

# “CONCEPTUAL FRAMEWORK FOR AN R&D COOPERATION MODEL IN SMES”

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## Abstract

*Europe’s small and medium-sized enterprises (SMEs) are the largest economic factor both in terms of their frequency and with regard to employment levels. However, when measured in terms of R&D expenditure, they lag well behind large companies. SMEs either have no time for innovation or simply lack the right personnel, infrastructure and financial means. This is often compounded by a lack of contact with research partners within the innovation network or the fact that the risk of innovation is too high.*

*We developed an R&D Cooperation Model based on a number of various R&D projects and the Stage-Gate® model by Robert Cooper. This model can be used to plan, realise and manage SME innovation projects and research partnerships between qualified research partners and SME. We show two examples as a concrete proof how the model is implemented.*

*SME achieve various benefits from such cooperative R&D partnerships. Projects are attractive in pricing terms as the majority of the work is carried out by students, the qualified research partners are well linked to one another, and SME can call upon a one-stop shop for their R&D management. The R&D Cooperation Model is still largely a theoretical conceptual framework which needs to be validated in the form of an international, multi-sector, Europe-wide empirical study.*

## I. INTRODUCTION

Economic growth in Switzerland has been stagnant since the 1990s. Growth of 0.9% was measured between 1990 and 2000 (Federal Statistical Office (bfs – Bundesamt für Statistik), 2004; Eisenhut, 2004, p.121). According to the 2001 census, small and medium-sized enterprises (SMEs) are measured according to their frequency (99.7% of all companies) and their significance for the labour market (66.8% of all employees work at an SME) and form the main pillars of the Swiss economy as well as being a guarantee for current and future growth (bfs 2001)<sup>1</sup>. However, if you compare their R&D expenditure with that of large companies, a sobering picture emerges. SMEs make up just 16% of the

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<sup>1</sup> Europe demonstrates an almost identical scenario, meaning that European SMEs are key factors for strong growth, more and better jobs – the two main goals of the Lisbon Strategy: A Partnership for Growth and Employment. They represent 99% of all companies in Europe, generate over two thirds of the European gross domestic product and employ around 75 million people in the private sector (European Commission, 2007; Caputo et al., 2002).

total annual R&D expenditure (bfs 2000). Of this figure, most of the companies are growth-oriented SMEs striving for economic or social importance rather than firms aiming to secure survival, prestige or status (Schumpeter, 1934, p. 122pp.; Wagner&Ziltener, 2007) This is accompanied by the fact that, in Switzerland, state expenditure for basic research is around four times the amount spent on applied research and development; in other countries it is the other way round (bfs, 2004; Hallauer, 2005, p. 31).

Several empirical studies found that half of all product developments do not reach market maturity due to insufficient knowledge of the market and requirements, incorrect cost estimates, inadequate analysis of the competition or poor timing. Even more surprising is the fact that only 22% of the cases fail during actual development (Cooper, 2001; Cooper & Kleinschmidt, 1987; Cooper & Kleinschmidt, 1993). On the other hand, the Swiss Innovation Promotion Agency (CTI – Commission for Technology and Innovation), which is part of the Swiss Federal Office for Professional Education and Technology (BBT – Bundesamt für Berufsbildung und Technologie), mainly finances projects during the development phase. A similar scheme is also in force for EU funded projects within the scope of the 7<sup>th</sup> framework programme under the title “FP7 Capacities Work Programme: Part 2 - research for the benefit of SMEs”. Equally of interest is the fact that R&D costs are neglectable when compared to other factors such as deviations from projected production costs or the speed of bringing new products/services to market (Holman, Kaas & Keeling, 2003).

The ability to innovate is one of the most complex and yet most important management tasks (Brockhoff, 1999; Hauschildt, 2004, mtr, 2000). By the same token, economic pressure is increasing drastically as a result of short innovation cycles and supply periods, and due to a simultaneous increase in the required quality and functionality in the wake of permanently sinking market prices (Eversheim&Krah, 1998, p. 31). R&D partnerships (open business) can be used here as a way out (Chesbrough, 2007a, p. 24) by way of which SMEs need a compatible interface (responsible contact person) to the cooperation partners, as R&D partnerships require mutual trust that extends far beyond any legal framework (Wolff et al., 1994, p. 17).

Based on the initial situation described above, the following four issue / question formulations can be derived:

1. What are the reasons for the lack of innovation among SMEs?
2. What steps and stages need to be passed through to convert ideas into products and services that can be marketed?
3. How can qualified research partners such as universities of applied sciences, universities, laboratories and state testing centres support SMEs?
4. What experiences have there already been in terms of cooperative R&D projects?

We will attempt to answer these questions in the corresponding order in the following sections. In conclusion we will sum up the points and provide an outlook for further work.

## II. REASONS FOR LACK OF INNOVATION AMONG SMES

Imagine an entrepreneur at a successful SME in the machining industry who goes for a walk with his family and a good friend and his family one Sunday afternoon. The friend is the general manager of an industrial company with some 4,000 employees. During their walk the two friends discuss various innovative ideas. When they get home both of them agree that the ideas have a genuine opportunity of gaining market maturity status. They also agree that both ideas have huge sales potential. The following happens on Monday morning: The first thing the general manager does is call his development manager and commission him to carry out preliminary investigations, such as market and competition analysis as well as a small feasibility study, to sound out the idea formulated the day before. Our entrepreneur, however, probably has few options available to him on Monday morning. Instead he has to take care of the day-to-day business that will occupy him for the rest of the week, leaving no time for innovation management.

This example is designed to demonstrate that SMEs with no R&D department are faced with an innovation obstacle. We are now faced with the question of which other basic differences are there between large and small companies in terms of innovation management. What are the possible reasons for SMEs not carrying out R&D activities to the same extent as large companies?

These obstacles, which also apply to growth-oriented companies, were observed in numerous projects (see the annexed project list) that were initiated, planned and supported by the Swiss Institute for Entrepreneurship SIFE of the University of Applied Sciences HTW Chur as a form of outsourced R&D management. Theory and empirics state the same reasons for a lack of innovation among SMEs. The most important obstacles are summarised below:

*Firstly*, in many cases the management of SMEs have little or no time for innovation. Entrepreneurs are absorbed in their day-to-day business to such an extent that they can only deal with R&D as a side activity. This means that they invest the majority of their time in acquisition tasks, staff management or managing supplier relations. In the end, all general management functions such as planning, controlling, organisation and management are combined into one person (Wolff et al., 1994, p. 8; Minder, 2001, p. 80).

*Secondly*, innovations require special resources such as suitable personnel and infrastructure. In particular, this means expert scientists, highly specialised equipment or laboratory facilities that an SME simply does not have access to. Added to that is the funding requirement which, depending on the risk level of the innovation, may have to be invested without any chance of getting it back (Wagner et al., 2006, 12; Minder, 2001, p. 80; Caputo et al., 2002).

*Thirdly*, SMEs often do not have the necessary contacts to research partners within the innovation network and in some cases lack the necessary knowledge within the company itself. Even knowing how to complete the form to apply for subsidies from various promotion agencies is not something an SME can do on its own. What appears to be much more important here is the fact that an SME rarely has an overview of the individual subject areas of qualified research partners, such as universities, university institutes, test

centres and research institutes (Wagner et al., 2006, p. 15; Wolff et al., 1994; Caputo et al., 2002).

*Fourthly*, it can be presumed that SMEs always implement innovations when they are realisable from their own point of view and entail a financially limited and calculable innovation risk. If the innovation risk is too high, i.e. if the entrepreneur is not sure whether the idea can be implemented and whether the market will accept an innovative solution to a problem, he will not develop and push the innovation (Chesbrough, 2007b; Acs&Audretsch, 1992; Minder, 2001, p. 80ff.; Caputo et al., 2002, p. 274).

To summarise, SMEs demonstrate of a lack of innovation when compared to large companies for the following reasons:

- No time for innovation
- Lack of suitable personnel, infrastructure and financial means
- Lack of contact to research partners within the innovation network
- Innovation risk is too high

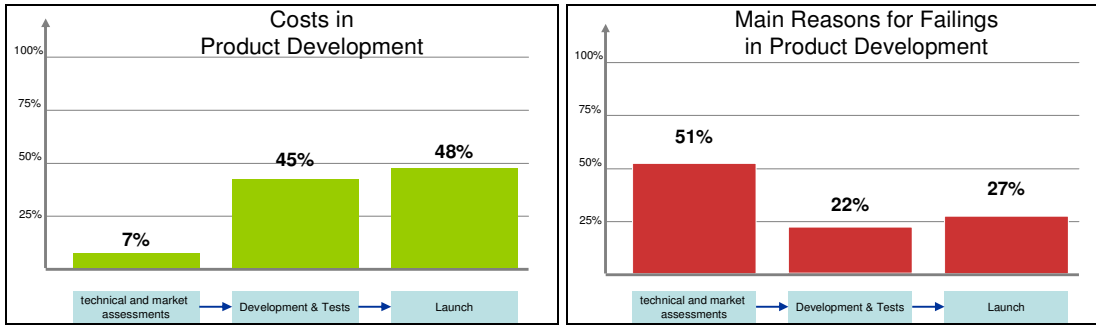
The following section will present a tried-and-tested approach with the aim of demonstrating which general steps and phases need to be passed through during product innovation in order to create targeted innovative solutions to problems.

### **III. STAGE-GATE® MODEL**

The Stage-Gate model® developed by Robert G. Cooper is a tried-and-tested approach frequently used during the development process of new products. To empirically develop and establish the Stage-Gate® model, Cooper and his staff carried out several detailed studies over many years to ascertain the reasons why certain new products are successful and why some fail. During the course of their studies, they identified 13 key activities in the product development process. With failed projects they assessed the quality of the execution of key activities in order to identify causes for the failure. The weakest link in the chain of key activities was attributed to insufficient market orientation. In 22 per cent of failed projects, no detailed market research was carried out and in a further 45 per cent of projects the market analyses carried out afterwards were considered insufficient. Activities such as test marketing and test sales, product launch on the market and detailed financial and business analyses were also seen as being inadequate (Cooper, 2001, p. 27)

Particularly surprising about these results is the fact that the relatively low-cost key activities at the start of the process are often carried out insufficiently or not at all. Based on a lack of or imprecise groundwork, the significantly more expensive follow-up stages are carried out with the naïve belief that it will all work out in the end.

This situation is illustrated in Figure 1 by means of a highly simplified product development process consisting of just three key activities (in the style of Cooper, 2001).



**Figure 1: Costs and Failings in Product Development**

Other studies (quoted in Cooper, 2001, p. 53) that also investigated successful and failed product developments prove that success in developing innovative products is not just a question of luck. On the contrary: A well-defined product development process, the quality of implementing the stages in this process, the players involved, sufficient allocation of resources, interdisciplinary teams and, last but not least, an explicit innovation strategy are the crucial factors that separate a successful company from an unsuccessful one.

Based on these findings Cooper identified 15 factors that are critical for the success of the product development process. He used these factors to develop requirements for a generic innovation process. At the core of this is the perspective that product development process management is nothing other than risk management, and that a successful product development process has to be understood as a risk reduction process. A risk reduction process divides the long path from the idea to the product launch into manageable stages. The risk reduction process also aims to reduce input with high levels of uncertainty and to increase input when the level of uncertainty drops. The risk reduction process installs ‘emergency exits’ between the stages, and forces decisions regarding usage.

The Stage-Gate® model divides the innovation process into five development stages, from the idea through to product market launch.



**Figure 2: Stage-Gate® Model (Cooper, 2001)**

Test gates for decision-making intervals have been added in between the development stages. These test gates force the user of the model to continually assess the progress of the product development process, to compare the results with the goals originally set, and to make clearly reasoned decisions as to whether the process should continue or not.

#### IV. COOPERATION WITH UNIVERSITIES

The Swiss Institute for Entrepreneurship SIFE at the HTW Chur has developed a bottom-up conceptual framework for R&D partnerships between SMEs and qualified research partners. The model is based on the theoretical framework of the Stage-Gate model® as well as on existing market needs brought to the institute from SMEs in various branches (see Section 7, experiences and the project list in the annex). During these R&D projects the institute takes on parts of or the entire innovation management. The knowledge gleaned and the innovation services remain within the company. Depending on requirements, knowledge, infrastructure, labour services or services from all kinds of institutes within the innovation network such as other universities of applied sciences, universities, laboratories, Swiss Federal Institutes of Technology and materials science and technology institutes can be brought in to assist the process.

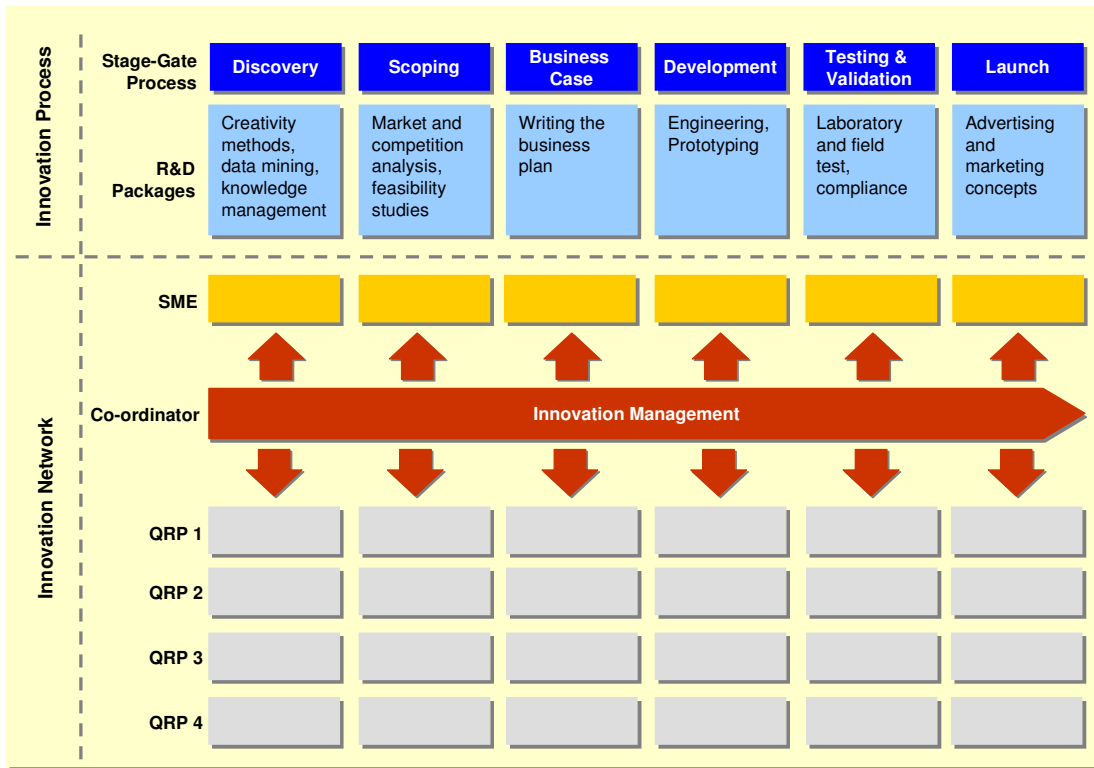


Figure 3: R&D Cooperation Model © Jenni & Ziltener, 2007

For each of the individual innovation process stages R&D packets are bundled for which the various innovation management methods are available. These work packets are worked on in cooperative partnerships by qualified research partners (QRP) such as universities, research institutes, laboratories or test centres and innovation is driven stage by stage. The SMEs’ company management can concentrate on their day-to-day business during this time. It is sporadically involved in the innovation process if for example, decisions need to be made or results are to be presented. The following is a summary of a potential selection of methods.

## Discovery

As already outlined above, innovations can be systematically planned (deliberate innovation) although many innovational ideas occur intuitively and arbitrarily (emergent innovation) (von Hippel, 1988; Füglistaller, 2005).

Many tried-and-tested methods are available to a planned innovation, which for their part can be applied together with qualified research partners:

- Creativity technology (Schnetzler, 2006; Foster, 1998)
- Data mining (Han&Kamber, 2005; Liu, 2007)
- Knowledge management methods (Ichijo&Nonaka, 2006; Bodendorf, 2006)
- Suggestion schemes (Schulte-Zurhausen, 2005)
- The Delphi Method and focus groups (Häder&Häder, 2000)
- Syntegration® (Beer, 1994)

Newer approaches increasingly focus more on scoping the environmental spheres of a company and stakeholders for latent, unarticulated needs that can be satisfied by the new services or products. In doing so everyday rituals, artefacts or verbal communications over longer periods of time are observed in order to draw conclusions about future needs from everyday life (Schütz&Luckmann, 1984). The following main methods are currently in use in the USA:

- Ethnomethodology (Garfinkel, 1967; Sacks&Jefferson, 1992) and as a form of applying ethnography (Genzuk, 2007; see also Intel, 2007).
- Trend research (Ochoa&Corey, 2005; Popcorn&Marigold, 1999)
- Lead user method (von Hippel et al., 1999)

Suitable research partners for these methods are sociological and organisational psychology universities and institutes, universities of applied sciences and arts, future-research centres and private consulting firms.

## Scoping

As Cooper et al. proved during the course of several empirical studies, too little care is taken during this first stage. The initial analyses are critical to the later success of the innovation. Market and competition analysis, compliance and feasibility studies (Michaeli, 2006; Romppel, 2006; Behrens, 1991; Roth, 2005) are all kinds of competitive intelligence that form the central methods used in cooperation with research partners.

Potential partners for cooperation in the Scoping Stage are generally business-oriented universities and research institutes. On the other hand, compliance and feasibility studies should be carried out with the corresponding applied sciences (e.g. electrical engineering and communications technology for ICT applications or banking and finance institutes for innovations in the financial services sector).

### **Build Business Case**

This R&D packet aims to bundle the results of the analyses and to develop these into a business model together with the actual business idea. In doing so the business plans are drawn up, taking the business model into consideration. These plans generally describe the problem that needs to be solved, the market needs and the actual solution. Also included in such plans is information regarding the market, financing, personnel, infrastructure etc. (Cannon, 2006; Hofmeister, 1996). Potential target groups of the business plan include the administrative board, the executive board, banks, investors, customers, suppliers and cooperation partners.

When searching for cooperation partners to draw up the business cases, business-oriented universities followed by schools with an entrepreneurial focus should be approached, as the students and tutors there often have a great deal of experience in generating business plans.

### **Development**

The methods used in development depend heavily on the results that are trying to be achieved. Completely different methods are used when developing medicines when compared to, say, developing software (von Hippel, 1988). Nevertheless, some general methods should be listed that could be used in various phases of the development process. Both the Quality Function Deployment QFD (Akao, 1992) methods and the Failure Modes and Effects Analysis FMEA (Franke, 1989) represent two older but still up-to-date tools to provide a weighted assessment of performance and quality requirements, which can be combined with various customer needs. The results of these two methods can then be translated into individual product features, based on which prototypes are made in specialised development laboratories. Further methods that could be used here include Engineering Data Management EDA and Variant Mode and Effect Analysis VMEA (Schuh, 1999) or Methods of Operations Research (Hillier&Liebermann, 1986).

Regarding the selection of potential development partners, no generally applicable statements can be made, as this is largely dependent on the intended results. What appears to be most important is for partners to have sufficient resources, knowledge, experience and infrastructure to be able to develop the prototypes within the desired timeframe.

### **Testing & Validation**

During the Testing & Validation Stage, the first decision to be made is whether a laboratory test or a field test should be carried out. A suitable test environment must be found to carry out the intended validation procedure. This means e.g. that new avalanche prevention systems can be tested for breaking and tensile strength in a laboratory, while a field test could be used to perform a resistance to weather test on the same system. Integrated quality management now has a multitude of test procedures such as Seven Tools, Seven New Tools, sampling plans, reliability technology, Poka Yoke, assessment, critical path analysis etc. (Seghezzi, 2003).

Cooperation partners for this stage can often be found in state test centre or universities, which have the right infrastructure to perform these specific tests.



## **Launch**

As proven by Cooper et al., the greatest focus in terms of R&D expenditure in the firms they studied occurs during this stage. In a previous study by McKinsey, it could also be shown that the profit gained from a product throughout its entire lifecycle suffers heavy losses if the product launch is delayed (Dumaine, 1989; Holman et al., 2003). But speed is not everything. What is important at this point is an extended marketing mix which incorporates the needs ascertained during the Discovery Stage, links these needs with the innovation features and then brings the entire system to the right customer at a fair price and via the correct channels. Also vital is a suitable form of communication that draws the customer in and points out their need for the product as well as the fact that it is an innovative product.

Institutions with a business orientation, which are heavily involved with marketing, sales and communication should again be sought when cooperating with research partners. Individual marketing and communications concepts can then be developed with these partners. Specialised organisations can also be brought in for test market simulations and interviews, actual genetic, psychomotor and mechanical test procedures, range surveys or for performing consumer panels.

## **V. APPLICATION EXAMPLE**

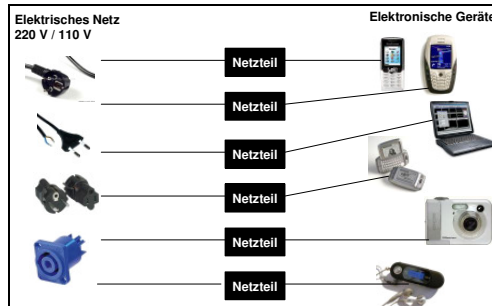
### **Charger for Mobile Devices**

#### ***Partner Company***

The company Polycontact AG ([www.polycontact.ch](http://www.polycontact.ch)) is a medium-sized company based in Chur (Switzerland) active in the areas of micromechanics, sensors and microswitches. The company develops and produces sensors and microswitches for e.g. the automobile industry. This includes production not just involving the highly automated microsystems production site in Chur and manual production in China; it also extends to equipment and plastic moulding. Polycontact's in-house R&D department and high level of production integration mean that it can react flexibly to customer needs and develop customised products, which can then be produced in very large quantities.

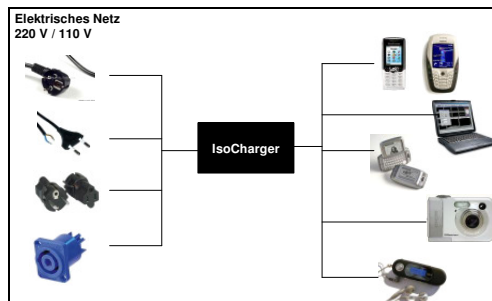
#### ***Description of the Problem***

We all know the problem: Every electronic device (mobile phone, organiser, notebook, MP3 player etc.) is supplied with a mains charger that has a proprietary output voltage, proprietary output current and proprietary plug. The flood of electronic devices, whether wanted or not by the customer, is accompanied by a huge, unwanted deluge of mains chargers. Consumers do not see why each device has to have its own mains charger. From a technical point of view, too, there is no reasonable explanation for this.



**Figure 4: Problem**

The aim of the “IsoCharger” project was to develop a standard mains charger (IsoCharger) for electronic devices. The mains charger to be developed should replace the manufacturer’s own mains charger.



**Figure 5: Solution**

### ***Project Background***

In May 2005 Polycontact contacted the University of Applied Sciences (HTW - Hochschule für Technik und Wirtschaft) in Chur with the aim of developing with students various solutions to the problem described above. The initiative originally came from the owner of Polycontact who was sick and tired of carrying round all kinds of cumbersome mains chargers and adapters when on business trips.

A further meeting with Polycontact took place on the SIFE’s initiative. The problem was discussed and an opportunity for a cooperation was drawn up. After ascertaining the internal resources available, the SIFE produced a tender and a project plan. The tender and a non-disclosure agreement were then signed on 29 June 2005.

### ***Project Offer***

A master plan for the overall project and a project plan for the pre-project resulted from the meetings. The aim of this pre-project was to provide basic information by means of a market and needs analysis report and to investigate potential technical solutions in order to achieve a go/no-go decision to develop a new business segment. If given the green light, the master plan would then involve a detailed business plan, which would then develop the IsoCharger with support from CTI.

The pre-project consisted of project management, market and competition analysis, customer needs analysis, technical market analysis and the derivation of various IsoCharger solutions.

### ***Project Implementation***

The market and competition analysis, customer needs analysis and technical market analysis were carried out as planned and on schedule from September 2005 to March 2006. A total of 14 students and 3 professors from technical and business departments worked on the project. Whilst all this was going on, discussions regarding a feasibility study were conducted with the Interstate University of Applied Sciences of Technology Buchs NTB in summer / autumn 2006.

The results of the market and customer needs analysis provided clear specifications for the IsoCharger. Following various discussions regarding potential technical solutions involving a professor from the NTB, it emerged that the required usability criteria could only be fulfilled by means of a wireless transfer of energy and information. This finding was contradictory to the original IsoCharger draft. This shift in perspective was the result of a basic analysis of customer needs and assessment of the competition, which was ascertained by means of interviews with universal adaptor manufacturers.

The solution options could not be started in spring 2006 as planned because no students replied to the thesis work offer. The following attempt to place the work with the University of Applied Sciences (HSR) in Rapperswil also failed, as the tender deadline had already passed. The client decided to hand the feasibility study over to a specialised institute. The project manager looked into the options and found an institute in Austria specialising in wireless energy transfer. During the course of the research work, the project manager also came across a product from a company in the UK called SplashPower ([www.splashpower.com](http://www.splashpower.com)). SplashPower has exactly the same properties as IsoCharger and is protected by 15 patents. SplashPower was not identified during the previous competition analysis because “wireless energy transfer” was not looked into. As a result of this the IsoCharger project was abandoned.

21 meetings took place during the course of the entire pre-project stage. One or more employees from Polycontact were involved in 13 of the meetings.

### ***Adaptation of the R&D Cooperation Model***

The following diagram shows how the work packets are embedded in the R&D Cooperation Model. The work packets with a red background were carried out as part of this project. The idea derived from the SME itself. The SIFE assumed coordination of the entire project and was responsible for carrying out the pre-project. The pre-project consisted of several business work packets (SIFE) and a technical work packet (NTB).

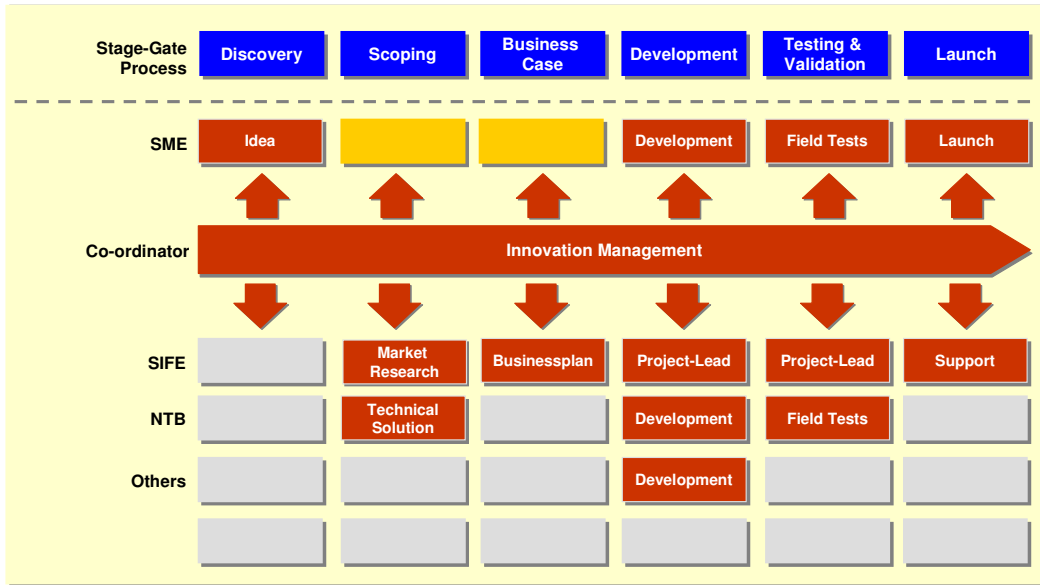


Figure 6: The IsoCharger Project in the R&D Cooperation Model

**Drive Belts**

*Partner Company*

The partner companies of this project can only be described very briefly for confidentiality reasons. The main partner company is a Swiss SME with around 20 employees. It is a global market leader with a niche product in the textiles industry. Two other partner companies are also Swiss SMEs with 40 and 3 employees, respectively. The fourth partner company is a French SME with around 120 employees.

*Description of the Problem*

Drive belts are used in conveying technology and excavation machinery. Drive bands currently used are made of plastics that are strengthened with nylon. The negative properties of this material include creep behaviour when under stress and a relatively low tensile strength.



Figure 7: Drive Belts in Conveying Technology

The creep behaviour means that the belts have to be shortened from time to time as the clamping mechanism cannot accept the belt's change in length when under stress. The low tensile strength means that the drive belt often rips and generally leads to a low lifetime. Both of these factors cause high maintenance and operating costs.

The innovation project aims to replace the nylon carcass in the drive belts with new types of textile fibres that are much stronger, and thereby double the lifetime of the belt with a maximum price increase of 30%.

### **1.1.1 Project Background**

Dr. Martin Bundi initially contacted the SIFE of the HTW Chur in February 2005. Dr. Bundi knows the Swiss innovation promotion agency KTI/CTI inside out as the CTI promotion act was passed under his National Council Presidency (verbal information from Theo Bearth). He was also a regular participant at the HTW Chur knowledge transfer events and has thorough knowledge of the knowledge transfer and innovation promotion activities of the SIFE.

Dr. Bundi learned of a business partner's idea of developing something innovative in the drive belts sector from Theo Bearth, a former employee of the European Patent Office in Munich who, after retiring, founded and actively manages a technology transfer office. But the idea lacked a university partner in a position to align a CTI project with several partners. This provided the innovation idea's link to both the SIFE and the business partner.

#### ***Project Offer***

After just two meetings in Chur involving the two brokers and two business partners the master plan was already in place and a rough project design was accompanied by the decision to submit an application to the CTI. The master plan involved splitting the overall project into a pre-project and a CTI project. The aims of the pre-project were to draw up an application for the CTI with the goal of getting it successfully through the evaluation procedure and then develop a detailed business plan for the future product. The aim of the CTI project is to develop a prototype of the new drive belt.

#### ***Project Implementation***

The SIFE headed the pre-project. One critical activity in a pre-project of such complexity involved the search for suitable partners. University partners with the corresponding competencies had to be sought, evaluated and recruited for the project by the time the CTI application was successful. Two other business partners able to cover the critical activities along the value chain during production of the drive belts were also missing. The search had to be coordinated and negotiations had to be carried out. A market study and patent research studies had to be carried out, and a project plan drafted in order to submit an application to CTI. The long-winded negotiations regarding the utilisation agreement also had to be organised, moderated and managed. These negotiations dragged on largely due to an institute of technology, which has an internal legal department with a lot of time on its hands, a standardised contract process and extensive guidelines and formalities.

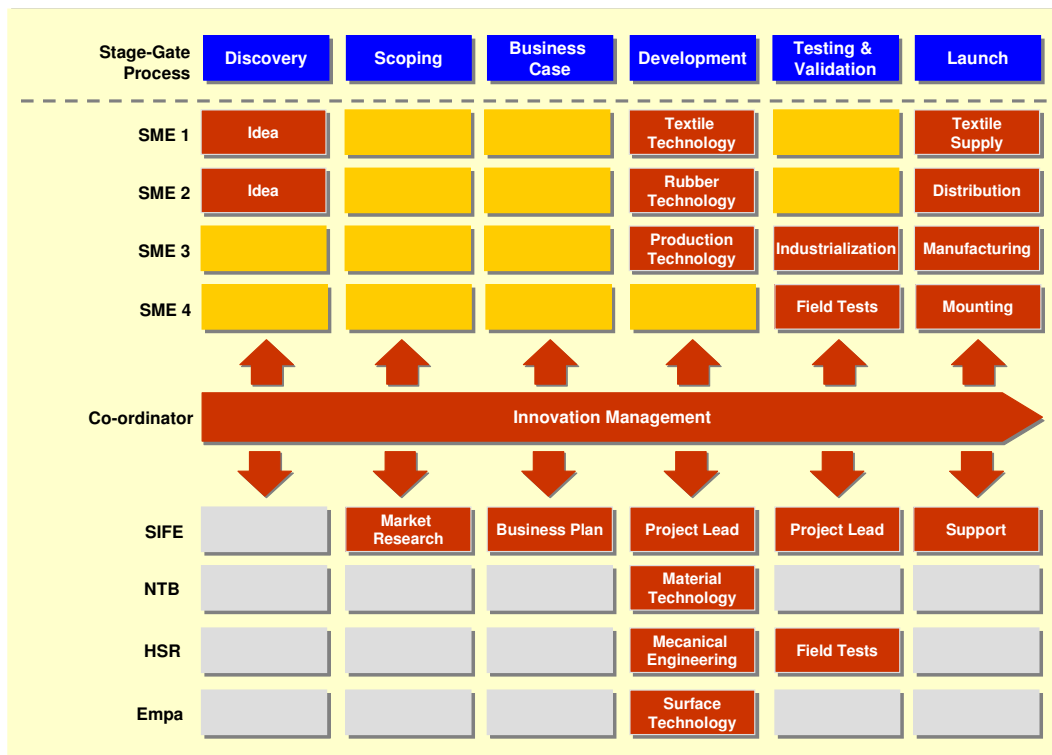
The pre-project went on for more than a year and incorporated around 1,000 hours of work. Around 30 people were directly involved in the pre-project.

At the same time as managing the pre-project, the SIFE organised and supported a dissertation being worked on with a group of business management students. This dissertation led to the drawing up of a business plan for a company to be set up as a result of the project. Contacts to promote business in the Swiss canton of Graubünden were procured, and negotiations to facilitate the set-up of a company were supported.

The project is to last for around three years with a volume of some CHF 800,000. Four University partners and four business partners are involved in the project.

**Adaptation of the R&D Cooperation Model**

Figure 8 shows how the work packets are embedded in the R&D Cooperation Model. The work packets with a red background are being carried out as part of this project. The idea derived from two of the SMEs. The SIFE is responsible for coordinating the entire project and for carrying out the pre-project. The pre-project consists of several business work packets and the development of a business plan (SIFE). Three qualified research partners are involved in the development and test packets (NTB, HSR, Empa). The SMEs are involved in the development and test packets as well as in utilisation of the product.



**Figure 8: The Drive Belts Project in the R&D Cooperation Model**

## **VI. EXPERIENCES**

The initial experience in such R&D cooperation projects compiled in the annexed list show that the model is very well received among SMEs, but contains a few challenges that need to be mastered.

### **Positive Experiences**

The model has been met with great interest among SMEs, as it is highly attractive, particularly in terms of price. Many of the services are rendered in the form of student projects, which in turn entail few costs for the SME. In most cases, the SME only pays for the project coordination costs and any infrastructure usage fees incurred.

The qualified research partners also have a well-developed network within the applied sciences that can be taken advantage of by the SME.

More and more people work on R&D partnerships so that the project can fall back on a whole host of differing knowledge and experience that a single SME is simply unable to provide.

A single point of contact in projects involving several partners arises through the cooperation with an institute, which the R&D management assumes on behalf of the SME. This means that SMEs have a one-stop shop in terms of a virtual R&D department, which plans, manages, steers and controls the innovation from the idea stage right through to the launch.

Qualified university partners have access to subsidies as well as experience in formulating applications for state-funded support services (EU projects, CTI projects, Swiss National Funds).

The creativity and impartiality of students can be used by involving the students in the individual innovation stages. This often leads to solution approaches that are not per se for an SME.

### **Challenges**

Some of the previous projects showed that the Business Case Stage is not necessary at many SMEs because the entrepreneur manages and finances the project him/herself. They also do not need to justify their own project to anyone else, meaning that documentation often seems superfluous to them. Exceptions to this are projects financed via venture capital or banks. SMEs often have little experience when it comes to large-scale market and competition analysis and are thus less inclined to spend money on such things.

The urge to prototype among SMEs was however felt during the course of many of the supported projects. Apparently SMEs do not rate lengthy analyses and studies too highly. For this reason a somewhat pragmatic approach is taken where results count above all. Hence the reason why a prototype or showcase is often demanded, which in turn allows initial feedback to be collected.

Long development periods can be seen, particularly with projects for which the majority of the R&D services is rendered by students. This is directly linked to the universities'

semester schedules, which only allow certain work-study activities during the summer or winter semester. An example of this is the fact that group dissertations aiming to develop a prototype are only carried out at Swiss engineering schools once a year.

Another problem was the insufficient number of and lack of availability of human resources among the qualified research partners. Many of the people involved hold lectureships concurrently with their research and consulting activities, meaning that they can only dedicate their full attention to the project business for limited periods.

The financing required to get new R&D projects off the ground proved to be a challenge among qualified research partners. Many teaching and research institutes had no budget set aside for acquisitions, initial discussions, partner searches, tender and contract drafting or subsidy applications, meaning that new projects can only be launched thanks to cross-subsidisation or weekend work.

One unclarified subject that remains a point for discussion is the protection of innovations, particularly in cases where many research partners within the network are involved in the same project. Those currently involved in projects (students, researchers, tutors, project managers etc.) are obliged to sign non-disclosure agreements, which in fact provide insufficient protection.

## VII. CONCLUSION AND OUTLOOK

SMEs can apply Robert Cooper's Stage-Gate® model in cooperation with qualified university partners, thus establishing a kind of virtual R&D department that deflects some of the disadvantages vis-à-vis large companies. This results in a genuine win-win situation as the qualified research partners gain access to applied research plans that are relevant to real-life scenarios while the SMEs can sell their innovation services on the market and generate additional cashflow.

Although developed on an existing market needs basis (bottom-up), up to now this model has dealt with a theoretical concept that has to be empirically validated in an initial step. To this end, a widely supported comparative case study research (Yin, 1994; McClintock et al., 1979; Backhaus&Plincke, 1977; Ziltener, 2006) should be carried out to allow sector-specific characteristics flow into the model. A second step should see the model applied to various European cultures and validated there with a qualitative investigation to allow social and cultural differences to be taken into consideration. At the end a roadmap should be developed to provide SMEs in individual sectors and countries as well as qualified research partners with a useful tool on innovation management in SMEs.<sup>2</sup>

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<sup>2</sup> In this respect we intend to launch a Europe-wide research project within the scope of the 7th EU framework programme for research and development. The envisaged result of this research project is a European Guide for Innovation Management in SMEs.



## APPENDIX

## Project List

Company	Project	Status	Idea	Scoping	Business	Develop-	Testing	Launch
ADM	HLS - Holistic Life System	closed		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
AMK-Collectra AG	Beratungsprojekt Erweiterungsbau	closed		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
AMK-Collectra AG	Mit Sonnenkollektoren beheizbare Strassenrampe	open		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
AQS AG	Käseschneidemaschine	open		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Aquamedic	Aquabike	open		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Arthaus	Beebox	in progress		<input checked="" type="checkbox"/> <input type="checkbox"/>				<input checked="" type="checkbox"/>
Biereria Tschlin	Vermarktungskonzept Kleinbrauerei / Verkauf	closed					<input type="checkbox"/>	<input checked="" type="checkbox"/>
Cobatec AG	Emagine (RFID für Laborautomation)	closed	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				
Couture Création Collection	strategische Neuausrichtung	closed		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
Die Regionen GR	Innovative Regionen	closed	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
F24.ch	Plakatwerbung in spez. Formaten	closed			<input checked="" type="checkbox"/>			
Hofzaun	Lärmschutzwand	closed						<input checked="" type="checkbox"/>
IC Surselva	SurselvaFutur	open		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IC Surselva	Sportnetz Surselva	open		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IC Surselva	Künstlernetzwerk	open		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IC Surselva	Agri-Produktverkaufs- und Vertriebsnetz	open		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IKT	EasySpeech	in progress		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Minalp SA	Goldsuche Surselva	open		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ness Industries	Big Rodder	in progress		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Personal Massager	Personal Massager	open		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Polycontact	ISO Charger	closed		<input checked="" type="checkbox"/>		<input type="checkbox"/>		
ProfTech	Vegetable Oil	open		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q.Products AG	Business Plan	in progress		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Renzo Giovanoli	Hochwasserschutz	open		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rii-Seez	Vermarktung Öko-Strom	closed						<input checked="" type="checkbox"/>
Robert Mutzner AG	Businessmodell für Partyservice	open		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Streule+Alder AG	Wasserschneidmaschine	open		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Swissprotec	Innovative Antriebsgurten	in progress		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Triopan	akustische Gefahrenstellenabsicher.	in progress		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

- planned  
 finished

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