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Selecting Early Adopters to Foster the Diffusion of Innovations in Industrial Markets: Evidence from a Multiple Case Study

Abstract

Purpose - This paper brings new empirical evidence to the controversial role of early adopters in the diffusion of innovations in industrial markets.

Design/methodology/approach – The authors apply an actor market configuration perspective to the analysis of four longitudinal case studies regarding the commercialization of new products in the textile, plastic and energy industries.

Findings - The diffusion of innovation is an interactive and iterative process where the commercializing firm engages in repeated interactions with different categories of companies that are targeted as potential early adopters. This process ends when the commercializing firm identifies a category of early adopters that can stimulate subsequent acceptance in the later market, by playing one of the following two roles, i.e. word-of-mouth trigger and industry benchmark. During this process, through which the role of the early adopters is constructed proactively by the commercializing firm, the product innovation is also subject to changes to provide a better fit with the selected category of early adopters.

Research limitations/implications – The paper calls for a re-conceptualization of the diffusion process, from a passive identification of early adopters to an interactive process that entails a trial-and-error approach in the targeting and involvement of different categories of early adopters, which ends when the innovation reaches the desired levels of diffusion.

Practical implications – The study provides managers with a number of recommendations for targeting, through a trial-and-error process, early adopters and working with them to champion the dissemination of new technologies.

Originality/value – This paper significantly adds to existing literature on the diffusion of innovation, which has up to now conceived early adopters as static and given entities, that cannot be proactively targeted and involved by the commercializing firm, and innovation as an immutable object.

Keywords Diffusion of innovation, early adopters, market actor configuration, industrial marketing.

Article classification Research paper

Selecting Early Adopters to Foster the Diffusion of Innovations in Industrial Markets: Evidence from a Multiple Case Study

1. Introduction

New products fail at a stunning rate, both in consumer and industrial markets (Cierpicky et al., 2000; Page, 1993; Booz Allen and Hamilton, 1982). Several product innovation projects are of course interrupted during the technical stages of the development process. An equally remarkable number of innovations, although functionally superior to competing ones, turn out to be far less successful mainly because of poor commercialization and diffusion strategies (Hartley, 2005). Indeed, commercialization is widely acknowledged to be a critical stage in the innovation process (Cooper, 1979; Calantone and Di Benedetto, 1988; Schilling, 2005), and very often the single costliest one (Guiltinan, 1999; Langerak et al., 2004). A study by Cooper and Kleinschmidt (1988) reports that on average 54% of all development expenses are related to launch and diffusion activities. Despite its relevance, the commercialization phase has been traditionally overlooked by both practitioners and academic scholars. A few comparatively recent studies have examined the commercialization phase, focusing on the precursors to successful product launch (e.g., Hultink et al., 1997, 2000; Di Benedetto, 1999; Thoelke et al., 2001; Lee and O'Connor, 2003; Langerak et al., 2004). Nevertheless, the academic literature still does not provide a comprehensive understanding of the commercialization practices that enhance the diffusion of new products and their resulting market performance, especially in industrial markets (Frattini et al., 2014; Chiesa and Frattini, 2011; Calantone and Montoya-Weiss, 1993).

In attempting to fill this gap, this paper focuses on the role of early adopters in the diffusion of innovation in industrial markets[1]. Early adopters are those clients who adopt an innovation soon after launch (Rogers, 2003). They include a sizable portion of the potential market of the innovation (13-

[1] Everett Rogers (2003) defines diffusion as the process by which an innovation is communicated through certain channels and adopted over time among the members of a social system.

14%, according to Rogers' studies) that is in search for a leap forward in their lives and businesses and purchase the innovation earlier than the average client because they perceive a compelling reason to use it. The role early adopters play in diffusion processes, however, remains controversial, both theoretically and empirically. According to some conceptualizations of the diffusion process (i.e., probit and rank models), early adopters are not predicted to stimulate nor hinder subsequent innovation diffusion (Davies, 1979). On the other hand, theories like information contagion and fad models argue that early adopters will strongly affect subsequent purchases because of the opinion leadership and word-of-mouth or imitation effects that they bolster (Arthur and Lane, 1993; Di Maggio and Powell, 1983). Similarly, industrial marketing handbooks indicate that the use of references documenting early adoptions to encourage subsequent purchases is a very well established practice (Hutt and Speh, 1992; Brierty et al., 1998; Kotler, 2003). From an empirical point of view, there are examples of innovations that are quickly withdrawn from the market because they experience limited acceptance among early adopters, (this is the case, e.g., of the Google Wave networking service), as well as examples of innovations, like the Sony Walkman or the Palm Pilot, that experienced a steady diffusion in their target markets due to the momentum resulting from a very positive acceptance among their early adopters. Both cases suggest that the latter should have a role in affecting subsequent diffusion.

The overall purpose of the paper is thus to increase our understanding of the controversial role of early adopters in the diffusion of innovations in industrial markets, which have received far less scholarly attention than consumer markets (Frattini et al., 2014; Chiesa and Frattini, 2011). To this aim, we adopt an actor market configuration perspective (Andersson et al., 2008; Araujo, 2007) that has recently attracted much interest among scholars of marketing practice. According to this view, firms should no longer be conceived as entities that merely react to a given market structure and spectrum of market actors, i.e. those involved in the buying and selling of the goods and services.

Rather, they have a wide range of levers that can be acted upon to drive, shape and configure these market actors (Kjellberg and Helgesson, 2007; Jaworski et al., 2000).

With reference to diffusion of innovation, early adopters are clearly among the market actors with which a firm might interact, and deserve particular attention. In line with market actor configuration theory (Andersson et al., 2008), which has been recently used to study commercialization problems in industrial markets (Harrison and Kjellberg, 2010), we argue that during the process of launching and diffusing an innovation, firms can act on the early adopters, by proactively selecting and interacting with different categories of companies that could be targeted as potential early adopters, until they identify a category of early adopters that can successfully stimulate subsequent acceptance in the later market. This process is not a linear one, where firms discover and realize the role of the early adopters of their innovations, and design a commercialization and launch strategy that is the most appropriate to target them. This is what existing marketing and innovation research assumes. Instead, firms proactively shape the role of the early adopters of their innovations, by going through a trial-and-error process which leads them to interact with different categories of potential early adopters, until the most appropriate one is identified. During this process, the product innovation is also subject to changes to provide a better fit with the selected category of early adopters.

This approach represents a significant departure from previous literature (Rogers, 2003; Easingwood and Harrington, 2002), which has conceived early adopters as given entities that exist "somewhere out there". As a consequence, insights from past research have been limited to the identification and description of early adopters during the commercialization process. By accounting for the active role of firms in the process of configuring market actors, this paper not only broadens the theoretical and empirical debate on diffusion of innovation in industrial markets (Day and Herbig, 1990), but also provides managers with some insights that could help them in the targeting and involvement of those early adopters that will enhance customer acceptance in the target market.

Four longitudinal case studies regarding the commercialization and diffusion of industrial innovations are used in the paper to gain a conceptual understanding of the role of early adopters in the diffusion of innovation, and how firms select them during the earlier stages of the commercialization process. These show that the firms did engage in repeated interactions with early adopters during commercialization and, through a trial-and-error process, target and involve those that can play a particular role in the diffusion process. In particular, we identify two distinct roles for early adopters, that we call *word-of-mouth trigger* and *industry benchmark.*

Five sections follow this introduction. In Section 2, the theoretical underpinnings of the study, namely diffusion of innovation research, are reviewed. In Section 3, we describe the design of the empirical studies and the analytic procedure. In Section 4, we present the four case studies. In Section 5, we analyze the empirical evidence and discuss our emerging understanding of the role of early adopters in the diffusion process. Finally, in Section 6 we conclude by summarizing our findings, suggesting implications and avenues for future research.

2. Early Adopters in (Diffusion of) Innovation Research

Diffusion of innovation has been studied from many different although complementary perspectives, e.g., historical, sociological, economic, business strategy and marketing (Hall, 2005). As a result, several interpretative and predictive models, each assuming a particular nature of the diffusion process, have been developed. Four main classes of diffusion theories can be identified: probit or rank, epidemic or disequilibrium, bandwagon and sociological theories (Geroski, 2000; Van den Bulte and Stremersch, 2004).

Probit or rank models (Davies, 1979) assume that potential adopters are characterized by perfect rationality and are able to estimate without uncertainty the benefits of the innovation for the uses they have in mind. They make adoption decisions by rationally comparing the costs of purchase and the

benefits resulting from the use of the innovation. Therefore, it is the reduction of the price of the innovation over time that drives diffusion: because potential adopters have different characteristics and hence perceptions regarding the benefits of the innovation, they will adopt only when the cost of purchase is more than outweighed by the perceived benefits. Based on these models, early adopters will have little if any role in affecting subsequent acceptance.

According to epidemic or disequilibrium models (Griliches, 1957; Baptista, 1999; Mansfield, 1961), it is information dissemination that drives innovation diffusion. All potential adopters have the same characteristics and each adopts the technology when he/she hears about it. Therefore, some firms or individuals adopt the technology more slowly than others simply because they find out about it later than other firms or individuals (Brown, 1981). These models suggest that early adopters can be an important source of information about the fact that some firms or individuals have actually adopted the innovation, and the dissemination of this information drives subsequent purchases.

Bandwagon theories (Abrahamson and Rosenkopf, 1997) assume instead that early adopters generate pressure over later potential adopters to purchase the innovation. This pressure can have different origins. This allows distinguishing between two main bandwagon theories, information contagion and fad theory. Information contagion models assume incomplete information and that, for a potential purchaser, an innovation can be a source of considerable uncertainty (Arthur and Lane, 1993). Specifications and advertising brochures may be available, and the cost of purchase precisely known, but the purchaser may be unsure about how the product will perform for him/her, and how easily it can be integrated into existing operations. In cases like these, the potential purchaser tries to reduce the uncertainty by asking previous purchasers about how they have fared with the product they bought and subsequently used. As a result, the opinion about the innovation of the early adopters, which is disseminated through a word-of-mouth process (Czepiel, 1975), affects subsequent purchases. On the other hand, according to fad theories, a bandwagon effect might originate when information about the innovation does not move along the social system, but only the number of previous adopters is

known to potential later buyers (Di Maggio and Powell, 1983; Tolbert and Zucker, 1983; Abraham and Rosenkopf, 1990). When this type of information is disseminated, potential adopters are encouraged to purchase because they perceive the risk of quickly losing competitive advantage relative to early adopters. According to this model, therefore, the role of early adopters is to stimulate imitative and competitive reactions among later adopters (Di Maggio and Powell, 1991; Abrahamson and Rosenkopf, 1993). Other comparatively more recent studies (Bowden and Corkindale, 2005; Garcia et al., 2007) support the interpretation of the diffusion process provided by bandwagon theories.

However, bandwagon theories do not sufficiently account for the fact that the potential adopters are part of a social network, in which they occupy different positions. What each potential adopter finds out about an innovation depends on the structure of the social network that disseminates the information about this innovation, and on his/her position in that network. This further element is incorporated into sociological models (Coleman et al., 1966; Turnbull and Meenaghan, 1980; Burt, 1987; Midgley et al., 1992; Deroïan, 2002). In particular, social cohesion models (Burt, 1987; Harkola and Greve, 1995; Van den Bulte and Lilien, 2001) assume that diffusion is channelled through communication networks. In the first step, external actors, such as mass media, make potential adopters aware of an innovation and may affect their evaluations of the innovation as well. But it is largely internal influences that potential adopters exert on each other in a second step, which persuade them to adopt. Potential adopters at the core of networks are highly interconnected and tend to be more reputable. In particular, this body of literature agrees that opinion leadership is greater among earlier adopters than later adopters (e.g., Kassarjian and Robertson, 1973; Czepiel, 1975; Turnbull and Meenaghan, 1980; Rogers, 2003) and that an opinion leader is more exposed to the mass media that the rest of the population (Katz, 1957). According to this standpoint, it is the network position of early adopters (and consequently their opinion leadership) that influences adoption decisions from later adopters (Wasson et al., 1970).

An interesting debate in the diffusion literature considers which factors have the greatest influence on diffusion. Rogers' model (2003), originally published in the early 1960s, contended that product factors (relative advantage, compatibility with existing values and products, complexity, divisibility, and observability of results) were the main drivers of diffusion, and that positive word-of-mouth from early adopters drove adoption by later buyers. More recent research on this topic shows that written and virtual word-of-mouth have stronger influence compared to personal word-of-mouth in shaping the perceived usefulness (Parry et al., 2012; Kawakami and Parry, 2013) and credibility (Parry and Kawakami, 2015) of an innovation. On this topic, Kapoor et al. (2014) have recently conducted a literature review, followed by a meta-analysis, on the 30 attributes that steer the process of innovation diffusion initially identified by Tornatzky and Klein (1982).

Geoffrey Moore (1991, 1998) found that many industrial innovations failed to take over in the bulk of their target market although they were very well received by early adopters. In his crossing-the-chasm model (1991), he suggested that customer segment differences need to be considered. Strong dissimilarities between early adopters and later buyers hinder communication between these two segments. If early and later buyers seek different product attributes, and/or if later buyers do not use word-of-mouth from early adopters as an information source, diffusion will stall and the innovation will never catch on with the majority of the market, as was the case with the Apple Newton, for example (Chiesa and Frattini, 2011). It is interesting to note that the original Rogers model is conceptually similar to the diffusion process as explained by bandwagon theory, while Moore's crossing-the-chasm model shares similarities with the probit or rank models in that early adopters may have little or no role in influencing the decisions of later buyers.

There is an emerging stream in the product innovation literature on the importance of commercialization, and the precursors to successful launch (Calantone and Di Benedetto, 2007 provide a review). A poorly-executed launch can result in a failed innovation, even if the rest of the product development process is done well (Montoya-Weiss and Calantone, 1994), while effective

launch is significantly related to improved marketplace performance (Parry and Song, 1994; Guiltinan, 1999; Calantone and Di Benedetto, 2007, 2012). Much of the empirical literature on commercialization focuses on precursors to effective launch, such as availability of better marketing information (Hultink et al., 1997; Hultink and Robben, 1999) and a proper assessment of the amount of marketing support required for commercialization (Hultink and Robben, 1999; Langerak et al., 2004). Nevertheless, the constructive dimension of commercialization, and the potential benefit to firms of proactively selecting the most proper early adopters to be targeted to stimulate innovation diffusion, has been comparatively understudied in this literature.

Another body of literature shedding light on the relationship between the process of developing and launching an innovation and its adopters is user innovation research (Von Hippel, 2010). This stream of research has grown exponentially over the last years, since the seminal work of Eric Von Hippel (1988), as recent review articles suggests (see, e.g., Greer and Lei, 2012). This literature shows that firms are increasingly interacting - during the development of an innovation - with their customers, which serve as sources of products and service innovations and ideas for future development. Several frameworks have been proposed which attempt to lay the theoretical foundations of the user innovation phenomenon (e.g., Ojanen and Hallikas, 2009; Etgar, 2008), the benefits, reasons and challenges of engaging in user innovation have been discussed as well (Elofson and Robinson, 2007; Franke et al., 2006), but little is known about how the process of user involvement in innovation unfolds (Greer and Lei, 2012). Moreover, some studies suggest that users involved in the process of developing an innovation are often early adopters of the new product and service (Droge et al., 2010), but the role that these users – who later on become early adopters - play in the subsequent diffusion process has not been investigated in detail. A concept related to user innovation is that of learning-by-using, which was first introduced by Rosenberg (1982). This concept emphasises the learning effects that the innovating firm experiences as a result of interacting with users, and the impact that this learning has on the quality and performance of the innovation itself, which is typically improved

after interaction with the users. Some studies (see, e.g., Mukoyama, 2006) investigate the implications that this learning-by-using phenomenon has on the diffusion process of an innovation, but this literature is silent on the other mechanisms, pointed out by the diffusion of innovation theories reviewed above, through which the early users of an innovation affect subsequent purchases and diffusion in the later market.

From this brief synopsis of (diffusion of) innovation research, it appears that a clear-cut theoretical understanding of the role played by early adopters in the diffusion process is lacking. This is especially true in industrial markets (Chiesa and Frattini, 2011). A number of studies have tried to explain the differences between innovation diffusion in consumer and industrial markets (Higgins and Hogan, 1999; Day and Herbig, 1990), but they do not focus on the role played by early adopters. One recent exception is the paper by Frattini et al. (2014), who suggest that early adopters play two distinct roles in the diffusion process of platform and non-platform innovations, i.e. dissemination – in which early adopters trigger and bolster the diffusion of their opinion on the innovation after they have bought and used it - and imitation - in which early adopters inadvertently communicate to late buyers the purchase of the innovation, which in turn stimulate the subsequent adoption by late buyers for imitative reasons. Another exception is the paper by Reinhardt and Gurtner (2015), who bring into light the main differences between the early adopters of disruptive and sustaining innovations, with implications for the firms commercialising these new products and services.

However, diffusion of innovation theories, and the more recent contributions on the role of early adopters in diffusion of innovation processes, conceive early adopters as static, given entities, without accounting for the interactions that will take place between them, the firm commercializing the innovation, the innovation itself and other market actors (such as industrial associations), through which the role of early adopters is defined. We argue that the process of commercializing an industrial innovation is not only a descriptive one, where a firm analyses and identifies early adopters, targets them at launch and passively awaits the results of the market launch. Rather, it has an important

constructive dimension, which has largely been neglected by extant diffusion of innovation research. To gain clarifications concerning the process of early adopters' targeting and involvement, we analyse four case studies regarding the commercialization of industrial innovations.

3. Study Design

Given the aim of the investigation and our conceptual starting points, we adopt an exploratory approach in our empirical analysis. In particular, we examine four longitudinal case studies regarding the commercialization and diffusion of industrial innovations that involve a proactive selection of early adopters through repeated interactions with the firm commercializing the new product. Case studies allow investigating complex phenomena, embedded in their context, to collect detailed and rich data and are longitudinal by default (Easton, 1998, Yin, 2003). The selection of the four cases was based on the combination of ongoing research activities and theoretical interest (Siggelkow, 2007; Dubois and Gadde, 2002). The commercialization of the four industrial innovations discussed hereafter is part of a broader research project aimed at studying the reasons underlying success and failure in the launch of new products and services (Frattini et al., 2014; Chiesa and Frattini, 2011). Regarding collection of information, primary and secondary data sources were used to build the case studies. A regards the case studies involving Companies A and B (the real names have been blinded for confidentiality reasons) twenty-five personal interviews were conducted over a 12-month period between 2005 and 2006, as well as six additional telephone follow-ups in 2008. Ten individuals (CEOs, sales and marketing managers, technical specialists) from the two firms which promoted the commercialization of the innovations were interviewed, plus ten individuals with management responsibilities from five companies that adopted the innovations soon after launch. As regards the case studies involving Companies C and D, twenty-one personal interviews were conducted over a 12-month period between 2016 and 2017. Eight individuals (CEOs, sales and marketing managers, technical specialists) from the two firms which promoted the commercialization of the innovations

were interviewed, plus nine individuals with management responsibilities from five companies that adopted the innovations soon after launch.

All the interviews lasted between one and two hours and were tape recorded and transcribed. This information was complemented and triangulated with material from secondary sources, including internal records and documentation provided by Companies A, B, C and D, as well as press releases and publicly available data collected through the professional database www.lexisnexis.com. The data analysis, which was undertaken jointly by the authors, was based on a comparison of the four cases and our current understanding of the role of early adopters as discussed in (diffusion of) innovation literature (Eisenhardt and Graebner, 2007), plus a critical cross-case comparison between the four cases (Miles and Huberman, 1984).

Of course, it is not possible to statistically generalize results from an exploratory case study analysis (Yin, 2003). Our aim is to make analytical and theoretical generalizations to the existing body of knowledge regarding the role of early adopters in the commercialization and diffusion of industrial innovations. It is our intent that the findings will inform future theoretical and empirical studies regarding diffusion of industrial innovations, but we recognize that they cannot be generalized to populations of firms or markets.

4. Four Case Studies of Proactive Targeting and Involvement of Early Adopters

4.1 Company A and PlasmaTech

Company A is a small Italian firm founded in 2001 with the mission to carry out research on the properties and industrial applications of vacuum and atmospheric pressure plasma. Two years after its foundation, the firm started the development and engineering of PlasmaTech, a machine that is able to treat the surface of different types of fabrics with plasma. The properties of plasma allow the

machine to alter the chemical characteristics of the textile surface, e.g., making cotton, wool, polyester or propylene fabrics more resistant, waterproof, printable, colourable or adhesive. Company A developed different versions of PlasmaTech, each suited to a particular surface treatment. The target market for PlasmaTech comprised Italian textile manufacturers, which could use the machine in the last phases of the fabrication process to give desired properties to their products, at lower unitary costs and with higher quality in comparison with traditional methods. PlasmaTech was a revolutionary technology that required textile manufacturers to considerably change the methods and instruments they had been using for decades in the fabrication process and demanded a sizeable investment. Since the first participations in five specialized fairs and exhibitions that took place in 2005, it soon became apparent to Company A that textile manufacturers were reluctant to accept such a revolutionary technology. Despite its potential advantages and although product specifications were clearly illustrated, the intended clients were highly unconfident regarding how PlasmaTech could fit their fabrication processes and which would be the real costs to switch to it. As noted by the Chief Operations Officer from one of the textile manufacturers that considered purchasing the machine after attending a specialized fair: *"The type of treatment that PlasmaTech realized on the textile was radically new for our industry, I had no means to understand if it would be able to deliver what it promised. Considered the high investment that it required, I needed to have more tangible evidence of what the machine could do in our specific processes."*

Company A thought that, to win resistance to purchase PlasmaTech, it needed first to stimulate adoption by some well-respected textile firms that could serve as opinion leaders for the machine in the planned target market. Therefore, Company A decided to target as early adopters, by implementing focused marketing actions, a subset of textile players (including 14 companies) which were: (i) very large firms, with a considerable manufacturing capacity; (ii) top-quality manufacturers, working in the high-end of the market; (iii) firms with a positive brand reputation for being innovative players in the Italian textile industry. The assumption was that these firms would have a compelling

reason to purchase PlasmaTech and, if satisfied with it, would stimulate a very positive word-of-mouth effect. Contrary to expectations, Company A failed to convince these large, high-quality, innovative textile manufacturers to adopt the new machine. After more than 30 interactions with such companies (more than 2 meetings or face-to-face meetings for each identified company on average), Company A recognized that they usually took months to evaluate the properties of PlasmaTech, during which several people from operations, R&D, finance and senior management took part in the decision process. Because not all of them agreed on the factual advantages of the radically new machine, the decision to eventually purchase it was continuously delayed in an attempt to collect further evidence on how PlasmaTech will perform in their specific operations. A clear tendency toward overestimating the required switching costs could also be observed, which documented an irrational tendency of these large textile manufacturers to stick to their status quo.

Dissatisfied with these early results but convinced of the value of the new machine, Company A started, at the end of 2005, to enter into close contact with representatives from the most important associations and industrial districts in the Italian textile industry. The aim of these informal interactions was to discuss the characteristics of PlasmaTech, challenge the assumptions that guided its development and engineering process and identify some firms that could be interested in adopting it and hopefully endorse the machine in the target market. The most relevant industrial district targeted by Company A was located in the north-west of Italy. It was one of the biggest textile/wool districts worldwide, with a particular specialization in the textile machinery sector. Around 1,600 companies were active in the district, with few big groups with a global recognized brand (which typically covered all the phases of the fabrics production process) and a large number of SMEs, which were able to offer excellent products in terms of quality and technical features, but without an attractive brand for the end customers. Thanks to these interactions, Company A met some small, technology-intensive service firms whose business model entailed the provision of specialized and advanced treatments on different types of fabrics for third parties, i.e. textile manufacturers. These

firms appeared since the beginning to be very interested in the characteristics of PlasmaTech, especially if it could be modified to enable, by using the same machine, different types of surface treatment. Company A worked in close contact with two of these firms for several months during 2006 and was able to develop a new version of PlasmaTech. This entailed a standard technological platform (including a small power unit, cathodes that produce the plasma, a control system and reels for material handling), to which different chemical dispensers could be applied, each enabling a particular surface treatment for a specific type of textile. As a result, Company A also changed its business model: it sold the standard machine at a considerably lower price, in comparison with the first version of PlasmaTech, and earned sizeable profits on the sale of the chemical dispensers.

When the new machine was ready to launch, Company A targeted as early adopters all the above-mentioned firms specialized in supplying textile treatments service working in all the Italian textile industrial districts. These had the technical competencies to understand the properties of PlasmaTech and particularly appreciated the opportunity to have one single machine through which different types of treatment, for different clients, could be provided. What is more, the relatively low price of the standard machine reduced their financial barriers to adoption. As a result, sales of PlasmaTech among these early adopters grew very rapidly and, most importantly, the clients were very satisfied with it. The Chief Executive Officer of one of these service providers noted: *"Thanks to PlasmaTech we are now able to save costs and improve the quality of our service. More importantly, we have a very flexible platform that allows us to serve different clients with a limited amount of fixed costs."*

These service providers started to disseminate, within the cohesive industrial districts in which they operated, information about how the machine had performed for them and how they fared with it. They especially illustrated the properties of PlasmaTech to their clients, i.e. the textile manufacturers that usually outsourced to them some low-volume, very specific and complex treatments, as an element which differentiated their service offering. This significantly lowered uncertainty regarding the value and real costs of the technology perceived by large textile manufacturers, which eventually

started to buy it under the effect of the positive word-of-mouth triggered by early adopters. Firms providing surface treatment services had usually a reputation for being reliable and innovative firms in the industrial districts in which they worked and had a long-lasting relationship with their clients. This furthered the positive impact of their word-of-mouth. The marketing manager of a textile manufacturer that purchased PlasmaTech said: *"We strongly believe in the opinion of our providers of treatment services. They have been experimenting with new technologies for years and, most importantly, they have a long lasting relationship with us. They will never say something in which they do not completely believe, as this can worsen our collaboration."* Whereas textile manufacturers used PlasmaTech for their core, high-volume and standard manufacturing treatments, they continued outsourcing to service providers the low-volume and most complex operations. This also explains why the early adopters did not fear that, by illustrating the characteristics of PlasmaTech to their clients, they could suffer from a competitive disadvantage.

Since the second half of 2006, sales of PlasmaTech have grown rapidly in the intended target market, meeting and even exceeding (by more than 20%) the goals established by Company A. This was primarily the result of the positive word-of-mouth effect triggered by the service providers that enthusiastically adopted the second version of PlasmaTech early after launch.

4.2 Company B and InjectionTech

Company B is the Italian subsidiary of a Swiss multinational firm specialized in the development and manufacturing of sensors and electronics for the measurement of pressure, power, momentum and acceleration. InjectionTech is a new system based on piezoelectric sensors for measuring pressure in mould cavities, used in the injection moulding of plastic products. It is able to directly analyze the pressure of different mould cavities during the process and automatically evaluate and adjust the product's characteristics along pre-determined criteria. InjectionTech was developed by Company B

in 2005 and launched on the Italian market starting from 2006. The intended target market included high-volume plastic component manufacturers, which could particularly benefit from the extremely precise real-time control of the injection process enabled by InjectionTech, that would potentially reduce material waste and the cost of monitoring activities, as well as improve the overall quality of the finished product. One of the further advantages of this new system, according to Company B, regarded the fact that it was easy to use and integrate into existing manufacturing processes. It represented indeed an incremental improvement over the established systems used to control the injection process in the plastic industry, with which it was largely compatible. The switching costs for adopting InjectionTech appeared therefore particularly low.

Company B thought that a critical success factor for InjectionTech would be to involve in the development process those firms that were more likely to adopt the new system soon after launch. By ensuring that InjectionTech was consistent with their needs, Company B believed that they would enthusiastically receive it and promote a positive word-of-mouth in the intended market. The sales manager of Company B said: *"If we manage to involve in the development process those companies that are more likely to purchase InjectionTech soon after launch, the chance that they are happy with the new technology after having tried it will be high. This will propel a positive word-of-mouth and hopefully stimulate sales".* Company B assumed that this effect would be strengthened if early adopters were high-quality and innovative plastic components manufacturers, with the knowledge and competencies to properly weigh the advantages of InjectionTech. Therefore, Company B entered in touch and collaborated during the last phases of the development process with 12 specialized plastic components manufacturers operating in top-quality market niches. With regard to the characteristics of the early adopters, they were big moulding companies (up to 50 presses) for large multinationals, which manufactured very complex parts and components on a large scale (such as air conditioning splits and automotive carters). The relevant sectors are the automotive, medical and electricity, and the drivers of adoption of InjectionTech would be technology-based, given their need to achieve ever

higher quality standards. Company B organized several focus groups and one-to-one meeting involving these companies to gather feedbacks about the innovation. They offered several clues regarding how InjectionTech could be engineered to meet their needs and they also purchased and used the new system very soon after the official launch, at the beginning of 2006. These early adopters, which operated in market niches where competition was not particularly tight, were willing to disseminate their opinion about InjectionTech and interacted with Company B to write case studies and real-word experiences on which the communication campaign for the new system was based.

Despite this fruitful participation of the above-mentioned early adopters in the early commercialization process, sales of InjectionTech plummeted and acceptance in the intended target market was very limited. It soon became apparent that the enthusiastic word-of-mouth triggered by the early adopters was ineffective in convincing large-volume manufacturers to purchase InjectionTech. According to Company B, this was due to the fact that the intended clients were not in need of information regarding how the new system performed and how easily it could be integrated into their existing operations. This was straightforward to understand and appraise due to the non-revolutionary, incremental nature of InjectionTech, which merely represented an improvement over existing solutions. Rather, they were reluctant to adopt it because none of their direct competitors have already done so and InjectionTech was not such a revolutionary technology that could give to those who adopted earlier a decisive first-mover competitive advantage. This is clear if we consider the words of the Chief Operations Officer of a plastic component manufacturer: "*We have heard about InjectionTech and we know that it can improve our moulding process at reasonable costs. However, it is not something that can radically change the game. If any of our competitors, especially the market leaders, will purchase InjectionTech, we will take it into consideration, we cannot lose competitiveness to their advantage."*

Based on this understanding, Company B decided to completely change the targeting and commercialization approach for the new system. Through interacting with the major plastic

manufacturers consortia in Italy (i.e. PlasticsEurope Italia, which have 45 members), the two firms with the largest market share and well-known for their cost advantage were identified and contacted. The assumption for targeting the largest and most efficient producers was that they would have a more compelling reason to buy InjectionTech considered its distinctive characteristics. They were given the opportunity to use InjectionTech for free on one of their production plants and they eventually decided to buy it for their whole manufacturing capacity. These early adopters of the innovation were unwilling to let Company B disseminate the information that they had purchased and used InjectionTech. Company B was even asked to sign non-disclosure agreements (NDAs). This was due to the fact that they feared being rapidly imitated by competitors and that the cost advantage ensured by the new technology could rapidly disappear. Despite this, in the Italian plastic component industry the information that the two leading players had adopted InjectionTech rapidly spread, due to an unintended leakage of information, triggered by participation to specialized fairs and exhibitions. Interestingly, this initiated a very quick diffusion process for InjectionTech. More and more manufacturers decided to buy the new system under the fear that the competitive disadvantage they already suffered from – in respect to the top players that have already purchased InjectionTech – could become larger. As the Chief Technology Officer of Company B said: *"It was the fear of losing efficiency in comparison with early adopters that ultimately convinced more and more plastic components producers to buy InjectionTech. In my opinion, they purchased it without a proper evaluation of its pros and cons, but mainly for imitative reasons".* The further diffusion of the InjectionTech was also driven by the interest of the medium-size adopters (20-30 presses) and small-size ones (5-10 presses), pushed by the need to differentiate from emerging competitors, given the rapid growth of manufacturers from Eastern Europe and the Far East.

As it happened with the previous case study, starting from the second part of 2006, sales of InjectionTech have rapidly grown (as shown in Table 1) and the new product turned out to be one of

the most successful innovations launched by Company B in the last decade. The average price of InjectionTech in the 2006-2009 period was around 10.000 €.

Year	Unit sold [#]
2006	19
2007	42
2008	55
2009	63

Table 1. Sales of InjectionTech

4.3 Company C and ControlTech

Company C is a small Italian firm founded in 2001 in a city close to Verona. It is active at a national and European level in the study, design and implementation of energy efficiency solutions, mainly in the industrial sector. Of particular importance is the firm's focus on R&D and technological innovation, developed both internally and with the support of external parties, primarily universities and technology providers. This has also led the firm to receiving major awards at the national and international level, such as: (i) a mention for one of its energy efficiency project among the best global practices in the International Energy Agency (IEA) 2013 Annual Report; (ii) the Energy Efficiency Award conferred in 2015 by CESEF (Centro Studi sull'Economia e il Management dell'Efficienza Energetica) of Bocconi University for the innovative content of one of its energy efficiency project.

In 2012 the firm started the development of ControlTech, an advanced control system for the optimization of industrial plants management, with a particular focus on energy consumption. The advanced control acts on some alterable process variables, in the respect of critical constraints defined in the production process. The advanced control technique used in ControlTech (so-called Model Predictive Control - MPC), making use of an explicit system dynamic model, predicts the effects of possible future changes of the alterable variables on the energy consumption of the industrial processes.

The target market for ControlTech comprised Italian energy-intensive companies, which could adopt such technology in order to significantly reduce energy consumption associated to the operation of their production plants. Such industrial companies could particularly benefit from the adoption of ControlTech because it could help them save up to 10% of the total energy consumption, with a relatively small initial investment (between 100 and 300 thousand Euros on average). Company C believed that the implementation and use of ControlTech was quite straightforward, given that it represented an incremental improvement over the established control systems used to monitor production processes in energy intensive industries.

To promote a widespread diffusion of ControlTech, the involvement in the development process of the Italian energy-intensive companies that were more likely to adopt the new system soon after launch was perceived as a crucial point by Company C. Such companies were identified as those that had already implemented a relevant number of energy efficiency interventions in their plants, under the assumption that this represented an important signal of their willingness and ability to understand the benefit from the adoption of ControlTech. According to Company C, these early adopters would enthusiastically implement the new system and trigger a positive word-of-mouth in the intended market. Therefore, Company C identified a set of 30 energy-intensive industrial companies it had already collaborated with in previous energy efficiency projects, to be involved during the last phases of the development process of ControlTech. Such companies could be considered as frontrunner for what concerns energy management issues, however they were not market leaders, and intended to use ControlTech to save costs and improve profitability. The cluster of companies that decided to support Company C (which included 10 firms belonging to the metallurgy, pulp & paper, construction materials and glass sectors) significantly helped it in the development of the technology. Moreover, some of them implemented the new system very soon after launch, at the beginning of 2013. As a result, the design of the solution took place in close contact with these potential early adopters, pooling their know-how and experience on the functioning of advanced process control systems and operation of industrial plants in the different industries. As stated by the CEO of Company C: "*The*

involvement of customers from the early stages of the project, which was strongly supported by our top management, allowed anticipating the problems that often characterize any type of intervention in complex industrial sectors such as the steel and cement ones". An exemplary project of early application of ControlTech took place in 2013 in the plant of an Italian steel firm, in order to control the heating phase of metal billets for a furnace. The new system, which required an initial investment of about € 200,000, enabled a saving of natural gas of over 10% per year, far higher than the typical savings that characterize this type of energy efficiency measures (usually in the order of 2-5%).

These early adopters were willing to disseminate their opinion about ControlTech during conferences and workshops on energy efficiency. This was done to raise the awareness of different stakeholders about their first-mover status in the field of environmental sustainability and energy efficiency, by pointing out the remarkable energy saving achieved through the adoption of the technology and the easiness with which it was implemented and used to adopt. Company C leveraged this experience to support its commercial campaign in 2014, which was based on advertising on sectoral media and the participation in fairs and other institutional and academic events.

Despite this involvement of the above-mentioned early adopters in the early stages of the commercialization process, the sales of ControlTech was very low compared with the established targets, despite the positive word-of-mouth triggered by the early adopters. Only 4 control systems were sold in the years 2013-2014. The reasons behind this unsatisfactory commercial performance were due to the fact that the target customers were not so sensitive to energy efficiency issues. In particular, according to Company C the intended customers were reluctant to adopt ControlTech because none of their direct competitors had already done so and ControlTech was not such a revolutionary technology that could give to those who would adopt it earlier a decisive first-mover advantage. This is clear if we consider the words of the Chief Operations Officer of a plastic component manufacturer: "*Energy efficiency investments are perceived as non-core investments within my company, given that they don't give us the opportunity to differentiate from our*

competitors, at least regarding the products we offer to our target customers. This is the reason why we monitor and follow the behaviour of our competitors, especially the market leaders, about this kind of investments, thus avoiding to increase our gap from them."

Based on this understanding, in the beginning of 2015 Company C decided to completely change the targeting and commercialization approach for the new system. Through interacting with the major sectorial industrial associations in Italy (such as ANIE - Federazione Nazionale Imprese Elettrotecniche ed Elettroniche – and the sectorial associations within Confindustria), the firms with the largest market share and well-known for their interest towards sustainability and environmental issues were identified and contacted. They were given the opportunity to adopt ControlTech without any upfront payment on one of their production plants and then share a fixed amount (around 20-40% depending on the specific industrial sector) of the energy saving achieved thanks to the implementation of ControlTech with Company C. Five installations were realized in the first half of 2015, interestingly in the same industrial sectors were ControlTech had already been adopted, i.e. steel, cement and aluminum sectors.

Despite these early adopters were unwilling to disseminate detailed information about the results of the adoption of the innovation, basically for confidentiality reasons, they communicated to their stakeholders the existence of such initiatives to boost their "green" image and reinforce their leading position. This enabled the diffusion of information among other industrial companies, thus promoting a very quick diffusion process for ControlTech, in addition to the definition of an adequate marketing strategy (e.g., no upfront costs with shared benefits) targeted to higher energy intensive industries. As the Chief Technology Officer of Company C said: "Today firms' competitiveness is not only based on their ability to differentiate their products and services or to be cost leader. Sustainability plays a major role in the eyes of end users, and firms understand they cannot neglect this aspect".

As it happened with Company B, starting from the 2015 sales of ControlTech have rapidly grown (as shown in Table 2) and Company C established itself as the leader in Italy for the implementation of energy efficiency measures in the industrial field.

Year	Unit sold [#]	Turnover [€]	Industrial sectors
2013	2	240,000	cement, steel
2014	2	280,000	glass, steel
2015	5	800,000	steel, cement, aluminium
2016	12	1,680,000	Lime, glass, steel, bricks, aluminium

Table 2 Sales of ControlTech

4.4 Company D and StorageTech

Company D is a large Japanese chemical firm founded in 1962 and currently active in two businesses, i.e. the manufacturing of functional materials (such as electronic materials, inorganic materials and polymer science materials) and advanced components and systems (such as automotive products and energy storage systems). In 2009, the firm started the development of StorageTech, a lithium-based battery system that could store electricity and deliver it when necessary. The characteristics of lithium technology enables the development of high-versatile batteries, which could be adopted in different fields, from applications in the electricity network to applications in association with energy production plants, such as renewable energy sources (RES) plants. Company D developed a single version of the StorageTech, targeting large-scale energy storage applications, with particular reference applications in association with big photovoltaic (PV) plants and wind farms, as well as grid applications. RES plants owners could use the innovation to store energy produced by their plants during low price times and then discharge during high price times. Instead, grid operators (i.e., transmission system operators – TSOs – and distribution system operators – DSOs) could adopt StorageTech to defer the need to replace or to upgrade existing transmission and distribution

equipment. StorageTech was a revolutionary technology that required RES plant owners and grid operators to considerably change the methods they had been using for decades in managing energy production and grid assets.

The first interactions with potential customers that took place in 2011 showed that they were reluctant to accept such an innovative technology. Despite the potential benefits stemming from its use, the intended clients were highly unconfident regarding how StorageTech could fit their traditional way to operate production and grid assets and which would be the real costs to integrate them within the existing assets management systems. As noted by the Chief Operations Officer of the Italian transmission system operator: *"The way in which StorageTech could solve the emerging issues related to transmission network management is completely new for our industry, however we struggle to understand if it would be able to be integrated in our network management system and to deliver what it promised. Taking into account that the safety and reliability of the Italian electricity system depends upon our ability to manage it properly, I need to be deeply well-informed about a new technology before adopting it."*

Company D thought that, to win resistance to purchase StorageTech, it needed first to stimulate adoption by some well-respected RES plants owners and grid operators that could serve as opinion leaders for the innovation in the planned target market. Therefore, Company D decided to target as early adopters, by implementing focused marketing actions, a small number of players that: (i) had a large portfolio of RES plants (above 100 MW, with a particular focus on wind farm owners) or a significant portion of electricity grid managed (above 10% of the national transmission or distribution grid); (ii) firms with a positive brand reputation for being innovative players. The assumption was that these firms would have a compelling reason to purchase StorageTech and, if satisfied with it, would stimulate a very positive word-of-mouth effect. Contrary to expectations, Company D failed to convince these large and innovative players to adopt the new storage system. They usually took months to evaluate the properties of StorageTech, during which several people from operations,

R&D, finance and senior management took part in the decision process. Because not all of them agreed on the factual advantages of the radically new system, especially in terms of expected lifetime (+64% compared to the average lifetime of lithium-based battery systems offered by competitors) and price-per-cycle (-57% compared to the average price-per-cycle of lithium-based battery systems offered by competitors), the decision to eventually purchase it was continuously delayed in an attempt to collect further evidence on how StorageTech will perform in their specific operations. A clear tendency toward overestimating the required costs to integrate the system within the existing asset management systems could also be observed. This tendency for RES plant owners can be considered as unjustified in the light of the factual advantages of the StorageTech, in terms of expected lifetime and price-per-cycle, which make such application economically viable. However, the targeted early adopters were sceptical about the capability of StorageTech to actually achieve this performance, thus reinforcing the general idea that batteries were still a very expensive and unviable technology. On the other hand, grid operators had public funds available to carry out pilot projects focused on the adoption of energy storage systems, mainly promoted by the Italian energy authority. Nevertheless, they were reluctant to adopt StorageTech. The results of the first commercial campaign are showed in Table 3.

Year	**Unit sold [#]**	**Turnover [€]**	**Industrial sectors**
2011	5	333,000	RES plant (2), grid (3)
2012	11	795,000	RES plant (7), grid (4)

Table 3 Sales of StorageTech

To overtake this impasse, Company D started, in the second half of 2012, to enter into close contact with representatives from the most important system integrators active in the electricity market worldwide, which typically collaborate with RES plant owners and grid operators in project related to the adoption of innovative technologies. This represented an opportunity to show them the characteristics of StorageTech and the expected benefits provided to its users, challenge the

assumptions that guided its development and engineering process and identify some firms that could be interested in adopting it and hopefully endorse the storage system in the intended target market.

Thanks to these interactions, Company D met some small and innovative RES plant owners and grid operators that had already implemented smart grid projects, i.e. project related to the adoption of innovative Supervisory Control And Data Acquisition (SCADA) solutions or advanced metering infrastructures. These firms appeared since the beginning to be very interested in the characteristics of StorageTech, especially if it could be modified to provide not only the battery component, but the whole energy storage system, i.e. comprising the Power Conditioning System (PCS) and the other minor components (e.g., cooling system, fire-extinguishing system). Company D worked in close contact with these firms and the system integrators for several months during 2012 and the beginning of 2013, and was able to develop a new version of StorageTech. This comprised both the battery and the other energy storage system components, i.e. the battery management system, PCS and other ancillary systems. As a result, Company D also changed its business model: instead of selling only the battery to final users (leaving to them the choice of the PCS, the auxiliary systems providers and the system integrator) it sold StorageTech as a turnkey solution.

When the new system was ready to launch, Company D targeted as early adopters all the above-mentioned firms that had already realized smart grid projects. These had the technical competencies to understand the properties of StorageTech and particularly appreciated the opportunity to have a turnkey solution to be integrated within their existing asset management systems. Moreover, this all-encompassing solution, based on an optimized design of all the energy storage system components, reduced the overall investments required for the end user, thus lowering their financial barriers to adoption. As a result, sales of StorageTech among these early adopters grew very rapidly and, most importantly, the clients were very satisfied with it. The Chief Operation Officer of one of these company noted: *"The adoption of StorageTech enabled us to remove a bottleneck in our grid, avoiding around € 1 million CAPEX for grid upgrade and around € 0,1 million per year of OPEX.*

Moreover, we are now able to provide our customers with a higher power quality, thus avoiding annual penalties that the Energy Authority charge us".

These companies started to disseminate, within the cohesive sectorial associations in which they operated, information about how the system had performed within their assets management systems. This significantly lowered uncertainty regarding the value and real costs of the technology perceived by large RES plants owners and grid operators, which eventually started to buy it under the effect of the positive word-of-mouth triggered by early adopters. Small grid operators (more than small RES plants owners) had usually a reputation for being reliable and innovative firms in their sector, which is typically a temporary monopoly, and therefore they were available to share experiences and know-how and had a long-lasting relationship with their peers. This furthered the positive impact of their word-of-mouth. The operation manager of a grid operator that purchased StorageTech said*: "It is not uncommon that we look at the experiences of smaller and innovative players to guide our investment decisions. In fact, we share with them the same management problems of our assets, although on a larger scale."*

Since the second half of 2013, sales of StorageTech have grown rapidly in the intended target market (as showed in Table 4), meeting the goals established by Company D. This was primarily the result of the positive word-of-mouth effect triggered by the RES plant owners and grid operators that enthusiastically adopted the second version of StorageTech early after launch, accompanied by a realignment of the business model and a better adopter targeting.

Year	Unit sold [#]	Unit sold [kWh]	Application fields
2013	42	3,990	RES plant (31), grid (11)
2014	87	10,440	RES plant (69), grid (18)
2015	112	20,160	RES plant (86), grid (26)

Table 4 Sales of StorageTech

5. Discussion

According to our review of the literature, numerous theoretical interpretations exist of the diffusion of innovation process, each taking a different perspective on this key phenomenon for firms' success. These models arrive at different conclusions regarding the role of early adopters in influencing customer acceptance in the target market, some of them neglecting it (e.g., probit or rank models), others emphasizing this role (e.g., bandwagon and sociological theories). Common across these models is however the assumption that early adopters are static and given entities "somewhere out there." Under this assumption, diffusion is conceptualized as a process involving the identification and characterization of early adopters and their subsequent targeting through appropriate communication and distribution campaigns.

The four cases presented in this paper highlight a different nature for the diffusion process in industrial markets. From our empirical analysis, an interactive and iterative process emerges where the commercializing firm engages in repeated interactions with different categories of companies that are targeted as potential early adopters, until it identifies a category of early adopters that can stimulate subsequent acceptance in the later market. Interestingly, such an interactive process initiated when the attempts of the four companies to target early adopters failed. Companies A, B, C and D approached the commercialization phase for their new products with a clear idea about potential early adopters: textile firms for Company A, specialized plastic component manufacturers for Company B, companies with a high propensity to energy efficiency investments in the industrial process for Company C, large and high-reputation RES plant owners and grid assets owners for Company D. This choice was based on a well-defined set of criteria: size, competitive positioning, reputation, and potential for exerting opinion leadership. With these users in mind, the companies put traditional targeting and commercialization practices into action. However, it soon became clear that the initially envisioned early adopters either did not purchase the technology themselves (in the case of

Companies A and D) or did not bolster subsequent purchase in the target market (in the case of Companies B and C).

These failures marked the transition to a different type of diffusion process, one where the features of the innovation and its intended applications gradually evolved to fit with the characteristics of a new category of early adopters, which were not predicted at the outset of the commercialization phase. In this process, the commercializing firms took a proactive role in shaping the role played by early adopters. According to the empirical evidence gathered, the act of targeting and involvement the most appropriate category of early adopters by the four firms occurred through (i) repeated interactions with the early adopters, which took the form of collaboration agreements and informal information exchanges, (ii) modifications to the characteristics of the product innovation and (iii) interactions with other market actors, such as industry associations and consortia.

First, market actor configuration from the studied companies involved intensive interaction between them and various early adopters. Rather than replicating the prior static early adopters identification and targeting approach, Companies A, B, C and D established joint activities and open bi-directional communication with potential selected clients with the aim to overhaul the product innovations in a way that best fits with the needs of the newly identified category of early adopters. This revision of the new products' characteristics was undertaken even if the development projects were formally completed. Soon after the initial failure, Company A realized that the early version of PlasmaTech did not fully perform the functions that were most needed to satisfy the compelling reason to buy of the textile service firms. So they asked advice to these new early users and decided to invest in improving some features of PlasmaTech, such as the engineering of a standard platform that could perform different types of surface treatment. Company A's management felt that, by doing so, also later market acceptance could have been fostered. Also in Company B, the features of the new product were adapted in response to early users' feedback. Therefore, the interactions with early users transformed the innovations sensibly, to gradually acquire a shape that suited to them. This second

feature of the actor configuration process, i.e. the modifications to the characteristics of the innovation, questions the assumption underpinning most research on diffusion of innovation, that conceives the object of the commercialization as fixed and immutable along its lifecycle. Finally, the constructive diffusion process promoted by the four companies we have studied entailed informal interactions with other market actors, specifically representatives from industrial districts, associations and consortia. These contacts facilitated not only the approaching of early adopters by the firms and their mutual relations, but also the diffusion of the products into the remainder of the market. Indeed, the neutrality and objectivity of these third parties and the long standing trust-based relationships between members of these associations helped reduced transactional uncertainty and the tight cohesion of players in these districts favored information spreading. This bridging role played by industrial associations is in line with the sociological embeddedness theory that has traditionally explained the diffusion of innovations by emphasizing the social ties within which innovative products are brought about (Burt, 2004; Powell, 1996; Tsai, 2001).

The cases also improve our understanding of the role that early adopters play in the diffusion process of industrial innovations. Consistently with bandwagon and sociological models, the analysis shows that early adopters do exert a significant influence on subsequent purchases, which arises from a universal phenomenon, i.e. the presence of a temporary information asymmetry between early and late adopters about the existence of the innovation, its characteristics and value, and its potential impact on the buyer's competitive advantage. Early adopters of industrial innovations thus act as transmitters of information that triggers adoption among later buyers. However, it is the kind of information that is disseminated by early users that distinguishes the four cases in our sample. Consider for instance the differences between Company A and B. While the information diffused by the technology-intensive service firms to the remainder of the target market was rich and concerned the properties and performance of PlasmaTech, the signal inadvertently sent from the major plastic manufacturers that were first to adopt InjectionTech contained more basic information, i.e. the simple

fact that these players had adopted the technology. The role of early adopters in the diffusion of ControlTech resembles that found in InjectionTech, whereas the case of StorageTech follows the same patterns found in PlasmaTech. Based on these insights unearthed by our case analysis, we suggest that early adopters of industrial innovations assume two different roles: (i) word-of-mouth trigger – as in the case of PlasmaTech and StorageTech and (ii) industry benchmark – as in the case of InjectionTech and ControlTech. These roles are consistent with the theoretical explanations offered by bandwagon models, particularly those that incorporate sociological notions, and have been observed in recent research (Frattini et al., 2014).

What is different with respect to prior research is the fact that, according to our cases, the firms commercializing the innovation, by proactively targeting a particular category of early adopters, actively assign to early adopters a specific role in the diffusion process. It is by steering the interactions with early adopters toward specific modifications to the innovations that the four companies in our sample, after the initial commercialization mistakes, made sure that the newly chosen early adopters had a specific role that helped maximize the diffusion of the new products. As such, our findings are not inconsistent with Moore's crossing-the-chasm model (1991). If the early adopters do not interact in a meaningful way with the majority, diffusion stalls. This seems to have happened in our four cases. Yet, when the early adopters were selected so that they were steered toward useful interactions with the majority, the diffusion process ultimately was rectified and the four companies achieved satisfactory sales targets. Notable here is that the companies themselves were able to overcome the initial lack of meaningful interaction by proactive intervention, namely by selecting a different category of early adopters and steering the interactions in such a way as to overcome the barriers between early adopters and later potential clients – that is, the companies, through their own actions, found ways to cross the chasm.

The role of word-of-mouth trigger by early adopters clearly emerges from the case of Companies A and D. With reference to the case of Company A, by early purchasing and using PlasmaTech,

specialized textile treatment providers built a deep knowledge of the functioning and performance of the technology. Prompted by Company A, they then consciously echoed their opinion and expertise about the technology's value, its advantages and disadvantages, which helped reduce the level of uncertainty associated with the potential adopters' purchase decision and ultimately favored diffusion (Czepiel, 1975; Chiesa and Frattini, 2011). This effort of triggering word-of-mouth communication was successful in stimulating product acceptance thanks to advanced technical competencies that the service firms possessed, or at least were reputed to possess. The technical opinion leadership position that these small firms held inside the social system and of which Company A was fully aware, ensured that their judgment was taken into great consideration by the other members of the network. It is interesting to note that the uptake of PlasmaTech by service firms affected textile manufacturers' purchasing behavior even though the two categories of actors strongly differed in terms of business models, competitive factors and the like, a condition that according to Geoffrey Moore would impede any pattern of communication and interaction able to stimulate wider product acceptance (Moore, 1991). A similar pattern can be found in the case of Company D.

The role of industry benchmark assumed by early adopters in the case of Companies B and C differs from word-of-mouth trigger in the type of information propagated from early to later market and in the origin of the pressure exerted by early users to the remainder members of the target market. As mentioned above, in the case of Company B, information was limited to the fact that two leading companies had already purchased and implemented InjectionTech in their operations. This was enough to stimulate imitative adoption of InjectionTech by other plastic manufacturers. Extensive diffusion occurred even though early adopters were not willing to activate any information dissemination process fearing that this would erase the benefits from being the first to adopt InjectionTech. Our analysis shows that subsequent purchases by potential clients have imitative reasons, as later adopters reproduced purchasing behavior of comparable firms. The rationale is to avoid ending up at a competitive disadvantage relative to early adopters. This is clearly a risk

minimization competitive reaction by later adopters who at least put themselves on equal footing with large cost leader firms and avoid the worsening of their productivity gap. The industry benchmark role could not be assumed by the initially chosen early adopters, i.e. specialized plastic components, since they did not compete in the same market arena as the intended targets. Realizing this, Company A was prompt to approach, through the mediation of industry consortia, firms in the same market that could act as role models in the adoption on InjectionTech and so that could more easily stimulate imitation. A similar pattern can be found in the case of Company C, which highlighted the crucial role played by the industry benchmark factor in the diffusion process, in parallel with the importance to define an adequate marketing strategy (e.g., no upfront costs with shared benefits) targeted to higher energy intensive industries. The diffusion of innovation through industry benchmark effect contains elements of organizational isomorphism (Armbrüster, 2008): being the consequences of the adoption of the technology not known with certainty, then the purchasing decision of market actors is, on a mimetic or normative basis, oriented toward the behavior of other organizations. If a number of leading companies have adopted a particular technology, this event is interpreted as meaning that it generates improvements. From a sociological neo-institutional perspective (Meyer and Rowan, 1977; Di Maggio and Powell, 1983), the adoption decision is not based on proven economic effects of an innovation, as probit or rank models suggest, but more important is the collective belief in its efficiency and usefulness, and the resulting increased legitimacy in the environment for the firm adopting it (Strang and Meyer, 1993). The progressive diffusion and institutionalization of InjectionTech and ControlTech as cost saving levers therefore constituted a strong normative pressure to adopt them.

Finally, even though our empirical evidence does not allow us to conclude that the role that firms create for the early adopters of their new products is contextual upon the nature of the innovations being commercialized and diffused, interestingly early adopters appear to play the role of word-of-mouth trigger when the innovation being commercialized is a radical one, whereas they play an

industry benchmark role in case of incremental innovations. A radical innovation can be defined, following the definition provided by PDMA (Product Development and Management Association), as ‘‘a new product, generally containing new technologies, that significantly changes behavior and consumption patterns’’ in the target market. An incremental innovation, on the other hand, is ‘‘an innovation that improves the conveyance of a currently delivered benefit, but produces neither a behavior change nor a change in consumption’’. These definitions can be found in the PDMA glossary available at http://www.pdma.org/npd_glossary.cfm.

In particular, in the case of the radical innovations in our sample (i.e. PlasmaTech and StorageTech(, early adopters represented key sources of information for later buyers that felt highly unconfident about the worthiness of the technologies. The necessity to change operational routines and methods made mainstream customers anxious and doubtful about the opportunity to adopt the innovations and eager to gain further evidence about their real value. This need for rich information about the value of the technologies activated a word-of-mouth process of referrals. This finding may be interpreted considering that, the more radical the innovation, the higher the level of customer uncertainty perceived by mainstream market’s customers and, hence, the more strongly their purchasing decisions are influenced by the opinion of well-informed and expert reference organizations (Chiesa and Frattini, 2011). Therefore, commercializing firms may seek for early adopters among firms with strong reputation in their social network, because they may confer higher legitimacy upon an innovation and strengthen word-of-mouth effects. This might be a viable explanation for the patterns emerged from our data, and in particular the fact that PlasmaTech and StorageTech - both characterized by a word-of-mouth effect triggered by their early adopters – were both radical innovations. On the contrary, with the incremental innovations in our sample (i.e. InjectionTech and ControlTech), it appears from our data that there is no need to transfer detailed information about the properties of the technology to later adopters, as this can be quite easily assessed. The purchasing decision by later adopters is not linked to the availability of technical information, but rather

competitive information. What matters in this situation is the information about the adoption of the technology by early adopters, which stimulates strong imitative behaviors among competitors. Although this aspect will require further theoretical and empirical research to be properly understood, it points to the existence of a relationship between the nature of the innovation and the mechanisms through which early adopters affect subsequent purchases.

In sum, the commercialization efforts of Companies A, B, C and D highlight a constructive dimension of the diffusion of industrial innovation. Rather than a process of targeting a given subset of customers, our companies engaged in the gradual diffusion of new products through a live emergent process where they played a major active role in proactively engaging and selecting different categories of companies as early adopters, through the activation of joint activities and information exchanges. In markets in the making, i.e. "markets whose characteristics are still in important ways undetermined" (Harrison and Kjellberg, 2010, p. 785), the assumption of early users as given entities does not hold, nor does the one concerning the immutable nature of innovation. In contrast to prior literature, our analysis suggests an alternative way of shaping the role of early adopters, one consisting of incremental sequences of actions and decisions on the supplier's side that put together viable early adopters and uses of the new products. In this process, the offer itself evolves as a result of the experiences gained through interaction between the commercializing companies, early adopters and later potential clients. This aspect unearthed through our case studies is consistent with the role of users as sources of innovations and triggers of learning processes, that were already identified and discussed in existing innovation research (Von Hippel, 2010; Rosenberg, 1982).

6. Conclusion

Considering the high failure rates of industrial innovations, we have investigated the role of early adopters in influencing the customer acceptance of new products. The adopted methodology involved

a comparison of four cases and current diffusion of innovation understanding in a search for similarities and differences. Moreover, the emerging actor market configuration perspective (Harrison and Kjellberg, 2010) has been adopted with the aim to improve our understanding of the phenomenon under investigation. Our major conclusion is that the diffusion of industrial innovation is an interactive and iterative process, where the commercializing firm engages in repeated interactions with different categories of companies that are targeted as potential early adopters. This process ends when the commercializing firm identifies a category of early adopters that can stimulate subsequent acceptance in the later market, by playing one of the following two roles, i.e. word-of-mouth trigger and industry benchmark. During this process through which the role of the early adopters is constructed proactively by the commercializing firm, the product innovation is also subject to changes to provide a better fit with the targeted category of early adopters. In sum, commercializing firms take a proactive role in shaping the role played by early adopters through repeated interactions with them and modifications to the innovations to suit their requirements.

Our study contributes to the diffusion of innovation literature by highlighting two main limitations of previous theories, i.e. the conception of early users as given entities and of innovation as an unchangeable good. In the light of our results, the current conceptualization of the diffusion process in industrial markets needs to be expanded from a passive target practice to an emergent and interactive process of targeting and involving early adopters, shaping their role in the diffusion process, and modifying the characteristics of the innovations in markets that are in the making. We extend the innovation literature on commercialization, which has focused on the precursors to successful innovation but has so far not considered the active role firms can play, through appropriate targeting and involvement of the most proper category of early adopters, in activating mechanism that involve early adopters and stimulate subsequent acceptance. In this regard, we corroborate the preliminary findings of the received literature on the channels through which early adopters influence subsequent diffusion (Frattini et al., 2014). At the same time, we find results that lend support to the

crossing-the-chasm model (Moore 1991): in both cases, the firms had initial difficulties in achieving diffusion into the mainstream market, but found ways to cross the chasm by increasing meaningful interaction between early adopters and later potential clients. In addition, this paper further expands research on actor market configuration showing that the adoption of constructive perspective improves our understanding of marketing phenomena and practices, like diffusion and market segmentation. Moreover, our cases provide further empirical evidence supporting the user innovation mechanism, which has been largely documented in the received literature (Von Hippel, 2010), and the processes through which an innovation is modified through the process of interaction with early adopters, as highlighted in the learning-by-using concept (Rosenberg, 1982).

The proposed re-conceptualization of the industrial innovation diffusion process has important implications for practicing managers who need to consider different diffusion tactics when launching innovations into developing markets. Product and marketing managers should actively handle early adoption so that early users are targeted to take the appropriate role, but they must also apply co-development techniques since the characteristics of the innovation are likely to change in the early stages of the diffusion processes, where different categories of companies are targeted as potential early adopters, in a trial-and-error process. The shaping of early adopters requires going beyond identification techniques to include the management of close interactive relationships with customers and of networking activities with third parties. Also marketing practices, such as communication, targeting, configuration and distribution, should be tailored on the role of early adopters (Chiesa and Frattini, 2011).

The investigation leaves some gaps that future research could fill. First, it would be interesting to investigate whether, and to what extent, the roles of early adopters examined in this article also hold true in consumer markets or for service innovations. Secondly, the relationship between technology radicalness and role of early adopters should be deepened theoretically and tested empirically on a quantitative basis. Third, it should be noted that the four cases in our sample show a similar pattern

characterized by an initial failure in the diffusion of the innovation, followed by a modification of the new product and of the marketing approach, which lead to the market success of the innovation. This points to a general nature of the phenomenon. However, it would be of paramount importance to study other cases which may follow different patterns and enrich the framework developed in this paper, e.g., cases in which the trial-and-error process could be even more complex, going through multiple stages of failure before reaching market success. Finally, future research should explore the existence of other contextual factors, e.g. user's resource and competitive positioning, which influence the role of market actors and how they are configured.

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