The cleantech mystery: A new theoretical model for understanding export capabilities in small and medium-sized innovative cleantech companies

Per Frankelius, Claes Hultman, Gabriel Linton, Conny Johanzon and Claes Gunnarsson, all at Swedish Business School, Örebro University. Corresponding author: per.frankelius@oru.se

Abstract
Observers argue that Swedish cleantech companies are excellent at technology, but lack in making business and creating export. We call this the cleantech mystery. Two important questions are what creates export capabilities, and what are the barriers cleantech companies face when exporting viewed from different perspectives? We suggest a holistic model for understanding the export conditions of innovative cleantech companies at micro and macro levels. The model relies on foundations from four different theoretical views, and two case studies. The first case is United Stirling (related to Kockums and FFV in Linköping) and its spin-offs. We focus on the dream to create sun-powered engines that in turn generate electricity. The second case is the Aerosoltrap™ illustrating a creative inventor and his struggle with commercialization. The result is a tentative model, as well as some critical notions regarding the cleantech mystery.

Keywords: Cleantech, Innovation, Export, Capabilities, Market orientation, Stirling engines, Aerosoltrap.

1. Introduction

Nature is affected by damage and pollution, as a result of the modern society. At the same time societal actors are dedicated towards "a greener world". Many factors can contribute to that goal, most significantly including changes in people's way of living. But also the cleantech industry has received attention. This industry it is looked upon both as a growth vehicle and a way to improve the natural environment.

2. Problem, research questions and purpose

At a ven-cap-meeting in San Francisco 2007, the former American Ambassador to Sweden, Michael Woods, presented 30 Swedish cleantech companies including Kockums and the Stirling engine technology inter grated with solar dishes. After Wood’s action, many investors believed in finding "future Microsofts" among Swedish companies.

But what has happened? Where are the business rockets? The magazine Ny Teknik concluded in 2007 that companies were excellent at clean technology, but fail at exporting it. The same situation is present today. We call this the cleantech mystery and derive the following research questions: Which obstacles does Swedish cleantech companies face when exporting?; How can a theoretical framework be designed for understanding barriers and solutions?
The purpose is to propose a tentative model with the aim to identify barriers of innovative cleantech companies.

3. Research design

The study focuses on small and medium-sized innovation-based cleantech companies and we choose to combine inductive and deductive research. The case study approach included Swedish companies and the applied method for collecting empirical data was based on desk research in combination with personal communication. The research is a part of the EU-project "Enabling a Global Vision for the Baltic cleantech industry". The paper does not aim at delivering the final answer on the cleantech mystery but rather to propose a possible route to research this issue.

4. The concept of cleantech

There are many terms that refer to solutions for a better natural environment. Examples are clean technology (cleantech), environmental technologies, eco innovation, environmentally sound technologies, eco-industry, green technology (greentech) and environmental technology (envirotech). All these terms should not be discussed here, but a note on cleantech is relevant. The term cleantech was probably first used in 2002 by the Cleantech Network (earlier known as Clean tech Venture Network). This organization was part of Clean tech Group which was associated with the ven-cap business. According to them:

"Clean technology, or 'cleantech,' should not be confused with the terms environmental technology or 'green tech' popularized in the 1970s and 80s. Cleantech is new technology and related business models that offer competitive returns for investors and customers while providing solutions to global challenges. While greentech, or envirotech, has represented 'end-of-pipe' technology of the past (for instance, smokestack scrubbers) with limited opportunity for attractive returns, cleantech addresses the roots of ecological problems with new science, emphasizing natural approaches such as biomimicry and biology. Greentech has traditionally only represented small, regulatory-driven markets. Cleantech is driven by productivity-based purchasing, and therefore enjoys broader market economics, with greater financial upside and sustainability." (Cleantech Network, 2011).

The concept of cleantech is criticized because its connotation to an unconditional ideal of cleanliness, while the relative term of ‘cleaner’ tech implies a technology that produce less anticipated deleterious effects on the environment in comparison to currently employed technologies (Markusson, 2011). Viewed from a customer perspective, economic value creation by the application of technology is central. The concept of technology, in terms of different skills and knowledge, can be understood as product-, process- and market technologies (Ford and Saren, 1996). These are universal types of technologies that relates to the generative, productive and representative value-creation processes of a company (cf. Wikström, 1996; Wikström, Normann et al, 1996). The clean-ness of clean technology can therefore include, not only environmentally improved engineering-based technical solutions inherited in the production apparatus, but also relate to the particularities of its business application in terms market activities.

An important aspect in commercialization of clean technology is the supplier’s ability to relate its services to customers’ requirements. The scope for cleaner technology or rather ‘cleaner innovation’ (Markusson, 2011) outline a broad range of customer improvements. As technology is employed for particular purposes that occasionally go beyond the technical abilities of a company, this may outline barriers in achieving strategic stretch (Pralahad and Hamel, 1991). Barriers for customer investments in green technology can originate in
5. Common views on obstacles for cleantech business

Sweden has been considered as a cleantech leader. During 2009 the cleantech export increased about 5 percent and was estimated to be worth 39 million SEK. But we do not see many export gazelles. The situation raises questions: How can people talk about success, when the "successful phenomena" is difficult to grasp and is closely related to obstacles? The Swedish Growth Agency, in a report 2010, concluded that it was difficult to export Swedish cleantech. The subtitle of the report was: "A success with obstacles" (von Bahr, 2010). What are those obstacles?

Common hypotheses regarding the problem reveals that the cleantech companies are too small; lack of venture capital and have a weak home market for public procurement. Some argue that customer's interest in the products is not the main problem.

Minister for Trade (Government of Sweden), Ewa Björling, commented to Dagens Industri: "There is an enormous interest for Swedish environmental technology worldwide. I have travelled in nearly 60 countries and everywhere [people] request Swedish solutions" (citied by Nordenskiöld, 2011, our translation). She continued: "The problem is that many international customers request large quantities. And these suppliers are unable to manage such large orders." (Ibid).

According to Björling the Swedish cleantech companies are too small. A group of analysts interpreted a related problem: "Customers and suppliers have pointed at the difficulty of ordering complete systems from Sweden. When systems expertise and solutions are presented there are often a number of competitive products available, but not always a main contractor. One success factor relies on a locomotive supplier company that is responsible for the complete service delivery. However, to act as a locomotive business is less attractive because it implies considerable financial risks.” (von Bahr, 2010, p. 6, our translation).

Considering the lack of venture capital, The Swedish Energy Agency writes: “The lack of venture capital in start-up and expansion phases entail that many businesses will never reach the market with their products. The gap between seed funding and commercialization is sometimes called the Death Valley because there are many companies that run into problems when raising capital. Death Valley affects young companies in all industries, but is perhaps an additional challenge for cleantech companies.” (The Swedish Energy Agency, 2011, s. 33, our translation).

The discussion about capital is based on the assumption that inflow of cash should not come from customers, but from other actors. At the same time there are indications of successful companies that focus on customers to gain capital. A noteworthy conclusion from a study of cleantech companies: "Every five projects bring in capital from angel investors (i.e. individuals with capital). It is equally common to allow the customer to finance part of the development or to use research funds to bring in angel investors.” (Englund, 2010, summary with no pagination).

What about the opinion that the main problem or barrier is too weak public procurement in the home market? Jenny von Bahr states: “The companies need a home market that function as a good economic base, as well as, a first customer reference.. This is crucial for small
businesses. It is tricky to sell solutions in other countries if one has not succeeded to sell in the home market” (von Bahr, 2010, p. 6, our translation).

Some investigators argue that the barrier to market is due to the customer’s inertia. The main conclusion from a study on cleantech companies’ barriers was: “Customer’s conservatism and reluctance to take risks by trying new technologies” (Englund, 2010, abstract with no pagination).

The main problem, according to that conclusion is that customers, not the suppliers, are the biggest problem. But that conclusion can be seen in a critical perspective, and from the same report we can cite the following:

"For example: it is costly and difficult to reach customers; it is difficult to get a first customer; other needs than those that the innovation solves has higher priority to customers; and it is costly to demonstrate the innovation and its benefits.” (Ibid).

This cited reflection can be interpreted as that the problem is placed on the supplier side and not on the customers’ side. By contrast, some observers argue that customers are not a problem, but a driving force. For example, Berit Gullbransson (CEO of Swentech) told the magazine Ny Teknik: “There are customers that are technology driven. There are customers who ask for new solutions.” (Karlberg, 2010).

6. What does the research literature discuss about cleantech barriers?

Cleantech barriers address a broad spectrum of factors which can include elements attached with mechanisms that generate obstacles for cleantech companies with export ambitions. Hence various types of barriers can be recognized as relevant for cleantech companies (cf. Carlbrant and Hedin, 2010). A literature review on market entry barriers identifies exogenous barriers (e.g. cost advantage, product differentiation and government policy) and endogenous barriers (e.g. incumbents increased advertising, sales promotion or price competition) (Pehrsson, 2009).

Hemel and Cramer (2002) identified barriers and stimuli for eco-design in 77 Dutch customer SMEs. The most salient barriers were ‘no clear environmental benefit’, ‘the company does not feel responsible for realizing the option’ and ‘realization depends on available technical possibilities; there are currently no proper alternative’.

Gerstenfeld and Roberts (2000) indicated a high awareness among SMEs about green management but identified barriers in terms of a lack of competence, expenses involved and non-appropriate standards for SMEs.

Woolman and Veshagh (2006) reported a number of surveys that identified drivers and barriers faced by UK manufacturing SMEs in moving towards environmentally conscious design and cleaner production. The survey results indicated a consistent view that the majority of SMEs found it difficult to adopt green management because of the perceived high costs of investing in such changes, lack of capital or long pay-back, particularly given a lack of customer demand. It is noteworthy that the study recommends support that addresses the barriers of lack of in-house expertise. Market orientation is emphasized as: “both current and future customer / market signals to find sources of value in addressing environmental aspects in products and production” (ibid.:286).

In brief, current research on cleantech barriers calls for several perspectives which jointly account for issues of competence, market orientation and institutional factors. Entry barriers (exogenous and endogenous) influences the companies market strategies in an interactive way (Pehrsson, 2009). This put attention on how companies can achieve a fit between entry barriers and marketing strategy. In addition, questions about competence and resources are put on the agenda.
7. Proposal for a critical view - and a holistic mix of four perspectives

Our assumption is that the problem in the cleantech business primary is about competence, not least matching R&D and customer's demands. This calls for a more elaborated understanding of relationships between factors that influences barriers and resources to outline competitive market strategies. We have discussed some policy reflections on what the problems or barriers for expanding the greentech business might be, and we suggest that a multi-view is needed to identify such barriers. Therefore we propose a mixture of four views as a frame of reference: a) resource-based-view, b) market orientation, c) cluster view and d) institutional view. Our message is twofold. First we suggest that academic (critical) thinking can contribute to a deeper understanding of the problem. Second, we propose that it is important to combine different perspectives to understand the problem.

The resource based view

In the so-called resource based view (RBV) a company’s resources determine the competitive advantage (Wernerfelt, 1984; Barney, 1986a and 1986b). Originally built on the theory by Penrose (1959), the increased knowledge of resource utilization will lead to specialization of various resources used. This specialization refers to the underlying knowledge-base of resources and capabilities and not to the specific end-outcomes as final applications, products and services.

A firm’s ability to create value to its customers and to society is dependent upon its resources and also how these resources are the managed. The skill to acquire, leverage, structure, bundle and re-bundle the resource-base into refined useful capabilities to provide customer value are within the RBV-perspective regarded to determine the firm's ability to act on the market and its competitive advantage (Schultz & Hofer, 1999).

It is important to understand that a firm does not need to acquire or own the resources. In different forms of co-operation companies can use others resources and in reality have similar resource-base as a large companies (Bjerke & Hultman, 2002). Both lack of suitable resources and human actions (management skills) to co-ordinate these resources appropriately is one type of barrier to a successful commercialization process.

Hence, when discussing barriers to commercialization process of potential innovations it is important to develop an understanding about the following aspects: the amount of available and suitable resources, as well as the managerial capacity to leverage, organize and use these resources.

The market orientation view

This is not the place to discuss the origins of modern marketing, however, fundamental constructs such as the marketing concept can be traced back to Adam Smith’s (1776) discussion about making the customer the focus of businesses. To focus on customer needs, to co-ordinate firm’s efforts toward value-creation and to be profitable in a market exposed to competitor’s actions. We regard this as important aspects of the marketing concept.

One of the classic constructs reflecting this in modern mainstream marketing is market orientation (Naver & Slater, 1990; Kohli & Jaworski, 1990). We see this construct as the starting point for our discussion of applying a marketing perspective on barriers to commercialization of potential innovations.

Naver & Slater (1990) argue that market orientation is constituted by three components (Customer orientation; Competitor focus and Cross-functional coordination). In their view market orientation affects a firm’s core capabilities (customer service; quality; innovation)
that in turn affects the firms’ “Competitive advantage” (customer loyalty; new product success; market share) overall leading to “Business performance” (profitability; sales growth).

The learning aspect of market orientation is further stressed by Slater & Naver (1995). A market oriented firm focuses on the ability to continuously collect and evaluate the buyer’s needs as well as the capabilities of the competitors and other actors in the market place. An organization that favours learning has a competitive advantage compared to others, because of its capabilities to create superior value to customers is difficult to imitate in turbulent and dynamic environments.

Sustainable market orientation (SMO) (Michell, Wooliscroft and Higham, 2010), emphasize a green marketing approach. In alignment with the shared value perspective, SMO moves beyond the trade-offs between satisfying cost-efficient conscious customers and ecological concerns. SMO outline management principles based on socially and environmentally responsible value systems. Consequently, one type of barriers to commercialization can be traced back to lack of elements related to the dimensions of market orientation.

The cluster view

One background to the cluster analysis is the idea of so-called industrial districts, a concept Alfred Marshall launched in 1919. He related mainly to areas in cities with the densification of certain types of professional activity, such as jeweler. Marshall noted that the geographic concentrations of firms or industrial investments contributes to a) facilitate labour specialization, b) facilitate the development of specialized inputs and services and c) enable and facilitate the transfer of technology, information and tacit knowledge (experiential knowledge).

Michael Porter’s diamond model (1990) has been seen as successful approach for analyzing clusters. It consists of four components: Factor conditions; demand conditions; related and supporting industries; and firm strategy, structure, and rivalry. Factor conditions are people, money and machines, but also knowledge and infrastructure. Demand conditions are mainly about the domestic market for products or services for a particular industry. Porter points at the importance of the presence of demanding customers in the domestic market. The third part of the model is the presence of clusters of complementary services and products to the central sector. The fourth main component is the structures of the industry. These include factors such as industry structure and rivalry, but also potential entrants.

Interest in clusters has increased in recent years, both among practitioners and researchers (compare Becattini, Bellandi and De Propris, 2009). A recurrent theme has been how local forces interact with the world - and how this interaction can enhance the welfare and development. The basic idea is that companies are most successful if they "do everything by themselves." The key to success is related to collaboration.

A note on the institutional view

There are many different kinds of theories under the headline “institutional theories”. In this paper we refer to the theory developed by Nobel Prize winner Douglass North. In the book The Rise of the Western World - A New Economic History (published 1973), North and Robert Paul Thomas developed the thesis that the West's growth largely was related to the institutions and especially the protection of property rights.

The book focus on institutional changes and their effects. The basis of western institutions, especially property right protection was due to the formation of nation states, which gradually brought about a uniform law. But a series of support structures - largely developed in England
and Holland - contributed to the favourable climate. These include limited liability company laws that reduced the personal risk and enabled the financing of future investments. In addition, business combinations (mergers) and regulations relating to this, favoured the climate because it helped to take advantage of economies of scale. Patent and trademark laws increased the incentives for efforts aimed at creating innovations. North says that the institutions are not solely the public authorities and the like. Equally important are habits, norms, values and formal regulations. In his own words: "Institutions are the same as the rules of the game in a society or, more formally expressed, the restrictions people put up to indicate the forms of human interaction." (North, 1990, p. 16).

What is the difference between institutions and organizations? Both phenomena can be seen as structures affecting the interaction between people. North might have replied that organizations are the players, while institutions are rules of the game. Institutions can be looked upon as both success factors and barriers to commercialization.

**Synthesis: The CRIM frame of reference**

In our opinion all research and understanding depends about perspectives. We think it is fruitful to use more than one perspective when trying to understand the issue in question. Therefore we propose the following perspectives in our combination frame: the Cluster view, the Resource based view, the Institutional view and the Market orientation view, we call it the CRIM frame of reference (see figure 1).

![Figure 1. The CRIM frame of reference for understanding cleantech barriers.](image)

The four perspectives are not distinct and mutually exclusive lenses. Instead, these are complementary views that operate from related standpoints and reveals critical aspects of cleantech business factors. First, the cluster- and institutional view encourage a macro-level outlook. Cluster-propelled governance mechanisms of collaborative arrangements addressing resource complementarities and specialization mirror the framing of institutional norms, business recipes and industry wisdom among companies. Secondly, the resource-based and market orientation view jointly represent a micro-level outlook. The rational for combining the resource-based view with an market-oriented view stresses the iterative learning-relationship between resource development and market exchange.
8. Learning’s from reality

Case illustration 1: The Stirling Sun dream engine

In 1816 Robert Stirling invented an engine that made use of differences in temperature and produced mechanical motion without the need of a steam boiler and thus avoided the risk of explosion. However, it turned out to be hard to create this dream engine in practice, partly because it contains a gas at the same time as it undergo temperature shifts. The Stirling engine was forgotten in the 1920s because of the rise of the electric motor and the combustion engine.

In 1938 the Philips Company started a Stirling project. After developments, production started in 1951. There were 150 engines produced but they soon understood that the price would be too high.

In the late 1960s a person in USA whispered to the Swedish Embassy in Washington that Sweden had underestimated the military capacity of some potential enemies. The signal led to the conclusion that Sweden should boost the submarine program. Equally important was the fact that Sweden wanted new future export products. The two arguments harmonized.

Part of the strategy was Stirling technology. Therefore United Stirling AB was established in 1968 in Malmö by FFV (United Defence Works, Linköping site), Kockums and Husqvarna. The platform was built on a licence agreement with Philips and the target applications were submarine engines but also bus engines and auxiliary power units. It was a time of big visions!

Many projects were conducted in the early 1970s, but commercialization was sporadic. One engine, called V4X-30, saw its birth in 1972. It was based on double acting operation and had a sliding seal instead of the Philips solution of seal. This was an important improvement. Another project was the very small V160 engine, developed 1973-74 in Linköping. This engine had two cylinders but was single acting. It was aimed for electricity generation in the army and for Televerket, but this solution resulted in nothing but two generator wagons. Another applications area was using the engine as an electric generator in mobile homes and yachts in USA.

Still another engine project was the 4-95 Mark I. The development started 1978. This engine had 4 cylinders. It was tested in an Opel Record car and was shipped to USA to be used in a NASA-sponsored project. At the end of this project the interest for car applications faded away. Initially, the strategic idea was to use this engine for submarines. However, the 4-95 Mark I engine turned out to be not as quiet as demanded from a submarine point of view.

Interesting enough, it was during the work with 4-95 Mark I, the idea of solar power came up. Many individuals got caught of the vision to use Stirling engines for creating electricity by means of only the sunshine. Also in USA there was an interest for that vision. The breakthrough project became a partnership between United Stirling and Georgia Tech, who had a solar plant in Atlanta in form of plane mirrors pointed at a tower. The first modern Stirling engine to produce electricity from solar energy to the grid was set up in 1980.

The activities included high-technology, and involved many business partners in Sweden and elsewhere. A whole Stirling cluster emerged. This cluster later ”begun to live a life of its own”, such as former United Stirling employees opening new companies.

Kockums continued in the submarine area. But many of the other application areas continued to develop in different forms. In 1983, the German architect company Schlaich, Bergermann und Partners started to use Stirling engines for solar plants by means of a licence from United Stirling. Later on they requested a smaller engine for new kinds of solar plants. They got information of the V-160 engine, and received a licence. Together with a consultant, they searched for an appropriate manufacturer. In Sindelfingen, Germany, they found the
company Solo Kleinmotoren who was equipped with an international service organization suitable for the Stirling adventure.

Solo Kleinmotoren started to manufacture the engine in 1990. The venture got funding from the German Ministry BMFT (responsible for science and research). In Germany there was a fear of Europe becoming to be dependent on Russian gas. Therefore the country funded pilot plants for new energy production. The pilot plant was established in the University of Stuttgart 1990 and a second in Almería, Spain, in 1991.

Commercial production was, however, not in place yet. By help of a consultant, improvement of the engine started in 1993. Entirely the new Solo engine took 8-9 years to develop, and the improved engine turned into serial production in 2002.

The first customer was Statswerke Kiel AG 2002, and they used gas (not the sun) as heating source. Many other customers followed, also in solar applications. However, the project became no big success regarding investment pay-offs. In 2007 the Stirling division of the company was in bankrupt and the assets were thereafter overtaken by a Swiss investment company.

Back in America many things had happened. Around 1995 the Stirling Energy Systems signed a contract with Kockums regarding the 4-95 engines. The goal was to set up 70 000 solar dishes. Because of the financial crisis it ended up in a smaller project. In 2008, Ireland-based NTR purchased a majority stake in Stirling Energy Systems and the company got new business vigour.

In Sweden new companies emerged in the field. An investment group in Sweden bought the Solo Kleinmotoren Stirling division from the investment company. Based on the Kleinmotoren assets, Cleanergy AB was formed in 2008. All equipment was shipped from Sindelfingen to the production site. This venture is currently taking off.

The revival of the Stirling vision also led to the establishment of Ripasso Energy AB 2008. The company agreed a licence with Kockums regarding the same engine as Stirling Energy Systems. At present time business activities are confidential.

What then about customers to the new Swedish firms? Malmö Stad got interested in the new technology in spring 2008. A year later they bought one plant from Cleanergy and one from Ripasso. Although it was too early, it ended up in one installation of used equipment. Peter Lindqvist commented on why Malmö became an early adapter of the technology: “We
have got around 1000 visitors from all over the world that want to visit our pilot plant. That means lots of hotel nights and other things that are very important for Malmö”.

There were many institutional factors affecting the process. Some of them were connected to X factors. One such factor was the nine eleven events in New York and Washington that resulted in an international foresight project with the mission to create small-scale solutions to replace the big energy plants that were fragile in a terrorist perspective (the EurEnDel project). The national agency for energy in Sweden wrote a report in 2006 based on the EurEnDel project, published in 2004. The interest about new sources for energy was also affected by big weather storms in Sweden that had shaped a debate around energy fragility. In that report Stirling technology was mentioned, however, in combination with biofuels and not sun-energy. Besides that, Al Gore’s documentary *An Inconvenient Truth* had made the world think green solutions. The increased societal interest about cleantech companies resulted in some funding for the companies mentioned above.

This is a very condensed summary of the case. We will present an extensive version of the case at the website www-global-vision.se. The conclusions that will follow soon are based on the whole case study material.

*Case illustration 2: The Aerosoltrap™*

In 1998 Conny Normann was living in an apartment in Örebro. His kitchen fan had to be checked every year by a certified technician to ensure that the fan and the ventilation system were not being clogged. Once, just shortly after the regularly check, it seemed that there was still fat in the fan. Therefore the technician was asked to come back for another check and he found fat dripping from the fan when opened. This triggered Conny to wonder if there were other ways to solve the problem.

He started to think about how cleaning systems in the nature works and realized that lakes and rivers are cleaned according to the physical laws of nature. What happens when a creek or a river is winding its way through the landscape? In some areas the water has a fast pace and in others it slows down and then mud and other particles sinks to the bottom. Could it be the same in a fan and a ventilation system if we force the airstream to different speeds? If this was the case, there would be a chance that the fat would stay where speed was slowing up. Based on this insight, Conny realized that his ideas might lead him to really exciting challenges.

He soon began to cooperate with a local sheet-metal shop to develop a prototype. It was a box with an ingoing and an outgoing pipe and with some metal sheets in different formations inside the box. The construction with the sheets in different positions was aimed to force the fume to alternately accelerate and slow down. When testing the prototype it was confirmed that the principle was correct. In certain areas the fat got caught on the plates.

The ideas got a general patent on the method and the process, but not the actual product. This allowed the Aerosoltrap™ (former “The fat-trap”) to be used for many different application areas (e.g. liquids, gas and applicable for a variety of solid particles). The time had come to test it in a greater scale.

The prototype was demonstrated for the franchiser of a McDonalds restaurant who became very interested and decided to test it. This restaurant (like other restaurants) had big problems with fat in their fans and ventilation systems. If anyone could help them to get rid of the fat in an easy way it would be great.
McDonalds and a new manufacturing partner, a sheet metal shop, were going to pay half each for the cost of the installation and Conny’s contribution was to work as a consultant for free. Five copies of the box were made and testing in a larger scale begun. At once it was obvious that the fat was fastened on the plates but another problem occurred -how to get the fat out from the trap?

Several different companies were involved trying to find a solution to the cleaning problem. Traditional cleaning agents were used, a special type of enzymes, and cleaning agents used in the forest industry. After four years of experimenting they finally found an effective cleaning agent. At this point the project had only generated costs, and McDonalds and the sheet metal shop paid just enough to cover the yearly patent fee.

In 2005 the sheet metal shop was dropped and a local sheet metal factory became a new partner. This partner could produce the aerosol trap for a third of the costs compared to the local sheet metal shop. Now the system was installed in about 10 fast food restaurants and the partner had developed an effective system for a quick and simple installation process.

Additional testing was documented by a researcher from Mid Sweden University and the results was blinding. A sweep was so impressed that he invited Conny to introduce the Aerosoltrap™ to the development unit for the sweepers association. Shortly after this Conny had a briefing with officials from the Defence department and other authorities. These contacts with institutional representatives ended up in additional formulations in national laws of environmentally appropriate ventilation systems.

After some discussions with the sheet metal factory, a partnership agreement was signed in 2006 and they anticipated a huge customer demand. However, there were no orders coming in. Just as the partners were ready to start production in a larger scale McDonalds decided to go further with an alternative method, based on new ozone based cleaning agent.

Out of luck in the fat cleaning ventilation business Conny turned to the pharmaceutical industry in hope of better luck. In fact he received great interest from one of the large Swedish actors. At the same time technical tests were made at the University of Örebro. These tests showed amazing results and cleaning effects high above pharmaceutical industry standards.

![Figure 3. The Aerosoltrap.](image)

When this is written, in spring 2011, signals from restaurants indicate problems with the ozone based cleaning agent because the technique involves possibly harmful nano particles. Might McDonalds move their interest back to the aerosol trap? Recent tests at a distribution center for distance heating seem very promising. And how about the pharmaceutical industry? Is there a chance that they decide to use this method because of the outstanding test results? We don’t know. What we know is that more than ten years of product development and testing shows outstanding results in different environments. But so far the commercial endeavor has only generated costs and empty wallets.

9. Conclusion and discussion

We should end up by briefly investigate if there will be any differences in what barriers that are identified depending on the perspective of investigation. The four previous presented perspectives and different barriers are put together in a table and thereafter shortly discussed.
Table 1: Discovering barriers using different perspectives

<table>
<thead>
<tr>
<th></th>
<th>Macro</th>
<th>Micro</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Institutional</td>
<td>Cluster</td>
</tr>
<tr>
<td>Home market is too weak</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Lack of venture capital</td>
<td>(x)</td>
<td>X</td>
</tr>
<tr>
<td>Customers want large quantities</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Customers hard to reach</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unsufficient knowledge of market</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customers inertia</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>No clear environmental benefit</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Unsufficient network contact</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of customer demand</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Lack of inhouse competence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High investment costs</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Lack of appropriate solutions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of responsibility to realize option</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Technology not fully developed</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Costly to demonstrate to customers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Institutional and cluster factors can be seen at macro level and market orientation and a resource based view from a micro level. All factors in the table are summarized through a brief literature review, opinions of policy-makers and cases. Although this is far from all factors and far from a finished model, it seem appropriate to use different perspectives in a composite perspective model as substantial elements of the barriers would be unidentified with too few perspective.

In the case of the aerosol trap the product is a generic and patented problem solution that is applicable to a variety of user contexts. The barriers relate to non-adequate network contacts as regard to specific industry clusters. Barriers can be identified as the technology needs to be further developed by potential customers and also to consider costs associated with prototyping. A fully functional product had been commercialized for a number of McDonalds restaurants but the customer currently doubts further purchases because of alternative options at hand. Prototype products had also been developed and tested with academic researchers and through this process experiential knowledge was gained. This documentation signified a qualifying criterion for future partnering interests. In addition, customer inertia in accepting this new technology was emphasized. One conclusion is that brave visions not always come true. Overcoming barriers in reality turns out to be more difficult than people believe.

From the cases we learn that the success of innovation is not only to place a product on the market, but to succeed in R&D payoff. Innovation can be defined as the development and commercialization of new products in a way that revenue match development costs so as the
venture become economically sustainably. Robert M. Hunter, Registered Patent Agent, know from experience: “It typically take several times more effort and time to license or sell an invention than it takes to patent the invention and prove that it works.” In addition, making production functioning according to quality and production price can be as much challenging as developing and selling products.

Barriers can relate to the management of existing project. But there are also barriers before a venture initiative occurs at the first place. Someone has to recognize a problem and it is equally important to search and find courses for the solution of the problem. Both these barriers are connected with brilliant thinking as well as information searching capability. The result of information searching sometimes is the connection between different companies and individuals. From the Stirling case we learn that cluster dynamics is not only about a couple of cluster actors or participation activities. Equally important is the cluster leader (and the cluster leadership organization) and political or other financial backers.

A third barrier-factor related to institutional conditions also plays in: external events including “X factors”. Compare the oil crisis in relation to energy research investments in the 1970s. Sometimes, like in the Stirling case, the whole beginning of a venture has to do with political decisions paving the way for lots of funding and specific targets.

As can be seen, a combination of perspectives opens up possibilities to more thoroughly examine barriers for cleantech ventures.

References


