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# Open Innovation Dynamics in an Entrepreneuship Ecosystem

## The Case of Healthcare Industry in Boston

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**Abstract**
The purpose of this study is to evaluate the dynamics of Open Innovation related to the healthcare industry in Boston for the sake of helping firms successfully identify, get, and use external sources of innovation. As companies are challenged by an increasing competition, the globalization of R&D, and technological complexity, adapting their innovation strategy has become critical. The authors identified the Open Innovation strategy to help tackle these challenges, and sustain market position and steady growth. By observing the ecosystem and the practices developed in Boston, he had an overview of the dynamics of Open Innovation in an innovation cluster for life science. In addition, based on case studies of large companies and semi-structure interviews of industry experts, the authors gathered the main practices and successful factors in order to implement this innovation strategy. The results demonstrate the main systems used to capture external sources of innovation, the importance of the organizational structure and culture changes, and the implications of top management as well as a process to support and accelerate decision-making. The analysis has proven that Open Innovation Strategy is well aligned with healthcare companies' vision and its implementation should only increase within the next 5 years.

Key Words: Open Innovation, innovation strategy, collaboration, ecosystem, innovation clusters, corporate innovation, technology intelligence, technology scouting, healthcare

## 1. Introduction

Today, the healthcare industry is facing unprecedented changes. Companies are challenged by an increasing competition, the globalization of R&D, and technological complexity. Therefore, their ability to innovate and stay competitive is becoming more critical (Reid, 2009). Information technology has been rising over the past years, allowing organizations to share knowledge and ideas easily and at a greater speed around the world. Subsequently, competitors come from all over the world, opportunities have increased and the business environment has become highly complex (Dogson, Gann, Salter, 2006). Traditional businesses are facing times of uncertainty when it comes to keeping their activities running as they have been for decades. Even companies with a strong market position run the risk of losing their market power when competitors introduce radical innovations characterized by a disruptive technology which significantly improve existing products. This process is called "creative destruction" or "disruptive innovation" (Schumpeter, 1942; Tidd, Bessant & Pavitt, 2005). Existing business models in diverse industries reach maturity, therefore, deliver slower growth. As startups create disruption with their new solutions, corporations more than ever need to create new businesses. In addition, in an era of extremely distributed knowledge and augmented rate of development, firms cannot rely on their own research, and subsequently must use external sources and buy or license technology, processes, inventions and solutions (Traitler 2009; Traitler and Saguy 2009).
Open Innovation (OI) is a common term defined by Chesbrough (2003) which involves that firms should use inflows and outflows of knowledge; this quickens internal innovation as well as enlarges the markets for external usage of innovation when companies look to advance their technology. The era of Open Innovation has just begun, and several researchers are studying this new paradigm and specify the relevance of this new innovation paradigm and why it is stimulating for organizations of any size to look into the processes of Open Innovation and learn about how they can gain from it. (Enke et al., 2009; Lindegaar 2011),
Moreover, studies on Technology Management emphasized the relevance of staying well-informed with technological development by implementing Technology Intelligence (TI) strategies to help companies become aware of technology opportunities and threats by identifying and delivering technological information to decision-makers through systematic activities (Kerr, Mortara et al. 2006). Amongst these activities, Gassmann and Gaso (2006) introduced the "listening posts" in innovation clusters to better access knowledge in the local "Buzz".
Studies have shown that the firms are facing risks connected to Open Innovation activities, such as: loss of knowledge, higher coordination costs, loss of control, and higher complexity (Enkel et al., 2009). Another challenge encountered is the proper selection of the location, institutions or organization where a firm will scan technology, access specific external knowledge and collaborate to foster innovation.

As this research is focused on the Healthcare Industry, Boston has been selected because it is one of the best innovation ecosystems for healthcare in the world. The concentration of big companies and world-class universities, the advanced development of its startup ecosystem, the public and private investments, and Boston's collaborative nature, all create an atmosphere of excellence. Open Innovation is part of the city's DNA. Boston is an epicenter for Life Sciences (Kristner s., 2016).

## 2. The Phenomenon: Closed and Open Innovation

The paradigm of closed innovation has been utilized during most of the 20th century among most of the companies. Conventionally, closed innovation was seen as very important for firms in order to have a sustainable development. Companies would generate their own ideas, and develop them throughout the entire process. Therefore, enterprises manufacture their ideas, finance them, market them, support them, service them on their own (Chesbrough, 2003). As a technology monopoly can present high trade barriers, organizations favor their own laboratories with enough resources to assure a monopolistic status in the market (Chesbrough, 2004).

Once closed innovation cannot meet the demands of innovation activities anymore, Open Innovation appears. Open Innovation is an innovation strategy, which has been one of the most-debated in management research over the past decade (Chesbrough, 2003; Gassmann, 2006; West and Gallagher, 2006). The term Open Innovation has first been introduced by Chesbrough (2003). It represents an essential change in the way firms innovate and bring products to the market. In contrast to the old paradigm, which assumes that innovations should be developed within the companies' boundaries, the Open Innovation paradigm is opened for external ideas and paths to market (Chesbrough, 2006). It explains the relevance of flows of knowledge and information within the innovation process.

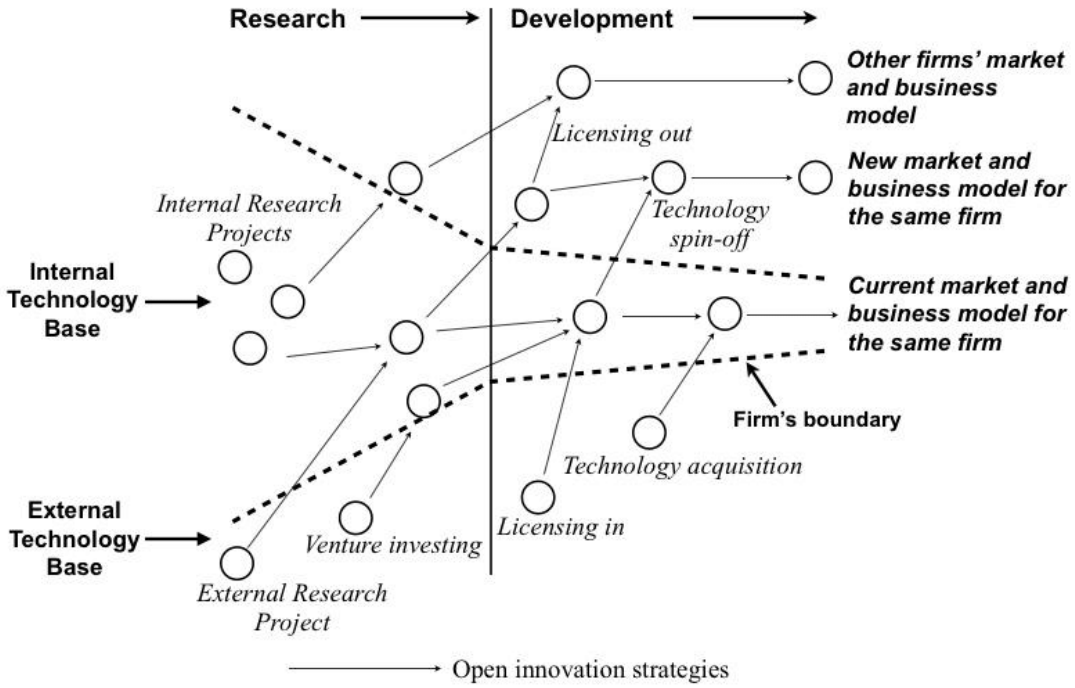


**Figure 1 Open Innovation paradigm adapted from Chesbrough (2003) by Ramos (2014)**

As demonstrated in figure 1, information flows across a firm's boundary inwards and outwards. Through these flows, companies can benefit from external knowledge to get new offerings as well as internal knowledge in outside collaboration within new business models. Thus, it allows firms to explore more opportunities through inward and outward flows as globalization and the information technology have facilitated the exchange of sources of information around the globe (Chesbrough, 2003).

### 2.1.1. Open Innovation Processes

Open Innovation can be performed in different approaches as it mainly depends on the firm's needs, resources and market situation (Lindegaard, 2011). Three different Open Innovation processes have been encouraged. The first is the outside-in process covers activities that enriches the resources base of the firm by bringing external knowledge inside the company. The second is the Inside-out process which focuses in bringing the firm's knowledge outside the company's boundary to be introduced by external parties. The third process is called coupled, which combines both outside-in and inside-out, while inside out is divided into outward IP-licensing and venturing (Gassman and Enkel, 2004; Enkel et al., 2009)

### 2.1.2. Outside-in

This process is defined by enriching the company's knowledge base using integration of external knowledge sourcing practices. Thus, it increases le level of innovativeness of a firm (Lauren and Salter, 2006). The sourcing mostly comes from consumers, competitors, suppliers, academic institutions and commercial research institutions. There is an increasing awareness of the relevance of innovation networks (Chesbrough and Prencipe, 2008; Enkel, 2010). New forms of external participation have emerged such as crowdsourcing (Howe, 2008). A significant part of this processes is the firms' absorptive capacity described by Cohen and Levinthal (1990) as "The ability of firms to recognize the value, of new, external information, assimilate it, and apply it to commercial ends and its innovative capabilities". Among this process, the outside-in involve different external as well as internal parties such as external networking, external participation, crowdsourcing, customer and user involvement, outsourcing R&D, and inward IP-licensing.

### 2.1.3. Inside-out

This process is described by earning profits by utilizing internal knowledge toward other markets and share unused ideas with other companies through venturing and outward IP licensing (Chesbrough, 2012). By transferring ideas to other companies, the firm moves strategically and no longer restricts its activities to the markets it usually serves (Enkel et al., 2009). Thus, it contributes in other segments using joint ventures, spin-offs and licensing fees to create more revenue from innovation (Lichtenthaler and Ernest, 2007). This process raises awareness of corporate venturing activities and new business model such as spin-offs and new ventures (Chesbrough, 2007; Vanhaverbecke et al., 2008). The most common concepts are venturing and Outward IP-licensing.

### 2.1.4. Coupled

This strategy captures benefits by connecting outside-in and inside-out process to jointly develop and commercialize innovations. It refers to co-creation with strategic partners through cooperation, alliances, and joint ventures. Within this process, give and take are critical to succeed (Enkel et al., 2009). Co-creation is broadly discussed in the Open Innovation management literature. Derivative from open source project management, OI focuses on peer-creation through communities, lead users, consumers, universities, research organizations, and partners from same industry as well as other industries (von Hippel E., 2005; von Hippel and von Krogh, 2006; Enkel et al., 2009). The coupled process is further divided in two diverse processes called passing-on and boomerang depending on the sources of ideas generated

whether outside or inside the firm's boundaries. Introduced by Holmen et al. (2010), passing-on is a process where ideas start as an outside-in process and cross the firm's boundaries several times. It allows external knowledge to flow into a company to be further developed and sent outside of the firm's boundaries back to the originating firm or to other companies (Lind et al. 2012). Boomerang is the process where ideas start as an inside out process and flow out to another company. Ideas can be modified or enriched and flow back to the firm as an outside-in process (Chesbrough, 2012)

## 3. Literature Review

As this study focuses on helping firms successfully identify, get and use external sources of innovation by evaluating the dynamics of Open Innovation related to the healthcare industry, the authors center the literature on the ways to access external sources of innovation and implement this strategy within the firm. Therefore, the research questions are concentrated on identifying and using external sources within the company involving the firm's structure changes as well as implementing processes to effectively use the sources.

*What are the dynamics of Open Innovation in Boston and how should corporations adjust their organization to Benefit from this strategy?*

Sub questions:
Where and how do firms look for external source of innovation? What are the important factors to assess the ecosystem relevance linked to the companies' objectives? What are the implications for company's culture and structure to successfully implement Open Innovation strategy?

Thus, the literature explores external sources of innovation to acknowledge the most common techniques as well as the importance of technology intelligence to manage knowledge flows coming from exploration and innovation clusters.

### 3.3. External Sources of Innovation and Knowledge Management

The concept of technology intelligence is developed to capture information and deliver intelligence. On one hand, it discusses how companies can identify knowledge and, on the other hand, how knowledge can be transferred in firms. First, the usage of a conceptual model explaining technology intelligence is of higher importance in this thesis to map a process from the input, technology gaps and needs, to the output, intelligence for decision makers in a firm. Then, as empirical evidence demonstrates that companies implementing Open Innovation necessitate the establishment of wide networks of inter-organizational relationships with many external parties such as research institutions and universities (Perkmann and Walsh, 2007), users (von Hippel, 2005), suppliers (EmdenGrand et al., 2006), to access source of innovation, the authors has decided to focus on the most commonly used practices in the healthcare industry: technology scouting, listening posts, crowdsourcing, user innovation, Industry-research collaboration, startups to access sources of innovation.

### 3.3.1. Technology Intelligence

Capturing and delivering technological data is defined by the concept of technology intelligence. The purpose is to include this process into the firm's strategy to develop knowledge of technological threats and opportunities (Kerr et al., 2006). It is also significant for strategic planning to identify trends and technology development in time (Lang & Mueller, 1997). By developing successful technology intelligence processes, firms will quickly answer radical trends (Lichtenthaler, 2004). Technology intelligence demonstrates how companies capture information and process it to deliver intelligence. The verb Capture emphases on collecting, categorizing, storing, and retrieving information. And the verb Deliver describes the process of analyzing, interpreting, disseminating, and turning information into intelligence. (Kerr et al. 2006). It is facilitated by a conceptual process, which includes all the necessary processes involved to operate technology intelligence system, see figure 2. The process is iterative and contains six phases. In coordinate phases, decision-makers refine the search goals and ideas are generated. Search, filter, and analyze phases form their own cycle inside the process until a substantial level of information is attained. Then, the firm's employees assigned to these tasks document the findings and disseminate the knowledge throughout the firm to help decision-makers (Kerr et al. 2006, Mortara et al. 2009).

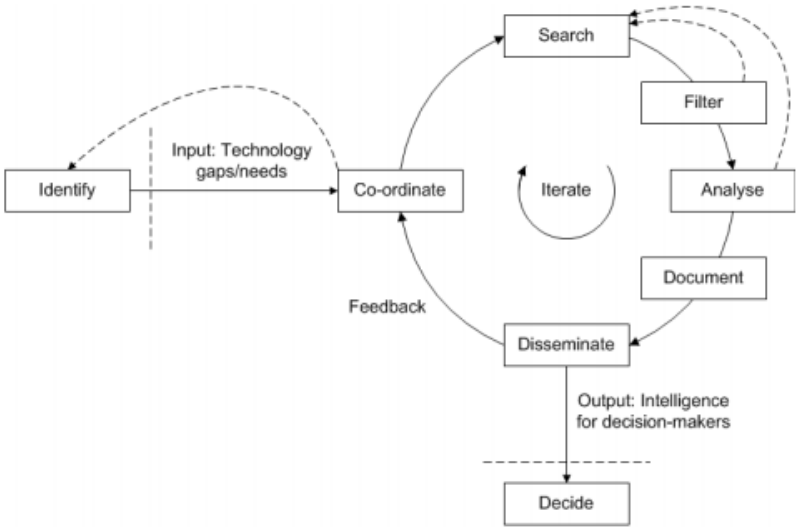


**Figure 2: The system operating cycle by Kerr et al. (2006)**

Technology Intelligence is a significant organization's activity to stay well-informed about technological developments. To enhance the company's ability to perform TI successfully, technology scouting practices and listening posts in innovation clusters are encouraged (Dang et al. 2010).

### 3.3.2. Technology Scouting

According to Rohrbeck (2007), Technology Scouting is an approach whereby companies assign their own employees or hire external intermediaries to gather information. It is perceived as a logical answer to the extension of technological know- how marketplace triggered by the globalization of R&D. It facilitates the sourcing of technology and identifies advance in technology and science, which may be use for the firm. This activity is separated in direct, technology monitoring such as seeking in specific fields or indirect, technology Scanning such

as seeking for technology not yet covered by the technological space of the firm. It trusts formal and informal data including a network of experts.

### 3.3.3. Listening Posts

In relation with Technology Scouting, Gassmann and Gaso (2004) focused on technological "listening posts" as a resource of knowledge in technology sourcing.
On the first axis, Type of processed knowledge is characterized by *trends and application knowledge*, including to both macro trends (marketplace shaping trends) and micro trends (what's hot in culture, lifestyle and attitude), and *technological knowledge*, which apply to complex tacit knowledge and, thus, harder for competitors to replicate. On the second axis, alignment of listening posts is divided by *Direct knowledge sources*, which refers to first-hand process to acquire knowledge and information of shift in the technical environment through journals, conferences, fairs, venture capital events, communication with customers, suppliers and competitors. The use of indirect knowledge intermediaries represents capturing knowledge assets through information exchange on a market basis, with specialized firm or partners. They uncover three archetypes such as Trend Scout, Technology Outpost, and Match Maker; which facilitate the knowledge acquisition in hubs of technological excellence and innovation clusters.

#### 3.3.3.1. Technology Outpost and Innovation Outpost

The goal of technology outposts is to gather advanced technological information and transfer it to the internal R&D. Usually, technology outposts are positioned in areas of technological excellence, such as academic institutions (e.g. MIT, Boston) or in innovation clusters. Technology outposts benefit from being entangled in the scientific community, innovation ecosystem as well as having high degree of independence and autonomy from the home-based R&D unit. Risks attached to technology outpost are that is can become an "engineer playground' and not delivering the expected value to the company, and might lose creativity and flexibility influenced by the directives from top management (Gassmann & Gaso, 2004). Another risk is the failure to propagate the value absorbed in innovation outpost back to the organization. To ensure the success of an outpost, companies need to implement a two-sided model, which use a "sense and capture" approach in the outpost itself and develop "integration and propagation" processes to make certain that the value is transferred to the headquarter and correctly used the wider firm. For the integration and propagation, three objectives are proposed; 1. Mapping out relationship through IT-system to share contacts, histories, and networks with the firm. 2. Propagate intelligence and insight to channel the intelligence from the cluster through the mothership by implementing processes and protocols. 3. Speed up the corporate deal-making process to avoid missing opportunities caused by delays of standard corporate processes (Di Fiore, 2017).

#### 3.3.3.2. Trend Scout and Technology Scout

Trend scouts' role is to identify technological and future trends as well as new application areas due to a shifting society. This is frequently done through being present in innovation clusters and lead markets. The mission is to capture and transfer trends to the firm's central R&D. To promote efficient transfer of tacit knowledge, companies implement job rotation programs within the firm's R&D units. Trend scouts' advantages are stable presence and high sensitivity

to domestic market as well as low investment costs, however barriers to get integrated within the local community and the NIH-syndrome at the R&D unit represent a weakness. (Gassmann & Gaso, 2004).
Technology scouts are employees of the firm or external consultants. Their role is to gather information in the field of technology and science and facilitate the sourcing of technology. They are often assigned to the scouting tasks either full-time or part-time. The ideal characteristics include being well-informed in science and technology, lateral thinker, cross-disciplinary focused, respected within the firm and imaginative (Wolff, 1992).

#### 3.3.3.3. Matchmaker - Knowledge Broker

The matchmakers are accountable for both technological and trends knowledge and are situated in a local scientific community or a regional innovation cluster. The matchmakers have wide informal networks and achieves their mission through as an intermediary between technology research institutions, suppliers, lead-users and other partners. Matchmakers' strengths are that they provide access to new and complementary ranges of knowledge, enable cost and risk sharing, and find radical and breakthrough innovations (Gassmann & Gaso, 2004). Knowledge brokers are companies working with diverse companies and industries and enable the transfer of knowledge and technologies. Knowledge brokers are organizations, which cross multiple technology areas and markets. It is usually firms that consult to other companies (Hargadon, 1998). Hargadon and Sutton, (1997) argue that brokers can enable the knowledge and technology transfer throughout industries, companies, and people.

### 3.3.4. Crowdsourcing

Crowdsourcing is described as outsourcing a task to the crowd, instead of a designated agent like an open call (Howe 2006). Crowdsourcing consists of involving different actors outside an organization's boundaries into specific stages of the company's innovation process. Studies have shown that opening access to a problematic to an extensive range of people via a crowdsourcing call, give access to diverse knowledge, and therefore, contribute to solving some issues in creative ways (Jeppesen and Lakhani 2010). Using several networks with specific expertise in certain domains requires an overall cultural change for companies as it is necessary to revise their collaboration models and their IP strategies.
Crowdsourcing is a strategy with potential for generating Open Innovation strategies and used to design innovation intermediaries. Innovation intermediaries help companies to use external actors and external knowledge. Intermediaries InnoCentive or NineSigma allow companies to discover external actors with specific expertise, who can endorse innovation tasks. It gathers a large audience of external innovators, who can offer their expertise (Lakhani et al. 2007).

### 3.3.5. User Involvement

#### End-Users involvement

Open Innovation follows a more iterative process and involves new parties in the development process such as end-users. Implication of end-users is recognized as an advantage for the innovation itself and for its following market-acceptance (von Hippel, 1976). A study led by Hani et al. (2016) suggests that the end-user involvement at all steps of the medical devices

technologies' design and development process facilitates technology acceptance, limit the reengineering necessity as a result of increasing the benefits and reducing costs.

### Lead-User innovation

Lead users is a term introduced by von Hippel (1986), which is described as users of products or services, who experience needs before it exists in the marketplace and will also benefit if they find a solution to those needs. It has been demonstrated that innovation through users have a tendency to be focused amid the "lead users" of the processes and products. As lead users usually try to find a solution to the needs they experience, they are able to deliver new product design and concept. Lead users are defined as a "need-forecasting laboratory for marketing research" When firms want to implement lead-user Innovation, they should adopt a methodology divided in four steps: 1. Start of the lead user process. 2. Identification of the needs and trends. 3. Identification of lead users and interviews. 4. Concept design workshop (von Hippel 1986). Lead user innovation and Open Innovation are connected because they both view the importance of external source of information as a fundamental good. The lead users drive the development in technology-based industries as they tend to be more informed about their current and future necessities (Parida et al., 2011).

## 3.4. Ecosystem – Cluster of Innovation

When a firm is seeking to access external knowledge, it is relevant to evaluate where potential information related to the core business field and needs could be identify. A significant factor to access knowledge is richness of an ecosystem. M. Porter (1990) described business clusters as "geographic concentrations of a critical mass of interconnected companies and institutions in a particular field whereby proximity leads to shared advantages through the aggregation of expertise and specialized resources". Similar to business cluster, a cluster of innovation is a global economic "hot spot" where new technologies evolve at a surprising rate and where expertise, capital, and talent foster new ways of doing business as well as the development of new industries (Engel J.S., 2014). According to A. Saxenian (1994), Boston and Silicon Valley are typical examples of successful innovation cluster models. Engel and del-Palacio (2009) identified key components, which influence the clusters; entrepreneurs, universities, government, R&D centers, venture capital investors, mature corporations and strategic investors, and specialized service providers and management.

### Benefit for Companies

Innovation clusters allow companies to have better access to knowledge. Indeed, the within these clusters, information flows are recognized to be expressly intensive. This fluent flow of knowledge and the idea transfers contribute to knowledge creation and exploitation, which can be easily access by companies operating within a cluster. In addition, the interaction between competing companies, consumers and suppliers empower the firms to capture market trends and support them with decision-making regarding their forthcoming technological focus as well as understand the limits of their knowledge (Dang et al. 2010).

## 3.5. Implementation of Open Innovation Practices

As shown in the literature, company are encouraged to consider Open Innovation strategy as they look to advance their technology and survive in the ever-changing business world threaten by environmental forces. This strategy induces that companies' boundaries become

“permeable”, which enable integration of resources between firms and external parties. As Open Innovation is seen as an innovation in itself, it has to be managed accordingly. Mortara et al. (2009) presented solutions to implement an Open Innovation Strategy with a focus on the cultural aspects of adopting OI. In this study, it is proposed to be linked to the organization’s culture, procedures developed, skills of human resources, and motivation toward this strategy.

OI culture adoption is a crucial first step toward implementing OI. Culture exists at many levels of the organization and cannot be developed overnight. It is recommended to create an OI implementation team to identify and evaluate the best ways to seed such a culture within different firm’s functions and increase the cross-functional connections. A set of ideal skills is necessary within the team in order to allow companies assessing internal opportunities and gaps, enable organizations evaluating the capabilities and opportunities, carry value of relationships with external environment to both external and internal participants, and establishing the appropriate structure and tools to support OI is critical. Motivation in OI considers what incentives can have an effect to promote cultural change and encourage employees to adopt these practices. In this section of OI, the observations have shown that overcoming the Not-Invented-Here (NIH) syndrome creates strong resistance to Open Innovation (Mortara et al. 2009). It often results in embellishment of the potential of the ideas developed internally and negligence of external opportunities. People are suspicious about ideas and knowledge coming from external sources because of lack of experience or motivation and previous negative experiences. To overcome this issue, it is recommended to integrate people early in the decision-making process and inform them of the real potential and practical advantage of other’s people’ s ideas and technologies (Cohen and Levinthal, 1990; Lichtenthaler and Ernst, 2006).

## 4. Methodology

### 4.1. Qualitative Research Design

For this subject, the methodological approach will be focus on a qualitative research. Qualitative approach implies an emphasis on description and discovery, thus the objectives are commonly focused on interpreting and extracting the sense of experience (Merriam, 1998). Qualitative methodology is selected due to the specific purpose of this thesis in terms of the identification of process, needs, successful factors, innovation approaches as well as providing managerial recommendations. To better the dynamics of Open Innovation, the authors believes that a qualitative research process could provide the most substantial results and is suitable for an interest in process rather than outcomes, in context rather than a specific variable, in discovery rather than confirmation. Insights gained from a qualitative study can directly influence policy, future research and, as for the purpose of this research, the practices (Merriam 1998).

### 4.2. Sample

This research’s sample selected is a purposeful sampling procedure. Also refers as purposive sampling (Merriam, 1998), this method is typical in the qualitative study methodology to yield the most information about the phenomenon under study. Reybold, Lammert, and Stribling (2013) specify that in qualitative research, the logic of selection is grounded in the value of information-rich cases and provide in-depth understanding which is not available over random

sampling. From this perspective, purposeful selection is a strategy for accessing appropriate data that fit the purpose of this study, the questions asked, the resources available, and the constraints and challenges tackled. The authors selected 4 case studies, 10 industry experts to interview, 4 organizations, and 5 Intermediaries.

### 4.3. Data Collection

The secondary data provided a theoretical framework and initial findings, which will be used as a support for the empirical research. The analysis of qualitative data is based on the research questions and issues which are explored during the fieldwork. Secondary data information has been acquired through written reports, case studies and third-party research.
The primary data emphasized on discovery as well as through this type of open-ended entry. As part of this thesis is link to the innovation clusters where external sources of knowledge can be leverage for the industry, this research has been written in Boston, which is one of the most important area on the planet for medical research and is seen as a hub for innovation. As a primary source of data collection, the authors gathered empirical material through field study observation, benchmark and interviews.

#### 4.3.1. Phase 1: Case Study Methodology

The approach to identify effective Open Innovation processes is through case studies. In this section, the authors develop the reasons why the methodology of multi-case study is suitable. To support the purpose of this thesis, case study in research is commonly used when the research questions seek to explain present circumstance how some business practices works. (Yin, 2009). Another reason is that case study makes it feasible to investigate and retain holistic characteristics of real-time events, such as managerial and organizational processes (Yin, 2009). In addition, case studies are the preferred method for “how” or “why” questions (Yin, 2008). Case studies are suited to answer exploratory questions as they are associated with operational links, which require to be traced over time (Yin, 2009).
The selection of case studies has been based on the research questions and amongst a specified population to control extraneous variation and define limits in order to generalize the findings (Eisenhard, 1989). Thus, cases were selected based on companies’ industry, innovation practices and presence in innovation clusters. Case study are Merck (biotech and pharma), P&G (consumer care), Medtronic (medtech), Novartis (biotech and pharma).

#### 4.3.2. Phase 2: Field Study, Observations, Benchmark

The observation method has been used by the authors as an introductory technique for data collection in this research. The objective was to have a deeper understanding of the market, capture how Innovative firms uses the ecosystem, create their networks, and scout for new technology in Boston. By visiting and contacting universities (MIT), incubators and accelerators (MassChallenge), consultancies (Boston Medtech advisor), and innovation intermediaries (Innocentive); in-depth information has been gathered and a network has been accessed. Swissnex Boston facilitated the access to additional networks and potential partners. The research has attended a class at MIT Professional Education on Innovation tools with Prof Michael Schrage to better understand user Innovation and build a network at MIT. In addition, linked to the case studies, the authors believe that benchmarking companies facilitate the evaluation how these companies capture the new technologies (Intelligence) and how they

convert knowledge (Innovation) into action. The research is centered on the firm's organization/focus toward Open Innovation, the method uses to capture and deliver technological information, and the processes implemented. The benchmarking helps selecting the expert to be interview in phase 3. Finally, the authors aimed to have a better understanding of the dynamics of the ecosystem and acquire knowledge as well as networks through attending events selected according to the sampling criteria (appendix 1).

#### 4.3.3. Phase 3: Interviews

The interviews were conducted in a semi-structured approach. The rationale behind this decision is to query qualitative data with in-depth information related to experts' experiences and perspectives. The question format was open-ended. To structure the interviews, the authors has conducted the literature review and derived a theoretical multidimensional framework. Three main research directions have been used including practices and decision, implementation and challenges, and future-oriented perception. The choice of semi-structured approach was to secure that each interview has a clear purpose and give me the possibility to adapt the questions in order to match them with the capabilities and experiences of the interviewee. In this case, it was more flexible as participant responses has affected which questions the researchers asked next. Therefore, the Study design has been iterative as data collection and further researches were adjusted according to what was learned in the field and throughout the interviews. Indeed, most of the interview provided new insights, which helped the authors understand the practices, benefits and the relevant of the innovation ecosystem in Boston. Purposive sampling method was used to select the interviewees based on the research sampling criteria developed above. List of the interviewees (appendix 2).
The industry experts selected have a strategic position in large corporations, which are well-developed and seen as major organization active in the healthcare industry. Concerning their innovation approaches, the selection has been made according to their Open Innovation strategy. The authors chose most of the companies, which are actively collaborating with the ecosystem in Boston including universities, research centers and startups. Some companies have actively implemented Open Innovation as a strategy for 10 years, others for the past 5 years and some firms have recently started. It makes interesting for the researcher to assess the evolution and successes as well as the recent trends followed strategically by corporations. The common fact is that all companies are still trying to develop, improve or implement new approaches to benefit from outsourcing their innovations.

### 4.4. Method for Data Analysis and Synthesis

In order to analyze the results and interpret them well, the research has organized the gathered information in a very structured way. The data collection and the analysis will be simultaneous and iterative. Thus, the analysis method will be interpretative due to the open structure of questions. The goals of the analysis were to identify the significant pattern and practices and construct a framework. The researcher has started off by analyzing separately the data provided by the experts and case studies. Then, he has performed a comparison across experts from different organizations, parties involve in collaboration such as universities, accelerator and innovation intermediaries. In addition, the researcher carried out a cross case analysis and compared as well case study analysis and experts' information from the interview. This approach is supported by Eisenhardt (1989), who argues that "*one tactic is to select*

*categories or dimensions, and then to look for within-group similarities coupled with intergroup differences*".

### 4.5. Limitations

A qualitative approach is considered by a number of limitations related to the validity or the reliability of the research. Validity refers to the degree in which the findings capture the right phenomena to be examined, whereas, reliability refers to the transferability or reproducibility of the discoveries (Anderson 2010). The fact that the selected companies have a different structures and links to the healthcare is a threat to the reliability of this research. But this heterogeneity means that many different viewpoints are integrated into this study. This expands the validity of the research since it delivers a more complete measure of the research question. In addition, the authors use the multi-cases study methodology to support the observations and interviews from the empirical study. Indeed, the case studies historically validated practices and successful factors of the firms' strategy through cross-case analyses linked to the companies' interviews and observations.

Open Innovation has been well studied for the last decades. However, this term introduced by Chesbrough (2003) can be interpreted and use differently depending on the firm's innovation strategy and the people involved in this process. Organizations use the new paradigm of Open Innovation at different level and, therefore, interpret and implement these practices differently. As emphasized by Anderson (2010), a limitation of qualitative studies refers to the competence of the researcher during the data collection. The nature of the interview, semi-structured with open-ended questions, could also cause variances in the discussion of specific themes with the risk of covering information, which are less targeted, too wide or diverse. To handle this variance, the important factors used by the authors was to set the context of the interview, clarifying the goal and the specific motive why questions were asked.

## 5. Findings

Based on the literature review, case studies, observations, and interviews, the authors realized that Open Innovation strategy is very important and well-developed in innovation clusters such as Boston. In this research, the purpose is to provide guidance for companies looking to open up their innovation process to respond stay at the cutting edge of the technology, and therefore sustain a competitive advantage and a steady growth. Hence, the authors focus mainly on the outside-in approach, which has been more studied, is more used by the firm interviewed and is identified by the authors as an appropriate first step to implement such a strategy (Gassman and Enkel, 2004; Lauren and Salter, 2006; Enkel et al., 2009). Subsequently, the analysis provides mediums to obtain outside sources, synthetizes the important aspects of the implementation, and highlights the successful factors.

To begin, the sourcing part analyzed the mediums used by these companies to identify external source based on the listening posts, crowdsourcing, technology transfer intermediaries, accelerators/incubators, research institutions, and users. In addition, the benefits perceived by the firms as well as the introduction of the stakeholders, which take part in their Open Innovation process, are demonstrated. Then, the implementation of Open Innovation strategy is discussed based on the companies studied with a link to the literature including the decision-making process. And finally, the relevance of the ecosystem's key components is assessed.

### 5.1. External Sources of Innovation and Knowledge Management

In this section, the authors apply the theory of technology intelligence to the knowledge management in an open innovation context. Firstly, an analysis of the practices and has been assessed. The authors links the theoretical framework "listening posts" with actors facilitating knowledge and technology transfer in the healthcare industry including the crowdsourcing theory and user innovation. Secondly, the key components of the conceptual model proposed by Kerr et al. (2006) is explained to enhance ways to capture information and process it to deliver intelligence.

#### 5.1.1. Listening Posts Extended

The "listening posts" are linked with the dominant actors facilitating knowledge and technology transfer in the healthcare industry in Boston. The authors realized a table with the main practices observed through the empirical research. The frequency is assessed by the number of interviewees and companies studied using these practices in their innovation strategy: Low 0-2, Medium 2-4, High 5-7, and Very High 8-10. It serves as a metric to emphasize the relevance of the practices from the companies' landscape.

| Sourcing practices | Medium | Goal and benefits | Frequency |
|---|---|---|---|
| Scouts | ▪ Internal R&D expert (part-time)<br>▪ Internal employee R&D or Business development (part or full time)<br>▪ Staff from innovation team (part or full-time) | ▪ Create contacts with industry<br>▪ Understand business and technology<br>▪ Attend conferences, fairs and events<br>▪ Use formal and informal networks<br>▪ Enable knowledge transfer | VERY HIGH |
| Innovation outposts | ▪ Innovation Lab<br>▪ Innovation Hub<br>▪ Outpost office<br>▪ Brigham Innovation Hub<br>▪ Merck Innovation Hub<br>▪ Jlabs | ▪ Proximity of innovation cluster and understanding of the ecosystem and challenges<br>▪ Follow local trends<br>▪ Create networks and relationships<br>▪ More flexibility, work autonomously from HQ<br>▪ Deal with collaboration process<br>▪ Access foreign expertise and resources<br>▪ Penetration of local and regional markets | HIGH |
| Research institutions RI | ▪ MIT<br>▪ Harvard<br>▪ Wyss Institute<br>▪ Koch institute<br>▪ MIT Media Lab<br>▪ MIT Industrial Liaison Program | ▪ Access to technology/invention from government funded research<br>▪ Informal networks with professors and students<br>▪ Access to new talents<br>▪ Facilitate industry-university relationships | VERY HIGH |
| Consultancies | ▪ Boston MedTech Advisors<br>▪ Boston Consulting Group<br>▪ Strategos | ▪ Large network of contacts<br>▪ Experience from working with different firms<br>▪ Access to huge amount of reports and databases<br>▪ Cross different technologies and industries | MEDIUM |

| | | | |
|---|---|---|---|
| | | ▪ Expertise | |
| Technology Transfer Intermediaries TTI | ▪ Universities Technology Transfer Offices<br>▪ Institution Technology Transfer Offices<br>▪ AUTM<br>▪ CIMIT<br>▪ Yet2 | ▪ Access to new technology<br>▪ Screen new technology<br>▪ Connect the industry with emerging technology from research institutions<br>▪ Facilitate industry-university relationships<br>▪ Help commercializing innovation | MEDIUM |
| Incubators and accelerators IA | ▪ MassChallenge (Pulse)<br>▪ Boston Children Hospital Digital Health Accelerator<br>▪ M2D2 (Medical devices) | ▪ Facilitate corporate-startup<br>▪ Access to innovation at seed level<br>▪ Create networks with executives from different firm | MEDIUM |
| Research institutions RI | ▪ MIT<br>▪ Harvard<br>▪ Wyss Institute<br>▪ Koch institute<br>▪ MIT Media Lab<br>▪ MIT Industrial Liaison Program | ▪ Access to technology/invention from government funded research<br>▪ Informal networks with professors and students<br>▪ Access to new talents<br>▪ Facilitate industry-university relationships | VERY HIGH |
| Users | ▪ Customers<br>▪ End-users<br>▪ Lead users<br>▪ Care providers<br>▪ PatientsLikeMe | ▪ Access to future trends<br>▪ Understand the market<br>▪ Understand the technological needs<br>▪ Get feedback to improve product or service | MEDIUM |

**Figure 3: External sources of innovation, goals, and benefits**

#### 5.1.1.1. Scouts

Scouts are employees of the firm (R&D, business development, innovation team) or external consultants assigned to the scouting tasks either full-time or part-time. Scouts are the most used to access external knowledge. In half of the firms studied, scouts are often present in innovation clusters and report back to the R&D units or HQ. As Open Innovation strategies, large companies are changing their scouting practices and tend to gather an innovation team in a Hub context to tighten to information flows and work through the entire deal process creating a good relationship. Therefore, it is seen as an evolution of traditional scouts. The analysis of the results of the interviews and case studies enabled the discovery useful practices from companies' scouts. In many cases, scouts are from innovation team or they are scientists and doctors. The most relevant techniques are attending conferences and events, networking with the local scene such as academics, startups, other companies (technology and innovation executives), screening through literatures, publications, patents, technology transfer offices and startups.

The most successful factors are: to define clear needs from business unit or corporate, use scouts with enhanced expertise in the desired fields, and be dedicated to this task. These factors are validated by Prof. McManus, Wolff (1992) and Rohrbeck (2007).

#### 5.1.1.2. Innovation Outposts

Innovation outposts has been adopted by forward thinking business, which built a team of employees to work outside of the corporate environment. The most valuable connections are

with academics, incubators, startup and industry's executive teams. The ideal team members present in innovation center have the expertise in due diligence, legal, investment, and transaction as well as clinical expertise. The most important benefits shared through the interview were the proximity to potential partners, access to conferences and events, the creation of networks and relationships, and being able to accelerate the deal-making process. Therefore, corporations were less likely to miss out on opportunities and could potentially innovate faster. However, before being present in the midst of the innovation ecosystem, senior level management must identify the strategic problem needed to be solved and assess which innovation ecosystem is appropriate linked to their objectives. In addition, the relationship and communication from innovation outposts to corporate and business units need to be strong and frequent. Have an innovation hub is seen as being an evolution of the scouts (Di Fiori, 2017). Some of the companies interviewed not only are present in Boston but also have innovation outposts in Israel, London, Shanghai or Singapore, and Silicon Valley.

#### 5.1.1.3. Challenges Platforms (CP)

Challenge platforms revolutionized the access to specific experts through crowdsourcing.
The interview of Steven Drew provides a clear definition of InnoCentive as the pioneer in crowdsourced innovation, which helps innovation-driven companies to solve their business, technical and scientific problems by crowdsourcing ideas and solutions from their global network of highly educated problem solvers. InnoCentive developed a "Challenge Driven Innovation Methodology", which has proved to enable companies to tap into varied perspectives and talents to solve problems quicker, and therefore, accelerate innovation outcomes and enhance business performance. The corporations interviewed using the InnoCentive have benefited from better selection of collaborations, help with challenge formulation, access to solution faster, lowering risk, lower cost of solutions than using their own resources or external consulting.
NineSigma connect firms, which want to solve a science and technology problem, with companies, consultants, public and private labs, and universities that have the ability to develop solutions. NineSigma develops technology brief the define the problem and send it to its huge networks of solution providers. Companies using NineSigma have declared that 50% of the projects launched have led to agreement for further collaborations.
This practice has proven to be an interesting method to access external knowledge. Firms can post challenges anonymously to preserve their exposure. However, there is a certain cost link to the usage of such platform. As fees are annual and pay-per-challenge based, it is rather interesting for companies facing a fair amount of specific scientific and technological problems. Companies use innovation intermediaries, such as InnoCentive or NineSigma to externally source solutions to internal problem (Dodgson et al., 2006; InnoCentive, 2017; NineSigma, 2017).

#### 5.1.1.4. Consultancies

Consultancies act as knowledge brokers providing both technological and trends knowledge due to their extended expertise. Companies working with consultancies see potential value because they provide reliable knowledge linked on specific needs using precise expertise (experience and skills), extensive reports and databases, and large networks of contacts. According to Prof. McManus, consultancies' outcomes have the most impact on Mid-range companies as they are more likely to use the complete solutions, whereas large corporations

get inspired by reports. Also, they often help with best practices to follow and how to deal with foreign regulations. Companies like Boston MedTech Advisors with an extensive expertise in Medical Technology and healthcare provide support in Open Innovation practices through scouting and screening the market through technology transfer offices, their network as well as in their internal and external databases. In addition, they create relationships and help with regulations.

#### 5.1.1.5. Technology Transfer Intermediaries (TTI)

AUTM Association of University Technology Managers is a non-profit organization devoted to bringing research to the market by enhancing the academic technology profession globally through professional development, education, and partnering. It facilitates technology transfer between academics and industry by creating a community, and organizing events and annual meeting of AUTM where innovation and technology executives from the industry can find new technologies and create relationships with research institutions. In events and an annual meeting, AUTM links industry, universities, partners and technology transfer expert as a one stop shopping due to the presence of directors of technology transfer from 200 universities. In addition, organization of companies' reverse showcase to reveal needs take place during these meeting to connect the right people together. AUTM develop a platform called Global Transfer Platform GTP, which is a search engine that give access to global new technology posted by research institutions (AUTM, 2017).

According to the interview with technology transfer Intermediaries and Siegel et al. (2007), marketing these new technologies is key as the industry needs to be aware of them. To make these practices successful, companies need to understand how technology transfer offices work, involve a dedicated staff or team, communicate frequently and efficiently, make decisions quickly as well as have well-define goals to understand both parties' motivations, which is bringing invention to market for firms and publishing for research institutions. In other words, collaboration is the beginning of a marriage with continued communication and close relationship between both parties. In addition, it is often better to keep building the technology in the university or research lab of the inventor who know better his/her technology. A different approach has been revealed looking to engage companies even before the invention is developed by asking what are the needs and challenges of the industry to develop a technology afterward.

#### 5.1.1.6. Research Institutions (RI)

Corporations looking to access to advanced technological innovations, which are sourced through scientific research need to establish partnerships with universities and public research institutions. This process aiming to acquire technological innovation is recognized as university-industry collaborations.
The main advantage of collaborating with researchers is that most of the time research has been previously granted, it has enhanced the discovery landscape and the industry can bring the invention to the market. Successful collaborations shared by the interviewees demonstrated that it can highly enhanced the competitiveness of a firm and generate expected revenues. In addition, an extensive value is seen when firms create industry-university relationships and value them over the whole innovation cycle. As cited in most of the interviews, "Creating a win-win situation is the most important". Through these relationships

built over time, companies have noticed a great value to access talents and understand each other's needs and challenges.
Based on the in-depth interviews from companies, the most significant challenges revealed when a company is working with research institution are keeping confidentiality and IP protection before publishing, building close relationship and making fast decisions. Therefore, the successful factors are having a dedicated staff, developing processes to help facilitate quick decisions as well as building a strong relationship. In addition, interviews from technology transfer intermediaries emphasized the importance of involving the top management, being available and building trust between the parties involved. Another critical factor is a good fit of industry strengths linked with research institution strengths to foster a win-win situation.
In Boston, world-class universities and research center are undoubtedly enriching the innovation ecosystem. All the interviewees collaborate with the research institution at a certain extend. The benefits perceived and proven are endless. Many organizations studied collaborate with MIT and Harvard in Cambridge, MA. Some are engaged with the Board institute (MIT and Harvard), others have long-term partnership with Koch Institute at MIT or Wyss Institute at Harvard. To facilitate industry-university collaboration and enhanced the success, MIT Industrial Liaison Program actively links MIT faculty excellence with corporation worldwide. Based on an annual membership, the main practice is to facilitate connection between professors and firms by assigning a MIT employee to get to know the firm's objectives and actively make connection to MIT Faculty as well as giving access to event, conferences and workshop gathering other companies with same interests, professors and startups.

#### 5.1.1.7. Incubators and Accelerators (IA)

Boston innovation ecosystem gathered many accelerators and incubator. Amongst the healthcare industry, Pulse@MassChallenge and Boston Children Hospital Innovation and Digital health accelerator are driving digital health innovation. The engine by MIT and M2D2 incubators provides laboratory facilities, co-working space, and mentors, as well as linking startup with the industry to offer them expertise, exposure, and connections to capital. Even the industry developed their own incubator to foster discoveries and successful collaboration. Most of the interviewees recognized the importance of accelerator such as MassChallenge with their new concept, Pulse@MassChallenge focused on digital health.
Pulse@MassChallenge gathered a community to connect entrepreneurs with strategic partners in healthcare, experts, institutions and resources. According interviews, to the most relevant benefit is to be linked to startups, MassChallenge executive team, Board of Advisors, the Government and Massachusetts Digital Health Initiative as well other Partners.
Johnson & Johnson innovation developed JLabs in Boston, which provides facilities where emerging companies can transform their scientific discoveries into the breakthrough healthcare products. It offers shared lab spaces, a capital-efficient environment, reduced infrastructure costs and centralized management, as well as network and life science innovation J&J have a "no strings attached" approach with the hope of collaborating later on if they see potential for their businesses.
Boston Children Hospital, Innovation and Digital Health Accelerator goal is to Combine BCH data, clinical expertise, and health care technology development experience, with industry partners including start-ups to transform health care (informatics, technology, clinical, digital, business development talent, TeleHealth). As digital technology has been disrupting several industries, this initiative is important for BCH to keep up with the best technologies and provide

the best care to their patients. According to the interview, the relevant parameter to be efficient is joining forces with the industry and startups. Thus, partnering with BCH give the industry access to their expertise, database and patients to test and develop new products linked to the industry capabilities and expertise as a result of fostering innovation.

#### Startups

Most of the companies interviewed are collaborating with startups to access innovation. Many experts highlighted the fact that startups are the innovators in every industry because they have freedom from corporate world and more funds available due to the extensive awareness of this phenomenon. Indeed, it is seen as cheaper and less risky than trying themselves. To find and approach startups, companies partner with accelerators/incubators, attend their events and pitching session or they develop their own facilities to welcome startups. According to the interview and Engel S. (2014), being present in an innovation cluster facilitate the access to emerging companies as well as build successful relationship.

According to the interviews of startups developing new solutions for the healthcare industry, they are all very interested in collaborating with the industry. They are bringing invention from university research to the market, whereas, two entrepreneurs started with their own invention. As their biggest challenge is funding, working with the industry to join forces and facilitate the development of their solution is the best way to access capital as well as the market. The important benefits beside funding is the ability to test their invention, use the industry capabilities and access the market faster.

#### 5.1.1.8. Users

In the healthcare industry, companies' visions are mostly focus on the patient and providing the best outcome. To do so, many firms understood that patients and care providers are the most likely to find solution related to their own needs. Thus, lead users and end user involvement is has become a common practice in the industry, especially in the medical device landscape. By involving the people who will us the product in the development process companies increased the market-acceptance and frim are able to improve their technology in relation to the market needs. This has been validated by Hani et al. (2016) suggesting involving the end users through all 7 steps of medical devices product development including, idea, preliminary assessment, concept, development, testing, trial and launch. One of the company interviewed has successfully implemented a platform to crowdsource new inventions exclusively from their lead users, the physicians. It has been well-understood by the company that physicians identify needs before it exists in the marketplace and that they have an intrinsic motivation as they will benefit if they find a solution. In addition, they involve the physicians and their in-field sales representative as a source of knowledge in a brainstorming session including advisory boards scientific research, innovation team and marketing. This has been validated through previous studies that It is significant to develop a good relationship with the stakeholders in order to access practical and creative knowledge by collaborating stakeholders such as lead-users and customers (von Hippel,1986; Parida et al., 2011).

The observations and interview exposed that many organization work closely with their targeted end users.

### 5.1.2. Adaptation of the listening posts

As developed by Gassmann and Gaso (2006), the indirect knowledge intermediaries are provided by matchmaker. The authors link the matchmaker with the knowledge broker theory provided by Hargadon (1998). The authors recognized throughout the analysis that when the corporations are collaborating with the external parties presented through the listening posts, the have access to direct knowledge through their own scouts and innovation outposts and indirect knowledge through many sources. Nowadays, the development of new intermediaries and organization promoting the technology transfer and linking the industry with startups and academics enable better relationship and, therefore, better access to knowledge and new ideas. The listening posts introduced by Gassmann and Gaso (2006) can be extended to with other sources of information, which provide direct and indirect knowledge to the company as well. One on hand, it is proposed to include the user as indirect knowledge intermediaries for trends & application knowledge as well as include the consultancies linking both type of processed knowledge, technological and trend & application knowledge. On the other hand, technological knowledge can be indirectly access through technology transfer intermediaries, challenge platforms, incubators/accelerators and research institutions.

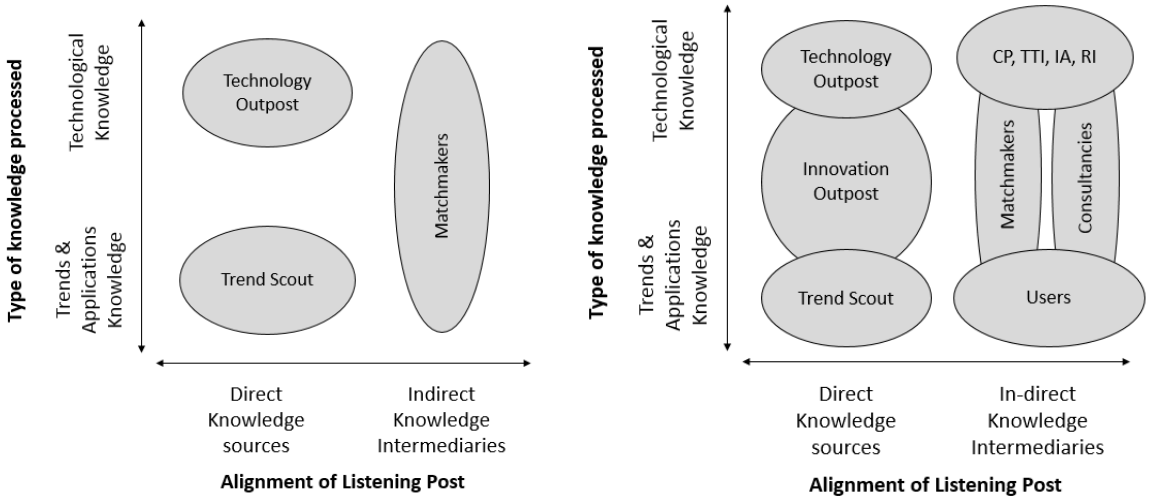


**Figure 4: Listening post adjusted by the authors based on Gassman and Gaso (2006)**

This model has been adapted to include Technology Scout with Trend Scout, and Innovation outpost with technology outpost.

## 5.2. Implementation

Not too long ago, when the world was less competitive and corporations were smaller, steady yearly growth was achievable through internal R&D. With evolution of new technology, challenge in R&D productivity and innovation success rate falling down, most of the companies studied understood that not all keen people can do everything themselves and that more innovation was coming from outside their walls. Therefore, they started looking outside of the firm boundaries for innovation. Consequently, challenges arose such as resistance to “not invented here” innovation, organizational change, processing external information and evaluating potential of external sources (interviews). Some companies created a specific platform either linking all open innovation practices or targeting specific sources, some created

innovation centers in innovation clusters, others gradually created corporate innovation team focus on standardized open innovation practices, or group/individual reporting back to the centralized R&D from business units or R&D departments (appendix 3).

### 5.2.1. Success Factors

The overall implementation of open innovation is challenging and takes time for most of the companies who took part of this study. The authors gather the successful factors, which were repeatedly defined by throughout interviews and case studies.

| Implementation | Success factors identified |
|---|---|
| Culture | ▪ Have an OI team with open culture<br>▪ Understand that it takes time to change the culture<br>▪ Nurture an open culture with the OI team that seeds this culture across firm's functions<br>▪ Constantly share objective, results and proven success with employees<br>▪ Shorten the internal innovation budget |
| Procedure | ▪ Strong leadership from top management<br>▪ Implementation of dedicated OI team outside of the structure<br>▪ Develop cross-department relationships<br>▪ Give more freedom to the OI staff<br>▪ Build an ecosystem with appropriate structure and tools to support activities |
| Skills | ▪ Select a multidisciplinary team<br>▪ Work with the best scientists from the inside to identify external sources and use them<br>▪ Work with team with introspective, extrospective, interactive and technical skills |
| Motivation | ▪ Integrate people early in the decision-making process<br>▪ Share the real potential and practical advantage of OI with the staff<br>▪ Demonstrate previous successes |
| Partner Relationships | ▪ Dedicated staff, project leader for each deal/collaboration<br>▪ Foster trust<br>▪ Select motivated and coachable team as team<br>▪ Build long-term sustainable relationships |

First, the most important factor acknowledge throughout interviews is ultimately having a dedicated team decentralized from R&D or business development. It helps developing an ideal ecosystem, giving more freedom to the staff, and thinking outside the box. In addition, it fosters more success when firms assign dedicated staff or project leader for each collaboration allowing better communication, alignment of the objectives, creation of a win-win situation and better knowledge transfer. This help creating trusty and long-term relationships. Indeed, the development of a legal framework gives employees more freedom to explore, be creative and take risk without strong limit in time and money. Supporting the activities with tools such as customized database software (sales force) or personal knowledge center website help managing and identifying external and internal knowledge to enhance efficiency. In some

cases, companies successfully implemented open innovation after a solid decision from new CEO coming with a new vision to open up the innovation process so fresh blood can help shaping this new strategy. Most of the companies highlighted the relevance of promotion through social medias, website and SEO to show that the company is open for external sources so that they can attract innovators.

Most of the companies studied pointed out the significance of cultural change within the innovation team first and gradually throughout the departments involved in the innovation process. It is emphasized that innovators should engage the business units early in the process, define needs, share interests and demonstrate the benefits for the business units. Thus, it enhances the potential outcomes and avoid conflict between innovator and the business units, which are result-driven and perceive a cut in their budget due to its allocation to innovation team. Hence, good communication and coordination between the parties involved is one of the most successful factors. Moreover, this facilitates the integration of knowledge and collaborations within the internal structure.

Finally, celebrating successful projects and demonstrate the value to the innovation team as well as the entire organization seem to be the most significant factors to successful to shift mind-sets away from resistance to NIH syndrome and embrace Open Innovation culture within the firm.

### 5.2.2. Decision-Making

The decision-making process is ultimately important when applying Open Innovation strategy. According to the interviews, the authors recognized that many factors are involved to help decision-makers setting goals and selecting the most promising ideas, projects and partners. Indeed, Kerr et al. (2006), identified 6 significant phases (coordinate, search, filter and analyze, document and disseminate), which aim to provide refined information seen as intelligence for decision-makers. In this section, the most relevant practices used by the corporations studied are link to theoretical framework below.

#### Identify

According to case studies and most of the experts interviewed, the first and most important steps is identifying and defining needs and objectives. Indeed, Schwartz and Mayne (2005) provide the “well-defined scope” metrics that should be applied to the intelligence activity. It points out that the objectives and the range of coverage must be evidently set out. At this stage, companies studied use need lists (10 most important needs related to the consumers), brainstorming session with a multidisciplinary committee (cross-department, business unit), or individual requests, findings or challenges (R&D experts, Business development) to generate search goals and ideas.

#### Coordinate

Innovation team coordinates with the open innovation program, scouts, innovation staff, networks, and innovation outposts to search, filter and analyze internal and external sources until a substantial level of information is attained. The coordination stage is challenging in large firms due to the complexity of business structures and geography operations (Horbaczewski

and Rothaermel, 2009). Companies shared that they are still working on developing a program to help coordinate between department and business units to face this issue.

### Search

Companies studied use the practices developed above to external and internal knowledge. In most cases, the search is made through events, conferences, academic publication, literature, patent analysis, networks, technology transfer intermediaries, new startups (incubator, accelerator, Pitchbook, CB insight). At this stage, an important factor is the quality of the data, especially in healthcare. This is emphasized by Schwartz and Mayne (2005), who introduced the metric of "*accurate data*" pointing out that the data gathered must be valid and reliable. Then, data are stored customized database software (sales force) or personal Knowledge center website for filtering and analysis.

### Filter and Analyze

According to the interviews, the filtering phase is often linked with the analyze phase. Some companies work amongst the innovation team according to the goals, needs and challenges previously defined by decision-makers (business unit, R&D, Business development). whereas other companies already involve, at these stages, expert in the specific field from the internal R&D, business development, business unit, legal department and the innovation team concerned. Indeed, involving a multidisciplinary team is believed to be more efficient and turns information into intelligence when shared (Ashton and Klavans, 1997; Rohrbeck et al. 2006). Some companies have some specific criteria develop through software or sheet (know-how confidential) based on these questions: Does it meet the brief/need/challenge? Does it fit our strategic vision? Is it transformative? Is it scalable, is it unique/differentiated? The most critical variables revealed by seven firms is the strategic fit and the competitive landscape differentiation. Indeed, the assessment of the strategic fit proving the potential value and competitive advantage through understanding the IP position is the key to filter and analyze.

### Document and Dissemination

In this phase, documentation is realized by the scouts, R&D expert, and innovation team. Four of the companies have specific metrics to gather the information needed in order to disseminate structured data to the suitable decision-makers. Depending on the magnitude of the deals, one or several levels are involved during an on-demand meeting (e.g. Innovation team level, head of business unit, president of R&D, CEO and Board level). Three companies adopted an interesting approach to speed up the process by creating a committee involving decision maker from Innovation, legal, finance and global business development, which meet on a monthly or weekly basis to make decision. Another company, which have a decentralized open innovation program and work with startups, gather all information needed with the startup and coordinate an on-demand pitch session with the head of the business unit concerned.

### Decide

The innovation team coordinate the information flows and disseminate them to the fitting decision maker. In most case the final decision come from the business units or investment boards as they allocate the funds. According to the interviews, the successful factors are involving the best scientist (R&D expert) who can assess the potential of the innovative projects as well as multidisciplinary teams including legal and business development, which base their

decisions on well-define needs and criteria. The committee approach is suggested to be efficient to accelerate the process in decision making.

### 5.3. Boston Ecosystem

The authors analyzed the ecosystem based on the key components identified by Engel and del-Palacio (2009), which influence the ecosystem into innovation clusters: entrepreneurs, universities, government, R&D centers, venture capital investors, and major corporations. The selection of an innovation cluster is based on many factors and is related to the dominant field of expertise. Focusing on the healthcare industry, Boston is debatably the best innovation ecosystems for healthcare in the world. Undoubtedly, because of the level of formal R&D activity and the number of the world's top research universities, in addition, it is constantly the largest recipient of NIH funding as a region (Weisman 2013). Going deeper in the analysis, the authors try to understand what makes Boston an epicenter for Life Sciences now and in the future.

In Boston, biotech has become a complete ecosystem with more than 1,000 biotech-related businesses implemented in Massachusetts. There are 17 of the top 20 biopharmaceutical companies and the 10-world's leading medical device firm maintain facilities in Boston (Massachusetts Life Science Center 2017).

The implication of the government to keep improving the situation in Massachusetts is very active with initiatives launched by Governor Baker such as Massachusetts Digital Initiative and Massachusetts Life Sciences Initiative. Indeed, Massachusetts Digital Health Initiative is a public-private partnership, which aim to promote and accelerate digital healthcare innovation. It gathers Massachusetts healthcare executives, legislative, and municipal partners with leaders in the business community as well as the Massachusetts Competitive Partnership (Governor Charlie Baker, 2016). In, addition, the numerous state organization support well this fostering innovation cluster. Thus, Government policy plays a large role in fostering the growth of Boston ecosystem as an innovation cluster (Engel S., 2014)

Immerged in world-class academic and medical institutions leading life science research, Boston hosts many of the biggest players in the healthcare industry. The presence of highly competent workforce, with ~80K workers exclusively in healthcare and 67.5% of working age adults with at least some college education, makes Boston a destination to find talents. In addition, the R&D spending as a percent of GDP is 5.86% in Massachusetts. In 2015, $6.3 Billion VC's investment with 40% in Biotechnology (Massachusetts Technology Collaborative, 2017).

The presence of the actors above nurtures an attractive ecosystem for startups. With a high concentration of accelerator and incubator spaces, it facilitates the development of a startup hub (appendix 4).

## 6. Conclusion

Currently, Open Innovation is a trendy strategy adopted by many corporations in innovation clusters like Boston. The authors realized many aspects of this strategy as well as the numerous implications at the organization level in order to utilize this paradigm efficiently and benefit from its success. The immersion within the Boston ecosystem facilitated the connection to big players involved in the Open Innovation dynamics in the healthcare in Boston. By talking with industry experts, technology transfer intermediaries and research institutions they realized that Open Innovation was very broad and, therefore, their focus has been concentrated in

providing practices and success factors to implement such a strategy including a process from identifying to making decisions.

The study pointed out that Open Innovation dynamics are enhanced in innovation clusters such as Boston. Indeed, the key components of an ecosystem that must be considered when looking at external sources of innovation, are entrepreneurs, universities, government, R&D centers, venture capital investors, and major corporations. Then, companies should focus on the area of interests defined by the fields where major corporations are active in: the prevailing study domain of research institutions, the investment per domain, the government development motives, as well as the entrepreneur's scope of innovations. Boston has proven for many years to be an epicenter for life sciences. The analysis provided assures elements supporting this statement and demonstrates a high level of collaborations amongst Boston's ecosystem's stakeholders.

The main actors facilitating the exchange and perceived as the most valuable sources are the scouts, innovation outposts and research institutions including the technology transfer intermediaries.

- The scouts access external sources by building a network with external parties, attending fairs, conferences and events, and, therefore, enabling the identification of threats and opportunities as well as transferring direct knowledge when information is shared back to the company. The important factors influencing the success of scouting are to have well-defined needs, use scouts with enhanced expertise in desired fields and be dedicated to this task.
- Innovation outposts are building a bridge between corporation operations and innovation clusters. Hence, this proximity allows the creation of networks and relationships with the innovative communities, direct access to potential partner and accelerate the decision-making process. This practice is often seen as an evolution of the scouts. Nevertheless, the senior management must assess clear needs and select the appropriate ecosystem linked to their objectives, and the relationship between the outpost and the companies headquarter or unit must be solid and steady.
- Collaborating with research institutions and gives access to new technologies and invention as well as new talents with the help of technology transfer intermediaries, which facilitate the industry-university relationship and offer memberships to enable the creation of a network with corporations, cross-industry firms, competitors, startups, faculty, and access to an ecosystem. To gain the most benefits a good fit between industry strengths and research institution strengths is necessary to foster win-win situation. In addition, the most important success factors related to having dedicated staff or team, communicating frequently and efficiently, making decisions quickly, and setting well-defined goals to understand both parties' motivations.

Following the top choices from the analysis, collaborations with incubator/accelerator and startups provide often access to breakthrough innovation at early stage and access to innovative communities. Some companies gain significant advantages through crowdsourcing the solution of their internal problems to external talents via challenges platforms. The expertise of consultancies is appreciated through their large network of contacts as well as

their access to reports and database. Other companies get impressive value through their lead-users due to their ability to provide solution to their own needs.

Throughout the analysis, the authors proposed to link these practices to access external knowledge with the listening posts theory developed by Gassmann and Gaso (2006). One on hand, it is proposed to include the users as indirect knowledge intermediaries for trends & application knowledge as well as include the consultancies linking both type of processed knowledge, technological and trend & application knowledge. On the other hand, technological knowledge can be indirectly accessed through technology transfer intermediaries, challenge platforms, incubators/accelerators and research institutions.

The authors learned that even if the Open Innovation paradigm emerged in 2003, such practices have been around for many more years through strategies including joint ventures, licensing and M&A. What makes it interesting is that the dynamics and new ways of collaborating amongst external parties has remarkably evolved. It became more and more part of corporations' main innovation strategy. The analysis has proven that Open Innovation strategy is well aligned with healthcare companies' vision and its implementation should only increase within the next 5 years. Supporting this statement, the increasing interconnectivity, development of crowdsourcing platforms and accessibility to partners around the world make open innovation impossible to disappear. Yet, it is believed that the term open innovation will disappear in a few years and be simply replaced by innovation.

## 6.1. Managerial implications

Throughout this research, the authors got a better understanding of the Open Innovation practices within Boston and provide recommendations in terms of accessing future-oriented information and implementing this new innovation strategy.

Technology Scouting is a significant practice to stay alert for future opportunities and threats. Many activities are providing support to scan, screen, access and integrate future-oriented information. Accessing the external sources of innovation is a virtuous step in adopting Open Innovation, however, this information, knowledge and ultimately innovation need to be efficiently used by the firm. To begin, transforming external sources into intelligence within the firm is challenging and require specific process and implementation within the company's organizational structure. A process based on technology intelligence (Roger G., 2001) has been developed by Rohrbeck (2007) and provides guidelines to identify and use external as well as internal information to innovate. The authors proposed to link this process with the 6 phases of the system operating cycle developed by Kerr et al. (2006). Therefore, it provides a process to be followed and links the identification to the decision-making. To begin, firms should have a well-defined scope with the objectives (identify). Then, a structure should be in place to coordinate the search goals and ideas with the right individuals or team to explore (coordinate). Following this phase, the appropriate actors should look through the right channels to find accurate data and store it in a database (search). At this point, the firm should involve a multidisciplinary team, who filters and analyzes the information based on specific criteria and linked to the strategic fit according to their vision (filter and analyze). Following this strategic phase, the information should be gathered and forward to the right decision makers (document and disseminate) to, finally, be evaluated by the appropriate decision makers,

depending on the nature of the information, in a multidisciplinary team or committee setting (decide).
It is recommended to actively seek for collaboration with external parties and have scouts present in Innovation clusters and access external sources by building a network with external parties, attending fairs, conferences and events, and, therefore, enabling the identification of threats and opportunities as well as transferring the information back to the company. When practices are tested and refined, having an innovation outpost within innovation cluster can be implemented. Indeed, this practice has demonstrated its efficiency in terms of creation of relationships with the innovative communities, direct accessibility to potential partner and acceleration of the decision-making process.

To benefit from external sources of innovation, the authors summarize the critical factors, which are structured by importance revealed in the analysis.

1. The importance of leadership to drive the implementation of Open Innovation
    a. Board of directors and CEO decide to focus on this strategy
    b. Top management supports all open innovation activities
2. Elaboration of well-defined needs and problems to be solved
    a. Gather needs and challenges from each department/business unit
    b. Involve multidisciplinary team to brainstorm
3. Allocation of resources to dedicated teams and dedicated staff to work with external parties
    a. Open Innovation team should be set apart from the corporate structure
    b. Assign dedicated manager for each project with external parties
4. The significance of the strategic fit as a key element in the decision process
    a. Linked with the companies' vision, objectives and differentiation
    b. Interconnected with the internal firm' expertise and strengths
5. The relevance of the organizational culture change
    a. Celebrate successes and demonstrate the value for each stakeholder
    b. Engage innovation team and business unit to share same interests
6. Active and accurate IP management
    a. Work with the innovation team to assess IP strengths and issues
    b. Involve the legal department early in the decision-making process

This research revealed that a strong commitment from top management is crucial. This strategy should be led by the CEO and Board of Directors with well-defined objectives and appropriate resources allocated to it. Top management should oversee all related activities. The results indicate that companies should have dedicated unit or team members outside of the corporate structure. This allows individuals to focus on these tasks and effectively manage the relationship with external parties. It is suggested to gradually allocate these tasks to coordinate the Open Innovation practices and link the external as well as internal sources of innovation throughout firm's departments.
To help with the cultural change and counter the NIH syndrome, an early engagement of the innovation team with the different departments is advocated in order to share same interests. In the long run, celebrating successes and encouraging the employee to look outside the firm for solutions through budget allocation has confirmed its relevance toward the acceptance of Open Innovation culture.

**Limitations and further research**

Studies in Open innovation have some limitation due to the novelty of this integrated strategy and the difficulty to evaluate innovation outcome in short term. The companies studied during this research recognize that their Open Innovation approach should be developed and revealed that they are currently experimenting, and looking for new ways to collaborate with external parties as well as leveraging external sources of innovation. Another limitation is that Open Innovation is broad and involve many aspect of the companies' organizational structure. This study did not have enough access to all stakeholders involved in innovation management due to the size of the firms studied. Therefore, each aspect can be studied in-depth involving all departments concerned to have a deeper understanding. Further research could involve a larger sample of companies over a longer period of time so results of this strategy recently implemented and evolution of the adoption could be assessed. Including companies of different sizes such as SMEs and mid-range firms can be interesting to evaluate different approaches with less resources. Thus, more complete guidelines for open innovation strategy could be established.

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# Appendices

List of the appendices

- Appendix 1: List of Events and Conferences Attended
- Appendix 2: List of the Interviews
- Appendix 3: Decision-making and Process from Finding to Implementing
- Appendix 4: Boston Innovation Ecosystem

## Appendix 1: List of Events and Conferences Attended

| Events list | |
|---|---|
| TECHMEETING When Engineering Meets Healthcare Open Innovation Club | May 2nd |
| BIOMEDevice Boston - Boston convention center | May 3th |
| MIT MEDRC – Medical Electronic Device Realization Center Workshop | May 4th, 5th |
| President; innovation Challenge - iLab Harvard | May 9th |
| Xconomy's EXOME Presents: What's Hot in Boston Biotech | May 11th |
| J&J Ventures - Pathways to Entrepreneurship | May 15th |
| MedTech Boston 40 Under 40 Awards | May 16th |
| Early Stage Pharma/Biotech Alliances: The Next Paradigm for the Life | May 17th |
| Brigham Innovation HUB - Digital Health and the Transformation of Care | May 17th |
| MIT 100K - Launch Finale | May 17th |
| MASS VDC Innovation and Entrepreneurship Summit | May 24th |
| MITEF - Breakthrough Innovations | May 31st |
| 2017 Massachusetts innovation day | June 1st |
| J&J Innovation - Race to the Market, Building an Efficient Discovery Engine | June 8th |
| PULSE MassChallenge Finale - A Digital Health Celebration | June 13th |
| Strategic Alliances: Pot of Gold or Pretty Poison? | June 28th |
| MassChallenge Startup Showcase | June 28th |
| Mass Innovation Nights - 100th celebration | July 9th |
| PULSE MassChallenge 2017 Application Launch | August 9th |

## Appendix 2: List of the Interviews

| Industry Experts | | |
|---|---|---|
| Name | Position - Field | Company - Institution |
| Lizabeth Leveille | Director Innovation Hub | Merck |
| Catherine Chassard | Open Innovation manager | Medtronic |
| Virag Nathalie | Strategic Partnership manager | Medtronic |
| Philip Gotwals | Head of strategic alliances | Novartis |
| John van der Linden | Global Open Innovation Manager | Procter & Gamble |
| Dana Deardorff | Senior Director of New Ventures | Johnson & Johnson Innovation |
| Marion Hitchcock | Strategic Alliances Manager | Bayer |
| Pascal Marmier | Head Digital Analytics Catalyst Boston | SwissRE |
| Gerardo Mazzeo | Open Innovation manager | Nestle |
| Anil Achyuta | Director of Advanced Research | L'Oréal |
| **Innovation intermediaries - Consultancies** | | |
| Michel van Hove | Partner | Strategos |
| Kevins Adams | Sales Director | Lux Research |
| Brian Palladie | Director of Business Development | Wellspring |
| David Barone | Principal | Boston MedTech Advisors |
| Steven Drew | VP, Business Development Europe | Innocentive |
| **Professors** | | |
| Prof. Johnathan Sims | Strategy and innovation | Babson College |
| Prof. Siobhan O'Mahony | Strategy and innovation | Boston University |
| Prof. Paul McManus | Strategy and innovation | Boston University |
| **Organization promoting Technology Transfer** | | |
| Stephen Susalka | CEO | AUTM |
| Michele Bernier | Commercialization Program Manager | MATTCENTER |
| Jim Gado | Director corporate development | MIT Industrial Liaison |
| John Roberts | Associate Director, Corporate Relations | MIT Industrial Liaison |
| Mary Tolikas | Operation Director | Wyss Institute |
| Monique Yoakim-Turk | Associate Director, Partner, Technology Development Fund | Boston Children Hospital |
| Gajen Sunthara | Program Director | Boston Children Hospital |
| Brian Mueller | Innovation Strategy Manager | Innovation HUB Brigham Women Hospital, Harvard |
| Kara Boudreau | Director, Partnership Development | Pulse@MassChallenge |
| Kathi Durdon | Director of Operations and Innovation | CNY Biotech Accelerator |
| Neda Amidi | Investment Director, Health at Plug & Play Ventures | Plug and Play |
| Ben Dwyer | Head of Partnerships | Rocket Space |
| **Emerging Companies** | | |
| Simon Carter | CEO | PredictBGL |
| Ken Steinberg | CEO | Glucosight |
| Sebastien Henry | Vice President, Program Management | Micron Biomedicals |
| Ana Duarte | Marketing | Patient-innovation |

## Appendix 7: Decision-making

| Decision-making actors involved | process | decision-maker |
|---|---|---|
| Innovation team - Business Unit | ▪ Well defined needs/challenges<br>▪ On demand meeting to evaluate projects<br>▪ On demand meeting to make decision | ▪ Head of business unit<br>▪ Head of innovation |
| Committee | ▪ Brainstorm session<br>▪ Monthly meeting<br>▪ Weekly meeting | ▪ Head of innovation program<br>▪ Legal manager<br>▪ Finance manager<br>▪ Head of Business development |
| R&D Level | ▪ On demand depending on the magnitude of the deal | ▪ President, Head of R&D |
| CEO Level | ▪ On demand depending on the magnitude of the deal | ▪ CEO |
| Board Level | ▪ On demand depending on the magnitude of the deal | ▪ Advisory Board |
| Innovation team | ▪ On demand meeting | ▪ Head of innovation program<br>▪ Head of innovation outpost |
| Business Unit | ▪ Well defined needs/challenges<br>▪ On demand meeting | ▪ Head of business unit |

## Companies Process from Finding to Implementing

| Companies | Process |
|---|---|
| Case 1 | 1. Define needs related to the consumers<br>2. Initial screening real time to meet the well-defined metrics<br>3. Log the product in IT tool catalog (Tool is a template to help organize facts about the product or technology such as core features/tech, needs fit, IP availability, image, sales)<br>4. Evaluation from business unit's general manager, brand managers, R&D<br>5. Specific alignment with the right department's director: assessment regarding Goals of the business, capability to develop at P&G, identifying eventual pitfall, assessment of the business potential.<br>6. Test in consumer panels<br>7. Moved to the product development portfolio<br>8. Engage external business development group to negotiate licensing, collaboration or other deals structure. EBD is responsible for licensing IP to third parties as well (good deals are license to and from the company<br>9. Product enter the in-house development phase. |
| Case 2 | 1. Receive ideas and evaluate with expert<br>2. Involve the committee (Innovation, Legal, finance, business development) to select the projects on a monthly basis.<br>3. Test and incubate the project involving R&D and the physicians<br>4. Business case to assess the potential<br>5. Forward to business units |
| Case 3 | 1. Experts (R&D, MD) or scouts identify future-oriented information<br>2. Work together with external parties to see what are their needs/objectives<br>3. Open Innovation team coordinate all process to assess possibility with multidisciplinary team through due diligence (licensing, M&A, Equity investment)<br>4. Integrating the opportunity into the process pipeline of the appropriate department |

## Appendix 8: Boston innovation Ecosystem

| Key components | Actors |
|---|---|
| Major Corporations<br>R&D Centers | ▪ Boston Scientific<br>▪ Abiomed<br>▪ Johnson and Johnson<br>▪ Philips<br>▪ MedTronic/Covidien<br>▪ Baxter<br>▪ Bayer<br>▪ Pfizer<br>▪ Novartis<br>▪ AstraZeneca<br>▪ Sanofi<br>▪ Merck<br>▪ Millennium<br>▪ Vertex<br>▪ Biogen |
| Entrepreneurs<br>Accelerators/Incubators | ▪ MassChallenge (Pulse)<br>▪ Boston Children Hospital Digital Health Accelerator<br>▪ M2D2 (Medical devices)<br>▪ The Engine MIT<br>▪ JLabs<br>▪ athenahealth MDP Accelerator<br>▪ UMass Venture Development Center<br>▪ Harvard i-lab |
| Government<br>State organizations | ▪ Massachusetts Digital Health Initiative<br>▪ Massachusetts Life Sciences Initiative<br>▪ MassBio<br>▪ MassMedic<br>▪ Massachusetts Technology Transfer Center<br>▪ MassLifescience |
| Venture Capital<br>Investors | ▪ Flagship Ventures<br>▪ Third Rock Ventures<br>▪ HealthCare Ventures<br>▪ Excel Ventures Management<br>▪ Polaris Ventures Partners<br>▪ Highland Capital Partners |
| Universities<br>Research institutions | ▪ MIT<br>▪ Harvard University<br>▪ Boston University<br>▪ Tufts University<br>▪ Boston College<br>▪ Koch Institute<br>▪ Wyss Institute<br>▪ Joslin Diabetes Center<br>▪ Massachusetts General Hospital |