

Market barriers for environmental innovations

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Abstract

This paper describes market barriers experienced by Swedish innovators in start-up companies early in the process of bringing environmental innovations to the market. The studied innovators are mainly active in a business-to-business market that often involves capital-intensive industry sectors and large companies are seen as important customers. Most of the market barriers identified can be related to customer relations. The innovators experience their customers' negative attitudes and unwillingness to try new technologies as major barriers. Furthermore, they perceived their customers to be conservative and reluctant to take risks. These barriers may be relevant in most innovation developments although they may be more articulated for environmental innovations since such innovations mostly evolve in emerging industries and since capital-intensive industry sectors dominate the area. Measures to stimulate diffusion of environmental innovation are discussed, including ways to encourage customers to test new technologies and to see the adoption of the innovation as worth the perceived risks.

Keywords: environmental innovations, market barriers, innovators, emerging industries, entrepreneurship, innovation diffusion.

1. Introduction

Increasing environmental awareness among policy makers, customers, the media, etc. has created a flourishing landscape for environmental innovations. A steady growth of the earth's population in combination with rapid economic development have led to an increased demand for resources such as energy, materials, and nutrients, all demands that lead to environmental problems (McNeill, 2000). For the last few decades, substantial improvements have been achieved in reducing mankind's negative impact on ecosystems by applying cleaning technologies to reduce industrial emissions, by disseminating cleaner production procedures, and by implementing other pollution mitigation procedures. Rockström et al. (2009), however, note that there are still many overarching challenges to overcome especially in the areas of biodiversity losses, climate change, and use of nutrients. It can, therefore, be questioned if incremental improvements as the result of cleaning technologies and cleaner production procedures are enough or if more radical changes are needed.

Development and diffusion of new environmental innovations (among many other measures) can help solve some of the massive environmental problems mentioned above. In this context, environmental innovations should be understood as the development of more radical solutions for environmental problems. Many industrialised countries have taken several national and regional initiatives to stimulate development and diffusion of environmental innovations. These initiatives often create win-win situations combining economic growth and technological development with a sustainable use of natural resources and ecosystem services, an approach that is a rather eco-modernistic approach (Hajer, 1995).

The innovative technology per se will not lead to any significant environmental improvements, but successful commercialization and diffusion are necessary. This requires not only the specific innovative technology but also an understanding of the tentative market and customer behaviour and perception. The innovator will most likely meet a number of barriers that have to be overcome to introduce the innovative technology in the market. As noted by Geels et al. (2011, 2-4), three problem areas can be identified. First, sustainable technologies tend to be more expensive and of lower performance compared to traditional technological solutions. Second, regulative uncertainties about future markets can hinder commitment of an industry's development of sustainable technologies. Third, lock-in mechanisms in existing technologies and sociotechnical systems can hinder the adaption of new technologies that do not fit the existing systems.

Innovations are realized in a large diversity of organizations including companies of various sizes and characters. This paper focuses on Swedish innovators in start-up companies early in the process of bringing the innovation to the market and further commercialisation. This paper identifies and analyses market barriers that environmental innovators have experienced while trying to introduce environmental innovations to the market. Furthermore, we discuss if and how the identified market barriers can be overcome.

There are several reasons why experiences from innovators in small companies are interesting to analyse. Geels et al. (2011, pp12-13) noted that sociotechnical regimes consisting of large established companies often only lead to incremental innovations. They argued that more radical innovations often occur in technological niches dominated by small actors and when an

accumulation of niche markets creates a breakthrough that influences sociotechnical regimes. A study of which market barriers innovators actually have experienced will provide valuable information for policy makers as well as innovators wanting to introduce their innovations to the market.

2. Methodology

This study interviewed Swedish innovators who were finalist in the yearly national contest “Environmental innovation” between 1998 and 2006. The contest is open for any innovator irrespective of technology. Every year, 50 to 100 proposals are submitted, and normally 15 of these are selected as finalists (in 1998, 41 finalists were selected, in 1999, 29, and in 2000, 21). Of these finalists, first, second, and third place are chosen. In total, about 700 innovations have been assessed generating 181 finalists. Each proposal is scrutinized by an expert panel using a broad set of criteria in four areas: sustainability, market potential, entrepreneurship, and innovation. The sustainability criteria are based on socio-ecological principles and indicators for sustainability originally developed by Holmberg (1995) and diffused in society by the organisation the Natural Step. In general, the criteria include resource and energy efficiency, recycling solutions, renewable energy and materials, green chemistry, cleaning technologies, and measurement technology. The criteria market potential, entrepreneurship, and innovation are assessed in a more general way based on the industrial expertise of the expert panel. No formal theories have been used, but when it comes to market potential, the criteria have been inspired by Porter (1998) and Rogers (2003). The entrepreneurship criteria has been inspired by Landström (1997, 1999), and the criteria for assessment of innovation has been inspired by Altshuller (1988) as well as Garcia and Calantone (2002). Over the years, the criteria and the knowledge among the organizers and the expert panel have evolved. In the earlier years, the emphasis on market and entrepreneurship was not as strong as in later years. Several follow-ups and evaluations of how the criteria have worked and how the companies have preformed after the contest have been conducted (Nilsson & Hedén, 2001; Lönngren & Nilsson, 2003; Agnvall, 2004; Englund & Leghamar, 2004; Hörte & Halila, 2006; Halila, 2007; Englund 2003; 2008a; 2008b; 2010). This information have been used over the years to help refine the criteria.

In this study, it was possible to contact 112 of the original 181 finalists (62% answering rate). Reasons for non-answers were that the innovation was not active anymore, that the innovator did not want to answer questions, or that the innovator had passed away. All interviews were performed during the autumn of 2009 and winter of 2010 via telephone using an interview template. Questions included open-ended questions about how the work with the innovation had developed, and about their experiences with market introduction, sales, learning outcomes, support needs, etc. Further questions with set answering alternatives were used to learn more about development stage, type of capital, type of development environment, market segment, types of customers, market barriers, and need for support. Statistical analyses were performed using the non-parametric ranking methods Kruskal-Wallis and Mann-Whitney tests. The interviews generated a great deal of data and only the results related to market barriers are included in this article. A detailed description of the full study can be found in Englund (2010).

The selection of the studied innovations might have led to studying innovations that were not representative for any environmental innovation. It is likely that the studied sample represents

rather successful innovations since the innovators actively have sent in their innovation for assessment. Furthermore, the assessment by the expert panel itself leads to a selection of what is judged as the most promising innovations. It is likely that innovations from large and medium-sized companies are underrepresented (Englund, 2010). The expert panel has made it possible to exclude innovations that are not seen as environmental innovations. It was also possible to gather information regarding a large number of environmental innovations efficiently since the innovations already had been identified. In addition, less successful innovations are likely over-represented in the dropout rate. One reason for this is that some innovation projects were closed down and therefore not possible to evaluate. Furthermore, less successful innovators can be expected to be more reluctant to answer questions about their innovation.

3. Results

This sections starts with a classification of the studied innovations according to technological fields. This is followed by a presentation of types of customers that the innovators try to approach. Finally, the identified market barriers are described.

A wide-range of technological fields is represented among the studied innovations (Figure 1). Almost one-third of the innovations can be labelled as energy related (including the fields of renewable energy and energy efficiency). Substitution of hazardous chemicals is another large group (19%). This is followed by waste management and recycling as well as traditional environmental technologies such as cleaning and measurement technologies. Another important group is material-related innovations (including renewable materials and material efficiency), whereas innovations with the aim to preserve biodiversity and sustainable use of land and water (labelled as ecological engineering) are much more rare. A few innovations can be labelled as involving multiple technological fields incorporating, e.g., both energy and material efficiency.

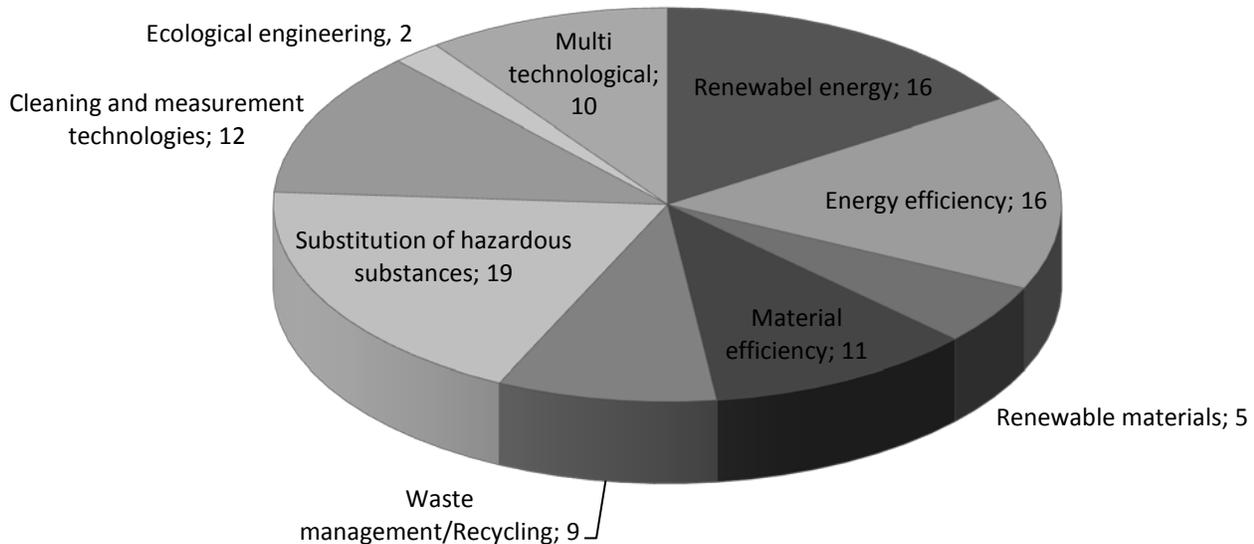


Figure 1. The studied innovations’ distribution (in per cent) according to technological fields.

Table 1 lists the type and size of existing and potential customers. Almost half of the innovators mention larger companies as customers followed by micro-, small-, and medium-sized companies. Local authorities and regions is another large group, and it is followed by governmental authorities and finally consumers. Potential customers are more evenly distributed. A large group of the innovators did not answer this question (21%). The category “Others” includes, e.g., non-governmental organisations.

Table 1. Type and size of existing and potential customers mentioned by the respondents. An innovator might have indicated customers in more than one category. Twenty-one per cent of the respondents did not answer this question.

Customer	Current	Potential
Consumers	8 %	5 %
Micro companies (<10 employees)	27 %	12 %
Small companies (10–49 employees)	25 %	11 %
Middle-sized companies (50–249 employees)	32 %	8 %
Larger companies (>249 employees)	45 %	9 %
Local authorities and regions	17 %	4 %
Governmental authorities	11 %	4 %
Other	1 %	2 %

The identified customers were also categorized according to their main industry sector (Table 2). Two sectors dominate: manufacturing industry as well as construction industry and real estate companies. Agriculture, forestry, and fishing only represent 10% of all the sectors and all other sectors represent just a few per cent.

Table 2. Industry sector in which the mentioned customers are operating. An innovator might have indicated customers in more than one sector. Classifications are according to SNI-codes used by official Swedish statistics. 33 % of the respondents did not answer this question.

Line of business	Current	Potential
Manufacturing industry	30 %	7 %
Construction industry and real estate companies (SNI 45, 70)	21 %	5 %
Agriculture, forestry, and fishing (SNI 01–05)	10 %	5 %
Sewage and refuse disposal plants, sanitation establishments (SNI 90)	8 %	4 %
Trade (SNI 50–52)	7 %	5 %
Electricity, gas, steam, hot water and water works (SNI 40–41)	4 %	2 %
Transport (SNI 60–63)	3 %	0 %
Other	4 %	1 %

It can be noted that several of the industry sectors (construction industry and real estate companies, sewage and refuse disposal plants, sanitation establishments and electricity, gas, steam, hot water and water works) relevant for environmental innovations are generally capital intensive (Johansson and Forssén, 2010).

This study identifies and analyses market barriers for the studied innovations. Table 3 summarises the results from the open-ended questions regarding experienced market barriers. Clearly, customer-related barriers dominate. Of the respondents who experienced market introduction of their innovations, 70% identified customer-related barriers (data not shown). Customers' conservatism and unwillingness to test new technology is mentioned by 25% as the most important barriers. In addition, 15% mentioned they lacked the resources to reach new customers.

Table 3. Market barriers mentioned by the respondents as being most important. An innovator might have mentioned more than one market barrier, giving a total of more than 100%. Groupings have been done using earlier research by Porter (1998), Rogers (2003), and Geels (2002).

Important market barriers	Percentage
Customer-related barriers	
It is costly and difficult to reach the customers	15 %
It is difficult to get a first customer	3 %
Customers have little capacity to pay	1 %
It is difficult to explain the benefit to the customer	10 %
Other needs than the ones solved by the innovation are prioritized	8 %
It is costly to demonstrate the innovation and its benefits	7 %
The customer experienced a tentative risk in changing technology	24 %
The customer does not have the right technological knowledge	9 %
Alternatives or competitors are less expensive	13 %
Other customer-related barriers	10 %
Other market barriers	
Competitors are actively hindering the innovation	2 %
Intermediate organizations are hindering [#]	7 %
Permits and planning processes are hindering market introduction	1 %
Financial issues	15 %
Current recession in Swedish economy*	6 %
Other non-customer related issues	5 %

[#] Resellers, agents, consultants, installers, etc.

* At the time of the interviews, there was a major recession in the Swedish economy.

The results in Table 3 are based on spontaneous answers from the respondents. In addition, we used a set of question about market barriers that required the respondent to use a set of answer alternatives. The respondents were asked to reflect on which pre-decided market barriers were of high, intermediate, or low relevance for their market introduction. Answers from that set of questions confirmed the dominance of customer-related market barriers. Several barriers became more pronounced: “It is costly and difficult to reach the customers”; “It is difficult to get a first customer”; “Other needs than the ones solved by the innovation are prioritized”; and “It is costly to demonstrate the innovation and its benefits”. It is also noteworthy that statements such as

“Legislation is a hinder” and “Specific taxes are hindering” were ranked as having low importance and were not mentioned at all in the answers to the open-ended question about market barriers.

A further analysis combining market barriers with technological fields highlights some interesting results. Innovators active in the renewable energy field experienced the barriers “Customers have little capacity to pay” and “Competitors are actively hindering the innovation” as less problematic compared to other technological fields. In contrast, innovators in the field of energy efficiency emphasized the barrier “Customers have little capacity to pay”.

Half of the innovators working with renewable materials experienced “It is difficult to explain the benefit to the customer” as a large barrier. Furthermore, they all see legislation as an intermediate barrier. Almost every innovator in the field of substitution of hazardous substances experienced little or no barrier in explaining the benefit to their customers.

Similar cross-analyses can be done that considers the size of the customer base. In these analyses, innovators trying to approach large companies differ significantly in many aspects. They experienced the barriers “It is costly and difficult to reach the customers”, “It is difficult to get a first customer”, and “The customers experience a tentative risk in changing technology” as even more pronounced. The results also indicate that larger companies more often finance innovative projects compared to other customers. However, this is not statistically significant (Mann-Whitney test, $P=0.0699$, 5% significance).

Analyses concerning the customers’ industry sector show only small differences between groups. Innovators having customers in the construction industry find the barrier “Customers have little capacity to pay” as more important. Customers in agriculture, forestry, and fishing mention legislative barriers while a small number of innovators selling to consumers did not find that it was a problem to get a first customer.

4. Discussion

The interviews show a number of barriers that are important for market introduction of environmental innovations. We have not been able to identify any similar study regarding which market barriers environmental innovators experience as most important. However, the results are in line with earlier findings on conditions for emerging industries. As early as 1934, Schumpeter (as cited in Geels et al., 2011) wrote that novel innovations will always have problems being accepted. Since environmental innovations often challenge older solutions and since the environmental technology market is capital intensive, it can be expected that market barriers can be even more articulated for such innovations.

As noted, the customer-related market barriers were totally dominant. Seven out of ten respondents gave such answers. These innovators mainly found it difficult to overcome customers’ conservatism and unwillingness to take risks, although they also found it difficult to reach customers. Large companies are seen as the most important customers. Englund (2010) discovered that such companies more often finance the innovation project, but at the same time the innovators working with them mention customer barriers more frequently. This discrepancy can perhaps be explained by the fact that the innovators in this group were more aware of their

customers' problems or by the fact that larger companies often are more reluctant to adopt new technologies (Geels et al., 2011 12-13). As indicated by this study, large companies are often open to finance pilots but more reluctant to introduce the new technology in full scale.

There are two important factors for the successful dissemination of new innovations: demonstration projects and testing (Rogers, 2003). A large group of innovators find it difficult to demonstrate the benefit for the customer and explain technical issues. For example, Porter (1998) found that for emerging industries it is common that the customer must be educated and convinced regarding even basic functions of an innovation, a finding that is also supported by Geels et al. (2011). This context can help explain the barriers mentioned in this study regarding costs and customer conservatism and priorities. As discussed by Sakao and Fagnoli (2010) and Sakao and Hjelm (2010), these findings further strengthen the need for environmental innovators to focus on customer value (including services).

Since distribution channels are important to be successful in the market (Porter, 1998), it is interesting to note that almost half (46%) (Englund, 2010) of these innovators are selling or are planning to sell directly to the customer and only 20% are using intermediate organizations. Most of the studied innovators are active in small companies and it can be difficult for such organizations to reach a larger number of customers. On the other hand, 7% point out that intermediate organizations can be major market barriers.

Porter (1998) noted that political and regulatory factors are main barriers. There is also an on-going discussion about whether such barriers are particularly pronounced in the environmental technology sector (Dealflower, 2003; Dealflower, 2006; Olofsson, 2009; Steen & Frankel, 2000). There is a risk that future political decisions will change the conditions for the companies to be successful. What is supported as a good solution today might be judged as an unwanted solution tomorrow. Furthermore, it is not known how future regulations will influence market success. In this study, only a few of the innovators spontaneously mentioned barriers related to regulations as the most important barrier. When regulations and taxes are mentioned, it is mainly the lack of these that is seen as a problem or that energy taxes and environmental taxes are too low.

Financial issues are mentioned by 15% of the innovators as a barrier even though it can be questioned whether this is a market barrier. The innovations are mainly financed using own capital (86%) and public development money (69%) (Englund, 2010). It is perhaps self-evident that finance is of importance, but it is worth noting that many of the innovations use public development money. It has not been the scope of this study to discuss the type of funding schemes, but a mix of different finance solutions is likely of utmost importance.

5. Conclusions

This study has highlighted several market barriers experienced by innovators actively trying to commercialize their innovations. Most of them are related to customer relations. One important implication of this study is that innovators should focus more on customer value if they want to convince a potential customer to adopt their innovations.

For policy makers, it is recommended that several measures should be adopted to stimulate diffusion of environmental innovation, strategies that include ways to encourage customers to test new technologies and to reduce their perceived risks.

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