attractive products (Franke and von Hippel, 2003). The benefits of User Innovation span from complementing the traditional innovation chain of the producing sectors to consideration of social welfare, where the freely available innovation positively affects society in the same way as free, accessible public goods.

3.1.1 Innovation Communities

The distributive models of innovation presented so far (i.e. OI and UI) show that the innovation process is not restricted to the exchange or flow of knowledge beyond firm boundaries for the development of innovative marketable products. It also includes any non-monetized knowledge spillovers between rivals that play a crucial role in advancing technological progress and thus in improving societal welfare.³⁹ An additional stream of research into distributed model of innovation is Cumulative Innovation (CI).⁴⁰

Cumulative Innovation focuses on the importance of non-monetised knowledge spillovers. These are essential for both the incremental and radical progress of technological innovation and hence for the improvement of social wellbeing. The knowledge spillovers from firms can be involuntary and they can also originate from co-creation processes, like those that take place in "innovation communities" in which users cooperate to successfully combine and leverage their efforts. These communities, particularly those which are developing *open* source software, are a practical and visible example of this innovative process. In this perspective, the meaning of *open* lies more in cooperation and co-creation than simply in the exchange of knowledge.

Innovation communities represent a good example of the intersecting characteristics of the model of distributed innovation presented above. As with OI, innovation communities include the exchange of knowledge flow. For UI, innovation communities highlight the centrality of the users and non-pecuniary motivation for innovation. Finally, from the

³⁵ Ibidem.

³⁶ For example, the creation of graphic interface that allows an intuitive use of complex operating systems.

³⁷ (von Hippel, 2005).

³⁸ For sporting goods, see Nikolaus Franke and Sonali Shah, "How communities support innovative activities: an exploration of assistance and sharing among end-users," RESEARCH POLICY 32 (1), 157-178 (2003) and Christoph Hienerth, "The commercialization of user innovations: the development of the rodeo kayak industry," R&D MANAGEMENT, 36 (3) 273-294 (2006). For computer synthesized musical instruments, see Lars B. Jeppesen and Lars Frederiksen, "Why Do Users Contribute to Firm-Hosted User Communities? The Case of Computer-Controlled Music," ORGANIZATION SCIENCE, 17 (1), 45-63 (2006).

³⁹ (Borges & West, 2010)

⁴⁰ Cumulative Innovation, together with Open Innovation and User innovation, is a stream of research on distributed innovation model. The analysis of innovation creation and commercialization as spanning firm boundaries (or outside them entirely) concentrates in three major streams of research: User innovation (UI) (von Hippel, 2005), Cumulative Innovation (CI) (Scotchmer, 2004; Murray & O'Mahony, 2007) and Open Innovation (OI) (Chesbrough, 2003, 2006).

perspective of CI, innovation communities develop around the use of non-monetized knowledge spillovers. Much of the research into online communities suggests that the nature of these communities, with their permeable boundaries and self-organization, makes them a powerful new *locus* of collective creativity and innovation. (Lee & Cole, 2003).

Box 1 describes the well-known Linux development innovation community.

Box 1: The Linux Community

One of the most well-known examples of new collaborative business models can be found in the development of the open-source operating system Linux. Linux is a self-organised open-source community founded in 1991 by Linus Torvalds. In twenty years, the Linux software-developer community grew considerably, reaching 3,500 participants in 2008. The division of labour in the Linux community is managed mostly collectively. The basic model of participation is based on user needs and willingness to cooperate. The community work on an open platform to collaboratively resolve technical issues related to Linux development. The development of the software is determined by the actions of community members and although Torvalds has the final say on it, there is no explicit project management within the community.

According to the Linux foundation - a non-profit technology consortium chartered to foster the growth of Linux (<http://www.linuxfoundation.org/about>) - the value of Linux in 2008 was about \$10 billion. This proves how alternative business model based on different organisation of work (self-selection of tasks, lack of ex-ante guidance and control, collective strategic decision) can be successful. The latest development shows that Linux, although not popular in the desktop segment, is the leading operating system in the area of supercomputing and cloud-computing. Furthermore, not only did the Linux Foundation bring together under its leadership the biggest competitors on the market with the common purpose of improving the Linux system, but the foundation also inspired other open-source projects such as Facebook's Open Compute Project that brings open-source methodology in data centres:

"The Open Compute Project Foundation is a rapidly growing community of engineers around the world whose mission is to design and enable the delivery of the most efficient server, storage and data center hardware designs for scalable computing. We believe that openly sharing ideas, specifications and other intellectual property is the key to maximizing innovation and reducing operational complexity in the scalable computing space. The Open Compute Project Foundation provides a structure in which individuals and organizations can share their intellectual property with Open Compute Projects." (From the Open Compute Project website - Mission and principles section-<http://www.opencompute.org/about/mission-and-principles/>)

3.2 Triple to Quadruple Helix: the Involvement of Users and The Second Generation Open Innovation.

The literature on models of innovation ultimately connects to the macro analysis of Innovation Systems. In this section, we recall the Triple Helix concept introduced by Etzkowitz in the 1990s and we analyse its connection to OI.

The Triple Helix concept of university-industry-government relationships resulted from "*the shift from a dominating industry-government dyad in the Industrial Society to a growing triadic relationship between university-industry-government in the Knowledge Society.*"⁴¹

Knowledge societies have "*capabilities to identify, produce, process, transform, disseminate and use information to build and apply knowledge for social development. They require an empowering social vision that encompasses plurality, inclusion, solidarity and participation.*"⁴² ICT technologies have created the conditions for the emergence of knowledge societies.

In the Knowledge Society, innovation has expanded from an internal process within and among firms to an activity that often occurs in other institutional spheres such as universities and governments. The Triple Helix thesis is that the potential for innovation and economic development in a Knowledge Society lies in the hybridisation of elements from universities, industry, and government to generate an Innovation System that encompasses the function of knowledge production, knowledge transmission, and knowledge transfer. The Triple Helix concept is proposed for modelling this interaction process and the evolution of the triad structural adjustments.

The increased interdependence of the business sector and public research institutions corresponds to critical changes to the innovation process, which are at the basis of the Open Innovation paradigm. Indeed, Ranga and Etzkowitz use the Triple Helix concept as an analytical framework to explain the interaction between knowledge flows and the development of an Innovation System.

As mentioned before, the original interpretation of OI involved a Triple Helix of players⁴³ in which users were not included. On the other hand, users are at the core of the innovation model proposed by User Innovation. This shortcoming of OI has led to the new concept of *Open Innovation 2.0* that integrates aspects of User Innovation. In *Open Innovation 2.0*, Curley & Salmelin (2013) put forward a new model, the *Innovation Network Systems* model, which is "*based on extensive networking and co-creative collaboration between all actors in society, spanning organizational boundaries well beyond normal licensing and collaboration schemes.*"⁴⁴ Civil society involvement in Open Innovation 2.0 follows the evolution of the Triple Helix innovation system into a Quadruple Helix innovation system (i.e., including the user), where "*the innovation trials and scale-up can happen more successfully due to strong engagement of citizens.*"⁴⁵ This concept will be furthered analysed in Section 5.

⁴¹ (Ranga, M. and H. Etzkowitz, 2013).

⁴² See Communiqué of the Ministerial Round Table "Towards Knowledge Societies", organized during the 32nd session of the General Conference of UNESCO, Paris, 9–10 October 2003 (document 32 C/INF. 26, para. 3), <http://unesco.org/images/0013/001321/132114f.pdf>

⁴³ (Giannopoulou, Ystrom, Ollila, Fredberg, & Elmquist, 2010).

⁴⁴ (Curley & Salmelin, 2013) p. 5.

⁴⁵ (Curley & Salmelin, 2013).

4. Social Innovation

Open Innovation and User Innovation are also developed, disseminated, and enforced through the creation of communities with a specific social connotation, either as regards their objectives or their means. Social Innovation refers to new ideas, institutions, and innovation processes that meet societal needs through new forms of civic participation and collaboration.

The challenge of Social Innovation is to involve society itself in finding alternative and novel ways to face current societal challenges such as climate change, epidemics, increasing inequality, and poverty. Social Innovation exploits Internet network effects and Internet collaborative power to harness the collective intelligence of communities in order to tackle these social challenges.

The theory is that citizens, enabled by ICT technologies, can "*develop awareness, forming a distributed intelligence constantly enhanced, coordinated in real time, and resulting in the effective mobilization of skills to tackle societal problems.*"⁴⁶

A major challenge for society is to scale up successful Social Innovations once they have been validated at local level or the pilot stage. Distributed innovation models, by which we mean both Open Innovation and User Innovation models, can act as scaling factors able to extend the network of influence far beyond the original innovators' networks.⁴⁷

Distributed innovation models, and in particular User Innovation models, are characterised by transparent communications, collective decision-making processes, distributed actions, and voluntary involvement.⁴⁸ That is, they offer an alternative strategy to reframe scaling issues and expand the social impact of innovative solutions to societal challenges. For example, the adoption of distributed models in social contexts can help empower the people benefiting from social programs and transform these people into active co-creators of innovative solutions. This approach, like in the User Innovation model, will allow the beneficiaries to develop ad-hoc solutions with greater possibility of success. In fact, the involvement of users on a voluntary basis in the co-creation process reinforces people's recognition by their communities, increases motivation and commitment, and results in the development of more solid innovation practices.

Moreover, the open environment, in turn, facilitates the replication and the adoption of similar experiences throughout different communities, enhancing the final impact of the social innovations adopted.

4.1 Systemic Innovation

The ultimate goal of Social Innovation models is systemic innovation.⁴⁹ Systemic Innovation typically entails fundamental changes to the social system, affecting many elements which shape society: e.g. social movements, business models, laws and regulations, data, infrastructures, and the development of new frameworks and new ways of thinking and acting.⁵⁰ For systematic changes to happen, it is also necessary to meet or

⁴⁶ (Bria, 2014)

⁴⁷ (Clay and Roshan, 2012)

⁴⁸ (OECD, 2011) Fostering Innovation to Address Social Challenges

⁴⁹ (Murray, Caulier-Grice, & Mulgan, 2010)

⁵⁰ (Davies, Mulgan, Norman, Pulford, Patrick, & Simon, 2012)

create new conditions to make the innovations valuable. These conditions include three essential ingredients: new regulatory frameworks, new institutional forms and the full access to new technologies.

Systemic innovation is very different from innovation in products or services as it refers to radical changes to the fundamental social systems on which society depends, such as healthcare, education, labour market, provision of public services, etc. It can be pushed forward by the advent of a disruptive technology, such as the Internet, and its results usually involve changes in infrastructures, behaviours and cultures. Examples of systemic innovation are the transformation of public services such as the collection and recycling of household waste and on-demand public transport services. which ultimately aim to reduce traffic and pollution. Other examples are innovations in the payment system like those introduced by the bitcoin, or in government such as the Open Ministry in Finland (that uses crowdsourcing to allow citizens to draft legislation that is later debated by the Parliament). For these innovations to scale-up and succeed technological innovation (i.e. the services are regulated by interactive open platforms) is necessary, as well as infrastructural and cultural changes.

The full exploitation of new technology capabilities and future internet requires an open distributed infrastructure able to leverage the potential of bottom-up social innovations. There are several examples of social innovation collaborative initiatives in an open context: Smart Cities, Open Data, Living Labs, time banks and digital currencies, new models of urban mobility, new models of collaborative consumption and also collaborative events such as BarCamps, Open festival, competitions etc.

Distributed innovation and User Innovation, in particular, could play a fundamental role in facilitating the emergence of creativity and grassroots civic innovations, which in turn might lead to systemic innovation. User Innovation can be seen as a way to better link disruptive and cumulative innovation to achieve systemic innovation.

5. Further Development of Open Innovation: Open Innovation 2.0

Curley and Salmelin have brought together the concepts of Open Innovation, User Innovation and Social Innovation in new a model they call Open Innovation 2.0 (OI2).⁵¹ In their model, the authors emphasise three main points.

First, they look at collaboration between competitors. This goes beyond joint ventures: interdependent competitors work together to find solutions and develop new products (mashed-up products of multiple concepts and ideas).

Second, the authors introduce the user as an integral member of the innovative process. The user, the fourth element of the quadruple helix, intervenes earlier in the innovation process to experiment, even before the innovation reaches the pilot stage, and actively participates in the co-creation of new markets for innovation. According to the authors, the co-creative process embedded in the quadruple helix approach leads to a win-win situation,

⁵¹ (Curley & Salmelin, 2013). Open Innovation 2.0 should not be confused with the previously term Open Innovation 2.0 that refers to a collaborative model of innovation where innovator share the solution (Grove, 2008) or open innovation enabled by internet tools and enabling user involvement in the innovation process (Milleder, 2010).

as users get the products and services they need, and the suppliers get scalable products and services. This allows immediate feedback on which innovation is successful. This enhances the probability of successes, speeding up the scalability and quickly dismissing innovation in unsuccessful areas.

Third, the authors highlight the fact that intermediaries must connect value networks to form value constellations. They point out that interdisciplinary approaches must be taken that go beyond the traditional boundaries of disciplines such as ICT, chemistry, or mechanics, which should be mixed together.

That is, OI2 *"is a mash-up parallel process where the public policy maker needs to create the framework for this interaction (mash-up) to happen. OI2 is genuinely intersectional as innovation often happens in crossroads of technologies and applications and is not linear extrapolation of past.*

*To speed up the scalability all stakeholders need to co-create the solutions/find the innovations together, in real world settings. Only then we have a strong driver to create new markets and services, and are able to scale up successes fast. There is inherent buy-in in this kind of innovation environments. On the other hand by involving end users as co-creators upfront and seamlessly we see very fast the less successful experiments and prototypes failing; "failing fast, scaling fast" is actually one of the strongest advantages of Open innovation 2.0."*⁵²

The distinctions between these processes are summarized in Table 2:

Closed Innovation	Open Innovation	Open Innovation 2.0
Dependency	Independency	Interdependency
Subcontracting	Cross-Licensing	Cross-Fertilisation
Solo	Cluster	Ecosystem
Linear	Linear, leaking	Mash-up
Linear subcontracts	Triple Helix	Quadruple Helix
Planning	Validation, pilots	Experimentation
Control	Management	Orchestration
Win-lose game	Win-win game	Win more-Win more
Box thinking	Out of the Box	No Boxes!
Single entity	Single discipline	Interdisciplinary
Value chain	Value network	Value constellation

Table 2: The change and drivers of the innovation paradigm (Source: Salmelin 2013 Table 1)⁵³

The authors argue that OI2 and the embedded Quadruple Helix model where the research community, industry, public sector and citizens are all active actors "create a win-win situation as it is targeting to create new markets and fast upscaling of the successful solutions."⁵⁴

⁵² (Salmelin, 2013).

⁵³ (Salmelin, 2013).

⁵⁴ Ibidem.

6. Conclusion

This report described models of distributed innovation, analysing Open Innovation, User Innovation, and Social Innovation. These models share similarities but differ with respect to their approaches and main objectives. Open Innovation essentially focuses on profit; User Innovation on user wellbeing; and Social Innovation on societal improvement.

Despite the growing literature on innovation models in general and Open Innovation in particular, there is still a need to carry out research on specific issues in order to describe and guide the changes in the innovation paradigms.

More research is needed to understand how firms should select the correct theoretical model within a specific innovation ecosystem. For instance, SMEs wishing to carry out successful Open Innovation may require the intervention of intermediaries. Another example is that high-tech and low-tech environments may require different Open Innovation strategies. This and other observations have researchers wondering when these models can successfully encourage innovation.

In addition, the contemporary Open Innovation and User Innovation research streams need to be better categorised. As well as, there is a need to further explore the emergence of new business models characterized by strong user involvement in all stages of innovation and by less profit-driven reasons to innovate. As for example, in the case of Open Source models.

Furthermore, though Open Innovation strategies have also been adopted by the public and non-profit sector, very little research has been done on the social impact of these practices and only at the most general level. Indeed, an additional level of analysis of Open Innovation at the individual, firms and society level could help us better understand how to encourage the adoption and scale-up the success of local innovation in order to set higher goals and help policy makers to face the current societal challenges.

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