

Networks for the commercialization of innovations: A review of how divergent network actors contribute

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Research highlights:

- The extant research on networks facilitating commercialization is scattered across divergent disciplines.
- Through a metatheoretical literature review we integrate the knowledge on the network approach in commercialization.
- Divergent network approaches - such as strategic, industrial, and social networks - are linked to commercialization.
- Network actors as contributors can perform commercialization tasks, facilitate adoption/diffusion and create markets.
- This article generates an integrative framework on how contributors can facilitate the commercialization of innovations.

Abstract

Successful commercialization is of great importance to innovative firms, and the recent literature has increasingly acknowledged that networks make a contribution not only to research and development but also to commercialization. A single company is rarely capable of generating successful diffusion in the commercialization of an innovation; success often requires cooperation between individual actors and organizations, and support from stakeholders. However, research on networks facilitating the commercialization of innovations is scattered across divergent disciplines. The aim of this study is thus, on the basis of an extensive, multidisciplinary, metatheoretical literature review, to integrate the extant knowledge on networks for commercialization and analyze how contributors external to the innovator firm can facilitate commercialization. The analysis identified divergent network approaches to commercialization, such as industrial networks, social networks, strategic networks, and entrepreneurship networks. According to the findings, customers and user communities, distributors, complementaries, suppliers, investors, associations, public organizations, and policy makers and regulators can perform diverse practical commercialization tasks, facilitate innovation adoption/diffusion and create markets. This article contributes by generating an integrative framework and a research agenda on networks for commercialization – a theme that is emergent, multifaceted, and crucial to innovative companies.

Keywords: commercialization, launch, innovation adoption, innovation diffusion, networks, relationships

Article classification: Literature review

1. INTRODUCTION

Innovations are increasingly developed within networks and hence there is a great deal of research being conducted on how networks and collaboration contribute to innovation development. However, commercialization in particular is known to be a critical part of the innovation process and most innovations fail in that phase (Chiesa & Frattini, 2011; Di Benedetto, 1999). Challenges in commercialization originate from the novelty of innovations which complicates the adoption of new solutions by raising adoption barriers, and leads customers and other actors in the business environment to resist new solutions (Chiesa & Frattini, 2011; More, 1983). Few firms have the capability to develop and manage innovations internally; success often requires cooperation between individual actors and organizations (e.g., Story, Hart, & O'Malley, 2009). And especially in commercialization, a new product or service requires acceptance and diffusion among networked market actors; it tends to fail if it does not attract support from stakeholders (Talke & Hultink, 2010).

As a single company is rarely capable of generating successful diffusion in the commercialization of an innovation, the network aspect in commercialization is crucial. To have a product with supreme technical features alone is often not enough. Due to the interconnectedness of market actors and technologies, innovation adoption is impacted by many interrelated organizations and individuals who reciprocally influence each other's behavior, and who will not switch to a new product unless they are convinced that most of the other players will also switch – a situation that is highly typical to some industries, such as interconnected high-tech (see Chakravorti, 2004; Chiesa & Frattini, 2011). In sum, network players' support is needed to promote an innovation in commercialization.

So the question is how network actors can support innovator firms in commercializing new products and services. Recent research has increasingly indicated that network actors can contribute not only to R&D but also to divergent aspects of commercialization. In the field of innovation management, research has shown that small innovator firms can commercialize their innovations by

combining resources in their networks to enter new foreign markets (Tolstoy & Agndal, 2010), and that adoption networks that may facilitate innovation adoption determine how an innovation might succeed in markets (Chiesa & Frattini, 2011). Investigations have shown that user networks can be activated to support product launch (Harrison & Waluszewski, 2008), and peer networks create community pull effects (Hienert & Lettl, 2011); thereby emphasizing the users' contribution to commercialization. According to recent entrepreneurship research, a portfolio of network relations with suppliers, distributors and customers helps small, new innovative firms acquire resources to commercialize incremental and radical innovations (Partanen, Chetty, & Rajala, 2011). In the field of business and marketing, recent research emphasizing interorganizational networks (particularly the IMP school) has evidenced that an innovator firm can intentionally activate its divergent network relations to advance commercialization and innovation success as an element of the firm's commercialization competence (Aarikka-Stenroos & Sandberg, 2012; Aarikka-Stenroos & Lehtimäki, 2013). Relational competences of firms developing radical innovations can be deployed also for commercialization (Story et al., 2011). Research emphasizing innovation networks has noted that the shift of resources from in-house commercialization activities towards collaboration with distributors and other actors seems to enhance commercialization success (Perks & Moxey, 2011). Furthermore, the literature emphasizing the strategic network approach suggests that innovative firms' networking creates new fields of business and markets for innovations (Möller & Rajala, 2007; Möller & Svahn, 2009). Our study thus assumes that diverse networks and relations can help overcome commercialization challenges, advancing commercialization by providing manifold complementary support and resources, and establishing a supportive context in which a new product might endure.

Even though findings by previous researchers indicate divergent network actors' crucial impact on commercialization and the relevance of the phenomenon, the extant literature does not provide systematic or integrative analysis of the divergent network actors contributing to the

commercialization; consequently, we still lack knowledge on networks for commercialization. Given the centrality of commercialization to innovation success, it is vital that contemporary research generates a deeper understanding on the value of relationships, networks, and interactions to the commercialization of innovations. However, the pace and disconnect of rapidly expanding research also generates a situation in which the knowledge on networks for commercialization does not accumulate. *Therefore, the aim of this study is to aggregate the current knowledge on how contemporary research and business have employed the network approach in commercialization, and construe how contributors external to the innovator firm can contribute to the commercialization of innovations.* We favor the school of thought which states that the innovator firm can intentionally develop and orchestrate its network relations with divergent actors for commercialization; our assumption thus follows the basic notions of the strategic network approach (e.g., Gulati, 1998; Möller & Rajala, 2007). We perceive that knowledge on how to employ networks for commercialization is becoming increasingly important for companies facing ever tighter financial conditions and growing competition, and for researchers who aim to advance understanding on the role of networks in the development and diffusion of innovations.

To integrate and structure the extant knowledge on networks for commercialization, this article conducts an extensive metatheoretical literature review (see Torraco, 2005). To map the multidisciplinary research area, we first answer the following research questions: 1) How are networks for commercialization discussed in the current research (i.e., the main approaches, the key concepts and terms related to networks for commercialization)? 2) What are the current research methods and which kinds of innovation and context are studied with regard to networks for commercialization? We will then be better positioned to answer our ultimate research question: 3) What kinds of network actor contribute to commercialization and how do they contribute? In order to answer these three questions we employed a multidisciplinary database, Ebsco Business Source, to identify articles linking networks to commercialization, and analyzed them through systematic

content analysis.

This article makes a pivotal contribution inasmuch as it is the first to generate an integrative framework on networks for commercialization – a theme that is emergent, multifaceted, and crucial to innovative companies. The analysis also seeks to clarify the incoherent terminology that originates from the diversity of approaches to the phenomenon. Mapping this rapidly evolving research, which links networks and commercialization both in content and methods will enable researchers and managers to employ current knowledge in their research and businesses more effectively; for example, researchers could position their studies more appropriately and practitioners become aware of the full contribution potential of network actors in their innovation business. We will also generate an agenda for further research as an outcome of our analysis.

Our paper is structured as follows. First, we present a short theoretical review with definitions of relevant concepts, such as networks and commercialization. The next section explains the methodology associated with the collection of the research data, and the content analysis of the identified research articles. We then identify key findings regarding networks for commercialization, propose a synthesis of commercialization networks, key actors, contributions, and their applicability to diverse innovation contexts, and construct an integrative framework on networks for commercialization. Theoretical and managerial implications follow as the research results enable us to suggest directions for researchers to study commercialization and networks, and to develop terminology; and for managers to develop the application of divergent networks for commercialization within divergent innovation industries. Finally, we discuss the limitations of the paper.

2. THEORETICAL FOCUS AND KEY CONCEPTS ON NETWORKS FOR COMMERCIALIZATION

The term *network* for commercialization can be linked to divergent network approaches with

different thematic emphases and background assumptions. Multiple established network approaches include for example strategic networks, industrial networks (IMP), social networks, innovation networks, network theory, and the economics of networks (see Table 1). The network approaches differ particularly in terms of the respective focal actors, what determines the network, and how the actors are managed (see e.g., Easton & Araujo, 1996). The networks also have internal linkages and confrontations; for example, innovation networks tend to apply strategic network assumptions, and IMP network and strategic network approaches disagree on the aspect of network management. The current divergent network research in relation to commercialization has studied both organizations' strategic or operational collaboration for commercialization (e.g., Perks & Moxey, 2011; Möller & Rajala, 2007; Partanen et al., 2011) and individuals' impact on successful adoption improving commercialization (e.g. Hienert & Lettl, 2011). In this study, network for commercialization refers to an extensive group of actors who contribute to the commercialization of an innovation.

INSERT TABLE 1 HERE

The *innovation* concept encompasses ideas of economic leadership and commercial success (Schumpeter, 1934); to become an innovation an invention has to be commercially successful, which presumes both a successful product or service launch and diffusion in the market. In the literature, the term “innovation” is employed to describe both radical, breakthrough novelties and incremental, modest novelties (Mohr, 2001; Garcia & Calantone, 2002). As this article aims to capture the diversity of the literature, we employ the term innovation in its broader sense; for instance, encompassing both radical and incremental novelties. The latter are often termed new products or services.

There is variation also between the concepts of *commercialization*, launch, diffusion, and adoption which arises from their different perspectives. Commercialization and launch emphasize the

innovator firm's perspective. Commercialization tends to refer to how an innovator firm can accrue income from its new product, service, concept, or technology; it includes divergent, strategic and tactical planning, and marketing activities concerning the product/concept, launch, and interactive activities with potential buyers and other relevant players (e.g., Jolly, 1997). The term launch refers to the specific introduction of the new product/concept to markets and its follow-up (Crawford & Di Benedetto, 2008; Di Benedetto, 1999). In commercialization and launch, a firm needs to focus on tasks such as the creation of demand, acquisition of marketing resources, effective communication with end users to facilitate adoption, building national and international distribution channels, and accessing market and customer information (Di Benedetto, 1999; Easingwood, Moxey, & Capleton, 2006). Noteworthy is that R&D and commercialization activities may overlap and interact during the innovation process (Aarikka-Stenroos & Lehtimäki, 2013; Prebble, de Wall, & de Groot, 2008; Prenkert, 2012).

The terms adoption and diffusion, on the other hand, emphasize the market's and market actors' perspectives: diffusion refers to how the innovation spreads and diffuses in markets, whereas adoption describes how the innovation is adopted and accepted for use (Rogers, 1983; Christensen, 1992). Adoption and diffusion thus determine the success of innovation, and are constitutive concepts in examining commercialization.

In sum, the key concept of this research is commercialization, as our focus is on the innovator firm's perspective. However, interrelationships between the above mean that these other related concepts, namely launch, innovation adoption, and diffusion are also employed in this study as appropriate; their different nuances of meaning are noted.

3. METHODOLOGY

3.1 Gathering relevant articles

As the research aim was to identify and analyze how the extant research articles linked networks and commercialization, the first stage in addressing the aim was to identify and collect as many relevant research articles as possible on commercialization networks; i.e. articles which linked networks to commercialization, launch, diffusion, and adoption. It became clear early in the preliminary searches that restricting the search to the most established journals or to journals representing particular disciplines might not fully capture the relevant research articles as the phenomenon is still emergent and vague. Therefore, although journal rankings are often employed as a proxy for quality and research impact (Singh, Haddad, & Chow, 2007; Van Fleet, McWilliams, & Siegel, 2000), we did not place specific emphasis on them. Instead, we emphasized representation across the disciplines. We selected the multidisciplinary EBSCO Business Source database as it covers a wide range of good quality journals in the field of technology and innovation management, marketing, and management, and includes recent research also from all geographic locations. For example, Web of Science excludes many European journals that we considered significant in this context as preliminary searches suggested that the research theme had emerged in these journals.

We started with a systematic search on all articles in which the title, keywords, or abstract mentioned the keywords “commercialization”, “adoption”, “diffusion”, or “launch”, in conjunction with “network” (searched as net*). The combined keywords commercialization and network were the most useful in sourcing the relevant articles, and keyword diffusion was the most challenging as it produced thousands of results, most of which were irrelevant to our particular research focus. Employing a database meant that we had to filter an extensive number of hits, so we decided to concentrate on those in which the Thesaurus terms of the database indicated relevance. Appendix 1 shows the number of articles identified through each search term combination. It should be noted that one article might be linked to several keywords. The whole search produced 883 articles.

3.2 Analyzing the identified articles

The next step was to eliminate articles in which the focal phenomenon did not sufficiently represent our focus, networks for commercialization. First we read the abstract, and if it was still not clear whether the article focused on our theme, we skimmed through the article. A considerable number of articles that were ultimately excluded concerned diffusion regarding a particular population and innovation policy, or discussed commercialization at the macro level, instead of focusing on networking for commercialization per se. If commercialization and networks were linked and discussed briefly with regard to the defined focus, even if not at the core of the study, the article was included in the analysis. Articles concerning adoption/diffusion were excluded if they were not linked to networking for commercialization or the market performance of an innovation. We focused on research articles and thus excluded, for example, book reviews and editorials. All of these decisions were made through comparisons by three researchers. As result of these eliminations, 81 research articles were selected as shown in Table 2. The full citations of these articles are listed in Appendix 2.

INSERT TABLE 2 HERE

We conducted a systematic content analysis of these 81 articles. Content analysis is an established method that enables minimal interference by the researcher on the phenomenon studied, and enables large volumes of data to be handled (Krippendorff, 1980). The method enables the employment of both quantitative and qualitative textual analysis (Weber, 1985). We first read through the articles to acquire a general perspective on the focal research, and then compared, categorized, and coded the contents of the articles in terms of the following:

1. Classification of the forum (i.e., the journal and its disciplinary orientation)

2. Identification of key terms concerning the phenomenon
3. Classification of innovation (i.e., type and nature of innovation or new product: e.g., incremental or radical, product or service) and its context (geographic and industrial)
4. Classification of commercialization perspective (e.g., commercialization, launch, and innovation adoption and diffusion aspects and tasks)
5. Classification of employed network approach and discussed network actors
6. Classification of the research methods and design
7. Identification of key findings on the contribution of the network actors to commercialization

Three business researchers participated in the data interpretation and categorization: one with a perspective on commercialization, one with an innovation-management perspective, and one with a perspective on network approaches. Knowledge of all these research streams was needed throughout the search and analysis process; for example, decisions relating to categorization and limitations were made by all three researchers together. The aspiration of the analysis was to identify multiple ideal types of network actor and their contribution to commercialization (see Doty & Glick, 1994). Coding procedures and categories were assessed in detail by the researchers together, and compiled accurately. Excel tabling was employed to ensure a consistent detailed categorization, and interpretations of the research findings and key content of articles were compared. Some aspects were discussed with experienced network researchers to ensure the consistency and validity of the analysis. Consequently, researcher triangulation increased the trustworthiness of the findings.

4. FINDINGS ON NETWORKS FOR COMMERCIALIZATION

4.1 The emergence of the network approach to commercialization within research

The analysis showed that research on the topic is growing swiftly. The first article that focused clearly on networks for commercialization was published in 1992, with the emphasis on technology networking and strategic alliances. Few studies on commercialization network issues were published between 1992 and 2001; however, the topic began to appear in 2003. 80 percent of all articles focusing on networks for commercialization were published more recently, namely, 2007–2012. This highlights the fact that, although companies and researchers are beginning to pay more attention to the link between commercialization and networks, the research focusing on this area is still emergent.

Our analysis also recognized the multidisciplinary nature of the phenomenon; there was a considerable variety of disciplines from marketing to engineering and planning within which networks for commercialization were discussed. Table 3 presents the main disciplines, their focus on the phenomenon, and the key forums of the identified articles. Many articles on networks for commercialization have been published by *Industrial Marketing Management* and the *Journal of Business Research*, in the field of marketing, and *The Journal of Product Innovation Management* and *Technovation*, in the field of innovation management.

INSERT TABLE 3 HERE

Even though the research on innovation commercialization networks is still emergent, the number of authors contributing to the research stream is surprisingly large. The studied articles were produced by a total of 178 different researchers, an average of 2.2 per article. Most authors were affiliated to European universities (particularly in the UK, Denmark, Finland and Switzerland).

4.2 Innovations, innovation contexts, and methodological approaches linked to research on networks for commercialization

The analysis indicated that the vast majority (85%) of the articles concentrated on incremental innovations or did not specify the degree of novelty, which we assumed implicitly to mean incremental innovations, as radical innovations are exceptional. Radical innovations can, however, create such substantial competitive advantages and profit margins that it is unsurprising they evoke special interest among researchers. Commercialization of radical innovations was discussed in up to 15 percent of the articles.

The innovation types were also analyzed. Product innovations (e.g., CD players and pharmaceuticals) are explicitly present in 33 percent and technology innovations (e.g., biotechnology and environmental technologies) in 24 percent of the articles, together representing a majority of the articles. Conversely, service innovations (e.g., mobile and computer services) were discussed in 9 percent and system innovations (e.g., banking and telecommunications) in 12 percent of the articles, thus being quite seldom contemplated. Of the service innovation articles, all except one were published since 2009, indicating the increasing interest in the service sector. In 22 percent of the articles, the type of innovation was not specified.

Innovation target markets are more equally distributed. 38 percent of the articles focused on b-to-b innovations, 28 percent on b-to-c innovations, and the remaining 34 percent did not specify the target market. 74 percent of the articles focused on specific industry sectors; of those, almost half concentrated on the IT and electronics sectors. Regarding other industries, almost 20% of the articles specified pharmaceuticals and biotechnology.

Most articles (38%) focused on European firms, with the UK clearly predominant, followed by firms from North America (24%). The market scope of the innovator firms was not clearly defined in 33 percent of the articles. However, the market was identified as national in 34 percent, regional in six percent (usually the EU), and global in 27 percent of the articles.

The analysis of the methods employed showed that 20 percent of the studies were conceptual, 55 percent were empirical based on primary data, and 25 percent being empirical relying on secondary data. It is noteworthy that only one of the 65 empirical studies explicitly relied on longitudinal data. Of the studies based on primary data, 62 percent utilized qualitative data (typically case studies with data collected mainly through interviews), 27 percent employed quantitative data (usually surveys), and 11 percent collected both. The studies relying on empirical secondary data were equally distributed between quantitative and qualitative data utilization.

With regard to methods, it is worth noting that the current research in most of the cases gathered data and analyzed them only from the innovator firm's perspective, almost always excluding other perspectives (e.g., complementaries; distributors; non-profit organizations).

4.3 Theoretical approaches and key terms applied to networks for commercialization

As the articles linking commercialization and networks were drawn from divergent disciplines, multiple theoretical network approaches were linked to commercialization. Table 4 incorporates the identified network approaches to commercialization, their emphasis on and conceptualizations for "networks for commercialization". Some articles explicitly stated their theoretical backgrounds and approach. Of those articles that did not, the approach was tracked by examining the employed references. In eight articles the followed approaches remained unsolved.

INSERT TABLE 4 HERE

It is striking that many articles employed several network approaches implicitly or explicitly; they combined mostly strategic, innovation, social and entrepreneur networks, and network economics approaches. Interorganizational network approaches (in particular, strategic network), focusing on organizations' relations, and social network approaches, focusing on key individuals' impacts, were

those most often employed in addition to the network economics approach that discussed relations between political actors, other stakeholders, and industry actors. Research articles focusing on the role of social networks have paid more attention to adoption/diffusion and made relatively limited reference to commercialization perspectives. However, there were a few articles that touched on the role of users' social networks in commercialization efforts. The lack of research focusing on the employment of social networks for commercialization tasks might potentially evidence a disconnection between commercialization and adoption/diffusion research. Nonetheless, most research articles on adoption begin by referring to commercialization and innovation success challenges. Surprisingly, the innovation network approach did not stand out in particular, even though innovation management journals published the largest number of the reviewed studies. Entrepreneur network approach discussed networking and partnering with regard to new ventures, their growth and internationalization. Network organization approach focused either on internal or interorganizational teams and projects that facilitate commercialization. The Actor-Network Theory (ANT) approach was adopted infrequently, employed in only two studies.

When analyzing the linkages between the employed network approaches and disciplines, we noticed that the industrial marketing and strategic network research emphasizes business networks and collaboration between different companies for commercialization, and how such collaboration can be induced and organized. The entrepreneurship network approaches were employed to emphasize the management of the firm and its relations for commercialization, from the perspective of the focal company/entrepreneur. Innovation management and engineering research employed different network approaches to highlight that development and management of innovation might also require resources from external contributors over the innovation process. The social network approach employed in particular by innovation management and marketing studies suggests that successful commercialization requires innovation-promoting interaction and communication between individuals and communities. Network research with a more societal, political, or macro perspective

(such as ANT and network economics) indicates that the whole society consolidates or diminishes the future of an innovation.

The analysis of the articles also captured contemporary terminology and revealed the diversity of terms linked to “networks for commercialization”. No predominant single key term was identified; instead, more than 20 conceptualizations were captured and listed in Table 4. According to the reviewed articles, the networks comprised:

- Individuals (e.g., users; experts; managers; entrepreneurs)
- Groups (i.e., collaborative communities; peer communities; sub networks)
- Organizations (e.g., firms; associations; universities)

These entities were labeled network *members, actors, players, stakeholders, partners, contributors, and supporters*. The divergent terms reflect the perspectives of different disciplines on innovation management issues in general; however, they also both enrich and confuse the definitions and terminology concerning the core phenomenon.

The synthesis of key concepts and network approaches not only describes contemporary terminology but also indicates the various actors that might contribute to commercialization. For example, user/peer/opinion leader networks comprise individuals, and informal communities and groups that contribute through social networks, whereas partner organizations discussed within the interorganizational network, strategic network, and entrepreneur network literature emphasize how distributors, complementaries, and non-profit organizations can facilitate operational tasks or strategic planning in commercialization through collaboration. These network members and their contribution to commercialization is therefore discussed in more detail.

4.4 Identified network actors and their contribution potential to commercialization

Analysis of the research articles indicated how divergent network actors/members such as customers and users, distributors, complementaries, competitors, universities, government agencies,

and associations (see Table 5) can contribute to commercialization.

INSERT TABLE 5 HERE

Actors such as individual users who form user networks or communities of peers can contribute intentionally or unintentionally to commercialization. According to the literature analysis, the social network approach in particular, which discusses innovation adoption and diffusion, examines the relevance of specific individuals in innovation success; these lead users, expert opinion leaders, and hub persons (with large numbers of contacts) have a substantial influence on opinion formation/change. These types of key person contribute by demonstrating a new product to other potential users, by explaining its unique benefits compared to what is currently available, functioning as lead teachers to followers, and acting as references (e.g., Goldenberg, Han, Lehmann, & Hong, 2009; Harrison & Waluszewski, 2008; Hienerth & Lettl, 2011). Users also build an impression of a “critical mass” of adopters that often impacts others’ adoption decisions and adoption intensity, and increases diffusion in terms of speed and extension (Van Siyke, Ilie, Hau Lou, & Stafford, 2007). Such user mass is crucial, particularly for systemic innovation.

At the organizational level, divergent firms, public organizations, and associations can contribute to the success of commercialization. Distributors are crucial as they make the product available to users (e.g., Perks & Moxey, 2011). Producers of complementaries, and even competitors, are potential sources of strategic collaboration that can fortify demand for a new product (e.g., Molina-Castillo, Munuera-Alemán, & Calantone, 2011; Snow, Fjeldstad, Lettl, & Miles, 2011). Public organizations and educational institutions can contribute to commercialization by, for example, envisioning the use of an innovation in society (e.g., Troshani & Hill, 2009). Universities can establish trust and expertise due to their expert status (e.g., Inganäs, Harder, & Marxt, 2007); it was notable that the articles which emphasized the role of universities as network actors tended to focus

on the biotech sector. Political authorities can provide information within their own areas of expertise and facilitate the development of new business fields (e.g., Inganäs et al., 2007; Tolfree, 2008). Firms with supplementary resources (e.g., consultants; advertising agencies) fortify and upgrade innovator firms' commercialization activities (e.g., Story et al., 2009). Investors provide financial resources for commercialization, and also enable further networking (e.g., Pittaway, Robertson, Munir, Denyer, & Neely, 2004). Established firms with high profile names acting as partners and supporters can also play an important role throughout the commercialization process as their stability, credibility, and good reputation often spread to their partners and establish the credibility of new ventures in particular (see e.g., Tolstoy & Agndal, 2010). Based on the reviewed articles, associations and public organizations constitute knowledge brokers which disseminate information, and establish expertise and credibility (e.g., Aarikka-Stenroos & Sandberg, 2012; Troshani & Hill, 2009).

In comparing studies on radical and incremental innovations it became clear that similar kinds of diversity in network actors were prevalent in both. Convincing other actors to support the commercialization of radical innovations is particularly demanding, as they are extremely cautious in supporting an innovation that might endanger their current market position and has no guarantee of achieving market success. However, the successful launch of radical innovations often requires complementary products and services, new kinds of infrastructure, and the significant readjustment of existing business; thereby making the participation of other actors not only helpful, but crucial (e.g., Chiesa & Frattini, 2011).

5. DISCUSSION

This section summarizes and develops further the knowledge driven by the reviewed articles with regard to employed network approaches to commercialization, relevant network actors and their contribution to commercialization.

The findings support the idea that divergent actors surrounding the innovator company impart knowledge, relations, and other resources that are important to commercialization, and facilitate commercialization in many ways. Figure 1 provides an integrative framework depicting network actors contributing to commercialization; the conceptual framework comprises all divergent relevant actors and typifies each actor's main contribution to commercialization derived from the literature review. It shows that not only business organizations but also informal and not-for-profit organizations, communities, and key individuals impact commercialization success. As findings on network actors showed, users' ability to disseminate information and educate other users, and complementaries' ability to create supporting offerings and increase credibility are discussed quite plausibly; however, distributors, whose role is often pivotal in making the innovation available to users, merit surprisingly little discussion.

INSERT FIGURE 1 HERE

We emphasize that, although the framework depicts actors and their contributions in a simplified manner because the network is presented as a portfolio of relationships, our findings also reveal the phenomenon to be more complicated. Actors often are *interconnected* with each other, thereby turning portfolios into mutual relationships and interactive networks that influence the dynamics of the network. On network level, actors can for example collaborate horizontally or vertically within different network constellations. Moreover, the actors have direct and indirect relationships (e.g., distributors and the media provide indirect relations to customers) that also complicate the contributions. Furthermore, the contributions occur at *both organizational and personal levels*. Consequently, personal and organizational contributions can overlap; for example, members of professional associations are persons who through their organizations are involved in business networks and, as boundary spanners, are able to impart further knowledge that is important to the

diffusion of a product or technology. Moreover, each actor can bring forward several contributions, while some can be introduced by several actors (i.e., credibility can be enhanced by, for example, universities and associations). Actors can contribute *intentionally or unintentionally* and *directly or indirectly*. For example, policy makers and complementaries can intentionally promote the creation and development of a particular industry, although their contribution is intended to strengthen the industry or a product category as a whole, rather than a specific product or the business of an individual firm. However, their activities indirectly and unintentionally contribute also to an individual firm's innovation business and further commercialization. As our thinking perceives that an innovator firm can intentionally develop and orchestrate its network relations, our framework depicts actors with whom the innovator firm could engage and collaborate for commercialization. Moreover, we think that divergent actors' potential contributions to commercialization provide the reasons that might motivate innovation firms to engage with and develop relations with such contributors. Moreover, the analysis suggests that the interaction with network actors enhances learning in markets with regard to commercialization: the firm may realize what aspects are relevant to end users, distributors, and society and how to initiate entry to markets and interact with potential customers and other stakeholders.

We also clustered the contributors and outlined their key contribution types and modes. As our objective was to identify multiple ideal types for network actors' contribution to commercialization, and to develop an integrative typology rather than a taxonomy of mutually exclusive categories (see Doty & Glick, 1994), some types might partly overlap.

INSERT FIGURE 2 HERE

Our analysis indicates that divergent network actors make three types of key contributions to commercialization, itself a long and multilateral process (see Figure 2). First, some network actors

create markets for innovations; for example, related firms and other organizations collaborate proactively and strategically to prompt the emergence of new business fields. Regulators, investors, public organizations, the media, complementaries, suppliers, and manufacturers together shape markets by breeding ecosystems that enable the birth and growth of new business. Such collaboration does not support directly an individual product or company but builds grounds for commercialization per se. Research investigating how markets are created to commercialize new products has focused on interorganizational relations and clusters, and employed strategic network, entrepreneur network, and network economics approaches.

Second, all adopters and users as well as media, distributors and many other organizations *facilitate and accelerate further adoption* in markets by impacting attitudes and choices, and by creating the influence of critical mass. Research investigating a focus on this aspect, for instance, how networked adopters and users impact further adoption, has employed social network, ANT, and network economics approaches.

Third, some network actors can directly *perform practical commercialization tasks* that are crucial to the focal innovator company and the innovation: users, the media, and divergent organizations and communities inform and educate other actors and markets on the employment and benefits of the innovation; distributors deliver innovations; investors provide financial resources; and related companies conduct tactical co-marketing and/or increase the attractiveness of an innovation with offerings that turn isolated products and services into comprehensive solutions. Research investigating how relationships and networks of innovator firm(s) are created and employed for practical commercialization tasks has utilized industrial network, innovation network, user network, entrepreneur network, and network organization approaches.

We also propose a model (see Figure 3) that comprises four basic modes of contribution. These modes are characterized as a function of two vectors acting as a continuum. One of the vectors reflects the intentionality of the contribution to the commercialization, while the other relates to how

directly the actors contribute. *Partners* (e.g., distributors and complementaries) intentionally and directly provide resources and perform commercialization tasks through close and intentional cooperation; *intentional promoters* (e.g., associations and public organizations) can be indirectly engaged to support diffusion, market creation, or industry development through close cooperation; *unintentional promoters* (e.g., expert opinion leaders on the focal industry) contribute commercialization tasks distantly; *facilitators* (e.g., regulators) indirectly and distantly support diffusion, market creation, or industry development by shaping the market environment.

Noteworthy is that as one actor can offer several contribution types through diverse modes and also the innovation context impacts the relevance of different actors, the compositions may vary depending on contextual features.

INSERT FIGURE 3 HERE

Identification of the key contributions types and modes can also reduce conceptual fuzziness on the phenomenon: “commercialization networks”, “collaboration for commercialization”, and “adoption networks” are employed as synonyms referring to “networked actors involved in commercialization”; however, they often have clearly different meanings. For example, commercialization network emphasizes the innovators’ perspectives and the innovator firm’s intentional activities in motivating and committing potential actors, whereas adoption network highlights the macro level and customers’ and other stakeholders’ perceptions and actions that direct the innovation through acceptance.

The analysis also emphasized the firm’s ability to employ relations for commercialization. The size and novelty of the innovator firms reflects their potential to attract various kinds of contributor; as such, a small firm can encounter insurmountable obstacles when approaching prospective contributors (Aarikka-Stenroos & Sandberg, 2012). The reviewed articles indicated that firms producing radical innovations have usually needed to establish complex networks for research and

development (e.g., Harryson, Dudkowski, & Stern, 2008; Tidd, 1995; Story, O'Malley, & Hart, 2011) and presumably already possessed advanced network capabilities when commencing commercialization. Such capabilities are of paramount importance as reviewed articles showed that, unlike incremental innovations for which networks often develop incrementally over time alongside growing trust and commitment (e.g., Stuart, Ozdemir, & Ding, 2007; Van de Ven, 2005), networks are more likely to be created, abandoned, and remobilized swiftly for radical innovations (e.g., Story et al., 2009).

Innovator firms might adopt different profiles in relation to utilizing identified contributors with different types and modes of contribution. For instance, some firms seem to focus on particular contributors and modes of contribution, such as solely partnering (e.g., Wince-Smith, 1993), whereas others strive to attain a large variety of contributors with diversified contributions. The analyzed case studies in particular offer exemplars on how to employ these commercialization contributors, and what kinds of implication such employment can offer. For example, building a user network can turn a previously failed product launch into a success, as happened with a Biacore biosensor product; however, this required systematic identification and interaction with multiple potential lead-users, and facilitation of user-to-user interaction (see Harrison & Walusewski, 2008). According to Chiesa and Frattini's research (2011), crucial support can be acquired through the early building of long-term partnerships with critical actors, and out-licensing the technology both to competitors and complementaries. For example, the firm developing Tom Tom GO navigator networked early with Tele Atlas for the provision of digital maps and the US Department of Defense as it regulated the access to GPS satellites, both partners securing crucial features for the innovation. In addition, the three diverse types of lead-user had strongly positive attitudes concerning the innovation. Johnson (2008) shows the contributive role of a government actor in a triple helix network by reporting on an industry-led consortium, Precarn, which from the small innovator firm's perspective helps to gather the network actors needed for commercialization, and organizes a pre-commercial project. In such a

project, one party must be capable of commercializing the technology while other partners typically play the roles of a technology user (i.e., organize tests; be the first customer), scientific partners, and other technology developers. Through this pre-commercial project, expertise can be pooled, risks and costs shared, development accelerated, and the research-industry gap bridged; in addition, the consortium directly contributes to the creation of new industries.

6. CONCLUSIONS AND IMPLICATIONS

6.1 Theoretical implications and contributions

Commercialization and how it is managed through networks is an emergent issue that interests both practitioners and researchers across a range of business, engineering, and management disciplines. By reviewing the extant research on networks for commercialization, this study generates new knowledge on how innovator firms can employ networks to ensure the successful commercialization of new products. This study focuses explicitly on commercialization, and thus it extends research on networking for innovation that has mostly focused on R&D (e.g., Dhanaraj & Parkhe, 2006; Gulati 2000). Through a structured literature review, the study analyzes how different network approaches are applied to commercialization, identifies relevant network actors in terms of commercialization, and develops an integrative conceptual framework depicting how network actors contribute to commercialization. First, the key contribution lays in the analysis of *divergent network actors* (i.e., individuals; groups; organizations) and their potential input to commercialization, and in the development of an integrative framework that captures *the main contributions of network actors to commercialization*. The review highlights that not only customers and users but also lead partners, such as distributors, complementaries, public organizations, regulators, and opinion leaders, can contribute to commercialization in three ways by creating markets, performing commercialization tasks, and facilitating innovation adoption/diffusion (i.e. *types of contribution*). Such actors prepare

markets for an innovation and amend strategic planning, build credibility, ensure the delivery and existence of supportive complementary offerings, mobilize user communities to ensure market pull effects and improve customer education, to enable innovations to thrive in a supportive environment. We also identify different *modes of contribution*; from the focal firm's perspective, network actors can intentionally or unintentionally and directly or indirectly support the commercialization of innovations. Moreover, our review indicates that both incremental and radical innovations need help from diverse network actors; however, support from the network itself is even more crucial for the latter.

Second, we contribute by identifying and comparing *different conceptualizations and foci of divergent network approaches* that researchers in various disciplines have applied to the analysis of networks for commercialization to date, and in analyzing their implications. Due to its extensive approach, this review concludes that the interdisciplinary topic of innovation becomes increasingly interdisciplinary as the social and organizational interaction with and between divergent stakeholders becomes denser when an innovation faces markets at commercialization. Extensive cross-disciplinary analysis shows how each network approach reveals an interesting dimension of the phenomenon. For example, the strategic network approach emphasizes the competitive advantage of networking for commercialization, whereas industrial networking research improves our understanding on how interactive relationships for commercialization can be built. Social network and ANT research highlights how networked entities (i.e., individuals; groups; organizations; technologies) shape a macro system, an ecosystem. The entrepreneur network literature emphasizes how small innovator firms augment their scarce resources for commercialization through networking.

The systematic analysis of current research, however, shows that there is a need to develop coherent conceptualizations especially concerning network approaches and commercialization, and to accumulate the current knowledge that would strengthen the theoretical basis of this research field. Our integrative analysis facilitates the development of a more coherent theorization and terminology

for networks and collaboration for commercialization. Vagueness in the employment of concepts is typical to new research areas that lay at the intersection of various research streams. Researchers are therefore encouraged to provide clear definitions of terms so as not to complicate further this interdisciplinary field. Our analysis also reveals several research gaps that are proposed as topics for further research.

6.2 Implications for divergent stakeholders/network actors: researchers, managers, and politicians

The findings prompt implications for divergent stakeholders. First, this study calls for *researchers* to focus their attention also on networks for commercialization, instead of studying only research and development networks.

Innovative companies are encouraged to identify and motivate relevant actors for commercialization. The identification of contributors requires understanding on the potential supporters' perspectives on innovation diffusion/adoption and their goals, and to find ways of involving them in commercialization. In particular, our findings on commercialization actors and their contribution potential (see Table 5; Figure 1; Figure 2; Figure 3) will help innovator firms and new product developers identify relevant actors. The typologies of network contributors facilitate the identification of a firm's contributors, or those for which it strives. Mapping commercialization contributors, contributions, types and modes will help managers consider what kind of support they can expect from contributors, and what compensation contributors will expect in return. Firms can realize the full potential of actors in their existing networks and, when needed, purposefully develop new networks for commercialization. In addition to organizational actors from distributors to investors and complementaries, personal network actors such as opinion leaders and key users, and non-profit organizations' resources can promote an innovation. Although the input of potential network actors can be extensive, their mobilization to promote an innovation can be problematic.

Management issues and a lack of trust are typical of commercialization (see Aarikka-Stenroos & Sandberg, 2012; Heikkinen, Mainela, Still, & Tähtinen, 2007), and the actors' perspective on the nature, extent, and length of a jointly decided action can vary across the commercialization network (e.g., Mouzas and Naudé, 2007), which can in turn also complicate the employment of networks for commercialization. *All companies* are encouraged to acknowledge that they can better reach their goals by supporting an innovation, and encouraged to differentiate competitive advantage by co-creating value with innovative co-offerings. Through collaboration with innovative companies, they can offer complete solutions rather than isolated products.

Politicians and governmental actors are encouraged to realize that the commercialization of innovations requires resources but is crucial for society, and that successful commercialization often requires collaboration with various kinds of company and organization. These actors can facilitate firms' commercialization efforts, not only with financial resources but also by offering communication and networking support. It is challenging for a single and, in particular, a small innovative company to induce and activate networking, and therefore political deeds and strategic joint ventures are required.

6.3 An agenda for further research

The literature review revealed several gaps that are suggested as potential future research topics in the research agenda (see Table 6). As multiple network actors are able to impact the success of innovation throughout the long multidimensional commercialization process via divergent means, the topic clearly requires investigation from different perspectives of relevant network actors in markets over a long time span.

INSERT TABLE 6 HERE

Our analysis indicates that a holistic understanding involving *the examination of all involved actors' perspectives* on networks for commercialization is often missing, so researchers should investigate the perspectives of divergent network actors with contribution potential. This can also enhance the building of knowledge on how an innovator firm can mobilize and commit potential actors. In turn, this will link to discussions on the *management of divergent relations for commercialization* and network actor mobilization. In the reviewed articles, the management of business relations for commercialization in particular was highlighted as a pivotal topic. Therefore, the question is how can commercialization networks including diverse actors be orchestrated at an industry level or managed by the innovator firm in a network to grasp their contribution potential. In particular, unintentional and indirect contributions to commercialization by users, complementaries, policy makers, and other market actors can be crucial, although difficult to manage. Research on this area will also bridge the identified *gap between commercialization and adoption and diffusion studies*.

Moreover, the *longitudinal aspect* on the topic was missing. With regard to the commercialization theme, the process and its change over time are pertinent. We therefore call for future research with longitudinal designs to address the evolution of the commercialization network. In addition, the *dynamics of commercialization networks* merit more research but such research goals cannot be accomplished without longitudinal research designs.

It would also be beneficial to extend the current knowledge by *investigating different innovation contexts* and *also including related research* on alliances or stakeholders to provide a more accurate picture of the phenomenon.

Our analysis reveals that *some particular actors* tend to be relevant although they have been neglected by research. Even though *distributors* often occupy a key position in making an innovation available to users, their role in commercialization is unexplored. Also, divergent *non-profit actors* with extensive contribution potential to commercialization merit more research.

We believe that further research inputs to these topics can show how innovations truly are developed and established in networked markets.

6.4 Limitations of the paper

There are some limitations to our paper. Due to limited resources, our study covers one multidisciplinary database. However, we believe that the chosen extensive database provides a comprehensive depiction of the current state of commercialization network research, and the inclusion of other databases would probably not have radically changed this picture. We also focused on the conceptualization “network” and excluded the terms “alliance” and “stakeholders”. We acknowledge that the content analysis of the relevant articles was subjective in certain respects; for example, as many researchers did not position their work, we employed implicit and explicit cues to position their research, which might be positioned differently by the respective authors themselves. However, researcher triangulation and explicit coding rules increased the trustworthiness of the results. Despite these limitations, this review provides managers and researchers with a better understanding on the current and rapidly evolving field of commercialization network research.

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Table 1 Diverse established network approaches

Network approach	Characteristic	Key sources
The economics of networks	Focus on network effects and competition in the network environment; network externalities	e.g., Katz & Shapiro, 1985
Entrepreneur networks	Emphasis on small firms' networking for resources, e.g., for growth and internationalization	e.g., Aldrich & Zimmer, 1986
Industrial networks	Emphasis on interactive relationships between networked companies; the basic assumption is that networks cannot be managed	e.g., Håkansson & Ford, 2002
Innovation networks	Emphasis on managing networked firms for R&D and innovation	e.g., Dhanaraj & Parkhe, 2006
Network theory	Focus on network dynamics	e.g., Powell et al., 2005
Social networks	Focus on relationships of social entities, i.e., individuals and organizations	e.g., Granovetter, 1973; Burt, 1992; Uzzi, 1996
Strategic networks	The basic assumption being that networks of companies can be managed towards a shared goal	e.g., Jarillo, 2006; Gulati, 1998; Möller & Svahn, 2009
Actor networks	Networks comprise the material and semiotic relations between humans and non-human objects	e.g., Latour, 2005; Law, 1992

Table 2. The research stages: identification of articles, content analysis, and delimitations

Search and analysis stages	Result of the stage
The complete search with key concepts: commercialization, launch, adoption or diffusion, and network.	8874 articles
Delimitations from the database thesaurus.	883 articles
Content analysis on the basis of the abstract and further delimitations: all 883 abstracts were read by researchers and potentially relevant articles were chosen for further analysis.	201 articles
Content analysis on the basis of article content and final delimitations: all 201 articles were skimmed through by researchers and articles discussing the research theme were included for detailed analysis.	81 articles
Systematic content analysis for the final group of reviewed articles: all 81 articles were analyzed and coded thoroughly by researchers.	81 articles

Table 3. The multidisciplinary nature of the phenomenon: screening of the disciplines and forums for articles focusing on networks for commercialization.

Discipline	View on commercialization	Example journals	Number of articles linking networks and commercialization
Innovation management and technology	Commercialization, adoption, and diffusion within innovation processes and their management	Journal of Product Innovation Management; Technovation; Research Policy; IEEE Transactions on Engineering Management	34 42%
Marketing	Marketing and market creation of new products	Industrial Marketing Management; Journal of Marketing; Journal of Business Research; Journal of Marketing Management	20 25%
Management and organization studies	Management of the firm in R&D and commercialization	Management Science; Journal of Management Studies; Organization Science and Administrative Science Quarterly	12 15%
Engineering, information systems	Commercializing particular technologies and products	Journal of Management Information Systems; MIS Quarterly; International Journal of Mobile Communications	5 6%
Entrepreneurship and venturing	Innovation firms and entrepreneurship in commercialization	Journal of International Entrepreneurship; Entrepreneurship: Theory & Practice	3 3,5%
Policy and Planning	Innovation policy facilitating innovation industries in R&D and commercialization	European Planning Studies; Economic Development Quarterly	3 3,5%
Other	E.g., Creation of new business fields, clusters, and systems	American Journal of Sociology; RAND Journal of Economics	4 5%
Total			81 100%

Table 4. Identified network approaches to commercialization and their conceptualizations on the phenomenon.

Identified network approach	Narrower descriptions of the approach	Number of studies	Approaches' emphasis and conceptualizations of the phenomenon
Interorganizational network - IMP approach	<ul style="list-style-type: none"> IMP school (relying on, e.g., Ford & Håkansson, 2002); research highlights interaction and operational relationships for commercialization. 	12	<p><i>Emphasis:</i> relationships, partnerships, alliances, and collaborations between organizations formed for commercialization</p> <p><i>Conceptualizations employed:</i> interorganizational network, network for collaboration, commercialization network, collaborative network, relationships in innovation for technology commercialization, inter-firm relationships, and innovation partners</p>
Interorganizational network - Strategic networks	<ul style="list-style-type: none"> Strategic network (relying on, e.g., Gulati, 1998); research highlights how relations for commercialization are formed to manage future competition. 	11	<p>IMP-approach: e.g., Story et al., 2011</p> <p>Strategic network approach: e.g., de Reuver & Bouwman, 2012; Mu & Di Benedetto, 2011</p>
Social networks	<ul style="list-style-type: none"> Social network ties and structure (relying on, e.g., Granovetter, 1973; Burt, 1998; Uzzi, 1996), user networks, opinion leaderships in social networks, and communities at macro level impact adoption and thus also commercialization. 	19	<p><i>Emphasis:</i> networks between users or opinion leader individuals or communities formed and employed for commercialization</p> <p><i>Conceptualizations employed:</i> adoption network, diffusion network, user network, networks of users, peer networks, peer communities, opinion leaders, social network, advice networks, and communication networks</p> <p>e.g., Iyengar et al., 2011; Bohlmann et al., 2010</p>
Network economics	<ul style="list-style-type: none"> Network externalities (relying on Katz & Shapiro 1985). 	7	<p><i>Emphasis:</i> industry actors and public actors interacting for commercialization</p>
	<ul style="list-style-type: none"> Business and industry clusters. 	6	<p><i>Conceptualizations employed:</i> networked business system, industry networks, and networking within</p>

			clusters e.g., Chiesa & Frattini, 2011; Molina-Castillo et al., 2011
Innovation networks	<ul style="list-style-type: none"> • Innovation networks include networking also for commercialization activities. 	6	<p><i>Emphasis:</i> the innovator firm's networks and collaboration throughout the innovation process from R&D to commercialization</p> <p><i>Conceptualizations employed:</i> innovation network, the network of the innovator, strategic NPD networks, and supporting organizations</p> <p>e.g., Perks & Moxey, 2011</p>
Entrepreneur networks	<ul style="list-style-type: none"> • Networking and partnering for growth and internationalization in relation to commercialization (relying on, e.g., Coviello & Munro 1995; Johanson & Vahlne 2009). 	6	<p><i>Emphasis:</i> SMEs' and entrepreneurs' networking for commercialization</p> <p><i>Conceptualizations employed:</i> new venture networks; entrepreneurs' networks</p> <p>e.g., Freeman et al., 2010; Tolstoy & Agndal, 2010</p>
Network organization	<ul style="list-style-type: none"> • Project organizations and collaboration of small related firms facilitate commercialization (relying on, e.g., Kogut, 2000). 	4	<p><i>Emphasis:</i> internal and interorganizational teams and projects for commercialization</p> <p><i>Conceptualizations employed:</i> collaborative teams, collaborative project organization</p> <p>e.g., Bercovitz & Feldman, 2011</p>
Actor Network Theory (ANT)	<ul style="list-style-type: none"> • Societal network of human and non-human actors support the innovation (relying on, e.g., Latour 2005, Law 1998). 	2	<p><i>Emphasis:</i> the innovation is actualized with the support of the entire network</p> <p><i>Conceptualizations employed:</i> supporters of innovation, "the macro-cosmos" of innovation</p> <p>e.g., Harty, 2010</p>

Table 5. Synthesis of network actors and their expected contribution to commercialization in the reviewed studies.

Relevant actors	Contribution to commercialization	Examples of references
Consumers, clients, users, and adopters (individuals; organizations)	<ul style="list-style-type: none"> • Users support communication <ul style="list-style-type: none"> ○ they serve as references, provide endorsements, spread word-of-mouth, teach others ○ they represent the need for the innovation ○ they present benefits, display use, diffuse knowledge on new applications and utilization experiences, and advance evaluation of perceived risk regarding adoption • Users judge product quality and give product feedback, induce changes to products, generate new applications, generate ideas on possible uses, and develop functionality. • Users give feedback regarding market structure, sales, and promotion. • Adopters/users make the use and the user base visible to other actors and build an impression of a “critical mass” of adopters that impacts further diffusion. 	Vowles et al., 2011; Van Siyke et al., 2007; Perks & Moxey, 2011; Tolstoy & Agndal, 2010
Key user entities: lead users, opinion leaders, and hubs (individuals; organizations)	<ul style="list-style-type: none"> • Lead users and opinion leaders serve as role models as they act ahead of the mass market and influence opinion formation/change. Consequently, they raise the pace of the information stream and the adoption process itself. • Lead users assess products’ market potential, and test and evaluate the extent to which new products meet significant user needs. • Lead users facilitate the dissemination of knowledge as they often straddle boundaries between different clusters and groups; they teach how a new product works and explain its benefits compared to what is currently available. • Opinion leaders and lead users serve as important references in further marketing. 	Hienerth & Lettl, 2011; Iyengar et al., 2011; van Eck et al., 2011; Goldenberg et al., 2009; Harrison & Waluszewski, 2008
Communities; macro communities of users (peers; villages; neighborhood;	<ul style="list-style-type: none"> • A community stimulates public awareness within the group, mobilizes community members, and organizes information sharing activities: conferences, journals, seminars, meetings, and discussions. • A community creates pull effects. 	Hienerth & Lettl, 2011; Song et al., 2009

industry branch)	<ul style="list-style-type: none"> • Community members test and use new technologies/products and share knowledge on end user requirements. • Some community members are boundary spanners, influence members of broader communities, and outsiders, and signal through lead user status. 	
Distributors, retailers, and intermediaries	<ul style="list-style-type: none"> • Distributors provide distribution resources and make the product available to users. 	Lettl et al., 2008; Perks & Moxey, 2011
Suppliers, manufacturers, and subcontractors	<ul style="list-style-type: none"> • Suppliers and manufacturers increase the use of the technology/innovation, e.g., through licensing. • Suppliers implement applications and complementary offerings. 	Story et al., 2008; Story et al., 2011; Tolstoy & Agndal, 2010; Perks & Moxey, 2011
Experts: designers, engineers, and consultants	<ul style="list-style-type: none"> • Expert organizations increase organizational learning on commercialization. 	Robertson et al., 1996; Story et al., 2008
Complementaries: related companies and partners that supply products or services complementary to an innovation	<ul style="list-style-type: none"> • Complementaries together with other companies develop the industry; they create future demand by developing new business fields and constructing new long-range orientations through strategic and technology forecasting. • Complementaries can innovate new sub-elements of an offering, provide complementary solutions, resell products and services, and fortify demand for new products (e.g., they might require their clients to use the innovation); thus, they stimulate the size of the installed base and the variety of complementary products. • Collaboration with complementaries can save on effort and reduce the high costs of marketing. • Collaboration enhances organizational learning and market intelligence, and builds new knowledge on commercialization. • Complementaries facilitate growth: <ul style="list-style-type: none"> ○ they identify potential customers, suppliers, and consultants ○ they can provide access to global markets • Collaboration with complementaries increases the credibility of the innovator firm and its product, and provides reputational benefits. 	de Reuver & Bouwman, 2012; Molina-Castillo et al., 2011; Perks & Moxey, 2011; Snow et al., 2011
Investors; vendors	<ul style="list-style-type: none"> • Vendor investment directly impacts commercialization. Investors also enable innovator firms to find partners/companies seeking to fund. 	Inganäs et al., 2007; Danov et al., 2003

Public organizations, non-profit organization associations, and educational institutions	<ul style="list-style-type: none"> • Public organizations engage in the development of an innovation and its use, and articulate encouraging visions for the use of the innovation in society. • They establish trust, expertise, stability, credibility, and a good reputation. • They foster relations with political authorities. 	Troshani & Hill, 2009; Robertson et al., 1996; Aarikka-Stenroos & Sandberg, 2012
Trade and professional associations	<ul style="list-style-type: none"> • Associations as neutral knowledge brokers disseminate information and generate trust. • Associations with professional involvement tend to diminish perceived bias; their actors are from multiple sectors with multiple interests and thus provide extensive unbiased visions on best practices. 	Aarikka-Stenroos & Sandberg, 2012; Troshani & Hill, 2009; Story et al., 2008
Universities, academics, research centers and researchers	<ul style="list-style-type: none"> • Academics and university researchers bring scientific internationally informed knowledge. • Science partners generate trust and credibility regarding the innovation. • Academics and experts teach and research different facets of innovations. 	Bercovitz, & Feldman, 2011; Johnson, 2008; Inganäs et al., 2007
Policy makers, regulators, public sector actors, government, politicians, NGOs, authorities, municipalities, and economic development agencies	<ul style="list-style-type: none"> • Policy makers set, control and shape standards that impact commercialization. • Public sector actors provide information within their own areas of expertise. • Policy makers influence markets and investors. • Institutions increase technological absorption, promote local networking, link experts, legitimize actors, involve actors in new collaborations, and make the whole cluster more efficient. • Policy makers fund individual projects and thus provide financial resources. 	Story et al., 2008; Tolfree, 2008; Inganäs et al., 2007
The media	<ul style="list-style-type: none"> • The media build awareness and disseminate information on an innovation and the company. 	Aarikka-Stenroos & Sandberg, 2012
Industries as a whole: “all market players”; “members of clusters”	<ul style="list-style-type: none"> • Members of an industry identify commercial opportunities and extend scientific knowledge and access to financial resources. • Industry actors together control and shape standards and develop industries. • Markets create push and pull mechanisms. • Collaboration impacts the emergence of industry architectures and processes leading to institutional collective action. 	Chiesa & Frattini, 2011; Sillanpää & Laamanen, 2009; Powell et al., 2005; Van de Ven, 2005; Pittaway et al., 2004

Table 6. The research agenda: Identified research gaps and examples of research questions.

Identified gap	Potential topics	Potential research questions
Perspectives of multiple actors are absent	Different perspectives of involved actors to innovation commercialization.	<ul style="list-style-type: none"> • How do divergent relevant actors perceive the innovation and their role in commercialization?
Research on management of divergent relationships for commercialization is sparse	Management of business relationships in networks of commercialization; orchestrating commercialization networks.	<ul style="list-style-type: none"> • How can an innovator firm identify relevant network actors for successful commercialization? • How are relevant network actors mobilized and committed for successful commercialization? • How can divergent actors be orchestrated in the network for commercialization? • How can the contribution potential of the (loosely tied) supporters and facilitators of a commercialization network be grasped?
Longitudinal data are absent	Evolution of the: <ul style="list-style-type: none"> • commercialization network • commercialization process 	<ul style="list-style-type: none"> • How does the commercialization network evolve in terms of actors and their contribution over time? • How are innovations established in the networked markets? • What kind of learning occurs in the innovator firm through interaction with commercialization network actors?
Some relevant network actors are neglected	Distributors' roles in commercialization networks; Non-profit organizations' roles in commercialization networks.	<ul style="list-style-type: none"> • What kinds of role can distributors play as actors in a commercialization network? • What kinds of role can non-profit actors play as actors in a commercialization network?
Diverse commercialization contexts and innovation types are not compared	Contextual understanding on commercialization networks.	<ul style="list-style-type: none"> • What kinds of commercialization network can be identified in diverse industries? • What are the relevance and particular features of commercialization networks in divergent innovation contexts? • How do commercialization networks for radical and incremental innovation differ?
Commercialization and adoption/diffusion research perspectives are not combined	The link between commercialization and adoption networks.	<ul style="list-style-type: none"> • How can adoption networks be orchestrated to contribute to commercialization?

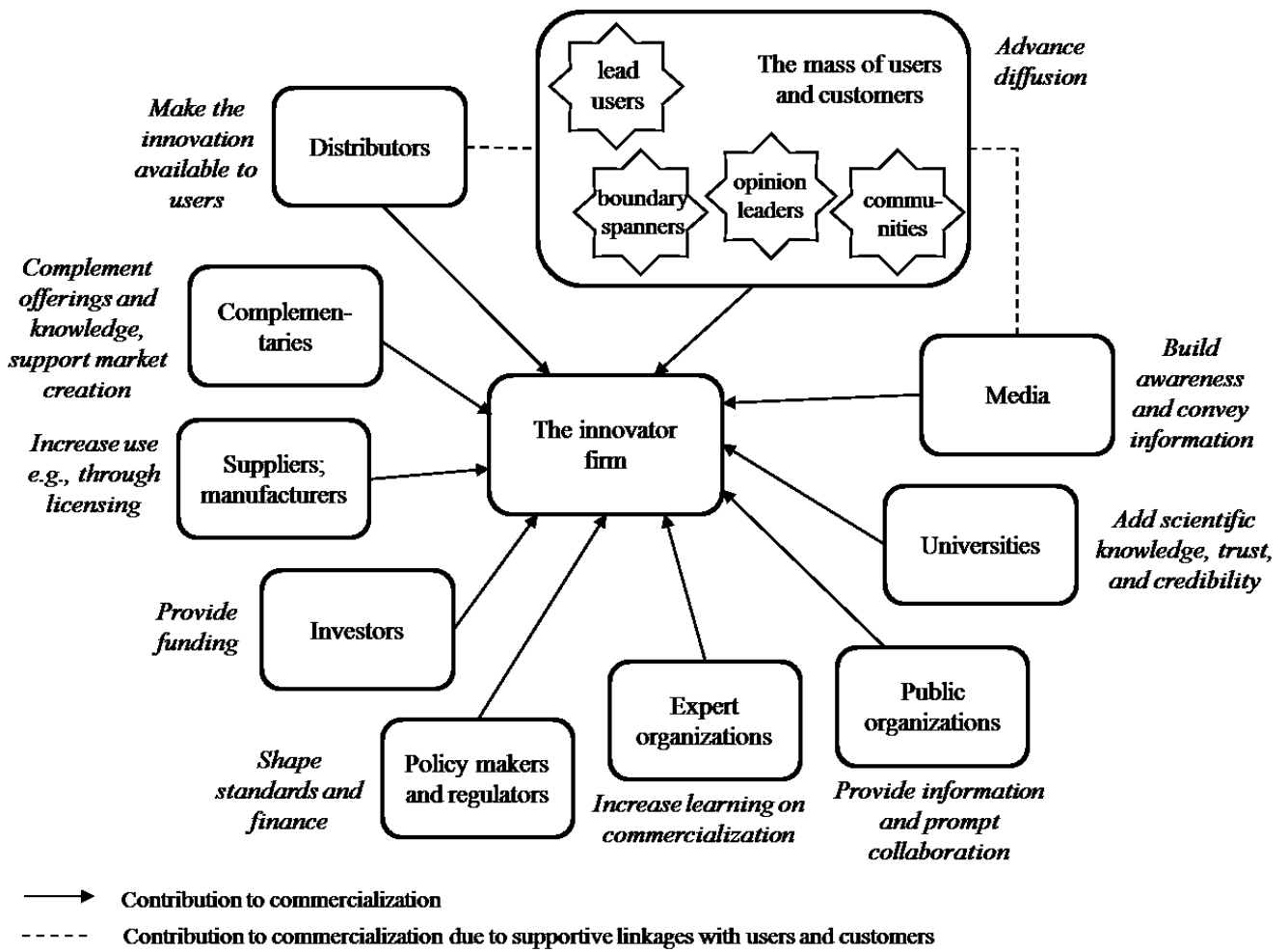


Figure 1. An integrative framework: the network actors and their main contributions to commercialization

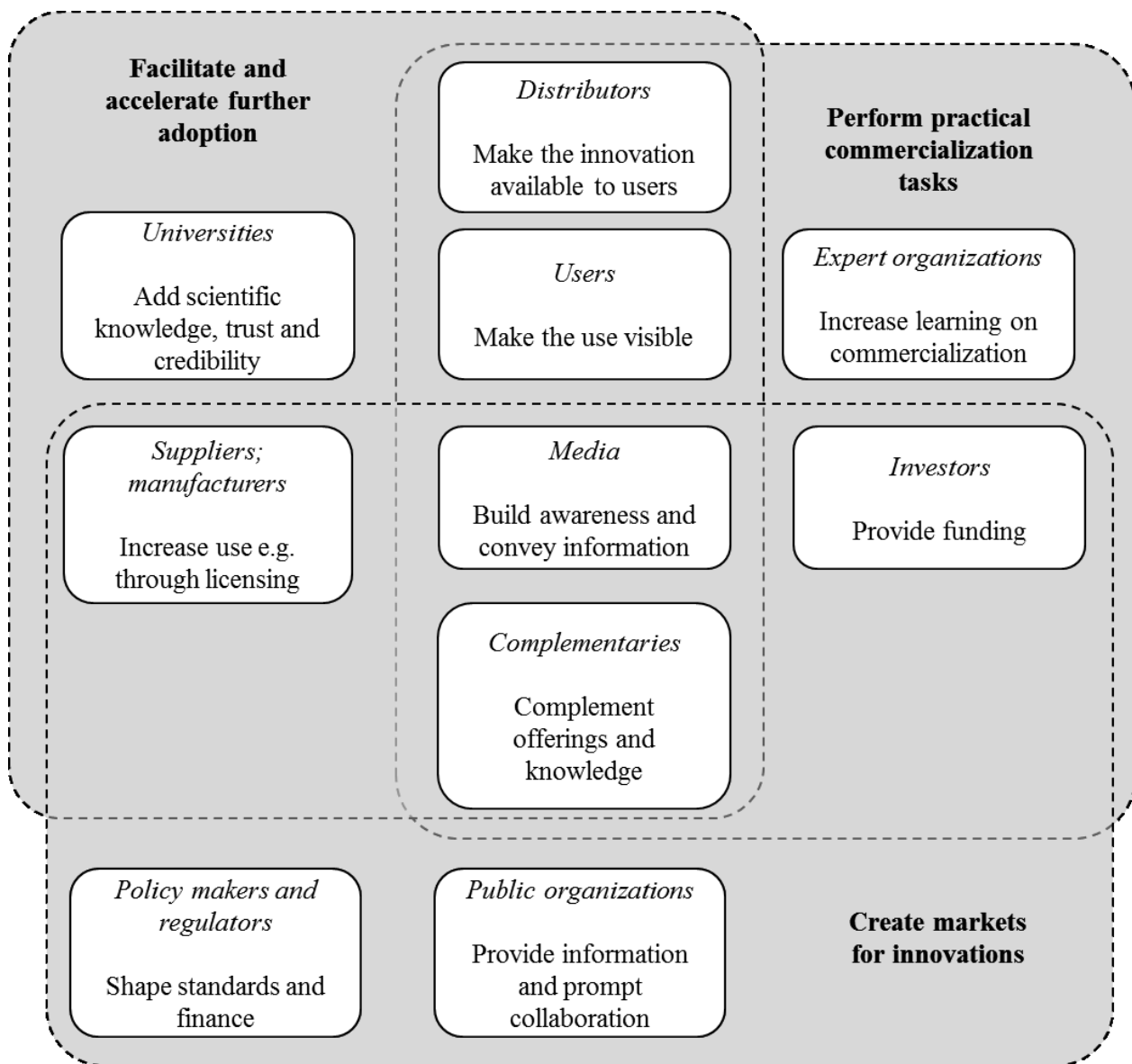


Figure 2 The three key contribution types and the actors with individual contribution potentials to commercialization – An illustrative example

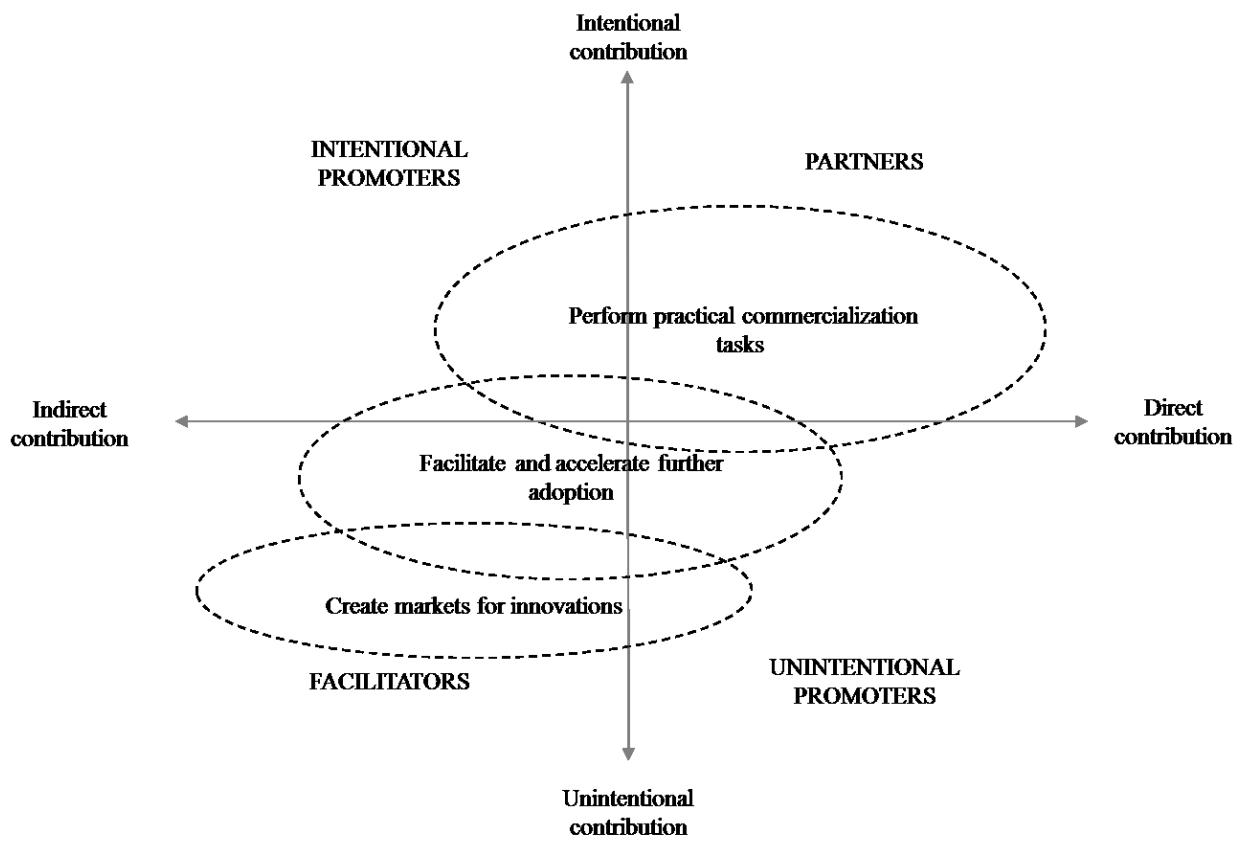


Figure 3 Modes of contribution

Appendix 1. SEARCH LOG– Commercialization networks

Search	Result	New limiter	Result	New limiter	Result	New limiter	Result	New limiter	Results	Remarks on search/limiters
commerciali* + net*	197	commercialization	53	new products	12	technological innovation	39	business networks	15	AB
commerciali* + net*	4	new products	30	innovation adoption	36	diffusion of innovations	94	business networks	29	TI
diffus* + net*	1029	new products	30	innovation adoption	36	diffusion of innovations	94	business networks	29	AB
diffus* + net*	134	diffusion networks	19	technological innovation	15	social networks	26			TI
adopt* + net*	4018	diffusion of innovations	48	social networks	140	product management	38	technological innovations	190	AB
adopt* + net*	88	business networks	7	social networks	13	technological innovations	10	innovation adoption	10	TI
launch* + net*	831	new products	44	product launches	8	social networks	16	technological innovation	34	AB
launch* + net*	18	new products	3							TI
commerciali* + net*	52	commercialization	15	business networks	9	new products	7	innovations in business	5	Com AB and net TI
commerciali* + net*	31	commercialization	15	business networks	6	technological innovations	6	innovations in business	3	Com TI and net AB
diffus* + net*	356	diffusion of innovations	30	social networks	56	technological innovations	37			Diffus AB and net TI
diffus* + net*	320	diffusion of innovations	59	new products	15	social networks	34			Diffus TI and net AB
adopt* + net*	1269	new products	18	business networks	54	social networks	79	product management	13	Adopt AB and net TI
adopt* + net*	279	innovation adoption	29	technological innovations	35	business networks	10	social networks	18	Adopt TI and net AB
launch* +net	175	social networks	9	business networks	8	technological innovations	7			Launch AB and net TI
launch* +net*	73	new products	9							Launch TI and net AB

Appendix 2. Analyzed articles

2012	<p>Aarikka-Stenroos, Leena; Sandberg, Birgitta. From new-product development to commercialization through networks. <i>Journal of Business Research</i>, Vol. 65, Issue 2, pp. 198-206.</p> <p>de Reuver, Mark; Bouwman, Harry. Governance mechanisms for mobile service innovation in value networks. <i>Journal of Business Research</i>, Vol. 65, Issue 3, pp.347-354</p> <p>Shim, Seonyoung; Lee, Byungtae. Sustainable competitive advantage of a system goods innovator in a market with network effects and entry threats. <i>Decision Support Systems</i>, Vol. 52, Issue 2, pp. 308-317.</p>
2011	<p>Bercovitz, Janet; Feldman, Maryann. The mechanisms of collaboration in inventive teams: Composition, social networks, and geography. <i>Research Policy</i>, Vol. 40, Issue 1, pp. 81-93.</p> <p>Chiesa, Vittorio; Frattini, Federico. Commercializing Technological Innovation: Learning from Failures in High-Tech Markets. <i>Journal of Product Innovation Management</i>, Vol. 28, Issue 4, pp. 437-454.</p> <p>Dewald, Ulrich; Truffer, Bernhard. Market Formation in Technological Innovation Systems-Diffusion of Photovoltaic Applications in Germany. <i>Industry & Innovation</i>, Vol. 18, Issue 3, pp. 285-300.</p> <p>Hienerth, Christoph; Lettl, Christopher. Exploring How Peer Communities Enable Lead User Innovations to Become Standard Equipment in the Industry: Community Pull Effects. <i>Journal of Product Innovation Management</i>, Supplement, Issue s1, pp. 175-195.</p> <p>Iyengar, Raghuram; Van den Bulte, Christophe; Eichert, John; West, Bruce; Valente, Thomas W. How Social Networks and Opinion Leaders Affect the Adoption of New Products. <i>GfK-Marketing Intelligence Review</i>, Vol. 3, Issue 1, pp. 16-25.</p> <p>Iyengar, Raghuram; Van den Bulte, Christophe; Valente, Thomas W. Opinion Leadership and Social Contagion in New Product Diffusion. <i>Marketing Science</i>, Vol. 30, Issue 2, pp. 195-212.</p> <p>Molina-Castillo, Francisco-Jose; Munuera-Alemán, José-Luis; Calantone, Roger J. Product Quality and New Product Performance: The Role of Network Externalities and Switching Costs. <i>Journal of Product Innovation Management</i>, Vol. 28, Issue 6, pp. 915-929.</p> <p>Mu, Jifeng; Di Benedetto, C. Anthony. Strategic orientations and new product commercialization: mediator, moderator, and interplay. <i>R&D Management</i>, Vol. 41, Issue 4, pp. 337-359.</p> <p>Perks, Helen; Moxey, Steven. Market-facing innovation networks: How lead firms partition tasks, share resources and develop capabilities. <i>Industrial Marketing Management</i>, Vol. 40, Issue 8, pp. 1224-1237.</p> <p>Snow, Charles C.; Fjeldstad, Øystein D.; Lettl, Christopher; Miles, Raymond E. Organizing Continuous Product Development and Commercialization: The Collaborative Community of Firms Model. <i>Journal of Product Innovation Management</i>, Vol. 28, Issue 1, pp. 3-16.</p> <p>Story, Vicky; O'Malley, Lisa; Hart, Susan. Roles, role performance, and radical innovation competences. <i>Industrial Marketing Management</i>, Vol. 40, Issue 6, pp. 952-966.</p> <p>van Eck, Peter S.; Jager, Wander; Leeftang, Peter S. H. Opinion Leaders' Role in Innovation Diffusion: A Simulation Study. <i>Journal of Product Innovation Management</i>, Vol. 28, Issue 2, pp. 187-203.</p> <p>Wang, Qi; Xie, Jinhong. Will Consumers Be Willing to Pay More When Your Competitors Adopt Your Technology? The Impacts of the Supporting-Firm Base in Markets with Network Effects. <i>Journal of Marketing</i>, Vol. 75, Issue 5, pp. 1-17.</p> <p>Vowles, Nicole; Thirkell, Peter; Sinha, Ashish. Different determinants at different times: B2B adoption of a radical innovation. <i>Journal of Business Research</i>, Vol. 64, Issue 11, pp. 1162-1168.</p>
2010	<p>Bohlmann, Jonathan D.; Calantone, Roger J.; Meng Zhao. The Effects of Market Network Heterogeneity on Innovation Diffusion: An Agent-Based Modeling Approach. <i>Journal of Product Innovation Management</i>, Vol. 27, Issue 5, pp. 741-760.</p> <p>Choi, Hanool; Kim, Sang-Hoon; Lee, Jeho. Role of network structure and network effects in diffusion of innovations. <i>Industrial Marketing Management</i>, Vol. 39, Issue 1, pp. 170-177.</p> <p>Decker, Reinhold; Gribba-Yukawa, Kumiko. Sales Forecasting in High-Technology Markets: A Utility-Based Approach. <i>Journal of Product Innovation Management</i>, Vol. 27, Issue 1, pp. 115-129.</p> <p>Freeman, Susan; Hutchings, Kate; Lazaris, Miria; Zyngier, Suzanne. A model of rapid knowledge development: The smaller born-global firm. <i>International Business Review</i>, Vol. 19, Issue 1, pp. 70-84.</p> <p>Gobbo, José Alcides; Olsson, Annika. The transformation between exploration and exploitation applied to inventors of packaging innovations. <i>Technovation</i>, Vol. 30, Issue 5/6, pp. 322-331.</p> <p>Harty, Chris. Implementing innovation: designers, users and actor-networks. <i>Technology Analysis & Strategic Management</i>, Vol. 22, Issue 3, pp. 297-315.</p> <p>Mas, Ignacio; Ng'weno, Amolo. Three keys to M-PESA's success: Branding, channel management and pricing. <i>Journal of Payments Strategy & Systems</i>, Vol. 4, Issue 4, pp. 352-370.</p> <p>Peres, Renana; Muller, Eitan; Mahajan, Vijay. Innovation diffusion and new product growth models: A critical review and research directions. <i>International Journal of Research in Marketing</i>, Vol. 27, Issue 2, pp. 91-106.</p> <p>Tolstoy, Daniel; Agndal, Henrik. Network resource combinations in the international venturing of small biotech firms. <i>Technovation</i>, Vol. 30, Issue 1, pp. 24-36.</p>

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