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Innovation and its diffusion: process, actors and actions

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ABSTRACT

Seeking to understand factors affecting innovation diffusion, research has increasingly focused on process, actors and activities. After two decades of research, however, a systematisation of these three sets of studies is still lacking. Thus, this paper contributes to the existing literature providing a comprehensive framework of factors affecting innovation diffusion between organisations. Specifically it evidences phases of innovation diffusion process, clarifies the role of innovator, adopters and intermediaries and evidences actions that policy-makers can implement to support it.

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1. Introduction

The increasing importance of innovation diffusion for creating competitive advantage of firms and comparative advantage of regions has triggered the managerial studies. Seeking to understand factors affecting innovation diffusion, research has increasingly focused on process, actors and activities. Thus, three sets of studies can be identified. A first set of studies has investigated the role of innovation characteristics. A second set of studies has primarily focused on attributes that typically operate at the network-level, such as trust and cultural distance among actors. A final set of studies has centred on activities to facilitate innovation diffusion. After two decades of research, however, a systematisation of these three sets of studies is still lacking.

Although reviews of the literature on innovation have surfaced, it would be useful to propose a conceptual paper aimed to clarify process, actors and activities affecting its diffusion. Thus, this paper contributes to the existing literature providing a framework of factors affecting innovation diffusion between organisations.

For this aim, following Battistella, De Toni, and Pillon (2015) we developed our database considering journals that typically publish studies of innovation and focus on general management issues. We acquired published empirical studies through a variety of sources. We searched the ABI/INFORM, EBSCO, JSTOR, Science Direct and Swetsnet databases, using multiple keywords to identify relevant articles. Then, we manually searched abstracts from the set of journals. Finally, we examined the references from the articles identified in these steps to locate additional studies that the other searches were unable to capture.

We selected studies on the basis of three criteria. First, we included studies that classify the innovation diffusion process. Second, we included articles that evidence actors of this process. Finally, we collected papers on actions for facilitating innovation diffusion. This collection provided an overview of 330 articles. Taking a qualitative approach, a closer look at papers allowed us to create a more detailed statement on the current state of the research on process, actors and actions of innovation diffusion. Results of our conceptual analysis are presented in the next sections.

In the next section we evidenced the process of innovation diffusion. Then we presented actors involved in this process. Finally, we evidenced actions to support innovation diffusion.

2. Innovation diffusion process

Innovation can be defined as a new technology embedded in a product or process (Ansari, Fiss, and Zajac 2010; Audretsch and Caiazza 2016; Barney 1991). Innovation diffusion from firm to firm is a multi-phase process by which an innovation is transferred from an innovator to an adopter. On the one side, introduction of an innovation on the market is a process through which the innovator transfers an innovation to one or more adopters. On the other side, adoptions incorporate a pre-adoption activity, a managerial decision to adopt the innovation, and a post-adoption activity of implementation (Allen 1977; Athanassiades 1973; Autio, Hameri, and Nordberg 1996; Bozeman 2000; DiMaggio and Powell 1983; Granovetter 1985). This process requires the involvement of many actors, imposes different actions and influences several industries and regions. In addition to studies strictly focused on innovation diffusion and adoption, other studies have labelled contextual factors and relational factors affecting this processes in alternative but related ways.

Some studies evidence contextual barriers (i.e. institutional, structural and cultural obstacles) that may impede the diffusion process (Caiazza 2015b). Institutional barriers concern fiscal and financial aspects, legal framework and intellectual property rights (IPRs). Structural barriers are tied to the industrial and local availability of funds, resources and technical assistance for diffusing new technologies. Cultural barriers are tied to environmental uncertainty, information availability, trust and social networks (Amesse and Cohendet 2001; Argote 1999; Nonino 2013; Pinch 2008). They concern entrepreneurial environment such as cultural hostility to take a risk of novelty, actors ability to predict the results of new actions, lack of information or ability to discriminate between relevant and irrelevant information.

Other studies evidence relational barriers (i.e. trust, connections and distances between parties) to diffusion of innovation between innovator and adopters. Research argued that the social relationships between the innovator and adopter play an important role in facilitating the exchange of innovation. Trust facilitates the innovation diffusion, as it increases the willingness of the innovator to commit to helping the adopter to understand new external technology. To establish a relationship of trust, it is necessary to ensure a strong sense of reciprocity (Angst et al. 2010; Barley 1990; Dougherty and Hardy 1996). The innovator is committed with time and resources to share its technology but, beyond the value established for this effort, only if adopters are motivated and capable, this can be done effectively. Trust is essential to overcome concerns about possible misconducts on the appropriation and misappropriation of technology. Intensity of connections facilitates access to potential use of technology and increases the likelihood of innovation transfer. Various studies showed that a high number of relationships with other companies increase the probability of access to new relevant technology (Argote and Ingram 2000; Attewell 1992; Bessant and Rush 1995; Caiazza 2015a).

Moreover, relationships improve the processing capacity of data, which allows a more effective flow of knowledge. While the number of links increases access to external technology, a central location within the general connections system determines whether it can be used advantageously. Typology of connection refers to the link through which innovator and adopter interact (contracts, collaborations, strategic alliances and acquisitions). These links affect the flow of technology, the depth and breadth of interaction and incentives for collaboration. Basically, higher density and multiplicity of social ties between the parties allow for better opportunities to diffuse innovation. Technological differences refer to the technological domain in which innovator and adopters operate (Strang and Soule 1998; Terlaak and Gong 2008; Van den Bulte and Lilien 2001; Zander and Kogut 1995). If technological gap between partners is too high, transfer is almost impossible because the adopter may not be able to identify and apply innovation. Cultural differences concern partners' visions, values, goals and behaviours in a particular social system. Shared systems and vision

promote mutual understanding and provide a fundamental mechanism that helps interaction between partners.

3. Actors of innovation diffusion

The external environment (contextual and relational) provides opportunities (information, resources, technology) and constraints (regulation, restriction on capital or information) to innovation diffusion that each actor has to recognise and manage. Specifically, the structure of the market (industry competition), technological dynamism, appropriability conditions and market growth are considered the main factors limiting innovator's introduction of a new technology on the market. To overcome these barriers innovator has to realise an activity of marketing of the new technology, production of complementary assets and reconfiguration of innovator's network. Marketing strategies can be focused on market penetration and advertising campaigns. These strategies have been used to introduce new products or processes (Bozeman, Rimes, and Youtie 2015; Golden 1992; Grosse 1996; Inkpen and Tsang 2005). A line of research has been initiated that studies whether and how marketing mix strategies affect new product diffusions (Burkhardt and Brass 1990; Caiazza, Richardson, and Audretsch 2015; Ferlie et al. 2005; Galbraith 1990). Specifically, lack of information, uncertainty and transition costs are considered the main factors limiting adopter implementation of a new technology.

To overcome these barriers the adopter has to realise several activities (Caiazza and Ferrara 2016; Caiazza and Stanton 2016; Markuerkiaga et al. 2016). Initiation consists of activities that pertain to find information for recognising a need and becoming aware of existing innovation. In this phase adopters learn of the innovation's existence, consider its suitability for the organisation, and evaluate its adoption (Caiazza and Volpe 2015a; Garud and Nayyar 1994; Hamel 1991; Huber and Power 1985). Adoption decision reflects evaluating the proposed ideas from technical, financial and strategic perspectives, making the decision to accept an idea as the desired solution, and allocating resources for its acquisition, alteration and assimilation. Implementation consists of actions that pertain to support transition costs. A line of research has focused on how innovation characteristics such as relative advantage, compatibility, complexity, trialability and observability can affect cost of substitutions of previous technology with the new one (Caiazza 2015b; Eveland and Tomatzky 1990; Greve 2011; Hansen 1999; Landry et al. 2013).

Actors are also intermediaries that facilitate the process of innovation diffusion across organisations and industries. Intermediate is an actor who may or may not be involved as part of the process of innovation transfer and acts as a third party agent assuming the role of mediation between the parties in order to facilitate the relational context and with the aim of supporting the development of the process in its criticalities, addressing enabling or constraining factors. Opinion leader, facilitator, champion, linking and change agents intervene in the process acting as mediator between innovator and adopter to facilitate the diffusion (Cummings and Teng 2003; Fennell and Warnecke 1988; Geisler 1993). Opinion leaders are identified as an actor to whom others go for advice about complex situations, and are thus seen as expert and credible. They are well-connected actors who have a wide peer and social network. They are not innovators, but rather they evaluate information for its fit with the local situation and try to obtain group consensus. They are also often identified as power actors able to influence the adoption of an innovation. Their primary methods of exerting influence are word-of-mouth and face-to-face communication (Strang and Macy 2001; Teece, Pisano, and Shuen 1997; Tsai 2001; Tsai and Ghoshal 1998; Zbaracki 1998).

They are considered knowledgeable, trustworthy, accessible and approachable and are willing to share their knowledge. Thus, they are respected authoritative sources of information for potential adopters. Facilitators are active and dynamic, concerned with helping, enabling and developing a changing process (from the old to the new) rather than persuading and telling the adopters what they should do. The overarching goal of the facilitator is to assist adopters through the process of implementing a change in practice. Facilitation is a goal-oriented dynamic process in which actors

(facilitator and adopter) work together in an atmosphere of genuine mutual respect in order to learn through critical reflection. A facilitator works with adopters for implementing change. Indeed, a central characteristic of the role is that it supports a goal-oriented process (Green 2004; Hargadon and Sutton 1997; Kogut and Zander 1992). Champions are transformational actors able to influence others to support projects. They are internal to the adopter and emerge unsolicited from any level within it. They are advocates for implementation of new ideas, products or projects. They are actively involved in all stages of the innovation adoption, and may use different skill sets during each of the stages. They can be described as persuasive and willing to take calculated risks, champions adopt innovation as their own and relentlessly promote them (Suddaby and Greenwood 2005; Swan and Newell 1995; Szulanski 1996; Tolbert and Zucker 1983).

Champions are able to accept risk, vigorously support the adoption of an innovation, and help it through critical times, overcoming opposition or leading coalitions. Linkers are human interface to connect new information and practices to those who could use them. A linking agent works under the premise that innovators operate in incompatible worlds and therefore interaction between the two must be achieved through linkage. It is ultimately the linking agent who spans this boundary to bring a closer collaboration between the two systems. The linking agent is a 'go between' that helps bridge the implementation gap by working at all stages of the innovation process (Haunschild and Miner 1997; Inkpen 2000; Lavie 2006; Mowery, Oxley, and Silverman 1996). The primary role, therefore, of a linking agent is making interpersonal contacts and transmitting information from innovators to adopter. They are, in essence, the communication network between the innovator and adopter. The authority that linking agents exercise arises from their ability to identify relevant knowledge and their skill in helping others acquire and use this knowledge. Change agents' main objective is to foster self-reliance in the client system. Indeed, most change agents are involved in projects that have a distinct beginning and end. The role may be formal or informal. Change agents can act as a link between the innovator and adopter. Change agents develop a need for change by helping adopter become aware of the need to alter their behaviour. In this sense, change agents already have the innovation chosen for the problem. Change agents can also be seen as playing an active role in assisting adopter through the process of change. They work with adopter to identify their needs and problems and then to adopt the appropriate innovation to meet those needs (Figure 1).

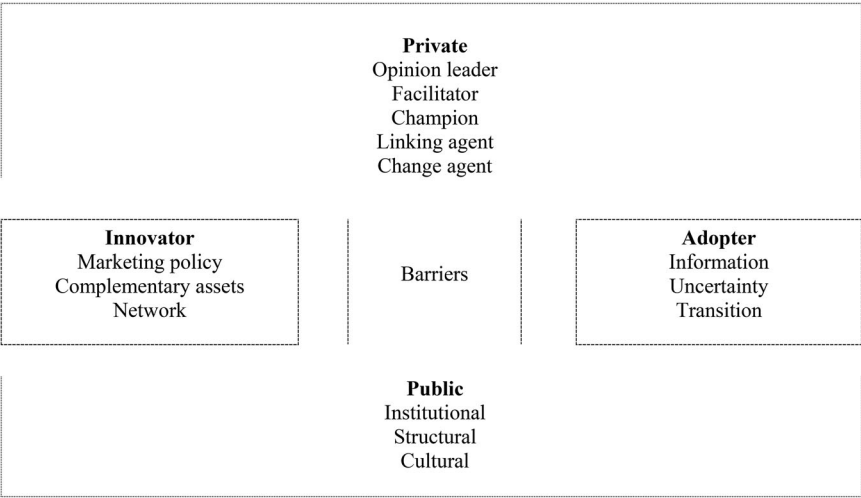


Figure 1. Actors and actions in the process of innovation diffusion.

4. Actions to facilitate innovation diffusion

Policy-makers can also facilitate the process of innovation diffusion through general-side, supply-side and demand-side policies aimed to reduce institutional, structural and cultural barriers (Caiazza and Stanton 2016). General policies are aimed at updating the economic and regulatory framework within which innovative activities takes place. Supply-side policies are instruments aiming to provide innovators with funds, human resources and technical assistance to face the market's resistance to innovation diffusion. Demand-side policies are measures aimed to improve the articulation of demand in order to spur innovations and allow their adoption (Caiazza and Volpe 2015b; Garud and Rappa 1994; Gilsing et al. 2011; Lane and Lubatkin 1998). Specifically, policy-makers can focus their attention on institutional aspects adopting macro-economic measures such as tax or financial incentives and favourable depreciation schedules to enterprises that invest on diffuse new technologies. Policy-makers can promote technology development through a process of standards development able to accelerate common agreement between innovators and adopters about standards and technological compatibility.

Policy-makers can support innovators by absorbing part of financial costs they incur when promoting innovations, as well as supporting innovators in their internationalisation strategy. A government can also sponsor the risk users' face while selecting and adopting a new technology or it may become itself the main acquirer of an innovation. Governments can adopt policies able to reduce financial constraints among users associated with the initial or ongoing costs of adopting new technologies such as direct financial support, grants, loans or interest write-downs or adopt itself new technologies for improving public goods and services, reducing costs, and the changing needs of society. Finally, governments can adopt public procurement measures. Public procurement can be defined as ordering of a public organisation for the fulfilment of certain functions that could be fulfilled through a new product or service (Lynn, Reddy, and Aram 1996; Millar and Choi 2003; Powell, Koput, and Smith-Doerr 1996; Reagans and McEvily 2003).

Policy-makers can focus on structural aspects aimed to integrate various regulatory authorities. They can support innovators establishing some centres able to promote technology improvement. These centres may extend the capabilities of existing research facilities, facilitate industry-driven initiatives and support adaptation of technology to market needs. Policy-makers can also create public centres to make potential users aware about available technologies, their possible applications and their benefits. A possibility is also to create applied technology centres with trained staff able to offer technical assistance, technological advice, conducts assessments and recommendations to firms in local industries. This category includes active structures that have as their purpose the support of technology diffusion, such as innovation agencies and regional development, the Industrial Liaison Office and Technology Transfer Office, the science and technology parks, centres for innovation, cooperation and transfer of science and technology (Rogers 2003; Sharif and Ramanathan 1987; Stan-kiewicz 1995; Stock and Tatikonda 2000). These structures create some bridges that overcome lack of links in the network of innovator and adopters. Finally, policy-makers can act on cultural aspects through a series of measures aimed to facilitate inter-firm collaboration, by reducing risks associated with the development of new products, resolving common problems and sharing information and learning, achieving scale economies and strengthening ongoing business and technology development relationships.

Levels of communication and dialogue between technology developers and users and among users, institutional credibility and leadership, and other aspects of social and cultural capital have been shown to be extremely important for the creation of a cultural propensity to technology diffusion. In this vein, the government can provide support in realising some public-private joint project aimed to commercialise new technology and evidence new opportunities in terms of potential users markets (Reed and DeFillippi 1990; Reisman 2005; Roberts 2000; Seaton and Cordey-Hayes 1993). At the same time policy-makers can realise some information programmes aimed to reduce the adopters' information search costs associated with new technology, can create exchange programmes to

Table 1. Public policies to enhance innovation diffusion.

	General	Supply	Demand
<i>Institutional</i>	Tax incentive, financial support, standards development and IPR	Reduction of innovators' costs for technology diffusion and support to their internationalisation strategies	Reduction of users' costs for selecting and adopting a new technology and public procurement
<i>Structural</i>	Integration of regulatory authorities and creation of centres aimed to support diffusion and adoption	Centres to promote technology improvement, extend capabilities of research facilities, facilitate industry-driven initiatives and support adaptation of technology to market needs	Centres to make users more knowledgeable about available technologies and to provide technical assistance in innovation adoption
<i>Cultural</i>	Programmes for collaboration and communication between innovators and institutions	Public-private projects aimed to commercialise new technology and identify potential users	Projects aimed to reduce adopters information search costs, improve adopters absorptive capability, to train users and to provide technical assistance in switching previous technology with new ones

improve adopters' absorptive capability or reinforce their existing personnel propensity to use new technology. Training programmes such as job training, classroom training, management seminars, team-building workshops and distance learning are also possibilities. It can also support the adopters' experimentation of a new technology providing information programmes on its existence and benefits, centres for technical assistance in switching previous technology with new ones, training programmes for utilisation, demonstration actions for showing innovation benefits and financial support for reducing uncertainty (Table 1).

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