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Marketing for Technologies: S-D Logic and the Open Innovation Paradigm *

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Abstract

Firms have been modifying their innovation management processes to generate, implement and exploit new technological knowledge. A gradual shift from a closed to an open model of innovation has been the recurring pattern of this change. Firms have to revise their overall strategic orientation to adapt their managerial procedures according to the Open Innovation (OI) paradigm. The New Service-Dominant (S-D) Logic can offer a useful guideline to firms in the implementation of an OI model. This paper presents the bases of the OI paradigm by means of the S-D Logic mindset. For each of the premises characterizing the S-D Logic, instances of firms that have implicitly adopted the OI paradigm are provided. We discuss how the S-D Logic can be put in practice within the context of the OI model.

Keywords: S-D Logic, Open Innovation, Value creation, Co-creation capabilities

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1. Introduction

The New Service-Dominant (S-D) Logic Paradigm was introduced by Vargo and Lusch in 2004. Since then, it has received much attention, been enriched by other authors, adapted to specific contexts and related to different approaches signaling its usefulness in understanding the essence of exchanges. The outstanding contribution of the S-D logic paradigm is to put ideas together which did not appear to belong together (Ballantyne and Varey, 2008). The S-D logic thus encompasses previously fragmented thinking in a perspective that is consistent, transparent, open and dynamic. This paradigm is founded on ten premises (Vargo and Lusch, 2004, 2008a) that offer a mind-set to re-evaluate what is exchanged, what is offered and how interactions between stakeholders should work in an efficient manner.

The Open Innovation (OI) Paradigm (Chesbrough, 2003) is a new perspective that centers on innovation creation as a function of both internal and external ideas of the firm. Chesbrough (2003, 2006b) presents eight aspects differentiating the OI paradigm from the traditional closed approach, which have a lot in common with the basic ten premises of the S-D logic paradigm. Chesbrough (2006b) has called for research to enrich the OI paradigm and we believe that analyzing it through the lenses of the S-D logic foundations can help better conceptualize the paradigm, open up new lines for research in innovation and especially, suggest new marketing practices for stakeholders.

We first introduce the OI paradigm and its bases and then focus on the ten premises of the S-D logic paradigm. Each of the ten paradigms are described, interpreted for innovative firms and analyzed to suggest how they translate to the OI approach with the help of real world examples. Practical implications for innovative firms are elaborated to suggest a new type of segmentation based on key elements of both paradigms.

2. The Open Innovation Paradigm

The main essence of the OI paradigm is that it contrasts with the traditional "closed innovation" approach, whose principles state that a firm invests in research and development (R&D) activity with the aim of developing new technologies that become the bases to create new products. Such new products are introduced either into existing markets (or segments), or into new markets. Thus, the new technological developments and, in general terms, the firm's innovative capabilities represent a relevant source of sustaining competitive advantage, which the firm can leverage to strengthen its competitive market position. Monopolistic profits can be gained when products are radically new, both to the firm and the market. The time sustainability of such monopolistic condition depends on how much the firm is able to prevent imitation from competitors by investing in effective appropriability mechanisms.[1]

Among all the available appropriability mechanisms, the most effective is "secrecy", a situation in which any uncontrolled public disclosure of information concerning the new technology is prevented. But secrecy can be maximized only if the firm develops the technology in-house without any linkage with external actors.[2] Therefore, the firm has to operate in a "closed" innovative environment. The resulting technology development

[1] Appropriability mechanisms concern any strategy that innovative firms pursue to capture the value of an innovation. Typical strategies include secrecy, the ownership of complementary assets in marketing and manufacturing, being first to market, and filing for intellectual property rights (patents). For an overview of the appropriability literature, see Winter (2006).

[2] The only linkages the firm establishes with the external environment are: i) from the supply side, with the scientific community, in order to absorb the scientific knowledge needed to start a technology development program; ii) from the demand side, with the consumer market, in order to assess unsatisfied consumers' needs and determine which product features to include in the new product.

process can be described as a funnel (figure 1), whose boundaries are represented by the physical boundaries of the firm itself: several new ideas of product are submitted to both technical and market assessments; most of them are abandoned because they do not satisfy minimal success requirements; some of them are maintained and follow the remaining development process; few of them are eventually converted into new products and then introduced into the market; even fewer ideas become successful products.

[Figure 1 about here]

Even though this closed innovation model has worked well for long time, recent changes in the technological, competitive and commercial environment (advent of mass customization, increase of pace of technological change, strengthening of competition due to globalization) have emphasized its main limits:

a) From the technology exploration side, firms' technological resources and capabilities have been inadequate to face the development of complex technological projects. A larger and increasing fraction of the needed knowledge is indeed located outside the firm's boundaries. The capability to settle various forms of collaborations with different actors (universities, public research laboratories, technological partners, suppliers, customers and even competitors) has become key in order to outsource such knowledge;
b) From the technology exploitation side, especially after the development of general purpose technologies, firms have found themselves lacking in complementary assets needed to enter all the potential application markets. As a consequence, besides traditional exploitation mechanisms, new forms of

technology commercialization (such as licensing and spin-off creation) have turned out to be a viable strategic alternative.

Firms' boundaries have gradually become porous and less defined, and the entry and exit of scientific and technological knowledge more frequent (figure 2). Consequently, firms have to adopt an "open innovation" approach, whose main characteristics (Chesbrough, 2006b) are presented in Table 1.

[Figure 2 about here]

[Table 1 about here]

3. Open Innovation from the S-D Logic Paradigm lenses

The S-D logic provides a bridge function that simplifies marketing thought by unifying consumer, business and industrial marketing (Vargo and Lusch, 2008b). Vargo and Lusch (2008b) note that this logic serves as a foundation for a theory of markets and marketing that is helpful in drawing implications for marketing practitioners interested in developing a true focus on service. We describe the ten foundational premises of the S-D logic based on the works of Vargo and Lusch (2004, 2008a) and Lusch, Vargo and O'Brien (2007). Then, an interpretation of the premise's meaning is offered for both the closed or traditional innovation approach and for the OI paradigm. In discussing the latter, we elaborate on the similarities between the OI and the S-D logic paradigms. To illustrate how these premises are translated into practice, we offer for each one an example of firms that have implicitly adopted the premise bases with successful results.

FP1. Service is the fundamental basis of exchange

The first premise posits that "service" is the heart of value-creation and reflects the process of doing something beneficial for and in conjunction with another entity. The parts involved (operant resources) apply their specialized competences (knowledge and skills) to create the service, which is the essence of the exchange.

In the case of innovation, the outcome of innovative activity – being it a tangible high-tech product or intangible technological knowledge – generates a value that depends on the level of novelty of the innovation and on the capability it shows to solve practical problems more effectively than available technological solutions. In both cases, it is not the innovation outcome per-se that possesses a value but the creative adoption and implementation of it by the user that generates it. This process of value co-generation is strictly influenced by the producer and user's competences and by the complementarities existing among the two actors. Thus, the basis of the exchange between producer and user is the service embedded in the technological outcome and the enhanced capability of innovation to solve current or future problems within the user's context.

The OI paradigm (Chesbrough, 2003) is based on a set of bases that suggest that a good performance requires specialized competences. The perspective is open in the sense that knowledge is maintained within the firm and also searched outside the firm boundaries. The need to connect with external sources of knowledge in order to produce the service is recognized. The nature of the service is the technological knowledge co-generated by the firm and a set of heterogeneous actors. The potential value of this service (that is, the new technological knowledge) originates from its use as a tool for enhancing the user's productivity or efficiency (or, in general terms, utility).

Take, for example, the technological knowledge embedded in a patent. Its potential utility can be converted in actual value depending on the application of it by any of the actors that have participated in its development or any other firm that might adopt the same technology in the future. Notice that such future adopters are often unknown at the beginning and might belong to sectors that are technologically very far from the developers' main sector. Thus, the total current value of that new technological knowledge is largely unpredictable.

FP2. Indirect exchange masks the fundamental basis of exchange

This premise indicates that around the direct exchange there are many products, processes, money, institutions and vertical marketing systems. These are only vehicles of exchange, which mask the service-for-service nature of the exchange. Micro-specialization is one of the illnesses that firms can have since the main basis of exchange can be sometimes forgotten.

A similar concern can be issued in the case of innovative contexts. According to the traditional innovation model, the main incentive that a firm has in innovating is developing a new (radical or incremental) technology to be embedded in a (new or modified) product in order to meet the needs of (current or future) customers. The firm thus creates or strengthens its competitive advantage.

This model implies micro-specialization at different levels:

i) at the sector level, the outcome of an innovative process is a technology whose unique use is in products that the firm develops for the markets in which it operates or in which it aims at entering in the future;[3]

ii) at the actor level, each actor is specialized in one activity. For instance, manufacturing firms develop technological knowledge to create new products; engineering or R&D consulting firms develop technological knowledge to provide customized technological services; universities and other public research organizations develop scientific knowledge that remains in the public domain and that can be freely used by any other actor;[4]

iii) at the contract level, each type of exchange requires specialized contractual arrangements (market contracts in the case of innovative products, licensing and/or service contracts in the case of technology consultancy, research grants in the case of scientific knowledge).

The picture is much more complex and less defined when we move from the traditional innovation model to the OI paradigm. The final outcome of a firm's innovative activity is technological knowledge to be exploited in different forms and through different means (from new product development to corporate spin-offs creation). So, the same technological knowledge can be creatively adopted in several industrial sectors, by different types of customers (individuals or firms) and by means of alternative contractual (and pricing) arrangements. This situation overcomes the traditional limits of

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[3] Notice, however, that such a sectorial specialization at the output side does not imply specialization at the input side. As shown in the case of multi-technology corporations (Granstrand, Patel and Pavitt, 1997), if the product to be developed is a complex system it is very likely that a firm needs to integrate different technologies arising from several technological domains.

[4] However, it has been recognized since long that, in order to develop adequate absorptive capabilities, firms need to spend at least a part of their R&D effort in producing scientific knowledge similar to that developed by the scientific community (Cohen and Levinthal, 1989; Rosenberg, 1990)

micro-specialization and transforms the firm in a more complex organization. The key to manage such a complexity, however, is to recognize that at the core of a firm's innovative activity stands a service (technological knowledge) and that any combination of sectors, actors, and contracts is indeed a service-to-service exchange.

As an example, consider Lockheed Martin corporation, whose main business is aircraft manufacturing. One of the critical components of an aircraft is its avionics system, which (electronically) controls the functioning of the whole aircraft. Given that any aircraft is characterized by specific physical features, it always requires a customized avionics system that differs at least in some aspects from existing systems. By recognizing the strict aircraft-avionics system interdependence and the fact that any future pilot would have had the need to train in using the new system before piloting the new aircraft, Lockheed-Martin typically develops a flight simulator that is sold as a complementary service together with the new aircraft. In order to further exploit its knowledge in flight simulators, however, the company decided to use the same technology to develop video games (that is, a product targeting a different market, with different customers, and with different contractual and commercial arrangements).[5]

As this example suggests, from the macro-economic perspective, the adoption of an OI paradigm expands the value created to customers. Indeed, what characterizes the production and use of (technological) knowledge is a high development cost and a close to zero reproduction cost. Thus, by limiting the exploitation possibilities to one sector/one contractual solution, as implicit in the micro-specialization pattern suggested by the traditional innovation model, a firm faces an opportunity cost of missed created value.

[5] This example has been drawn from Rivette and Kline (1999).

At the same time, in order to expand the possibilities of adoption and use (and value creation) of technological knowledge, the intervention of new actors –such as intellectual property intermediaries (for examples and references, see Chesbrough, 2003)– is often a necessary condition. Their role is that of assisting technology developers to search for and interact with potential users that might be dispersed in distant geographical and sectorial markets. From the macro-economic perspective, the costs associated to such intermediaries represent a drawback of the OI paradigm.

FP3. Goods are distribution mechanisms for service provision

This premise separates the "service" from the product, services or processes that transmits the service value. They are only mechanisms embodying knowledge or skills that render the service. This is useful for focusing on the essence of the service.

The same distinction applies in the case of innovative activity, whose outcome –new technological knowledge– is exchanged by means of different distribution mechanisms. This technological knowledge is either embedded in tangible products or remains un-embedded and transferred as intangible knowledge, depending on the typology of user. The first case refers to a situation in which high-tech final products or components (depending on whether a B2C or a B2B market is concerned) are sold by means of typical market contracts. The buyer of such products/components is indeed purchasing the service they provide, whose value depends on their actual utilization. By contrast, the second case refers to the provision of technology-based consulting services (un-embedded tacit knowledge), or to the exchange of patents (un-embedded codified knowledge). Among these two extremes, several combinations can be found. So, for example, it is not unusual to observe the provision of engineering services along with the licensing of codified, patented technological knowledge (Arora, 1995; 1996).

A firm which operates following the OI paradigm should be able to combine these possibilities according to the user's needs and characteristics.

In the chemical industry, firms pursuing a similar strategic approach are largely diffused. Take the example of the polypropylene producer Himont during the 1980s (Cesaroni, 2003). The company was active in the polypropylene market with customized polypropylene compound (embedded knowledge) and was also active in the chemical technologies' market, where it massively licensed its Spheripol process technology (un-embedded codified knowledge). Furthermore, it was not infrequent that would-be licensees were buying not only the licensed technology but also the engineering services (un-embedded tacit knowledge) needed to design and set-up the chemical plant based on the licensed technology.

FP4. Operant resources are the fundamental source of competitive advantage

Competitive advantage is driven by the comparative ability to cause the desired changes. It includes human skills, logistic capabilities, knowledge bases, supply chain relationships and non-imitable strengths.

Innovative firms know this premise well. The role of technological knowledge and the capability the firm shows in its generation, adoption and use have been outlined as fundamental bases for competitive advantage (Barney, 1991; Prahalad and Hamel, 1990; Rumelt, 1984; Teece, 2006). According to the traditional innovation theories, however, the main advantage arises when the firm is able to generate new technologies in-house by impeding other firms to participate in the technology generation. Any unintentional diffusion of knowledge is prevented and the firm can benefit from the largest appropriability that maximizes the expected returns.

In contrast, the OI paradigm stresses the importance of collaborative agreements that the firm has to settle along the entire process of knowledge generation (since the phase of ideas definition). Thus, the true source of competitive advantage shifts from the capability to develop technologies in-house, to the capability of monitoring the external environment, of setting-up relationships with different actors (providers, competitors, other non-competitive firms, public research organizations, and final consumers), and of integrating several knowledge components. Key in this is an appropriate management of intellectual property rights, which are often used as a contractual weapon to enhance the firm's bargaining power.

The example provided by the semiconductors producer ST Microelectronics is a case in point (Cesaroni, Di Minin and Piccaluga, 2005). ST Microelectronics has been a late entrant in the industry of semiconductors, which was (and still is) dominated by U.S. and Japanese giants. After having exploited the opportunities offered by the niche market of MPEG encoders and decoders, the company soon realized that an enduring international expansion path fed by a persistent innovative activity could be sustained only by developing a vast and diverse network of partners to be involved in a complex value chain. This implied the development of strong relational capabilities, which allowed ST Microelectronics to become the strategic center of a complex and geographically dispersed network of suppliers, technological partners and customers (Lorenzoni and Baden-Fuller, 1995). Furthermore, the company understood that significant improvements in chip design could be obtained only by investing in basic research.

Thus, an active participation to public research programs was encouraged, and collaborations were established with universities and public research laboratories.

FP5. All economies are service economies

Service has been central to the economy but is becoming more notorious as specialization and outsourcing increase.

Similar to other economic activities, innovative activity can be considered a service-based economy whose main objective is creating knowledge to solve problems, to increase efficiency and productivity, and to satisfy needs. The basis of any exchange is the technology-based service itself irrespective of the means by which new knowledge is exchanged (either embedded in or un-embedded from tangible products).

The same framework applies in an OI context where the heterogeneity of technology exploitation possibilities and of knowledge creation conditions makes it explicit that any firm is indeed contributing in the development, diffusion, adoption and use of knowledge. Technological knowledge is the unifying element of the entire innovative value chain and the unit of exchange among the complex network of actors.

FP6. The customer is always a co-creator of value

This premise is based on the interaction of operant resources and the co-creation of value. This means that the service will be best off if the end user is involved in the service production process.

The tendency to let customers be involved in value creation characterizes innovative firms since long and not only (as it would be reasonable to expect) in the case of un-embedded knowledge that requires further developments and applications. Let us consider two cases, one from the consumer market and another from the industrial market.

It is a common practice in the software industry for the consumer market to launch a new software package with the anticipated release of a “beta version”. This is a reduced version of the software package, which is given for free either to a reduced number of lead users or (more commonly) to every user, under the implicit and informal agreement that users report back to the company any problem and inconsistency they might find in using the software. Thus, users participate in software development and contribute to generating a higher value out of it. The open source software is an extreme (but constantly growing) case of the example outlined above. Indeed, by definition, it is created by a vast and geographically dispersed group of users-developers, who offer their software skills and experience for the benefits to themselves and any other potential user.

The second example is drawn from the industrial market of semiconductors. One of the most relevant changes promoted by semiconductors producers over the last decades has been the introduction of Application Specific Integrated Circuits (ASICs), which allow users to create customized circuits (Von Hippel, 1994; Von Hippel and Katz, 2002). The process works in three stages. In the first one, the semiconductors manufacturer designs and produces “standard” silicon wafers that contain an array of unconnected circuit elements. Then, by using a user-friendly CAD software package provided by the manufacturer, the user designs its custom interconnection layer to be applied to the standard wafer and uses the same software to conduct trial-and-error experiments. Finally, a silicon foundry produces the integrated circuit, according to the layer specified by the user. This process reduces the need for information exchange because each agent independently uses its tacit knowledge to solve its specific sub-problem. The underlying idea is that the technology supplier provides the user with a "technology package" containing a standardized technology and a tool kit, which enables the user to customize the same technology according to its own needs.

The example of ASICs brings attention to the more general consideration that any final user can participate in the technology provision phase and can contribute to generate value out of it only if two conditions apply:

a) The user must have enough skills and know-how in that specific technological field or, at least, the technology developer has to provide a specific tool to the user to apply the technology according to his or her specific needs;
b) The technology has to remain at a level that is general enough to be subsequently customized according to diversified needs – it has to be less context-dependent (Arora and Gambardella, 1994). Indeed, only in this case the same technological knowledge can be adopted in different contexts and adapted to meet the requirements of specific users' needs.

FP7. The enterprise cannot deliver value, but only offer value propositions

Firms cannot create and deliver value alone; they can only offer value propositions that create the service only following end user's acceptance, participation and consumption.

In the case of a new technology development the actual value depends both on its practical utilization and on how the new technology permits to solve existing problems better than past technologies or any other available alternative. The new technology only represents the possibility to create value but it does not provide any value per-se.

Consider the extreme case of patented technologies. A patent represents a property right granted to a technological invention, which protects the inventor from uncontrolled imitation. It can be traded among economic agents as it is an intellectual property right. One of the typical contracts by which patents are exchanged are licensing agreements whose specific pricing method exactly fits the idea of technology as value proposition rather than delivered value. Because the effective application of the technology is not known ex-ante, it results difficult to determine an exact price for it. Licensing contracts, on the other hand, distinguish two components of price, a fixed fee and a royalty component. The latter is usually computed as a percentage of sales that the licensee will obtain in the future by using the technology and thus represents the means by which the technology developer co-participates to the value created by the user. In sum, any patented technology can be described as a value proposition, whose actual value strictly depends on the user's application decisions.

There are other solutions in an OI context (apart from the licensing of patented technologies) that replicate the same conceptual framework. When a company decides to leave a newly-created corporate spin-off to further develop a technology and to bring it to the market, that company is offering a value proposition to the spin-off. By maintaining an equity share in the spin-off, the company then receives a part of the generated profits and thus captures a share of the value created by the spin-off by means of the original technology.

FP8. A service-centered view is inherently customer oriented and relational

The firm and the end-user are considered in a relational context since both create value in an interactive process. In combination with FP7, where value is finally determined by the end-user, the exchange is inherently customer oriented.

Innovative firms have recognized the centric role of consumers in new technology development since the 1960s when a “demand-pull” model of innovation started to replace the traditional “science-push” model (Rothwell et al., 1974). Even though that distinction between contrasting innovating models can be considered largely dated, recent studies confirm that consumers still play a dominant role in innovation development (Roberts, 2001). They represent a fundamental source of innovation and participate in different forms along the entire process of idea generation, technology development and technology implementation.

Fiat Research Centre (CRF –the corporate R&D centre of the Italian car manufacturer since the end of 1970s) is an exemplification of this approach (Cesaroni, Di Minin and Piccaluga, 2004). CRF has tried to convert itself from a “cost centre” to a “profit centre” by exploiting internal technological competences outside the group’s boundaries. This has made CRF act mainly as a technological consultant on behalf of local firms. One key aspect of CRF’s successful strategy has been that of recognizing the centric role of customers. In defining customer’s technological needs to be satisfied, CRF was used to take into account not only customer’s explicit requirements but also customer’s latent needs, customer’s competitiveness conditions and (most importantly) the expectations of “customer’s customers”. This meant a relevant technological, organizational and managerial effort for CRF because its researchers were required not only to integrate know-how and competencies from different technological areas but also to analyze the complex environment in which customers were operating. Nevertheless, such a complex effort was the key to success.

At first glance OI seems to underestimate the active role of customers. By stressing the idea that a firm can exploit its technological competences through different means even in situations of “false negatives” (that is, when a new R&D project fails to meet the criteria in earlier stages of the development process), OI seems to adopt a pure “science-push” approach. However, this conclusion may be incorrect for at least two reasons:

a) Irrespective of which actors will eventually appropriate the returns arising from the technology, any R&D project has to start from and conclude with an active involvement of end users, because only this condition can maximize the likelihood of functionality and success;
b) A false negative R&D project that exits the firm’s boundaries and follows an external exploitation path still needs further development and implementation. Such additional stages are managed by actors other than the firm that originally launched the R&D project. However, these actors will have to adopt a customer-centered view just like the original firm if they aim at generating a technological knowledge that offers a value proposition to their customers. The problem only shifts from the original firm to such external actors but it remains key for guaranteeing the success of the R&D project.

FP9. All social and economic actors are resource integrators

Organizations and individuals motivate and constitute the service exchange. All entities participating in the service production are considered social or economic actors.

In any innovative activity it is possible to identify several actors participating in technology development (such as universities, public research laboratories, providers, partners, competitors, and customers) and it can hardly be asserted that a single firm may possess all the needed resources and competences to manage the development process entirely in-house. Each actor offers its specialized technological, organizational, relational resources and competences. The value thus created emerges as the composition of marginal contributions.

The OI paradigm recognizes and emphasizes the importance of the complex network of actors that participate in technology development. It also identifies new resource integrators that often act as intermediaries among other actors and base their competences on the management of intellectual property rights.

One of the most cited examples is that of InnoCentive.com (Chesbrough, 2006a; Lakhani, 2008), which acts as a virtual innovation marketplace. The function of the InnoCentive business model is rather simple: it facilitates meetings between firms ("Seekers") that need to find timely solutions to their technological problems ("Challenges") and a vastly dispersed group of technicians ("Solvers") willing to offer their technological expertise. As soon as a Seeker poses a Challenge, external Solvers submit their proposed solutions. Solutions that are judged acceptable are then rewarded by the Seeker with a cash prize. InnoCentive manages the process to facilitate the transmission of intellectual property from the Solver to the Seeker. InnoCentive's role is that of a resource integrator, which contributes to value creation by allowing the exploitation of technological competences otherwise unexploited.

FP10. Value is always uniquely and phenomenologically determined by the beneficiary

This premise indicates that value is always judged by the end-user depending on the specific situation (time, place and network relationships) he or she is in.

This last premise fits the innovation context (and likewise the OI) perfectly. A new technology must be considered a potential solution to practical problems, whose actual usefulness (and, hence, value) strictly depends on the context in which it will be practically applied. The more a technology is General Purpose (Helpman, 1998), the higher the number of contexts where it can be applied and the higher the overall value generated.

Take, for instance, a patent protected technology and consider the structure of "claims" included in the patent documentation. Each "claim" represents a possible specification of the same technological knowledge from the most general –that explains the content of the technological base– to the most specific –that explains how to use that technological base to obtain a determined product. Each claim represents a potential outcome of the same technological base. Actual technology's value, however, only results from how end users will be able to adopt that technology to satisfy their particular needs. That is, how each claimed product will be effectively transformed into an actual and valued product. Once again, without end user's intervention, a patent is only a value proposition.

4. What can be learned from looking at OI through the S-D logic approach: Implications for innovative firms

One of the promising consequences of adopting the S-D logic framework to analyze the OI paradigm is that of redefining the way in which innovative firms should think of strategies for marketing their innovative outcomes in business-to-business markets. According to the OI paradigm, innovative outcomes resulting from technology development processes can be exploited by firms in different forms (embedded vs. un-embedded, codified vs. tacit knowledge), through different methods (in-house vs. external exploitation), and in different application contexts, depending on the degree of generality of the technological knowledge. Potential customers of each form-method-context combination are characterized by specific features in terms of competences (skills and know-how), absorptive capacities and application needs. Each form-method-context combination can be regarded as a unique segment of the overall market for technologies and a market segmentation process can be adopted by innovative firms to set the bases for a marketing strategy.

Applying this framework shifts the problem to the identification of the main variables to be used in the segmentation process and the analysis of each segment's characteristics and attractiveness. It might be useful to refer to the scheme reported in Figure 3 that compares two dimensions. The first dimension is the degree of *complexity of the technology* to be transferred. Technological complexity can be defined as the novelty and inherent sophistication of a technology, often resulting from the combination of knowledge coming from dissimilar and distant technological domains (Steensma, 1996; Tyre and Hauptman, 1992). It typically has two additional attributes, tacitness and specificity (Bou-Llusar and Segarra-Ciprés, 2006; Heiman and Nickerson, 2002; Simonin, 1999). Because a complex technology cannot be easily communicated and understood (Nonaka and Taceuchi, 1995; Polanyi, 1966; Zander and Kogut, 1995) and results from context-dependent creation processes, its transfer to other agents/organizations becomes difficult, often depending on long-lasting user-supplier interactions. A simple, explicit and non-specific technology, on the other hand, can be more easily transferred to other organizations by means of market-based transactions.

The second dimension in Figure 3 is *the level of customer's co-creation capabilities* –the customer's accumulated experience of the technological field specific to the technology to be transferred. Co-creation capabilities depend both on the amount of time spent on that field and the effort devoted to R&D activities. A customer's co-creation capabilities can be regarded as the customer's absorptive capacity (Cohen and Levinthal, 1989; Rosenberg, 1990), which relates to the customer's ability to acquire, assimilate, transform and exploit external technological knowledge (Zahra and George, 2002).

[Figure 3 about here]

It is possible to identify four situations by mapping these two dimensions together:

a) *Quadrant I - Transfer of embedded technologies*. The low technological complexity of this condition allows the innovative outcome to be embedded in physical products (such as machines, equipments, devices) directly sold in the product market. Potential customers are not required to understand the underlying technological solution embedded in the high-tech product but only need to recognize how to use it. This condition overcomes their reduced co-creation capabilities because original innovative outcomes do not require additional development stages in order to be applied;

b) *Quadrant II - Transfer of codified un-embedded technologies*. In this situation, the innovative outcome is based on a technology that is enough non-specific and codified to be protected by means of intellectual property rights (patents). Thus, the technology can be transferred to potential customers through market-based contractual solutions (e.g., licensing agreements), which imply a reduced user-supplier interaction. However, in order to be applied, the technology has to be further developed and implemented by the user, which has the needed absorptive capacity to perform such tasks;

c) *Quadrant III - Transfer of tacit un-embedded technologies*. Contrary to the previous situation, the higher complexity of the technology in this situation implies that it cannot be reduced to a bundle of patent-protected technological components. As a consequence, even though the potential customer possesses high technological capabilities, simple transfer methods cannot be adopted. Long-lasting, articulated user-supplier relationships are needed (e.g., cooperative R&D agreements) so that the resulting final innovative outcome is co-created by the two actors;

d) *Quadrant IV - Transfer of tacit un-embedded technologies*. This situation is very similar to that described in Quadrant III. However, because of its lower absorptive capacity, the user in this case has to be closely assisted in the acquisition and implementation of the technology. The transfer of the complex technological knowledge typically takes the form of consultancy or engineering services, by which the innovative firm provides technology-based customized solutions to the user.

It is worth noting here that the boundaries of the four market segments are not necessarily exogenously determined but can be endogenously modified by the same innovative firms. This possibility has a direct impact on the size and hence the attractiveness of each segment. The key to this possibility lies in a correct understanding of what a complex technology is and, specifically, of how the tacit component of a technology can be "codified". As revealed by the technological change in electronics and chemicals over the last decades, the codification of technological knowledge is often the result of efforts promoted by firms in order to use general and abstract knowledge bases applicable in diverse contexts (Arora and Gambardella, 1994). Such investments are directed to translate technological knowledge into more general and abstract categories, not directly linked to the specific application for which that knowledge has been originally developed. These go back to scientific bases that lie behind the technology itself so that the technology becomes less context-dependent.

Incentives to the codification of technological knowledge come from the fact that firms can maximize the returns from their innovative activity by transferring the technology to a higher number of users. Indeed, once a technology has been made less context-dependent, it can be applied to different sectors, contexts, and organizations without having to sustain high adaptation costs. The size of the market segment thus enlarges.

In the presence of complex, tacit technologies (segments III and IV), technology transfer can only be promoted by means of "one-to-one" interactions between technology suppliers and acquirers. The supplier will directly come to know how the potential user is going to apply the technology being transferred and will profit from this information by maximizing the technology's price according to its value for the user. This scenario represents a fairly "traditional" pattern within the context of division of innovative labor and is typical of research centers (or engineering firms) that work on behalf of external customers. This model of "one-to-one" technology transfer offers a higher degree of customization than that by a pure model of market-based transactions but limits the diffusion of the technology as a package.

When the technology can be highly codified (segments I and II), firms face an opposite situation and technology can be transferred to a potentially higher number of users. The supplier does not directly know all the users and the exact value they give to the technology (value-in-use) so that she cannot maximize the returns from each transfer. However, it may be possible to maximize the number of transfers by defining generic and standardized exchange contracts. The necessary condition for this situation to happen is the absence of tacit components of technological knowledge whose presence would imply a stronger interaction between the two parts.

This second scenario might represent an evolution of the first one, for firms that adopt strategies that increase the codification of technological knowledge. The net result of this choice may be positive in the presence of increasing returns from technological development. This condition is satisfied in many technological sectors, such as the software industry, provided the largest part of investments is required at the initial phase of knowledge generation and that subsequent applications cost close to zero. Furthermore, this pattern implies that firms might have incentives for developing general purpose technologies to be applied to several diversified application sectors (Arora Fosfuri and Gambardella, 2001).

Examples of firms active in segment II can be observed in knowledge-intensive large firms (e.g., producers of modules of complex technologies), in small firms focusing on technology development without downstream assets in production and marketing (e.g., some small firms in the semi-conductors industry) and in those organizations with relevant technological but scarce commercial competences (e.g., universities). It is worth noting that actors in this segment are not only firms producing and selling technologies but also intermediaries whose role is to connect technology buyers and sellers to reduce transaction costs.

Examples of firms active in segments III and IV can be found in more traditional industries like machinery and the automotive sector. Technologies developed in the automotive sector have context-dependent characteristics and result from the solving problems that have a specific and localized origin. These technologies have a strong tacit component, which makes their transfer particularly problematic and based on strict user-supplier interactions.

5. Conclusions

We have explored how the Open Innovation Paradigm and the Service-Dominant Logic Paradigm relate one to the other. Both perspectives see the value-in-use as the center of exchange and also consider that better value is to be gained from collaboration and co-creation of actors. These perspectives represent a step forward in the way of doing businesses, leaving behind the orientation to products and manufacturing that now are seen just as vehicles of service. The first contribution of this study is then the integrated view of two different areas of knowledge (marketing and innovation) that allows us to think in terms of the essentiality of the service. The examples presented for each premise demonstrate that innovative firms that have implicitly focused efforts on key aspects of the S-D logic have achieved successful results. This is another contribution of this work that encourages innovative firms to consider improving practices of the various premises. It is very likely that the better the performance based on the premises, the higher the competitive advantage of the involved actors. A third contribution of this work is the proposal of a new classification of customers according to four market segments. These are the result of simultaneously mapping two critical dimensions: complexity of the technology to be transferred and the level of customer's co-creation capabilities.

Many challenges based on the S-D logic are now opened for innovative firms. We outline at least four. One challenge is to think of new and more efficient ways to get other actors more involved in the co-creation processes of the service. An effective management of intellectual property rights is key to minimizing potential conflicts among partners and to create incentives to participate in collaborative agreements. A second one is to identify efficient ways for selecting actors to collaborate with. Interactions with different stakeholders and intermediaries become critical in the creation of value. Relationships based on trust, transparency and symmetry are the foundations of successful exchanges between involved parties and promotes long-term collaborations that are beneficial to all concerned. A third challenge is the value propositions and the new forms to communicate them. Efforts should be made by firms to create rational expectations of the exchanges. Clear and straightforward messages increase actors' satisfaction and enhance their ensuing positive behaviors. A fourth challenge regarding operant resources resides in recognizing the role that each of the operant resources play in producing services. Investing in training of employees and collaborators (for example, through internships, joint participation to research programs) will increase the value created in exchanges.

We believe that the S-D logic mind-set helps a firm in focusing on the real reasons of its function. In particular, the S-D logic makes innovative firms think of more open ways of conducting exchanges, creating more value not only for end customers and the firm but also for society at large. Research on the challenges outlined above is the beginning of innovative managerial practices that will fit the current trends of the global economy.

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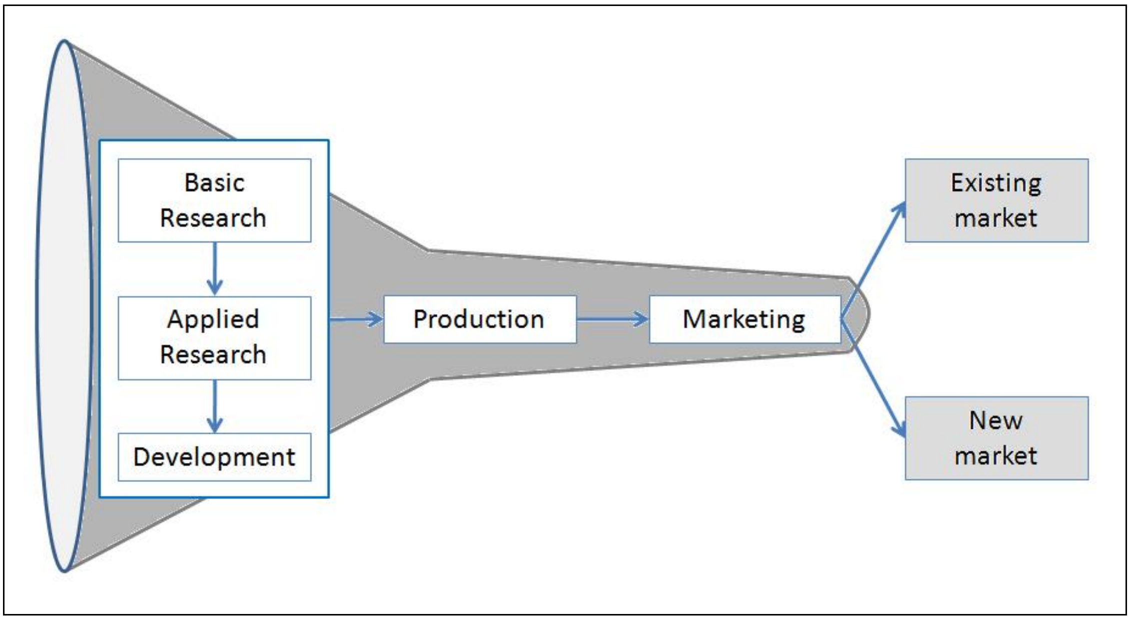

Figure 1 – The “closed innovation” paradigm

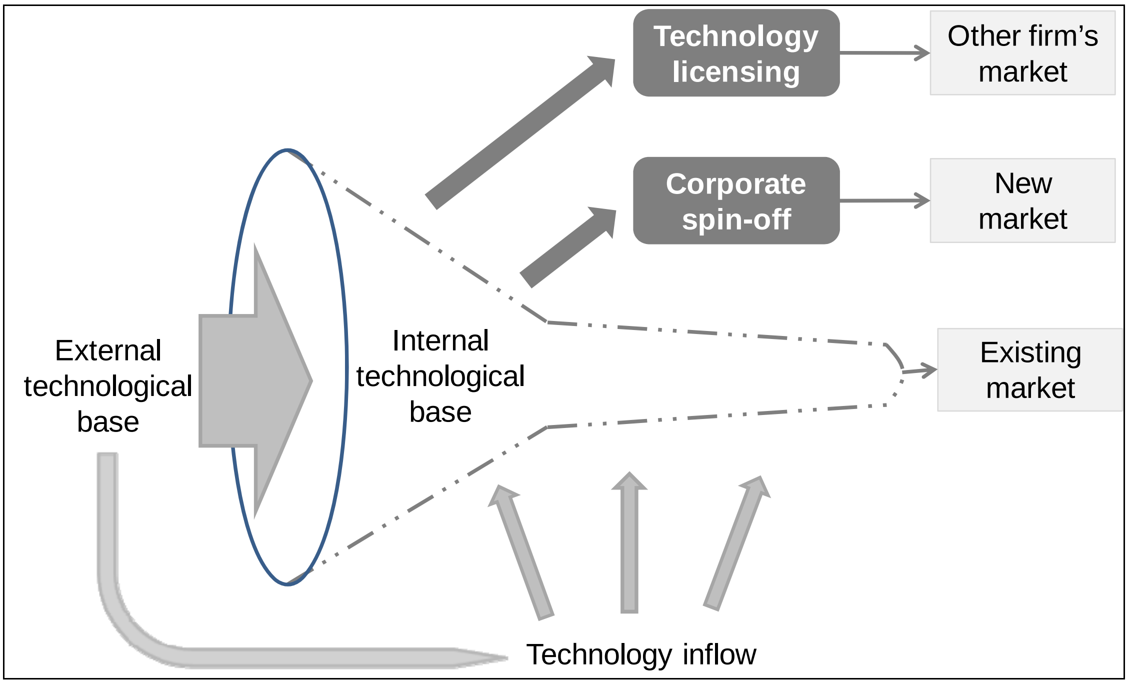

Figure 2 – The "open innovation" paradigm

Source: adapted from Chesbrough (2003)

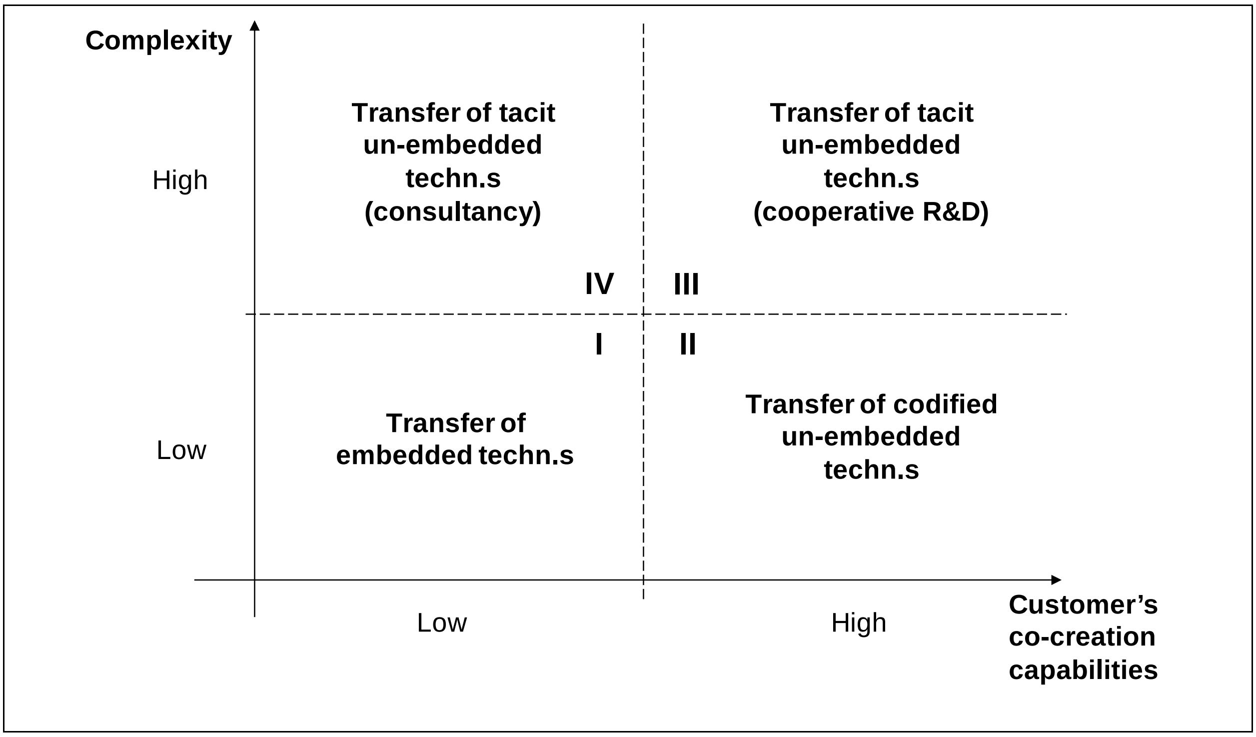

Figure 3 – B2B technology market segmentation

Table 1 – Main differences between “open innovation” and “closed innovation”

1.	External knowledge is as important as internal knowledge
2.	Continuous seeking of “genius people” inside and outside the firm
3.	False negative R&D projects can have a market
4.	New channels enabling flows of technologies that lack a clear path to market internally seek a path externally
5.	Knowledge is widely distributed and of high quality in general, so there is a need to connect with external sources of knowledge.
6.	Proactive role of IP management facilitating the use of markets to exchange valuable knowledge
7.	Intermediaries play a direct role in the innovation market: more intermediaries with more functions
8.	New metrics for assessing performance are needed (e.g. R&D in the supply chain, percentage of innovation generated outside the firm, time for an idea to get from the lab to the market and by channels, utilization of patents for others, value generated, investment in other firms)