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Open Innovation Strategies and Web Technologies

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Abstract:

The last decade have seen a rapid increase in academic studies and business practices of Open Innovation (OI). A key reason for this has been that OI embodies potentialities of expanding markets through external sourcing of innovation and minimize internal innovation costs. Moreover, it can capture enormous knowledge dispersed around the globe in order to buy/license inventions/Innovations or processes from other businesses. The article aims at characterizing OI strategies. We identify two fundamental dimensions of OI: Innovation uncertainty/complexity and Innovation clock-speed. Combining these two dimensions a conceptual framework of managing OI strategies is proposed. Four distinct typologies or archetypes OI strategies can be obtained: Enterprise network OI strategy; learning & experimentation based OI strategy; collaborative OI strategy; and partnership & alliances OI Strategy. We characterize each one and suggest few insights.

Keywords: Open Innovation, web technologies, strategy, coordination mechanisms, production systems, gatekeepers

Introduction

The Global and dynamic competitive business environment is forcing private and public organizations to look beyond their traditional boundaries for new ideas, new innovations and reliable and innovative network of suppliers. During the last decade Open Innovation (OI) has been the focus of academia and professionals due to their ever-increasing role in time based competition, customer satisfaction of tomorrow needs, shrinking innovation cycles and rising customer expectations.

OI is a relatively a new paradigm shift for business enterprises (Chesbrough, 2003; 2007a, 2007b, 2010, 2011; Enkel et al., 2009) that aims to seize the potentialities of the web and abandon innovation secrecy paradigm to a kind of paradigm of knowledge sharing. The ultimate goal is to expand markets for external use of innovation (Chesbrough 2006), reduce costs of internal innovation and capture the widely distributed knowledge in order to buy/license inventions/Innovations or processes from other businesses.

Although open innovation is attracting more and more researchers, the main problems, however, of creating ideas and sharing them along the supply chain are hard to resolve. In the same token, scanning and capturing new technologies through a web of inventors and startups, or any other channels that can be used as the basis for technology transfer, internal development and joint development exploration and exploitation are even much harder. Granted, a vertical and stable supply chain "à la Toyota, BMW or Walmart" makes the transfer and joint development relatively easy. In fact, the pivot (Toyota, etc.) in this kind of vertical and stable supply chain control the microcosm of process innovation from suppliers to consumers. Suppliers' involvement in new product development in this type of supply chain is well known and well documented. However, they are still underused and their innovation process is far from integrated in an open innovation process model.

The open innovation process model is much more challenging than the ecosystem of the vertical and stable supply chain. The pitfalls of this rising model are somewhat numerous. The new open innovation process model requires new management competencies for managing fuzzy boundaries, inter-organizational relationships, inter-organizational constraints and bottlenecks. Second, it requires the development inter-organizational information systems to provide visibility. Third, it requires developing trust or at least a kind of understanding to build and nurture collaboration and access the global pool of talent. Finally, it requires new measures to evaluate and share organic value creation

The main research question is how to develop web based OI strategies to scan and channel ideas, knowledge and innovations from varieties of actors distributed around the globe and integrate them in an open innovation process that expand markets through Licensing/Buying, Spin-off and Joint Development?

This research paper is not intended to provide specific answers or solutions to this under-unexplored question. It is not aiming to build a conceptual model and prove a variety of hypotheses. Its intent is somewhat much simpler and modest. It aims at providing a framework in order to help structure ideas, thinking and discussions related to challenges, opportunities and consequences created by the rise of web technologies and their impacts on open innovation. First, through literature review the paper highlights the fundamental problems of management of innovations in closed innovation ecosystem (closed

innovation) and problems of management of innovations in an environment of sticky information. After discussing briefly OI drivers, we turn to highlighting key central problems of OI. Then, a framework is developed and four archetypes of OI strategies are uncovered. Finally few insights of OI practices are generated and
Finally, we conclude with few insights and a brief discussion of possible future research.

2. Background

Management of innovation technology is the study of complex linkages among three central concepts: Innovation, management and technology. Technology refers to the theoretical and practical knowledge, skill, and artifacts that can be used to develop products and services as well as their production and delivery systems. Management refers to the management of idea generation, conversion and diffusion. Innovation refers to "the development and implementation of new ideas by people who over time engage in transactions with others within an institutional order" (Van de Ven, 1986). Management of innovation technology is central to technological progress, economic growth and society development.

Literature on innovation is relatively bulky (Rogers, 1995; Tornatsky & Fleischer, 1990; Tushman & Rosenkopf, 1992; Tushman & Anderson, 1991; Moore, 2002; Christensen, 2003; Christensen & Overdorf, 2000). However, research on "innovation has been narrowly defined on the one hand, and technically oriented on the other" (Van de Ven, 1986). Relatively little of it focuses on the role of interorganizational relationships, environment and particularly on information communication technology (ICT) channels, namely web technologies and applications. Despite this voluminous and extensive research on the determinants of innovation in an organizational setting, the results seem confusing and inconclusive. From Schumpeter (1942) to Thompson (1967) –Rogers (1995) -Van de Ven (1986) - Tornatsky & Fleischer (1990), fundamental theoretical constructs focused mainly on innovation at the level of one organization. However, during the last decade, the dynamic environment is shaping new organizational forms: extended organizational forms. These new organizational arrangement is increasingly attracting researchers (Bensaou & Venkatraman, 1995; von Hippel, 1994) to focus on interorganizational relationships as a medium to enhance innovation through technology transfer, resource exchange and shared learning. Three main reasons seem explain the "sudden" interest of researchers. First, the traditional innovation model (closed innovation - pure hierarchy) appears to have limited power to explain the managerial problems and the implications of technological flows among organizations on one hand and to ensure competitive sustainability. Moreover, the development and deployment of ICT and particularly web-technologies linkages are reducing coordination costs and helping business enterprises and organizations in general to speed up products to market, seize opportunities and increase the value added along the value chains by leveraging each other's strengths. The use web-technologies can carry rich and intense information among organizations engaged in exchange. Depending on the level of complexities, web-technologies can support the management of innovation value chain (idea generation to conversion to diffusion) across organizational boundaries. To survive in a more and more dynamic environment, organizations are rushing to: 1) search globally for opportunities and resources; 2) focus on core competencies and mutually beneficial longer term outside

relationships; and 3) reap the benefits of global knowledge sourcing by opening the R&D field replacing secrecy by information and knowledge sharing. This new environment will have a major impact on technology diffusion and technology transfer. In summary, because of environment competitiveness, web-technologies development, the global dispersion of innovation competencies, clock speed technological change, process and product complexity and uncertainty of the innovation process, we are seeing more and more organizations (particularly business enterprises) use web-technologies and applications to support their internal innovation capabilities and resources. The strategic intent of this opening R&D is to expand markets (Chesbrough 2006), and capture distributed ideas, knowledge and technologies in order to buy/license inventions/Innovations or processes from other businesses.

3. Open Innovation Drivers

The intensification of global competition combined to the shrinking of innovation cycle are making innovation more and more risky and costly. Facing this competitive environment, organizations and business enterprises in particular are increasingly opening their innovation processes and collaborating across different industries and countries with varieties of innovator actors (e.g.; global academia, researchers in developed countries; researchers in emerging markets; scientists in different industries, retirees, individual networks, dispersed start-ups and laboratories etc.). What drives these global open innovation networks? Many business enterprises find it very difficult to do cost-effective innovation. The global talent pool, cheaper and far "hungrier" is viewed by businesses as an opportunity to accelerate innovation pace and support their business model to make smooth transition toward satisfying tomorrow needs and ensure sustainability. This opening allows organizations to enlarge their peripheral vision which is constrained by the tyranny of actual served customers. The fast cycling and the more and more demanding customer are also pushing businesses to harness tremendous amount of knowledge and expertise dispersed around the globe. Time-to-market will significantly increase if the R&D process is sped up by having the organization connect with external innovator that has developed the technology or is further ahead.

The event of Internet technology and the rise of web-technologies are both the source of new paradigm shift where knowledge is more and more socially constructed and learning and innovation is more and more collective. This new paradigm contrasts radically with the old paradigm characterized by protection and secrecy. It promote collective innovation using collective intelligence (Wang, 2014). Risk reduction through risk sharing is another driver of open innovation. Organizations that combine internal knowledge and innovations with a thorough understanding of outside knowledge innovations help to reduce innovation risk. Finally, open innovation allows businesses to leverage the development and the commercialization of the new product development process. For example, established business enterprises can use open innovation to leverage innovations to take-off full-scale. They can spin out technology or Intellectual Property (IP) that has proved to be outside the core business.

Table 1 contrasts between closed innovation and open innovation and highlights its major drivers.

Closed Innovation	Open Innovation
Enterprises hires the greatest number of talented people for their R&D	Around the globe the number of talented of people working in the same field is 10, 50, 100, 1000, 10000 times greater.
Opaque. Protection of IP and Secrecy of idea/ inventions/ innovations	Licensing/buying, spin off and knowledge sharing
Individual learning	Collective learning
First mover advantage is key to get ahead of the competition	Successful business model is more strategic than to be first to market
Control of the whole innovation process excluding competitors profiting from one's idea	Collaboration, knowledge sharing and collective learning create a microcosm of innovations through licensing/buying/spin off innovations and technologies to enhance business model.
Innovations are internally business supportive	Innovations are externally business supportive
Economies of Scale	Economies of Scope
Conflict and competition	Trust and collaboration

Table 1: Closed Innovation versus Open Innovation

4. Open Innovation Challenges

Management of innovation is a challenging area for any organization private or public. Van de Vent (1986), in a seminal article, provides a thorough analysis of management of innovation drawing from the fields of organizational theory and industrial psychology. The authors asserts that "innovation is the development and implementation of new ideas by people who over time engage in transactions with others within an institutional order." He exhibited four fundamental problems confronting managers in management of innovation. **The first problem** that challenges managers is the management of attention. Form cognitive psychology Van de Ven shows how people that make up organizations are prone to acquiring routines, group-think, and protecting existing practices instead of paying attention to new ideas. Individuals are restricted by their physiological capabilities that limit ability to process large amounts of stimuli. As organizations become more successful at what they do, the less they are able to recognize new opportunities. Strong leadership is required to overcome the routine to recognize the merits of new ideas. **The second problems** that challenge managers are related to the management of ideas. Institutional change is precipitated by disruptive events which threatens the status quo. Van de Vent suggests that novel ideas need to be championed by individuals so they can become an issue for debate eventually gaining influence and succeeding to make change. **The third problems** that challenge managers are related to the managing part-whole relationships: The innovation process has been traditionally viewed as a sequence of separated parts, which can be seen in firms' functional structures (R&D, marketing, design, etc.). Difficulty in managing part-whole relationships stems from the difficult of overcoming ones interpretive schemas that filter perception: being able to think outside the box. **The fourth problems** of management of innovation is related to institutional leadership: an unsupportive organizational context is likely to undermine the benefits of a well-functioning team; this means that innovative firms need support from their leaders to succeed. Management has thus the responsibility to inculcate appropriate value systems and organizational culture that will foster innovation.

Management of innovation across organizational boundaries is much more challenging than management at the organizational level. First this environment requires two key resources: technologies infrastructures and inter-organizational competencies. Although web-technologies are now widely diffused and less costly, nevertheless because of bandwidth problems and the nature of information, these technologies cannot support all types of innovation across organizational boundaries. In an environment characterized by vertical and stable supply chain, web- technologies can significantly support management of innovation. In an environment of open innovation characterized by dynamic and fleeting opportunities, web-technologies cannot fully support innovations scanning and technology transfer. The latter is particularity challenging because of information and knowledge stickiness.

Von Hippel (1994) identified three major factors that can explain information stickiness and make technology diffusion costly and slow: 1) the nature of the information; 2) the amount of information; and 3) the characteristics of the information seeker and the information providers.

The nature of information can increase or decrease the cost of technology diffusion. There are two types of information: encoded or explicit information and tacit or implicit information. Encoded information is generally related to a process or a product where technical information can easily be transferred. Because design concepts that embody operations principles are mature, well framed and explicitly documented and written, the information is not costly to transfer or not sticky (von Hippel, 1994). However, information related to component knowledge « knowledge about each of the core design concepts and the way in which they are implemented in a particular component - or an architectural knowledge « knowledge about the ways in which the components are integrated and linked together into a coherent whole » can be tacit or implicit or, to use again the von Hippel term, sticky, and thus, costly to transfer. For a variety of processes and products, the knowledge and skills required are not « frozen into the design of machines, but largely stored in the minds of men » (Simon, 1982). Much of the knowledge and expertise used to operate or to solve problems is tacit and requires investments, and individual and organizational learning. Even in the traditional industrial system, the technology developed elsewhere is not free for any organization. Organizations cannot borrow freely the technology. They have to develop their own skills and make their own investment to acquire that sticky part of the technology (Pavitt, 1987). Consequently, information stickiness can be a barrier to technology transfer and diffusion. Individuals and firms alike have to develop their absorptive capacity with respect to new and outside technology in order to reap the potential benefit of the transferred technology. The amount of information can increase the cost of technology diffusion**.** Technology diffusion may vary according to the amount of information required to implement the technology. Because process and product complexity varies, one may need a very large amount of information to hedge against the contingencies. If we cannot anticipate the exact type and amount of information needed to implement the technology, we require a large amount of information about the use environment of the technology. Consequently, in order to reduce the cost of transferred information, firms have to acquire prior knowledge and make indigenous research. These research activities can help individuals and firms to anticipate the kinds of problems that can arise following the technology transfer. To support our arguments one should review Pavitt (1987),

Cohen & Levinthal (1990) and specially Evenson & Kislev (1975). The characteristics of information seeker and information provider. Technology diffusion cost can vary along the type of the project, firm localisation, product and process type and readiness of the information seeker and the behavior and commitment of the information provider. Teece's (1977) study of international technology transfer projects is very interesting for those firms that are going global. « The costs of transmitting and absorbing all un-embodied technological knowledge (i.e., information on methods of organizations and operations, quality control, manufacturing procedures, associated information, but not the knowledge embodied in capital goods, blueprints, or technical specifications)…. can vary from 2 percent to 59 percent of total project costs » (see von Hippel, 1994, p. 432). Information cost relative to innovation implementation can also vary along the information seeker. Prior knowledge and the attitude of the information seeker as well as the aim of the technology acquisition are crucial for implementation success. The behavior and commitment of the information provider may also influence considerably the technology diffusion cost. In summary technology scanning, transfer and diffusion is not a free or cheap good.

5. Framework for Open Innovation as a new Mode of Organizing Innovation

5.1 Antecedents of OI strategies

There are key central problems that must be analyzed, evaluated and harnessed in order to seize the opportunities of OI strategies. These are absorptive capacity, complementary assets, intellectual property (IP) and control, technology diffusion, networks and the rise of Peer-Production and Network Externalities and Dominant Design.

Absorptive capacity

Absorptive capacity is critical to organizations and business enterprises in particular to open their internal R&D and start transact ideas, scientific and technological knowledge across their frontiers. Organizations must have the capability to scan, identify technological opportunities, assimilate and integrate them in a profitable business model. Cohen & Levinthal (1990) already underlined this capability of absorptive capacity for firms to generate gains from recognizing, assimilating and adopting external knowledge. Recently other researchers have arrived to similar conclusion. Laursen and Salter (2005) stated that networked companies with high scientific and technical competencies tend to favor OI. Silicon Valley (SV) is an illustration of this phenomenon. The performance of SV cluster is the concentration of high scientific and technological skills that materialize in intense knowledge exchange and fast innovations and adoption (Saxenian, 1999; Kenny & Burg, 1999; Castilla et al., 200).

Absorptive Capacity can be developed by focusing on the following dimensions:

Awareness: Awareness requires the development of specific processes by which an organization scans for weak signal and uncover knowledge and emerging technologies.

Association: Association requires processes by which an organization uncovers the value of new ideas, prototypes, products or emerging technologies

Assimilation: Assimilation requires the design of processes that fit organizational design by which the organization dissimulate and debate these new ideas, prototypes, products or emerging technologies in order to create, capture and deliver value to customers.
Adoption and Implementation: Adoption and implementation requires the development of processes by which an organization transacts ideas, products or technologies for competitive sustainability.

Complementary Assets
Complementary assets are those capabilities (apart from those underpinning the technology) that firms need to exploit the technology (i.e. manufacturing, marketing, reputation, complementary technologies, brand names, supply chain networks, etc.).
The main idea, Teece asserts, that the more complementary assets a company possesses, the more likelihood the company will take advantage of sourcing external scientific and technological knowledge. Teece (1998) distinguished two types of complementary assets: freely available and unimportant and tightly held (kept proprietary) and important. The appropriability regime determines the importance of gains that companies can derive from external knowledge sourcing. Large companies with large assets pool of complementary assets (CA) and tightly held are more oriented toward sourcing external knowledge. The large pool of CA provides potentialities of integrating external knowledge or buying start-ups or buying even large companies. CA, therefore, are important to commercialize innovations and collaborate with other companies.

Intellectual Property: Appropriability and control
Under the traditional innovation paradigm where secrecy and control of intellectual property (IP) are the driving force for a company's ability to capture innovation value. Under the new paradigm of organizing Innovation (Open Innovation), the risk for loss of IP control increases particularly when innovation exchange flows are with competitors (Greenhalgh & Rogers, 2010).. The dilemma of OI is not easy to overcome if the firm avoids developing a kind of understanding and trust relationships based on adaptability to market and technology shifts and alignment of business interests.
IP control and protection refers to the extent to which technology can be protected from imitation. Control and protection depend on the degree to which scientific and technological knowledge is tacit (non-codified). IP control and protection depend on the kind of appropriability regimes: "tight" (e.g., Coca-Cola recipe) vs "weak" (e.g., standard consumer electronic).

Technology diffusion
Technology diffusion is at the heart of intra-organizational and inter-organizational relations (Teece, 1992; Dyer & Ouchi, 1993). Technology diffuses internally and vertically through the interactions of prime contractors and subcontractors (maker - user). As the primes develop their networks of suppliers and affiliated firms, which in turn re-subcontract, diffusion reaches thousands of firms. These networks ensure access to technology and skills from one firm to another (from prime contractor to subcontractor and vice versa). Technology diffuses horizontally through strategic alliances, partnerships, and private and public joint venture research programs. Technology is diffused through a variety of channels: project teams, dispatch of engineers and managers

to partners (prime or subcontractor), hiring of retired technical staff, written documents and so forth. However, the content of these channels is resilient to measurement. The combination of inter-organizational relations and complexities, and information stickiness, information that is costly to acquire, transfer, and use (Von Hippel, 1994) makes it difficult to evaluate the intangible and tangible technological flows among firms.

As outlined earlier, innovation literature is relatively bulky. However, research on "innovation has been narrowly defined on the one hand, and technically oriented on the other" (Van de Ven, 1986). Relatively little of it focuses on the role of up-stream supply chain, environment and particularly on information technology, channels, namely web technologies and applications. Depending on the level of complexities, electronic networks can support the diffusion of technology. For example, the use of Internet technology and web technologies can support organizational resources and capabilities, which in turn, help introduce new administrative practice and support the introduction of new products and processes. Third, to survive in a more and more dynamic environment, the new firm is rushing to: 1) search globally for opportunities and resources; 2) focus on core competencies and mutually beneficial longer term outside relationships; and 3) outsource those activities that can be performed more quickly and at a lower cost by subcontractors or independent business partner. Firms that follow this path find themselves with minimum productive assets, delayered and in the middle of a web, characterized by numerous exchange transactions and complex linkages. In the aerospace, automobile, computer industry and others, firms are building with theirs partners a competitive supply chain. Dynamic and innovative firms are pressing one step further and already using the web as a major sourcing channel. This new environment will have a major impact on technology diffusion and technology transfer.

In summary, because of environment competitiveness, electronic network development, dispersion of technical competencies around the global, process and product complexity and uncertainty of the innovation process, we are seeing more and more firms use web technologies and applications to support and enhance organizational capabilities and resources, which are the antecedents of internal and external technology diffusion and usage.

Networks and the Rise of Peer-Production

Metcalf's Law states a network's value grows proportionately to the square of the number of nodes within the network. Although one can dispute the accuracy of this law, intuitively it can provides the most casual observer with insight into the value of networks. All organizations and individuals recognize today the value of networks. In the domain of OI the power of networks to source scientific and technological knowledge (buying and selling) is paramount. The creation and thoroughly designed networks can support the development of a kind of understanding and ultimately a community of trust.

Web technologies based networks enhance inter-organizational relationships and interpersonal relationships (Johnson & Duxbury, 2010). These relationships are fundamental to cross-organizational frontiers resources exchange. This environment of web technologies based networks facilitate the strategic roles of OI community drivers. They are external brokers, internal brokers, technology entrepreneurs (P&G), champions (e.g., CEO of P&G) and Capital Venture/Angel entrepreneurs, embodying competencies

that allow them to manage cross-organizational relationships to facilitate bidirectional flows of scientific and technological knowledge. These drivers/leaders are key in diffusing technology, mobilizing volunteers, organizing social networks (Castella et al., 2000) and in managing issues such as technology path divergence (forking problems) and fragmentation of innovation process (balkanization problems) (Fleming & Waguespack, 2007). OI environment requires reputation and trust from OI community leaders to create and sustain an Open Innovation Ecosystem. The key roles of these leaders allow them to resolve issues through social brokerage in connecting OI actors and technological boundary spanning through a process of scanning, identifying, translating, and relaying scientific and technological knowledge across organizational frontiers (Fleming & Waguespack, 2007). Because of their key roles as organizational frontiers spanners, IO community hold a higher degree of trust. Because they have an early access to information and knowledge, they have enormous impact on technology diffusion and control. They can develop and implement varieties of strategies to different groups in an effort to hedge on alternative development. Case studies (e.g., P&G, Peugeot, PG, Coca Cola, etc.) and literature review seem to suggest companies that invest in *technology gatekeepers* not only enhance the flows of scientific and technological knowledge but can immerse themselves in a OI ecosystem that support strategic technological sustainability.

Web technologies fostered a new mode of production system that helped the emergence of the rise of the commons and new mode of producing and channeling information and knowledge. The old alternative modes of production, Markets and Hierarchies, are characterized by either high coordination costs or production costs. Web technologies support groups of individuals collaborate on large-scale projects following a diverse cluster of motivational drives and social signals. This web based emerging collaboration is characterized by both low coordination costs and low production particularly when the object of production is information or culture. Because of web technologies and the wide diffusion of computers, communications capabilities and increasingly mobile technologies, OI community will play in the future a major role in scientific and technological knowledge exchange among organizations.

The rise of the commons favor peer-participation where community membership is characterized by *anti-credentials* and there is no *a priori* selection criteria for participation (Bauwens, 2006). Low barriers to participate increase the pool of participants and increase the probability of solutions to problems and particularly the new flow of ideas. Moreover, the lower costs (almost null) associated with peer production allow OI community to play fully their roles without organizational financial constraints.

Web technologies based peer production foster diversity of theories, ideas, and perspectives and consequently improve quality outcomes through interactions in innovation open ecosystem.

Peer production system can be characterized by independence, pluralism, representation, decentralized decision-making and autonomous participation (O'Mahony, 2007). This environment of production can provide scientific and technological contribution to firms that invest in gatekeepers.

Network Externalities and Dominant Design

Network externalities effect occurs when open innovation increases the participation of users which increases the value of products for more users. On the demand side, the telephone service illustrates the network externalities. The benefit that people get from the telephone service depends on the extent to which other people also use this service. In other words, network externalities effect happen when "the attractiveness of a product to customers increases with the use of that product by others" (Fisher & Rubinfeld, 2000). Firms with dominant design (standard system) tend to gain enormously from direct network externalities (when an increase in the size of a network increases the number of others). They tend also to gain from indirect network externalities (when an increase in the size of a network expands the range of complementary products available to the users of the network). The more people who adopt the same standard system, the more services and applications the user can access, and so the greater the value of that system to each individual user. On the supply side the firm with the largest network tend to achieve increasing returns to scale because the cost of developing and maintaining the network can be spread over a large and increasing growth of the system or product.

In OI environment network externalities or network effects has a profound impact. The dominant design which is the source of network effects tend to favor an open innovation ecosystem in order to increase the direct and indirect effects. The more users (organizations or individuals) interact with each other, the more ideas and knowledge creation to improve the system and consequently the more the network will increase in value. The increase in the size of network will tend to create an environment of creation of new ideas and knowledge that benefits the creation of more complementary products.

5.2 Framework of Managing OI Strategies

OI embodies buying and selling external knowledge. The fundamental assumption that guides the practice of large firms and start-ups is by opening up the R&D and move away from secrecy, organizations can tap into enormous potentialities of ideas, inventions, innovations and also finding use for "dormant" patents and non-performing products or technologies through selling them or co-exploitation (Chesbrough, 2003, 2006, 2011). What kind of OI strategies should be formulated to reap the potentialities of the new OI ecosystem?

To develop a strategic OI management framework we considered several characteristics that might be useful in classifying OI strategies. At its most fundamental motivation however, organizations are opening-up R&D because of the increasing innovation uncertainty and complexity on one hand and because of the innovation clock speed on the other. Uncertainty is inherent in every innovation process. This uncertainty takes different and concomitant forms such as technological uncertainty, market uncertainty, social and political uncertainty and non-intended consequences uncertainties.

Coping with the rate of change in the world today consumes much attention of organizations and seniors. Markets, technologies, and competitors all move more quickly than a decade ago and twice quickly than two decades ago and may be four times more quickly than three decades ago. Central to this fast speed is innovation. Time-to-market based competition cannot be achieved without clock-speed innovation. The internal

innovation clock-speed is not fast enough to create new processes, new products and services. Because markets are moving faster than internal innovation clock-speed, rivals, new entrants, substitutions and other factors, companies may shift from offensive mode to defensive posture. To avoid this situation and technological and market disruptions, business enterprises are opening their R&D to source external scientific and technological knowledge.

Summing-up one can identify two dimensions that can be used to characterize OI strategies: Innovation uncertainty/complexity and Innovation clock-speed. Combining these two dimensions a conceptual framework of managing OI strategies is proposed. Four distinct typologies or archetypes OI strategies can be obtained: Enterprise network OI strategy; learning & experimentation based OI strategy; collaborative OI strategy; and partnership & alliances OI Strategy. The relationship of these four configurations is illustrated in Figure 1.

Before describing and discussing each typology, it is imperative to stress the following elements for better characterization of these typologies. The elements that best characterize typologies are: coordination mechanisms, strategic intent, gatekeepers, production system and business case that illustrate the typology. Among these elements coordination mechanisms (communication & control) is central to OI. The literature stressed three main coordination mechanisms (Mintzberg, 1979, Galbraith 1973): 1) mutual adjustment, 2) standardization, and 3) shared variable. However, web technologies (web 2.0 and their applications and web 3.0) (Chui et al., 2009; Flat World Business, 2014) can serve as an enabler and supporter of inter-organizational relationships and particularly in information and scientific and knowledge sharing. By allowing rapid information flows at much lower costs, web-technologies enable interactive relationships that otherwise might have been desirable but impractical. In OI environment web-technologies play a central role as a primary coordination mechanisms.

Enterprise Network OI Strategy (L-L Environment)

In an environment characterized by relatively low innovation complexity and uncertainty coupled to low innovation clock-speeds (Quadrant L-L – Figure 2), organizations tend to adopt an OI strategy that tends to network primarily their own **stable** supply chain where they play the role of pivot. The case of Coca-Cola products offers an excellent illustration of this type of OI strategy. Coca Cola processes and products have in general low level of technological complexity and characterized by stable technology cycle. Because of appropriability regime that characterize Coca Cola products, IP does not create cross-organizational relationships problems. However, this type of company is not sealed completely from technological progress. Today branding is not limited to the unique characteristics of the product, but go beyond to incorporate issues such as environment and corporate social responsibility (e.g., suppliers'relationships, contribution to local community). In this kind of context, green supply chain (waste management, water usage, packaging etc.) becomes fundamental to strategic sustainability. Granted, companies operating in the quadrant L-L, the impact of innovation on processes and products are relatively low. However, OI within the frontiers of the business enterprise and across its vertical supply chain is important. For that reason, they must use the application of Web 2.0 (Wagner & Jiang, 2012; Ooi et al.,

2011) which is Enterprise 2.0 (see Annex 2) to capitalize on internal ideas and knowledge and across their stable supply chain (vertical) to improve existing activities. Further, this type of business enterprise can use Enterprise 2.1 (see Annex 2) to interact with consumer and outside communities to gather ideas and knowledge particularly in the domain related to green supply chain. For strategic sustainability, companies in the Quadrant L-L can support OI by adopting Enterprise 2.0 and eventually Enterprise 2.1 based coordination mechanisms.

Coca-Cola

Coca Cola famous for keeping the recipe of its drink secret may not need OI to come up with new products or design new technological processes. However, their green supply chain and their Corporate Social Responsibility (e.g.; unemployment) is leading them to seek new ideas and knowledge to create better living for society. Combined to provide solutions to real society problems, the restricted opening of Coca-Cola aim at improving their corporate image on one hand and support their strategic sustainability on the other. The Web 2.0 and Enterprise 2.1 are used to create a network that support idea generation, interaction and debating to help converge toward solutions.

Collaborative OI Strategy (H-L Environment)

The collaborative Open Innovation strategy (H-L Environment- Figure 3) aims at mining opportunities through sourcing external information, scientific and technological knowledge. In order to accelerate internal innovation processes and deliver greater overall value to the market, P&G's "Connect + Develop" model was developed.

P&G CEO and senior managers believe that innovation constitutes the foundation of P&G Model. The company used the new organizing innovation model to create value with extended network of innovators, start-ups, established businesses, customers, and individuals through InnoCentive reaching untapped talent pools (Huston & Sakkab, 2006; Ruiz, 2009). The ultimate goal is satisfy customers and maintain strategic sustainability. P&G new organizing innovation model is customer focused rather than technology focused. Innovation is not limited to the upstream value chain. The innovation is involved along the product value chain in areas such as packaging, shopping experience, after the sale service and the in-home product usage experience. New structure called "Connect and Develop" was created. At its heart two driving forces: 1) Gatekeepers (Research Fellows and technology entrepreneurs) and 2) Enterprise 2.0 and enterprise 2.1.

Enterprise 2.0 and Enterprise 2.1 are both applications of web 2.0. These 2 applications help increase the involvement of employees in establishing and managing data. Moreover, P&G is also allowing its employees to personalize its web portal by adding RSS feeds of news and business information. These web- technologies based service allow the development of relationships with customers, suppliers, online hubs for all the interactions with supermarkets, scientific and technological knowledge providers around the world. Web based collaboration at P&G succeeded to source external knowledge through the creation of a network of weak ties (Ruef, 2002; Castilla et al., 2000) and also because of absorptive capacity, internal talent, and particularly gatekeepers that play a critical role as technological entrepreneurs. Combining the power of web technologies (Gruber, 2008) network and scouts (Technology entrepreneurs), P&G succeeded to hunt for new ideas, inventions and innovations cross organizational boundaries. Another type of gatekeeper that sustain absorptive capacity is the In-House R&D team (Research

Fellows at P&G) responsible for conceptual development and continuous refinement. This type of gatekeeper is a hedge against the risk of losing expertise to innovate.
Knowledge management tools are embedded deeply in the structure, supported by web based technologies such as web platforms like "Innovation Net" and Enterprise 2.0 and Enterprise 2.1 that leverage competencies of gatekeepers (research fellows and technology entrepreneurs), who play central role in the collaborative OI strategy of P&G.
Philips a pioneer and innovator of health and well-being products, adopted a somewhat different collaborative approach to P&G one can call it collaborative OI hybrid strategy (Philips, 2011). OI Philips Research strategy aims at maximizing the benefits of both outside-in and inside-out innovation approaches. This strategy is motivated by innovation stickiness (tacit knowledge), high intellectual proprietary regime and diffusion characteristics. For Philips collaborative innovation is a means to benefit from complementarities assets and complementarities among firms.

Learning & Experimentation OI Strategy (H-H Environment)

In the quadrant H-H (Figure 4) companies leverage the speed and the power of web technologies to manage the flow of ideas, scientific and technological knowledge and integrate them in fast flexible and responsive processes for accelerating understanding and learning of technology uncertainty and complexity in an environment of high-clock speed. In this quadrant companies use pure peer production system and web technologies as coordination mechanisms. They tend to combine knowledge generation through rapid cycles of experimentation and the rapid integration of the information generated. The use of web technologies based pure peer production system and the design of extreme flexible-structured-controlled processes allow companies to generate, document, develop and control activities. The following two cases illustrate the environment of this quadrant.

PSA Peugeot Citroën

During 2011, **PSA Peugeot Citroën** (French car manufacturer) has initiated a collaborative project to design the car of the future. The company developed a collaborative effort with dispersed scientific laboratories around the globe. The lunched project yielded a network of OpenLabs that allows collaboration between internal research centers and external research groups. The aim is to take advantage from dispersed ideas and knowledge when connected can create a platform for interactions and produce the car of future that fits for example the environment requirements and customer needs.

Local Motors

Local Motors is a start-up created in 2007 by a former marine, Jay Rogers. Designing a new car requires multiple teams and multiple competencies, experience and huge resources. The use of crowed sourcing can save the start-up time and money. Moreover, by using crowed sourcing, the start-up can gain from dispersed skills and experiences around the global and creating a global product that may speed-up it diffusion and adoption.

The H-H environment is characterized by a relatively low risk of external sourcing (low competitive imitation) and the need for high external knowledge and sophisticated competencies. The use of web-technologies based sourcing external knowledge allows companies to sense the market and somewhat predict the major source of unpredictable change of the market needs.
In the quadrant H-H, it is very difficult to predict tomorrow needs. By combining web technologies and its collective intelligence (Lesser et al., 2012) peer production and the

design of extreme flexible processes, companies can increase knowledge sharing and enhance organization learning in order to react, adapt and design very rapidly new products and new processes to fit market needs. Companies in this quadrant require gatekeepers with high competencies to integrate external scientific and technological knowledge and market needs. Their task consist of reacting continuously to the flow of information and knowledge in a synchronized way.

Partnerships & Alliances OI Strategy (L-H Environment)

The quadrant L-H (Figure 5) is characterized by relatively low innovation clock-speed and relatively high innovation uncertainty and complexity. Companies operating in this quadrant combine hierarchy, market and peer production system. They use Enterprise 2.0, Intranet and Extranet technologies as part of their coordination mechanisms. The gate keepers are externally oriented managers and virtual teams with high competencies in managing inter-organizational relationships.

Companies in this quadrant are Aerospace, pharmaceutical, consumer electronics and automobile manufacturers. They tend to keep internally activities such as design, branding, marketing, but outsource most other activities (assembly included for consumer electronics companies).

OI strategy is based on organizational alliances and partnerships (P&A) focused on creating and *capturing* value along the supply chain. Companies involved in P&A to source external knowledge in order to reduce innovation uncertainty and complexity need particular governance mechanisms and special contracting.

There are three types of governance mechanisms, markets, hierarchies and clans (Ouchi, 1980). For companies operating in L-H environment and engaged in OI strategy based on P&A, the clan mechanism determines the transaction costs (Williamson, 1975, 1979) through a system where contributions and retributions are balanced on the long run. Because of the nature of innovation (characterized by its uncertainty and complexity), clan mechanisms is the proper mechanism. In this environment characterized by performance ambiguity and difficulty of goal congruence among players engaged in sourcing external knowledge, relational contracting (Williamson, 1979) is best.

The environment L-H requires adaptability and alignment. Uncertainty and complexity of the technology require time and adaptation to changing needs caused by shifts in markets. For instance, structural shifts can occur due to economic progress, political and social change, demographic trends, and new emerging technology. Therefore, companies engaged in P&A for external knowledge sourcing must adapt their inter-organizational relationships and their processes to ensure the best outcome.

Alignment is a form of trustworthy relationships where risks, costs and rewards are equitably shared. Misaligned interests and OI strategies among players engaged in P&A is a sure path for P&A failure. If any participating member's interest is not aligned, it can cause conflict of interest and failure of OI strategy implementation and execution. Hence, it is critical that all participating member's interests are aligned so that OI strategy achieves its strategic intent. Finally, alignment will ensure a kind of understanding with minimum of ambiguity and of equivocality related to the purposes and priorities of the P&A.

6. Insights for practicing OI

1. The use of external sourcing, external and internal experimentation integration, and absorbing new ideas and experiences particularly from external sources constitute a real challenge. Not all organizations are ready to manage this variety of information, knowledge and technology flow and integrate it in a competitive business model.
2. We need to develop theoretical foundations for external innovation sourcing. Theoretical constructs such as RBV, TCT, network externalities, and absorptive capacity must be integrated in a coherent explanatory and predictive model.
3. IP issues is problematic (Pisano & Teece, 2007). How protect IP? Have safeguards in place to make sure IP is not accidentally disclosed, or external IP is not used in an illegal way.
4. Web technologies are blessing. However, connection and reach are not so easy to establish. It needs specific ICT infrastructures an applications integrated in organizational processes in order source external knowledge particularly for sticky knowledge.

7. Conclusion:

In review of the current literature it can be seen that external knowledge and expertise contributing to new innovations and new products development is increasing rapidly enabled by the evolution of the web and its collaborative capabilities. Web 3.0 and Web 2.0 and its application Enterprise 2.0 and Enterprise 2.1 has moved innovation from a traditional paradigm characterized by internal knowledge sourcing and secrecy to a new paradigm of organizing innovation (open innovation).

The fundamental assumption underlying open innovation paradigm is to bring external research institutions, customers, suppliers, competitors, retirees and individuals to innovate together through information and knowledge sharing (Ruiz, 2009). However, external sourcing of information and scientific & technological knowledge is challenging. Probably, information stickiness (Von Hippel, 1994) is the most important challenge to external knowledge sharing. Moreover, in order to seize the opportunities of OI strategies, key central problems must be analyzed, evaluated and harnessed. These are absorptive capacity, complementary assets, intellectual property (IP) and control, technology diffusion, networks and the rise of Peer-Production and Network Externalities and Dominant Design.

Through a brief and limited review of open innovation practices by most known and publicized business enterprises, fundamental dimensions for developing a framework for OI strategies are uncovered. Then primary channels and coordination mechanisms used to source external innovations are identified.

The framework highlighted in figure one shows four types or archetypes of OI strategies: Enterprise network OI strategy; Learning & Experimentation based OI strategy; Collaborative OI strategy; and Partnership & Alliances OI Strategy. How in each configuration organizations scan, identify and source ideas and innovations? Gatekeepers with high technological and inter-organizational competencies. What coordination mechanisms organizations are using to collaborate with outsiders like universities, suppliers, customers, global academia, researchers in developed countries; researchers in emerging markets; scientists in different industries, retirees, individual networks,

dispersed start-ups and laboratories? Web technologies are used as one of the primary factor for coordination mechanisms. What production systems are using to generate ideas and technological knowledge? Markets, hierarchies and peer production systems are combined and used. In quadrant H-H, for example, companies tend to use pure peer production system.

The aim of this paper is to build on prior contributions in the domain through the development of OI framework. Four types or archetypes of OI strategies are identified. Moreover, differences among these four OI strategies in terms of coordination mechanisms, gatekeepers, strategic intent and production system are uncovered.

Granted, much remains to be done from theoretical and empirical view. Practices of well-known and publicized such as P&G (2006), Starbuck, Coca Cola, Philips (20011), Peugeot, IBM, Lego, Local Motors, GE, Fiat, Cisco and others is not enough to validate the framework. The next important step is to formulate hypotheses and confront the framework to a more rigorous empirical testing.

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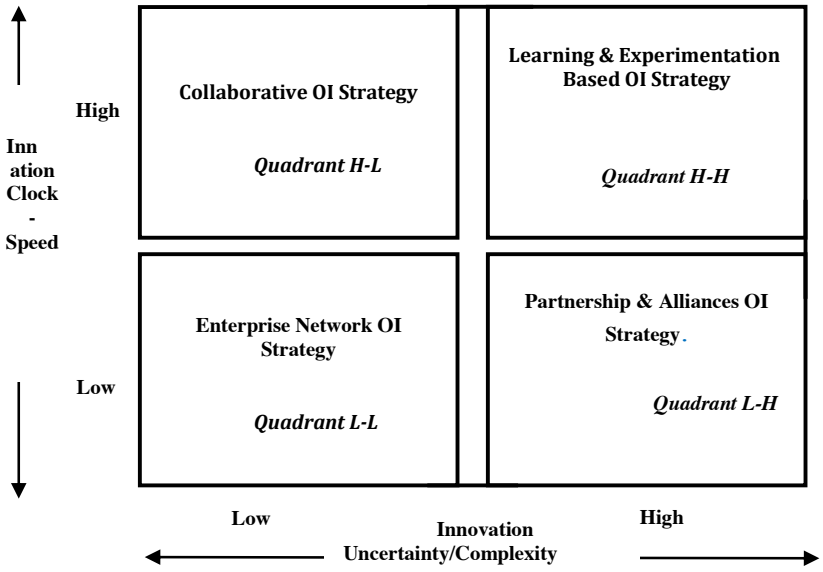


Figure 1: Typology of OI Strategies

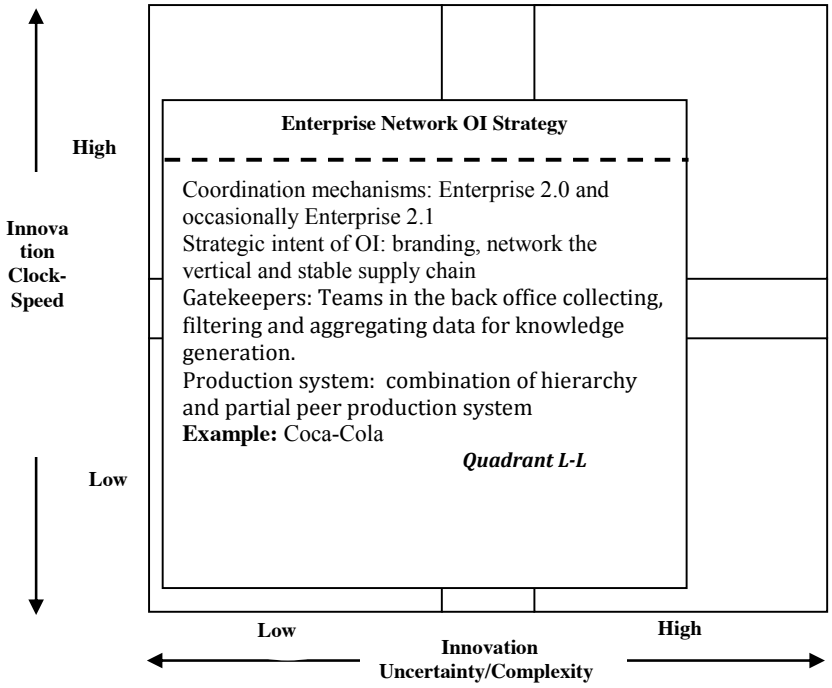


Figure 2: Stable OI Strategy

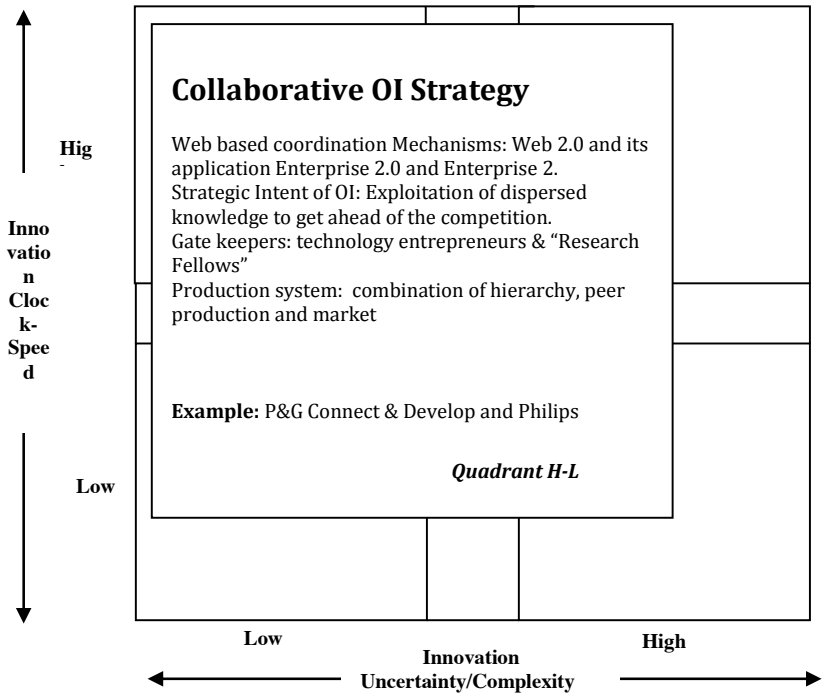


Figure 3: Collaborative OI Strategy

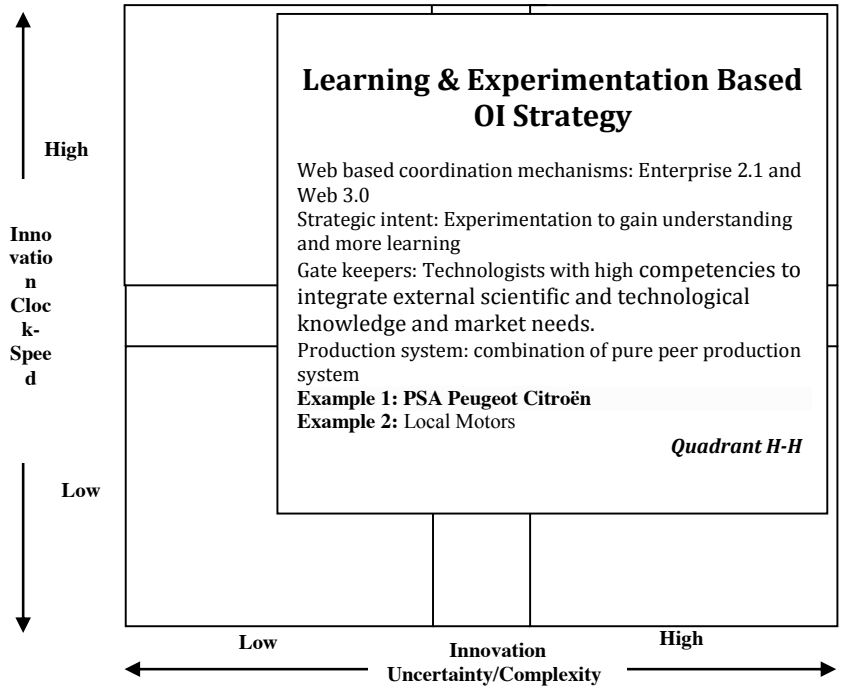


Figure 4: Learning and Experimentation Based OI Strategy

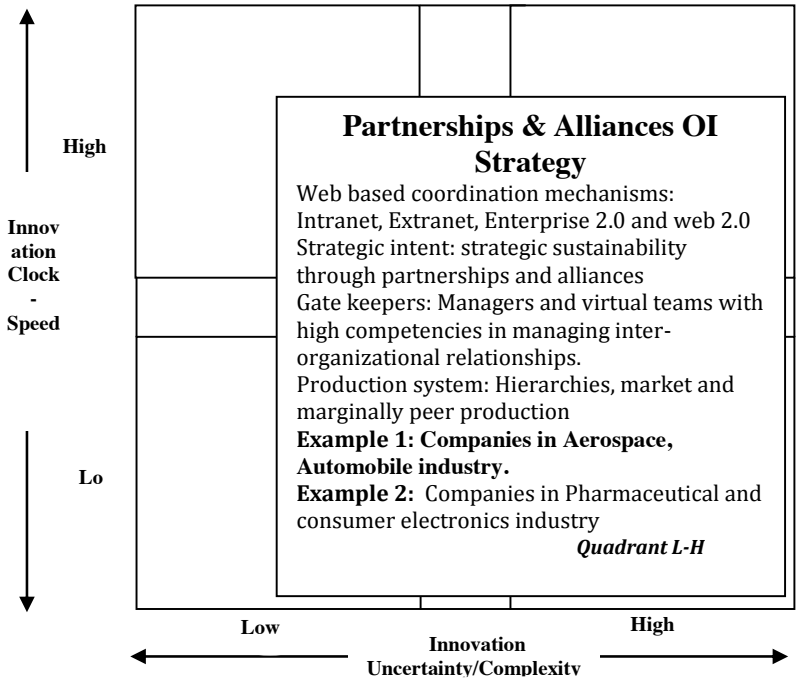
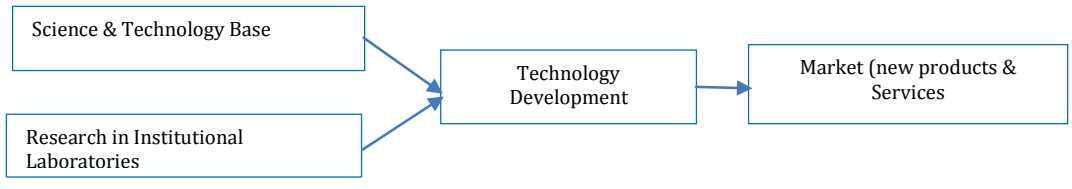
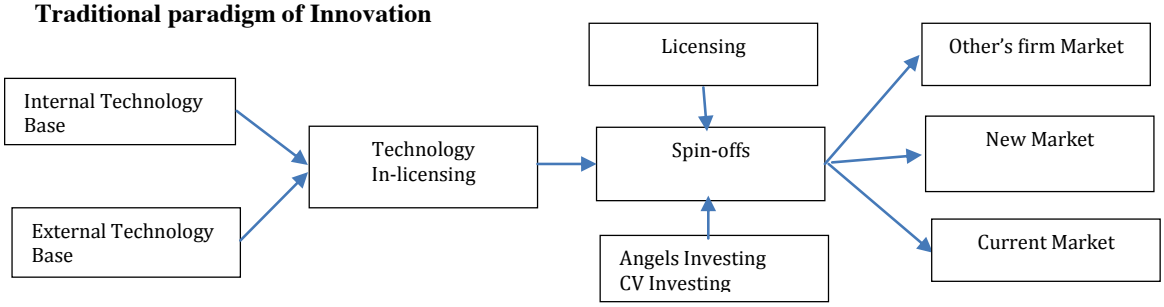


Figure 5: Partnerships and Alliances OI Strategy

Annex 1: Traditional paradigm of innovation vs new paradigm of organizing innovations (OI)



Traditional paradigm of Innovation



New paradigm of organizing Innovation (Open Innovation)

Annex 2: Web 2.0, Enterprise 2.0 and Enterprise 2.1, Web 3.0

The term Enterprise 2.0 is used first by McAfee (2006) in parallel with Web 2.0. McAfee defined Enterprise 2.0 as part of Web 2.0. The difference from Web 2.0 was that Enterprise 2.0 could be used to network internal functions, internal processes and knowledge workers. He characterized it as an emerging technology, low-cost driver of knowledge management with enormous potential of enhancing collaborative work and exchange of information and knowledge among employees. McAfee (2006) outlined the six components of Enterprise 2.0 – Search, Links, Authoring, Tags, Extensions, and Signals – with the acronym SLATES.

Enterprise 2.1 is an application of web 2.0 technologies aiming at networking actors and providers of external information and scientific and technological knowledge sources. To seize the opportunities of these technologies organizations must necessarily reengineer their processes in order to facilitate Web 2.0 technologies utilization to communicate with external knowledge sources.

Web 3.0, or the Semantic web, is a collaborative movement facilitating our ability to collaborate online, by providing the ability to access untapped knowledge and information in online networks. It has enabled a fundamental transformation in open innovation and supply chain management from linear sequential thinking and communication to dynamic communication and collective intelligence involving all innovators around the globe and all levels of the supply chain from extreme upstream to extreme downstream. The Web 3.0 is still in a very early phase of development and use with very little research on the topic, however Web 3.0 is already at work to support and use collective intelligence in open innovation collaboration along the supply chain.