

Bruno Rondani

Centro de Inovação Aberta
(CIA, Brasil)
bruno.rondani@openinnovation.wiki.br

Tales Andreassi

Fundação Getúlio Vargas
(FGV, Brasil)
tales.andreassi@fgv.br

Robero Bernardes

Fundação Educacional Inaciana
Padre Saboia de Medeiros
(FEI, Brasil)
bernardes@fei.edu.br

Universidade Federal do Espírito Santo

Endereço
Av. Fernando Ferrari, 514, Goiabeiras
29.075-910, Vitória-ES
gestaoeconexoes@gmail.com
gestaoeconexoes@ccje.ufes.br
http://www.periodicos.ufes.br/ppgadm

Coordenação
Programa de Pós-Graduação em Administração
(PPGADM/CCJE/UFES)

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MICROFOUNDATIONS FOR OPEN INNOVATION: IS EFFECTUATION A VALID APPROACH FOR OPEN INNOVATION MANAGERS?

MICROFUNDAMENTOS PARA A INOVAÇÃO ABERTA: A EFETUAÇÃO É UMA ABORDAGEM VÁLIDA PARA OS GESTORES DA INOVAÇÃO ABERTA?

ABSTRACT

Since Chesbrough (2003) first coined the concept of *open innovation*, it has attracted a growing attention in academia and practice. Academic research has spread its focus into topics such as innovation management, business strategy, organizational behavior and public policies, while practitioners have explored the concept of open innovation in diversified ways. Taking this into account, this article proposes microfoundations for open innovation by relating it to *effectuation theory*, originally developed in the field of entrepreneurship. Our aim is to show that effectuation theory can provide strong contribution to build a consistent micro level conceptual basis for open innovation practices.

Keywords: Open innovation management; Effectuation; Entrepreneurship; Innovation management; Innovation networks; Decision-making processes.

RESUMO

Desde que Chesbrough (2003) cunhou pela primeira vez o conceito de inovação aberta, tem atraído atenção crescente do meio acadêmico e profissional. A pesquisa acadêmica tem espalhado seu foco em temas como gestão da inovação, estratégia de negócios, comportamento organizacional e políticas públicas, enquanto os profissionais têm explorado o conceito de inovação aberta de formas diversas. Levando isso em conta, o artigo propõe microfundamentos para a inovação aberta, relacionando-a à teoria da efetivação, originalmente desenvolvida no campo do empreendedorismo. Nosso objetivo é mostrar que a teoria da efetivação pode proporcionar um forte contributo para a construção, no nível micro, de uma base conceitual consistente para as práticas de inovação aberta.

Palavras-Chave: Gestão de inovação aberta; Efetivação; Empreendedorismo; Gestão da inovação; Redes de inovação; Processos de tomada de decisão.

1. INTRODUCTION

In the past, large firms relied mainly on internal Research and Development (hereinafter R&D) to create new technologies and products. Manager's common sense would expect large firms with extended R&D capabilities and complementary assets to outperform smaller rivals (TEECE, 1986). This process in which large firms originate, develop and commercialize technologies internally has been named the *closed innovation model* (CHESBROUGH, 2003). Although this model might have worked well during the past decades, the current innovation scenario has changed substantially.

Chesbrough (2003) has identified erosion factors that disable enterprises to afford innovation relying only on their own internal capabilities, namely: (1) the increase of highly skilled labor mobility, (2) abundant venture capital availability, (3) widely dispersed knowledge across multiple public and private organizations, and (4) the increasingly capability of external suppliers. Enterprises found necessary to engage in alternative innovation practices that would systematically look for external sources of innovation as well as new paths to introduce internally developed ideas into the market. In order to tackle these new challenges, a growing number of large firms have moved from the closed innovation model to a more open behavior in which they use equally both internal and external pathways to develop and exploit new technologies (CHESBROUGH, 2003).

Since Chesbrough first coined the concept of *open innovation* it has attracted a growing attention both in academia and in practice. While practitioners have been exploring the idea of open innovation in diversified ways, academic research has spread its focus into different topics such as innovation management, business strategy, organizational behavior and public policies. Due to the variability found in open innovation practices and the extensive body of knowledge on innovation management, open innovation research agenda is still vast. Structural dimensions such as firm size, sector and geographic region, summed up with institutional frameworks (national systems of innovation, local governmental support, international intellectual property rights regulations), the emergence of intermediate markets of ideas, new organizational set ups (science park, consortiums, online communities, etc) and the different modes of partnerships (R&D contract, joint-venture, Mergers and Acquisitions (M&A), IP licensing, etc) make the understanding of open innovation management a very complex equation.

As a way of simplifying this equation and improve our understanding of open innovation, this work sheds light on the decision-making process of managers. As

observed in an OECD (2008) survey, it is possible to distinguish two different reasons why companies are embracing open innovation. Either the focus is put on the strategic need to systematically scan the available technologies and ideas inside the company as well as the environment; or the focus is on the recognition that companies need to be part of a community or network that is exchanging knowledge to develop new technologies and ideas (OECD, 2008).

The first decision-making focus (category I) induces managers to embrace practices such as technology and market scouting, technology intelligence and prize-driven innovation. It presumes the pre-existence of knowledge, technologies or ideas outside the firm that must be located and retrieved. The second (category II) will induce managers to team up with external partners who have complementary competencies and interests to build the future in common directions. It indicates that new knowledge, technologies or ideas could be co-created among partners.

Effectuation theory was originally developed in the field of entrepreneurship research and can be defined as a set of *teachable* and *learnable* decision-making principles that together form an overall logic that expert entrepreneurs employ in situations of uncertainty, creating new ventures and new markets (SARASVATHY, 2001; 2008). Nevertheless, as explained by Sarasvathy, entrepreneurship is a particular application of effectuation, which relates to the creative process focusing on human action as the “[...] predominant factor shaping the future” (SARASVATHY, 2008, p. 94) and can be extensively defined as a “[...] general theory of decision making in uncertain situations” (SARASVATHY, 2008, p. 254).

Contributing to previous research on both open innovation and effectuation, this article aims to identify valid microfoundations for open innovation by adopting the effectuation theory as a conceptual basis for managerial practices and decision-making processes performed by expert R&D and innovation managers facing the challenge of accessing external knowledge (category I) and building innovation networks (category II).

As stressed by Sarasvathy (2001a), business managers are, in general, trained on causal or predictive reasoning. Causal rationality begins with a pre-determined goal and given set of means, seeking to identify the optimal alternative to achieve the established goal. In the effectual reasoning, one does not begin with a specific goal (SARASVATHY, 2001a, p. 2).

Nevertheless, this two opposed logics of reasoning can be used by the same person at different times depending on what the circumstances call for. In fact, Sarasvathy acknowledges that “[...] the best entrepreneurs are capable of both and do use both

modes well, but they prefer effectual reasoning over causal reasoning in the early stages of a new venture, and arguably, most entrepreneurs do not transition well into latter stages requiring more causal reasoning” (SARASVATHY, 2001a, p.2).

What about open innovation management? Presumably, if a company embraces open innovation it is recognizing one of the pillars of the innovation managing theory which states that firms do not innovate in isolation (FAGERBERG, 2005) and that the growing complexity of knowledge necessary for innovation forces firms of all sizes to depend on external sources (GRANSTRAND; PATEL; PAVITT, 1997). If innovation management generally implies dealing with technology and/or market uncertainties, then when a company seeks external source of technologies or access to the market – as presumed by open innovation – a third dimension of uncertainty is inserted: the external relations.

Chesbrough (2006) argues that one of the reasons why project leaders reject external sources of technology is that at the same time it may increase the perceived risk of a project, if an external sourced technology is successfully absorbed, top managers might infer that they do not need so many people as part of the internal R&D staff anymore. This indicates that the use of open innovation is moderated by risk assessment and mechanisms of compensation. Chesbrough (2003) refers to the *not invented here* syndrome as a common behavior of a closed innovation R&D staff opposed to a culture of *acquired with proud elsewhere* of an open innovation firm.

Moreover, Chesbrough (2003) contrasts open innovation with closed innovation, where the companies’ target its innovation to its current business “like in a chess game” (MCGRODY apud CHESBROUGH, 2003). Open innovation approach, on the other hand, would be preferable for an innovation project that has to deal with both technical and market uncertainty.

While developing the effectuation theory, Sarasvathy (2008) points out three fundamental elements of *effectual problem space*: (1) Knightian uncertainty: it is impossible to calculate probabilities for future consequences; (2) goal ambiguity: preferences are neither given nor well ordered, and (3) isotropy: it is not clear which elements of the environment should be paid attention or ignored. Whether to invest or not in an open innovation practice can be classified as an effectual problem; this will be a more often case if the practice refers to a category II type of open innovation.

Effectuation reasoning is, then, an alternative *process* to cope with the question at the micro-level of what do to when faced with a problem space as defined above, which could be any open innovation artifact. Sarasvathy (2008) argues that mainstream theories on innovation management would indicate that the best is to advise the manager facing

an effectual problem “[...] to take his best guess about future events, have faith in his vision or trust his intuition to persist with the opportunity they perceive, and build charismatic leadership skills that would enable him to persuade others to join them and follow through to eventual success” (SARASVATHY, 2008, p. 72). In this article we intend to show that effectuation can provide an alternative decision-making methodology to open innovation managers facing effectual problems.

2. OPEN INNOVATION

Focusing on the firm level, Chesbrough (2003) proposes a new paradigm for industrial innovation management called *open innovation*, defined as follows.

Open Innovation reflects the ability of firms to profitably access external sources of innovation, and for the firms creating those external innovations to create a business model to capture the value from such innovations. Contrasted to the vertical integrated model, Open Innovation includes the use by firms of external sources of innovation and the ability of firms to monetize their innovations without having to build the complete solution themselves (CHESBROUGH et al., 2006, p.109).

In other words, it is a process whereby firms employ equally both internal and external pathways to develop and exploit new technologies.

Undoubtedly, the open innovation model is a more dynamic and less linear approach in which companies look both “inside-out” and “outside-in” (OECD, 2008). It supports a tendency to move to a more holistic approach that supports classical interactions with suppliers, customers and other sources of ideas for innovation. As explained in the OECD (2008, p. 18) study:

Innovation is based on knowledge assets outside the company and cooperation is a way to source knowledge in order to generate new ideas and bring them quickly to market. At the same time companies exploit their own ideas as well as innovations of other entities, with academic research occupying a major place.

Companies monetize internally developed technologies and intellectual property that is not part of their core business and thus better developed and commercialized by others. The companies’ boundaries become more permeable enabling knowledge to flow more easily between the external environment and the companies’ internal innovation process (OECD, 2008).

Despite being quickly adopted by practitioners, open innovation did not firm ground in academia without great dispute. Trott and Hartman (2009) argues that open innovation, as presented by Chesbrough (2003a; 2006a) is a mixture of previous theories;

the “closed” versus “open” dichotomy is too narrow and that in reality “closed innovation” does not exist; that the open innovation model is basically a variation on the well-known stage-gate model (COOPER; KLEINSCHMIDT, 1986) without any feedback or feed-forward mechanisms, and also that open innovation does not bring new phenomena nor new data. Trott and Hartman (2009, p. 17), nevertheless, recognized that Chesbrough has been very effective in disseminating “the notion of technology transfer and the need to share and exchange knowledge” and that “[...] the Open Innovation concept may have reached new audiences (e.g., CEOs of technology-intensive companies) that for so many years the innovation and R&D literatures failed to reach”.

Today, open innovation has become one of the most popular topics in innovation management. Huizingh (2010) offers four explanation of why open innovation became so popular and he gives four reasons. First, the use of a new term to a collection of developments that helped to give a body to the approach. Second, the appropriated timing, open innovation emerged in the theory at the same time companies were very motivated to open up their innovation processes. Third, open innovation brings the opportunity for the development of measurement instruments and management toolboxes that stimulate proliferation. Finally, connected the processes of acquiring external knowledge and exploiting internal knowledge externally by placing them both under the open innovation umbrella with the labels inbound and outbound open innovation.

According to OECD (2008) study the novelty of the concept of open innovation lies especially in the fact that the open innovation process has become an integral part of companies’ innovation strategy and business model. In prior theories of innovation, external knowledge played a useful, but supplemental role. In open innovation, external knowledge plays equal role to that afforded to internal knowledge (CHESBROUGH, 2006). Another difference is that in open innovation the inventive output from within the firm is not restricted to the current business model, but instead, it has the opportunity to go to market through a variety of channels.

Additionally, the concept of open innovation draws attention to the evaluation of false negatives and not only false positives regarding the selection of R&D projects, which can constitute new opportunities if exploited by an external channel and managed as real options, rather than traditional net present value approach for allocating budgets to projects (CHESBROUGH, 2004). Moreover, open innovation differs from previous theories by considering that useful knowledge is generally believed to be widely distributed and thus a purposive outbound flows of knowledge and technology exists and

must be exploited by companies; IP management must have a proactive and nuanced role; innovation intermediaries are raising which helps firms to commercialized ideas; and that firms need to define new set of metrics for assessing their innovation capability and performance (CHESBROUGH, 2006).

3. OPEN INNOVATION PRACTICES

Based on empirical observations, Gassmann and Enkel (2004) identified three core open innovation processes. The first process is called outside-in process, in which integration of suppliers, customers, universities, research organizations, competitors and other external knowledge sourcing enriches company's knowledge base and innovative capabilities. The outside-in mode is characterized by in-licensing, external R&D contract and acquisitions agreement. Then Gassmann and Enkel (2004) describe the inside-out process, in which internal ideas are brought to other markets by channeling them through different ways. Inside-out mode is done by out-licensing, divesting and creating spin-outs. Finally, there is the coupled process, in which outside-in and inside-out are linked by working in alliances with complementary entities during which give and take are critical for success. Consequent thinking along the whole value chain and new business models enable this core process. The coupled modes are related to the formation of innovation networks where consortia, cross-licensing, co-development, joint-ventures and - as we will see later - open innovation arenas are the common arrangement.

Open innovation is a very comprehensive concept. According to Vrande et al. (2009), studies have distinguished between purposive outflows and inflows of knowledge to accelerate or reduce costs of internal innovation processes and to generate new revenues from innovative efforts, respectively. Vrande et al. (2009) proposes another framework or an open innovation based on the technology exploration process, in which purposive outflows of knowledge implies innovation activities to leverage existing technological capabilities outside the boundaries of the organization; and technology exploration, in which purposive inflows relates to innovation activities to capture and benefit from external sources of knowledge to enhance current technological developments. In a completely open situation, firms merge both technology exploitation and technology exploration so as to produce optimized value from their capabilities (VRANDE et al., 2009).

Accessing and sourcing external knowledge and technologies as well as exploiting new ways to the market of internal developed technologies can take different formats. OECD (2008) identified the following modes of outside-in open innovation:

purchase of technology; joint venturing and alliances; joint development; contract R&D; licensing; collaborations with universities; equity in university spin-offs; equity in venture capital investment funds. OECD (2008) proposes a framework of how to choose one or more of these options depending on the companies strategy, it presents the options for accessing external technology or knowledge distribution in terms of strategic autonomy of the company and the corresponding time horizon. At one extreme, e.g., the use of licensing implies that the company can access technology relatively fast but with quite significant dependency on the external partner. At the other extreme, internal development will typically take a much longer time but assures appropriability and much more strategic autonomy for the company. Other alternatives such as acquisition, contracted R&D, joint venture, joint development and equity stakes have intermediate positions in the matrix (OECD, 2008). Table 1 summarizes the main open innovation practices in the point of view of an enterprise.

Table 1 – Open innovation practices

Modes of open innovation practice for an enterprise		
Outside-in process	Inside-out process	Coupled process
Integrating external Knowledge, Customers and Suppliers	Bringing ideas to market, selling/licensing IP and multiplying technology	Couple outside-in and inside-out process, working in alliances with complementarities
Acquisition/Spin-in with/out VC Contract R&D, in-licensing Inward technology transfer	Spin-out/off with/out Internal VC Fund Out-licensing Outward technology transfer	Joint development, joint-venture, strategic alliance, networking
Mode	Exploration (R&D)	Exploitation (commercialization)
Customer-provider Strategic alliance Inter-firm alliance	Funding, licensing, outsourcing R&D partnership, joint-ventures Network	Outsourcing Partnership Network
	Technology exploitation	Technology exploration
	Venturing Outward IP licensing Employee involvement	Customer involvement External networking External participation Outsourcing R&D Inward IP licensing

Source: Developed by the author adapting Van de Vrande et al. (2009), Gassmann and Enkel (2004) and OCDE (2008).

Additionally, we can divide the multiplicity of observed practices in open innovation into Category I and Category II: (I) Focuses on the strategic need companies have to systematically identify the available technologies and ideas inside the company as well as in the environment. Managers are induced to embrace practices such as technology and market scouting, technology intelligence, technology transfer and well target prize-driven innovation. It presumes the pre-existence of knowledge, technologies

or ideas outside the firm that must be located and retrieved, and (II): emphasizes the recognition of companies that need to be part of a community or network that is exchanging knowledge to develop new technologies and ideas. In opposition to Category I, it will induce managers to team up with external partners who have complementary competencies and interests and, therefore, create synergy to build the future in common directions. It indicates that new knowledge, technologies or ideas could be co-created among partners.

4. EFFECTUATION

Consistent with recent evidence from evolutionary economics on the dynamics of markets and industries, the theoretical development presented by Sarasvathy on *effectuation* (2000, 2001 and 2008) pursues to offer “valid microfoundations” for an economics in which Schumpeterian perceptions on innovation, competition and growth are integral. Developed around the empirical context of new businesses creation, effectuation theory is about the *creative process* in general, in which human action takes the preponderant role. Sarasvathy refers to *effectual entrepreneurship* as a *method* and as a *process* that can be identified, learned and taught. In Sarasvathy (2008, p. 180) words:

Just as scientific method enables the creation of technological artifacts from existing materials of the real world, the entrepreneurial method enables the creation of social and economic artifacts through the actions of individual entrepreneurs and their interactions with a variety of stakeholders in the real world.

In this sense, Sarasvathy (2008) aims to find out if there is a rational method of decision-making that can help entrepreneurs facing unpredictable situations, such as new market creation.

Causal rationality begins with a pre-determined goal and a given set of means, and seeks to identify the optimal alternative to achieve the established target. In the effectual reasoning, entrepreneurs start with a given set of means and let goals emerge contingently over time from their own imagination and diverse aspirations the people they cooperate with. Sarasvathy (2001a) acknowledges that the best entrepreneurs are able to choose the right logic for each circumstance. But still, they prefer effectual reasoning over causal reasoning in the early stages of a new venture, and arguably, most entrepreneurs do not transition well into latter stages requiring more causal reasoning.

While causal reasoning may engage creative thinking (e.g, creation of additional alternatives, strategic thinking), effectual reasoning is intrinsically creative. While both

causal and effectual reasoning call for domain-specific skills and training, effectual reasoning often demands more – imagination, spontaneity, risk-taking, and salesmanship (SARASVATHY, 2001a).

According to Sarasvathy (2008), causal and effectual problems may differ as well. In Sarasvathy (2008, p. 73) words:

Causal problems are problems of decision; effectual problems are problems of design. Causal logic helps us choose; effectual logic help us construct. Causal strategies are useful when future is predictable; goals are clear and environment is independent of our actions; effectual strategies are useful when the future is unpredictable, goals are unclear and the environment is driven by human action.

Sarasvathy (2008) points out three fundamental elements of *effectual problem* space: (1) *Knightian* uncertainty: it is impossible to calculate probabilities for future consequences; (2) goal ambiguity: preferences are neither given nor well ordered; (3) isotropy: it is not clear what elements of the environment to pay attention to and to ignore.

Effectuation reasoning is an alternative *process* to cope with the question at the micro-level of what do to when faced with a problem space as above, that could be a new venture creation or, as we argue, an innovation project investment. Sarasvathy (2008, p. 72) states that mainstream theories on entrepreneurship and innovation management would indicate that

[...] the best we could do to advise entrepreneurs or managers facing an effectual problem – as defined above – is to take his best guess about future events, to have faith in his vision or trust his intuition, to persist with the opportunity they perceived, and to build charismatic leadership skills that would enable them to persuade others to join the idea and follow through to eventual success.

Causal process starts by carefully defining the goal, planning resources and actions, and calculating the risks and returns of a new endeavor. Then it proceeds to execution, where activities are led as close as possible to what was initially planned. At every stage the planning is updated and new projections are made to keep track of future events in order to adjust to possible deviations or overcome obstacles. Causal process is based on a sequential progression from idea to: market research, financial projections, team, business plan, financing, prototype, market and exit. This progression should be made with caution knowing that surprises will happen along the way (SARASVATHY, 2001).

On the other hand, effectual process starts with the available means. The *effectuator* starts by asking (1) who I am: his characters, perceptions and skills; (2) what I

know: his education, training, expertise, and experience; and, (3) whom I know: his social and professional networks. With these means at his disposal, the effectuator begins to imagine and implement possible effects that can be created with them. Frequently, he starts very small with the means that are closest at hand, and move practically directly into action without any sophisticated plan. The effectuator's set of means and consequently the set of possible effects take shape and get combined into clearly feasible and desirable goals. At this point, entrepreneurs envisage discernible paths emerging from the vagueness (SARASVATHY, 2001). Effectuators discern that unexpected events during an endeavor are not defects or malformations; instead they are expected to appear as the norm and the response of the reality from which they learn to forge their way in shadowy setting.

Effectual reasoning principles are tied together into a comprehensible logic that assures it is a credible alternative to causal rationality. Causal reasoning is based on the logic "[...] to the extent that we can predict the future, we can control it" (SARASVATHY, 2001, p. 6). Effectual reasoning, conversely, is based on the logic "[...] to the extent that we can control the future, we do not need to predict it" (SARASVATHY, 2001, p. 6). Effectuation provides a methodological alternative for situations in which future is unpredictable and human action can actually change its course. Sarasvathy (2001b) explores three principles: *affordable loss*; *strategic partnership*, and *leveraging contingencies*.

According to the *affordable loss principle*, effectuators begin with a determination of how much they are willing to lose. They tend to find ways to reach the market with minimum spending of resources and do not bond themselves to any hypothesized or pre-existent "market" for their idea. Instead, they are open to surprises as to which markets they will ultimately end up building their business in or even which new markets they will end up creating. Effectuators use the very process of erecting the venture to bring other stakeholders on board and creatively leverage the resources available. At each stage of the process they choose options that create more options in the future. The estimate of affordable loss does not depend on the venture, but varies depending on the entrepreneur current financial condition and psychological appraisal of their commitment in terms of worst-case scenario. By this means, effectuators nullify the role of uncertainty in early-stages decisions.

As for the second principle, *strategic partnerships principle*, Sarasvathy (2001a) explains that effectuators focus on building partnerships rather than on doing a methodical competitive analysis. Since effectuators tend to start the process without assuming the existence of a predetermined market for their idea, detailed competitive

analyses do not seem to make any sense to them at the early phase. Instead, effectuators emphasize alliances and pre-commitment from stakeholders on the basis of preselected ventures or goals, allowing them to actively participate in the shaping of the enterprise. In fact, the strategic partnerships principle combined with the affordable loss principle is crucial to effectual logic and has vital ramifications for the concomitant creation of markets and firms. Commitment from key stakeholders helps to reduce uncertainty by contracting along certain dimensions for the future, and as the stakeholders operate on those contracts and the network grows, the future that comes to be begins to resemble the contracts agreed upon. At last, since the effectuator is not committed to any particular market for their idea, the expanding network of strategic partnerships determines to a great extent which market or markets the company will eventually end up in (SARASVATHY, 2001b).

Finally, at *leveraging contingencies principle* it is explained that effectuators have the ability to turn the unexpected into the rewarding. The realization that surprises, whether good or bad, can be used as inputs into the new venture creation process differentiates effectual reasoning from causal reasoning. Because effectuators often begin with only a very loose notion of their goals, they can make up their plans in an incremental way, utilizing uncertainty and contingent information as a resource for their goals rather than relying on goals as determining factors and resources acquisition and choice. Decision makers therefore accumulate and take advantage of path dependencies in the effects they choose (SARASVATHY, 2001).

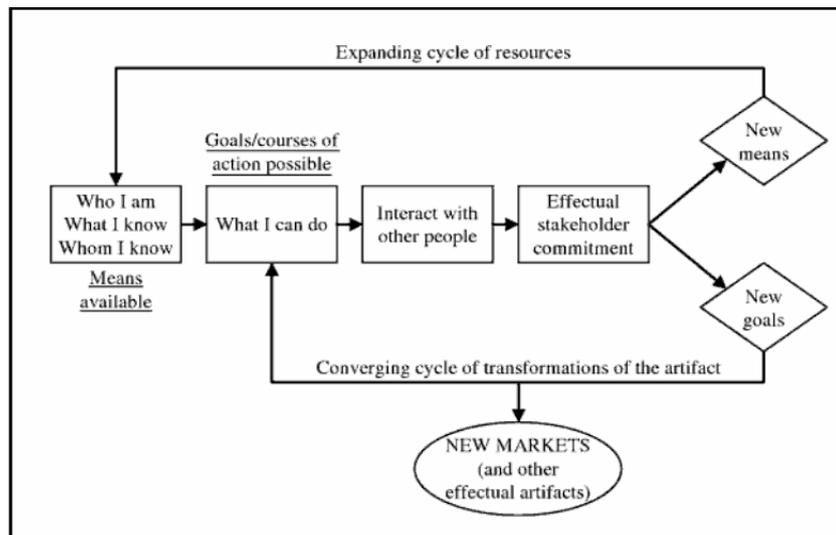
5. DYNAMICS OF THE EFFECTUAL PROCESS

According to Sarasvathy (2008) either “[...] new markets *exist* in some theoretical sense and firms enter them through a variety of exploratory strategies, or new markets *emerge* as a result of technological and institutional evolution of populations of firms engaged in adaptive processes of exploration and exploitation within a changing competitive landscape” (SARASVATHY, 2008, p. 98). When proposing the effectuation theory, she re-examines the big-picture philosophy of a pre-existent universe of every possible market as the micro-foundation for action and postulates a new micro-foundation based on the idea that “[...] human action transform current realities into new possibilities” (SARASVATHY, 2008, p. 100).

The author developed a dynamic model of effectuation thinking through an alternative philosophical basis on the exploration-exploitation paradigm for the creation of new markets. This dynamic model, graphically represented in Figure 1, illustrates how

an entrepreneur actor begins questioning “who he is”, “what he knows” and “whom he knows” and start doing what he *can* do and believe is worth doing. This actor interacts with other people and sets in motion a network of stakeholders, who will make commitments that on the one hand increase the resources available, and on the other, constrain future sub-goals and goals that get embodied into particular features of the artifact. Assuming the network keeps growing and is not dissolved due to exogenous shocks or fatal conflicts within its ranks, the pool of constraints converges into the new market or other effectual artifacts.

Figure 1 – Dynamic model of effectuation



Source: Sarasvathy (2008, p. 101).

At the heart of this dynamic model is the notion of an *effectual commitment*, which, according to Sarasvathy (2008), has some important characteristics. First, it emphasizes aspects that are controllable about the future and the external environment, regardless of how predictable they are, and it avoids analytical information that cannot be compressed into controllable aspects. Second, each effectuator only commits to what he can afford to lose, and not what may be calculated as necessary to achieve target returns or outcomes. Third, the goal of the network is determined by those who make actual commitments and by what they negotiate. Fourth, as the means available to the network increase, goals become more constrained and the artifact becomes solidified over time. Finally, the key to the process is not *selection* among alternatives (alternatives ends or means), but the *transformation* of existing realities into new alternatives (SARASVATHY, 2008, p. 109).

6. RELATING OPEN INNOVATION AND EFFECTUATION

As mentioned before, Sarasvathy (2008) developed the effectuation theory in the field of entrepreneurship. However, it was promptly applied to other specific decision-making problems such as corporate management, economics, psychology, finance and more lately R&D management (KUEPPER, 2009). As explained by Sarasvathy (2008), entrepreneurship is a particular application of effectuation, which relates to the creative process that focuses on the human action as the “[...] predominant factor shaping the future” (SARASVATHY, 2008, p. 94) and can be extensively defined as a “[...] general theory of decision making in uncertain situations” (SARASVATHY, 2008, p. 254).

Effectuation prefers control over prediction and offers an alternative method of creating new artifacts under unpredictable circumstances. Kuepper (2009) recapitulates effectuation in five key principles and apply them to the context of R&D projects: (1) *Means vs. goals principle*: effectual R&D approach starts on the basis of given resources and competences and creates a new outcome on the basis of an existing mean; (2) *Affordable loss vs. expected returns principle*: decision maker has to define how much he is willing to lose in a worst case scenario by making in-advance commitments of how many resources he is willing to put at risk; (3) *Reduce vs. identify uncertainty*: effectual R&D approach will focus on forming partnerships and getting commitments from potential customers, suppliers or external groups of researchers in order to reduce project uncertainties, a causal approach will focus on identifying risk and avoiding unexpected during the planning phases of the project; (4) *Acknowledge vs. overcome the unexpected*: effectuation considers surprises to be a vital source of opportunities. A causal approach follows a linear process that seeks to reach the given project target as efficient as possible and within the given timeframe, and (5) *Create vs. exploit opportunities*: human agency is considered to be the prime driver of future developments. A conventional causal approach is characterized by the assumption that future developments and existing trends are exogenously given.

Coherent with Sarasvathy works, Kuepper acknowledges that effectuation is a dynamic nonlinear approach also when applied to R&D management. Commitments concerning the affordable loss as well as commitments from stakeholders enlarge the decision scope and form a framework that leads to a converging process. The sum of the existing means and committed resources are the basis for the decision-making and for refining project goals. After deciding the project option (causal or effectual) that shall be pursued, the principles 4 and 5 guide to an iterative implementation process.

The work developed by Kuepper (2009) provides us with some insight that enables us to relate open innovation practices to effectuation reasoning. As mentioned before, Chesbrough (2006a) argues that a possible explanation for managers to reject external sources of technology is that they contribute to the perceived risk and, even worse, if an externally acquired technology is successfully absorbed, it might be deduced that internal R&D staff is not performing well. Moreover, Chesbrough (2003) contrasts open innovation with closed innovation in which companies' target its internally developed innovations to its current business "like in a chess game". In an open innovation approach, companies would be rather focusing on innovation projects that have to deal with both technical and market uncertainty "like in a poker game", where managers do not know all the information in advance and have to decide whether to spend additional money to stay in the game so as to see the next card (CHESBROUGH, 2003).

While we agree that closed innovation R&D projects can in general be classified as causal problems, we understand that not all open innovation practices implies both technology and market uncertainties that would characterize them as effectual problems. This means that external collaboration might characterize an R&D project as an open innovation practice but is not sufficient to characterize it as an effectual problem. Also, it is important to distinguish open innovation from R&D project. Open innovation might include other business practices besides R&D, such as business models, value chain integration, new business creation, mergers and acquisitions, technology transfer etc.

As described before, we proposed to divide open innovation practices depending on its focus. Category I of open innovation practices suppose the pre-existence of knowledge, technologies or ideas outside the firm that must be located and retrieved. Category II, in opposition, indicates that new knowledge, technologies or ideas could be co-created among external stakeholders as defined in effectual networks. We might infer that category II will often constitute effectual problems.

Taking a different approach, we can also relate open innovation to effectuation by the existing relation found in the literature of entrepreneurship and innovation management. Innovative entrepreneurs and corporate managers often believe that introducing new technologies or business models into the market is not a question of generating detailed market analysis and forecasts (SARASVATHY, 2008). Instead, they recognize that it is sometimes impossible to predict what markets will turn out to be like.

With those arguments it is possible to relate innovation efforts and effectual entrepreneurship. In Sarasvathy's own words :

A number of scholars in evolutionary economics have articulated the necessity of developing rigorous and useful microfoundations for the discipline (Dosi, 1997; Loasby, 1999). They contend that there is no theory of entrepreneurship/firm behavior that is consistent with the basic supply-push story of how new markets are created that has been articulated in evolutionary/Schumpeterian economics (Geroski 2003, Klepper and Simons 2000, Rosenberg 1996) (SARASVATHY, 2008, p. 119).

She explains that what emerges from comparing and cumulating the wide range of empirical studies on new market or industry creation is that the results are inconsistent with the micro-theories based on which the data were analyzed. In other words, conventional accounts of entrepreneurship and firm behavior do not connect well with conventional accounts of industry creation.

In particular, Sarasvathy (2008) considers at least two stylized facts: (1) consumer preferences are ambiguous and market cannot be created or anticipated, and (2) what consumers want is ill-defined, so there is no well-articulated demand, and therefore no market to be found or predicted (EARL, 1998; GEROSKI, 2003; LANGLOIS; COSGEL, 1993). Therefore, she believes these ideas challenge both the descriptive and prescriptive theories about firms doing market research to predict and innovate and that abstract demand does not do much to influence the direction of innovation and the creation of new markets.

Furthermore, according to Sarasvathy (2008), the basic evolutionary view is that new markets are induced from the supply side based on commercialization of new technology into marketable products. Especially, entrepreneurial firms create a huge amount of product variation around the initial components of a new technology; which implies that the product variation at the birth of markets is large. The argument that scholars have used so far is that this is a function of the fact that the technology is often new, so it is wide open to innovatory exploration of its various facets, and that consumer tastes are ambiguous, so different firms make different guesses about what consumers really want. In Sarasvathy's words:

Effectuation illuminates these patterns of variation by showing how bounded rationality, partial knowledge and particular chains of self-selected stakeholder commitments work in concert to stitch together new markets piece by coherent piece. If individuals knew what they wanted (to the degree and precision that a neoclassical economist would like) and/or if the environment maximally constrained what agents could do, new market creation would actually be easier and happen faster than the facts warrant - computational bounds on human cognition notwithstanding. But stitching together patch-by-patch and building coherence commitment by commitment takes the time most markets take to coalesce. Furthermore, the effectual logic at the heart of this intersubjective process is empirically observable, theoretically feasible, and

prescriptively useful in telling the troops what to do on the ground (SARASVATHY, 2008, p. 121).

By these reasons, we believe that effectuation can be proposed as solid microfoundations for the decision-making in the open innovation paradigm. Open innovation is the recognition that innovation is not made in isolation, but that inter-organizational cooperation agreements for developing innovation (and/or new markets) cannot be managed based only on causal reasoning. The more an organization relies on external collaborations to develop new knowledge, technologies or ideas to innovate (that means on resources that the firms does not fully control) the more effectual reasoning seems to be more suitable.

In Table 2 we propose a possible framework that relates open innovation management practices identified in the literature to effectuation theory. For each open innovation practice we suggest what we could expect from how managers would decide whether to approach it with a more causal or with a more effectual reasoning.

Table 2 – Open innovation practices vs. decision-making approach

Management practice	Target definition	Degree of Openness	Causation vs. Effectuation
Technology scout, brokering or prize-driven innovation: active scouts search for technologies or passive online platforms where individuals can submit their ideas to meet or solve pre-defined needs or problems	Usually targets are well defined	Usually solutions are found in one organization after having searched in many or received proposals from many	Causation approach is more useful to define the problem, plan the actions, plan resources, filter suspects and identify where to find solutions or what solutions to select.
Analytical method of monitoring, planning and identifying technologies such as technology intelligence, technology roadmap and technology prospection	Usually targets are well defined	Broad analysis of all possible prospects, openness will depend on specific opportunities, but in general are very focused	Causation approach shall be more suited
Technology transfer and IP commercialization: find partners to exploit inside-out or outside-in opportunities	Usually targets are well defined: find partners to exploit unused technologies or access external knowledge	Usually technologies are transferred, licensed or sold to one or a limited number of partners	Causation approach shall be more suited
Internal R&D: believe that competences are inside the organization	Usually targets are well defined	Closed innovation projects	Causation approach shall be more suited. If the project finds a challenge that cannot be solved with the internal competences it can open for external sources and rely on one open innovation practice
Employee involvement: initiatives that break down the hierarchical structure of the firm to produce unexpected results from ideas coming without management filtering	Targets might be or not well defined	In the level of individuals it is often very open	Causation and effectuation might be suited depending of the target definition
R&D contract: usually the contractor believes the	Targets are usually well defined	Limited to the contracted partners	Causation and effectuation might be suited depending of the degree of innovativeness. If

Management practice	Target definition	Degree of Openness	Causation vs. Effectuation
contracted organization possesses the required capabilities		previously defined	contractor believes the contracted firms possess all capabilities required, it will manage in a causal approach. Contracted might effectuate internally if required. It would be preferable that contractor and contracted share the same view on the decision-making approach
Joint-venture or co-developing: defined by complementarities of capabilities	Targets are usually well defined	Limited to organizations that formed the joint-venture	Causation approach shall be more suited
Spin-off venturing: sell a technology to external entrepreneurs	Targets might be or not be well defined	Limited to one group of entrepreneurs that will pursue the opportunity	In the perspective of the seller, causation approach shall be more suited in other to find a god deal. In the perspective of the entrepreneur as a new business creation, causation and effectuation might coexist and depend on the expertise of the entrepreneur and the level of uncertainty effectuation might prevail
Spin-out venturing: equity participation in a new venture to exploit a technology	Targets might be or not be well defined	Limited to one group of entrepreneurs that will pursue the opportunity	In the perspective of the mother company, causation or effectual approach might be suited depending on the level of uncertainty of the opportunity. In the perspective of the entrepreneur as a new business creation, causation and effectuation might coexist and depend on the expertise of the entrepreneur and the level of uncertainty effectuation might prevail
Spin-in venturing: acquisition of a startup company to increment corporation's capabilities	Targets are usually well defined	Limited to one group of entrepreneurs that will pursue the opportunity	Causation approach shall be more suited
Start-up incubator	Targets are usually not well defined	Usually a large number of candidates are expected	Effectuation approach shall be more suited
Science and Technology Park	Targets are usually not well defined	Usually a large number of organizations are expected to join	Effectuation approach shall be more suited
Customer involvement	Targets are usually not well defined	Usually a large number of organizations are expected to join	Effectuation approach shall be more suited
Research associations: not coupled R&D	Specific targets are usually not well defined	Limited number of associates for each research Project or Program	Causation and effectuation approach shall coexist in different stages of the research
Open call for projects and ideias	Specific targets are usually not well defined	Usually a large number of submission are expected	Effectuation approach shall be more suited
Open innovation arenas	Specific targets are usually not well defined	Usually open for self selected partners (unlimited number of partners)	Causation and effectuation approach shall coexist in different stages

Source: Developed by the authors.

7. CONCLUSION

As a young research field, the knowledge body of open innovation is being consolidated by contributions that are often still fragmented and restricted to one dimension, for example, user innovation or supplier integration. It was argued that there is the need for a consistent open innovation theory elaborated in a new perspective capable of integrating these disparate observed elements of evidence into a larger theory. We could be able to demonstrate how effectuation theory can contribute to open innovation theory into a new perspective.

We claim that our work provides us with two main theoretical contributions to build a more solid open innovation theory and four practical ones more directed to open innovation managers or entrepreneurs. Firstly, we could say that it is possible to divide practices of open innovation into Category I and Category II, so we can better relate them to causation and effectuation approaches as a preferable decision-making method utilized by managers.

- a) Category I open innovation practices: in such cases causation reasoning might be often more appropriate for managers;
- b) Category II open innovation practices: effectual networks play an important role in these situations.

Secondly, we verified effectuation in another area of inquiry different from where it was developed. Sarasvathy's (2000) initial work on effectuation has focused on the study of entrepreneurship, Kuepper (2009) has introduced effectuation to the field of R&D. We indicate four practical contributions that could help managers involved in the creation of open innovation management organizations. They are:

- 1) The identification of a method of decision-making adopted by expert R&D and/or innovation managers in the creation of organizations dedicated to the systematization of open innovation practices and the setting-up of innovation networks;
- 2) The proposition of a decision-making framework according to effectual logic to be used by R&D and/or innovation managers when setting-up effectual networks combined to Category I type of open innovation practices;
- 3) The identification of target definition as a moderator of openness in innovation project and target definition and openness as a moderator of effectuation, and

- 4) The identification of open innovation processes vs. decision-making approach presented in Table 2 for further research.

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Bruno Rondani

Doutor em Administração de Empresas pela Fundação Getúlio Vargas (FGV-EAESP, 2012). Coordenador do programa educacional em empreendedorismo de alto impacto organizado pelo Centro e Estudos em Venture Capital e Private Equity da FGV-EAESP. Coordenador do Centro de Inovação Aberta Brasil e Chairman do Open Innovation Seminar.

Tales Andreassi

Graduação (USP, 1989), mestrado (USP, 1994) e doutorado em Administração pela Universidade de São Paulo (USP, 1999). Mestrado em Science and Technology Policy Studies pelo Science and Policy Research Unit (SPRU, Sussex University, 1998) e pós-doutorado/pesquisador visitante da Simon Fraser University, Canadá (2000). Professor da Fundação Getúlio Vargas de São Paulo (FGV-EAESP). Coordenador do Mestrado Profissional em Gestão Internacional e do Centro de Empreendedorismo e Novos Negócios, ambos da FGV-EAESP.

Roberto Bernardes

Doutor em Sociologia da Inovação pela Universidade de São Paulo (USP, 1998). Professor do Programa de Pós-Graduação em Administração da Fundação Educacional Inaciana Padre Sabóia de Medeiros (FEI) e da Escola Superior de Propaganda e Marketing (ESPM).