

EFFECTIVE BUSINESS MODEL ADAPTATION STRATEGIES FOR NEW TECHNOLOGY-BASED VENTURES

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ABSTRACT

New technology-based ventures (NTBVs) in emerging markets are confronted with high levels of technical and market uncertainty. This complicates the ex ante identification of viable business models. While previous research has pointed out the relevancy of adaptability for NTBVs, i.e. the ability to redefine the initial business concept, insights on how to engage in such adaptation efforts remain underdeveloped. This paper explores how NTBVs in emerging markets address business model development.

Based on seven case-studies, two approaches are identified. A first tactic implies a committed choice for one specific business model, despite the acknowledged uncertainty. A second tactic translates uncertainty into the entrepreneurial activities and decision making process of the venture through experimentation with a range of different business models. Although this second tactic goes against the common investment model used by the VC community, we find investors willing to support such modes of experimentation.

When ventures adhering to the focused development model discover later on that assumptions have been too optimistic or wrong, changes of a radical nature are required to avoid failure. Development of a new business model then only makes sense if the transfer of assets and expertise compensate for the significant resources implications of crisis management. However, if such synergies need to exist between consecutive business models, one should ask whether it would not have been preferable to develop these activities from the start.

INTRODUCTION

New businesses ventures often start from a vision or from a technological innovation. In both cases, the exploitation of the initial capabilities requires the development of a business model (Chesbrough and Rosenbloom, 2002; Hamel, 2000). The business model is considered a construct that mediates the value creation process, by selecting and filtering technologies and ideas, and packaging them into particular configurations to be offered to a chosen target market. Innovations are by definition only successful when coupling a technological capability to a user need (Teubal et al., 1991).

However, for new technology-based ventures (NTBVs) in emerging industries, defining an appropriate business model at inception is not straightforward (Pitt and Kannemeyer, 2000) as these ventures are confronted with high degrees of uncertainty. Not only are the nature and the outcome of the technical activities inherently unpredictable (Steensma et al., 2000); also market selection forces are often unclear and selecting appropriate segments and business models implies uncertainty and ambiguity (Eisenhardt and Schoonhoven, 1990; Autio and Lumme, 1998; Chesbrough, 2003; Chesbrough and Rosenbloom, 2002; Saemundsson and Lindholm Dahlstrand, 2005). In emerging industries, technological options are at best marginally understood, distribution channels and sources of supply are problematic, market needs are not clearly defined, and hence, market viability cannot be proven a priori (see Abernathy and Utterback, 1975; Abernathy 1978; Eisenhardt and Schoonhoven, 1990; Bhidé, 1996 & 2000; Teubal et al., 1991).

As a logical consequence of this uncertainty characterizing emerging industries, the set of all feasible business models is in most cases not foreseeable in advance (Druilhe and Garnsey, 2004) and the ones that are foreseeable are highly conditional. Market signals may afterwards reveal information that was unknown or uncertain at the outset, indicating a need to redefine the initial business model (Stoica and Schindehutte, 1999). It is known that most initial selections of business models by new businesses have to be abandoned later on and that minor or major adaptation to the initial business model is needed for such ventures to survive and prosper (Brokaw, 1991; Drucker, 1985). These observations direct our attention to the question *how technology-based ventures in emerging industries approach the issue of business model development*, a topic which has received almost no attention in the literature so far. In this paper, we develop insights from seven in depth case studies on the existence of different approaches to business model development by NTBVs in emerging industries.

METHODOLOGY

Given that we want to explore how technology-based ventures in emerging industries approach business model development, we adopted an in depth case study approach. Case study research is often advanced as most adequate for developing insights in real-time processes (Yin, 1994; Janesick, 1994; Eisenhardt, 1989). We retrospectively studied and analyzed seven NTBVs. These seven NTBVs were all active in emerging industries characterized by uncertainty (see Table 1). Uncertainty has been defined as characteristic of a situation in which the problem solver understands the structure of the problem (including the set of relevant decision variables), but is dissatisfied with the knowledge available on the value of these decision variables (Schrader et al., 1993). NTBVs are hence confronted with uncertainty regarding their business model if the optimal values for some relevant business model attributes are not known.

When engaging in case study analysis, the use of a set of constructs or concepts can be seen as beneficial (Pettigrew, 1987; Eisenhardt, 1989, Van de Ven and Poole, 1990). In this study, we investigate various approaches taken to business model development. We therefore document over time and interpret the concept of 'business model' as it develops and changes over time. This construct stems directly from our research question and is hence specified a priori. According to existing literature, a venture's business model consists of different aspects. Hamel (2000) discerns four major components of the business model: core strategy, strategic resources, customer interface, and value network. Each of these components has several subcomponents. Pitt and Kannemeyer (2000) also consider distribution, facility or space requirements, marketing approach, and personnel resources as components of the marketing strategy. Morris et al. (1999) regard financial requirements as an additional component. Based on these previous elaborations of the business model concept, we therefore documented and analyzed changes for the following business model attributes: (1) technology, (2) product/service, (3) market (including industry, customer type and geographical market), (4) production, (5) marketing, (6) financial resources, and (7) human resources. We regard one observed combination of these seven aspects as one specific business model. If a company at the same time develops two or more such combinations, we regard these as different business models. Semi-structured interviews and document analysis were used to retrospectively document the construct of business model and the rationale behind these processes. Documents - such as company websites, available business plans and for some cases e-mail correspondence - were read and analyzed in preparation of the interviews. In addition, complementary documents were provided by the interviewees after the interviews (see Table 1). All this information has been used in the consecutive analysis.

Focused case study research does not only benefit from the use of central constructs, but also implies different levels of analysis (Pettigrew, 1990, Pentland, 1999). In a first phase, a historical description of each company was created based on the information from interviews and document analysis. These descriptions were presented to the interviewees in order to assess accuracy and completeness. In some cases, information was added, refined or corrected. In a second phase, this historical description was used to map the central construct i.e. 'the business model' (and how it changes over time) on a timeline for each of the seven cases (see Figures 1a to 1g). We did this by mapping the seven business model subcomponents mentioned earlier as well as the changes in these subcomponents'. In a third phase, important themes were identified for each case and in a fourth phase these were compared over the seven cases as discussed below.

Table 1: Case study overview

Company	Activity	Uncertainty at founding	Data sources
@Music	E-commerce	<ul style="list-style-type: none"> awareness about critical issues such as impact of internet on individuals' buying behavior, musical genres, geographical scope however, rate of diffusion unknown 	<ul style="list-style-type: none"> e-mail correspondence, meeting reports, financial reports 11 interviews with investors, founders and employees business plans
OOPs	SW Products that enable E-commerce	<ul style="list-style-type: none"> implicit assumption that B-to-C will be considerable market unawareness about the discrepancy between standardized solution and real settings, about the distribution approach, about market interest in B-to-B 	<ul style="list-style-type: none"> 6 interviews with two founders (one was interviewed twice), one investor, one consultant and one employee business plans
Image	Machine Vision Systems	<ul style="list-style-type: none"> difficult to estimate size of market and subsegments high number of applications in different industries possible but unclear which one is best 	<ul style="list-style-type: none"> interview with the former CEO business plans
L-goritm	Software and hardware for reverse engineering and quality control	<ul style="list-style-type: none"> unawareness about relevance of sales approach, position HW producers, geographical scope 	<ul style="list-style-type: none"> interview with founder/CEO business plans
SiS	Web-based Services	<ul style="list-style-type: none"> high expectations, but also high uncertainty regarding impact of internet on individuals' buying behavior lack of knowledge about international marketing and lack of knowledge about fierce competition on home market 	<ul style="list-style-type: none"> interview with founder website business plans
RegMed	Biomedical regenerative medicine	<ul style="list-style-type: none"> lack of market knowledge uncertain results of clinical studies 	<ul style="list-style-type: none"> interview with founder-CEO website business plans
BIOCHEM	Synthesis and purification of oligonucleotides	<ul style="list-style-type: none"> lack of knowledge about the market size for isotopically labeled nucleotides 	<ul style="list-style-type: none"> interview with founder website business plans

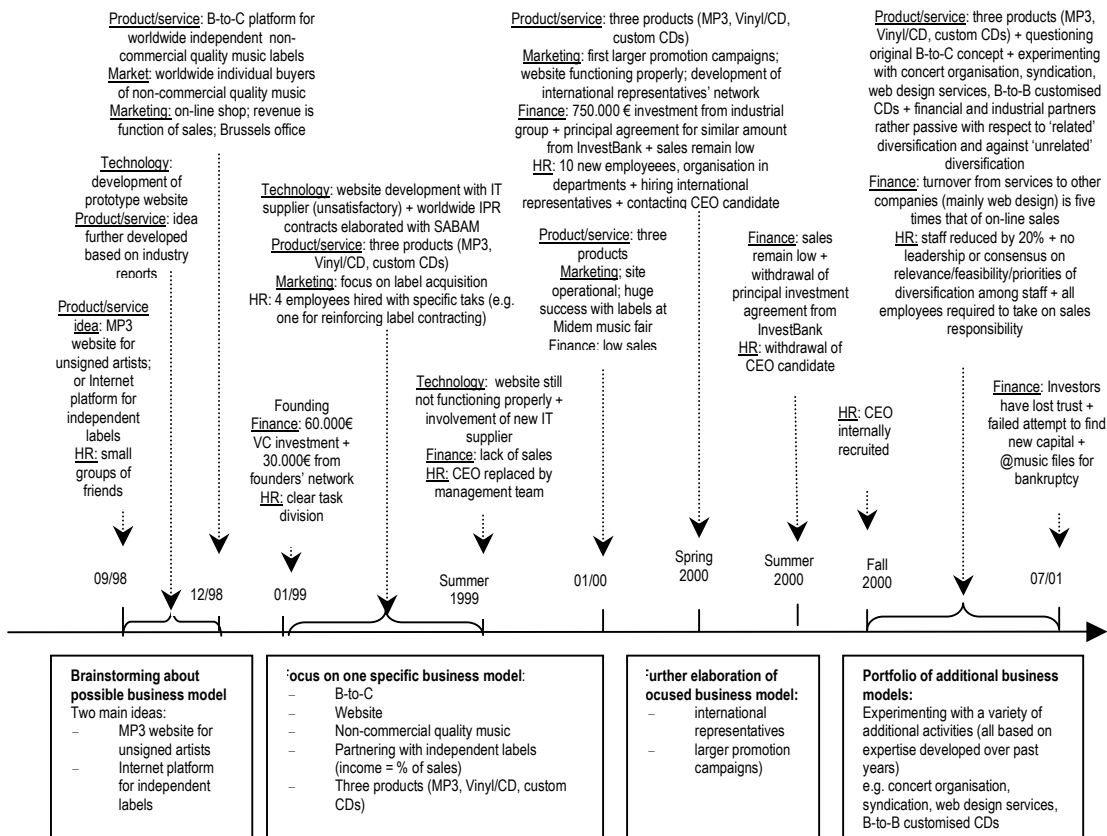


Figure 1a: Event history of @Music

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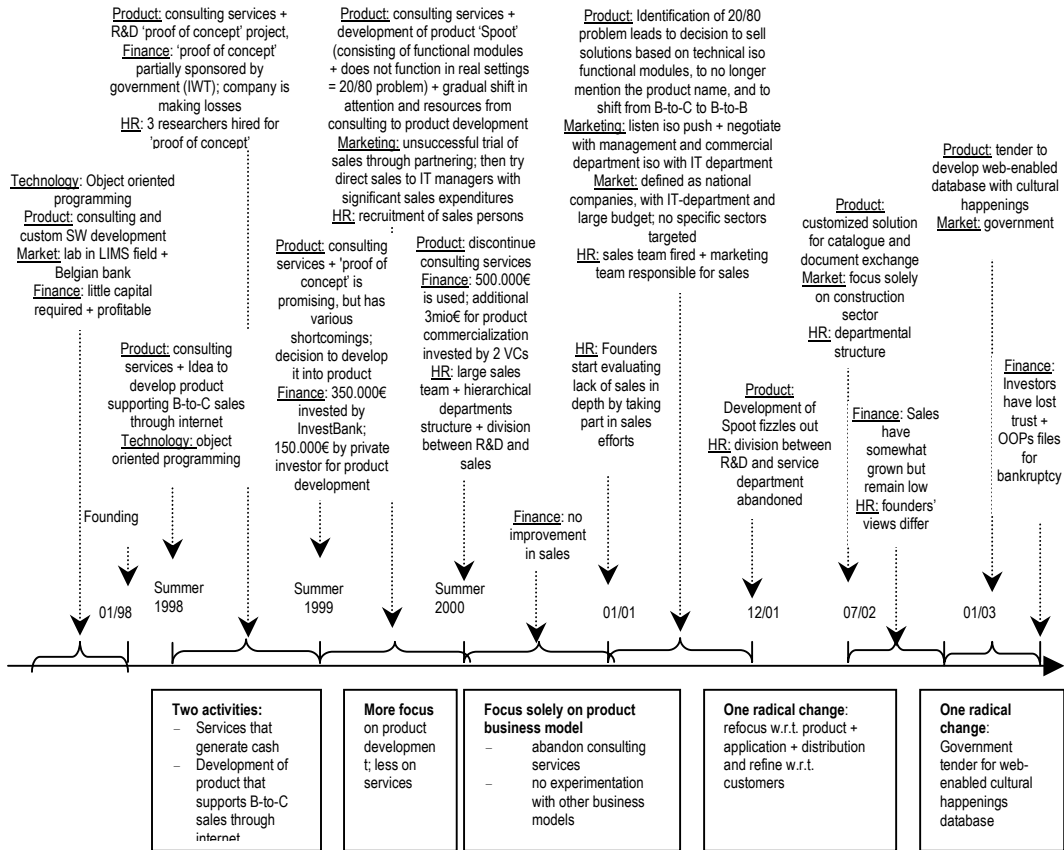


Figure 1b: Event history of OOPs

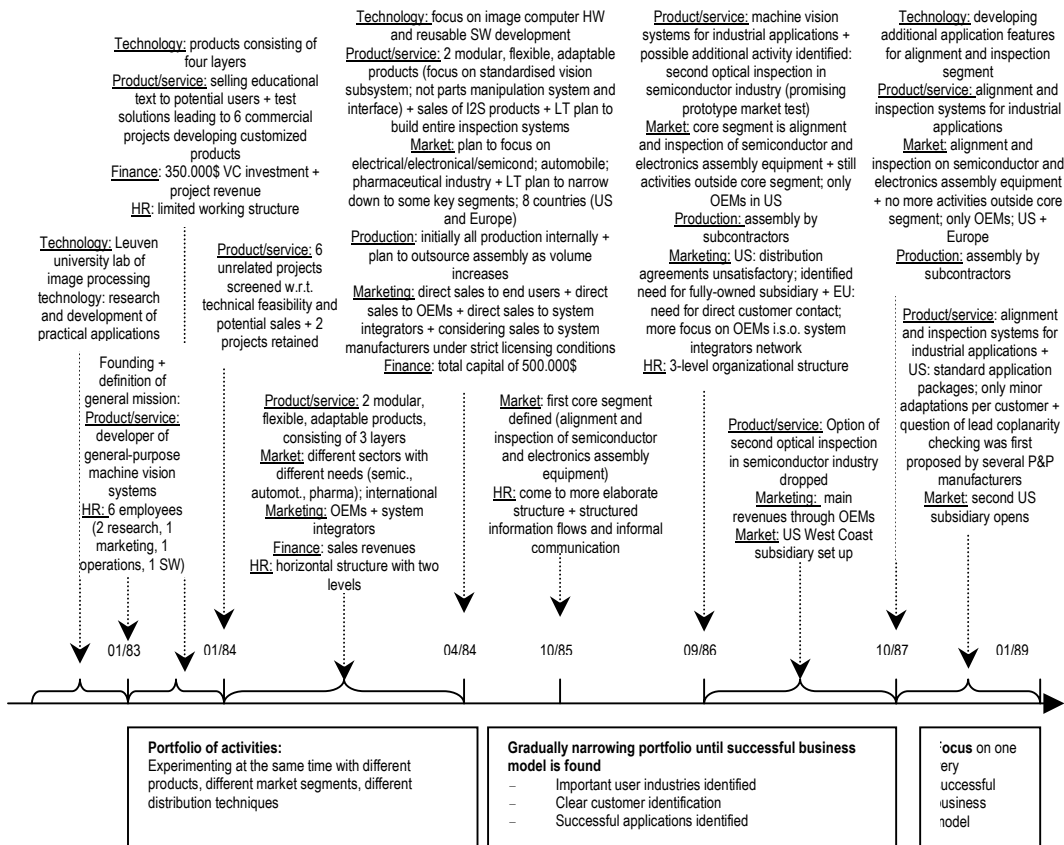


Figure 1c: Event history of Image

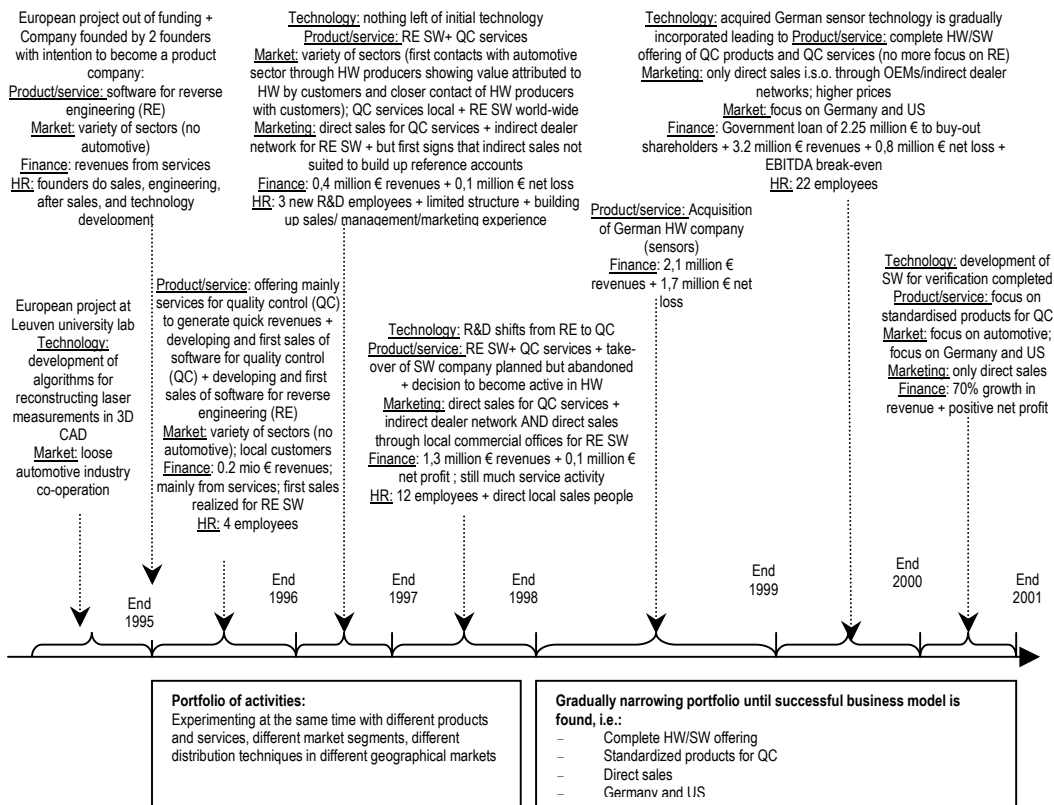


Figure 1d: Event history of L-goritm

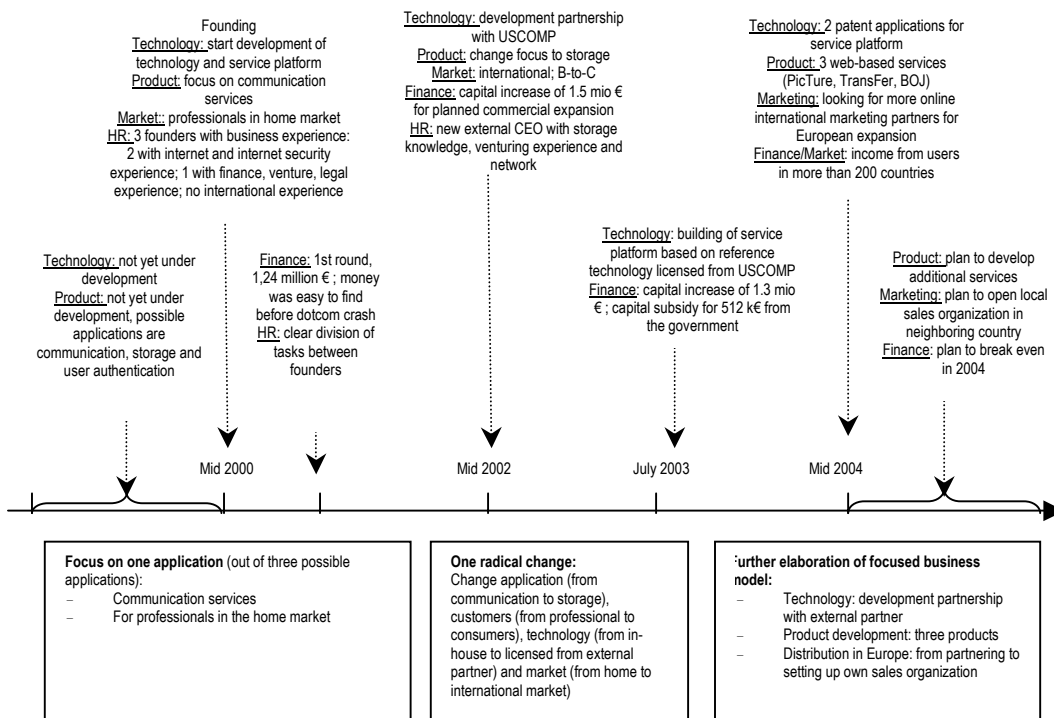


Figure 1e: Event history of SiS

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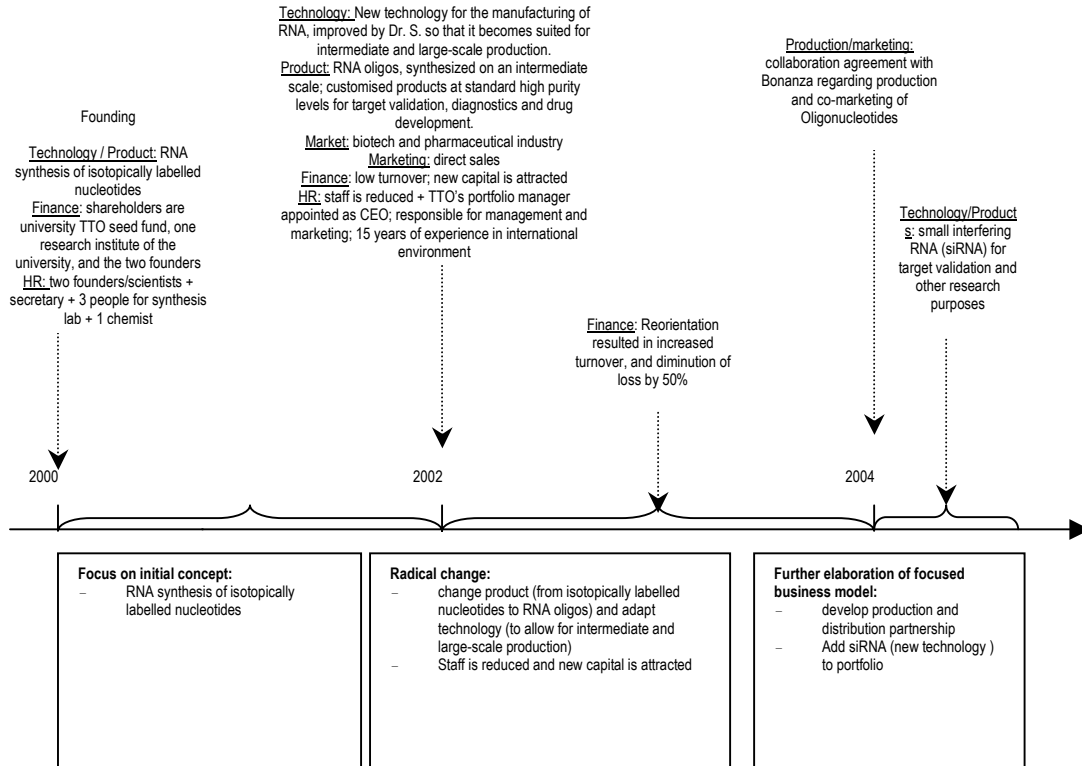


Figure 1f: Event history of BIOCHEM

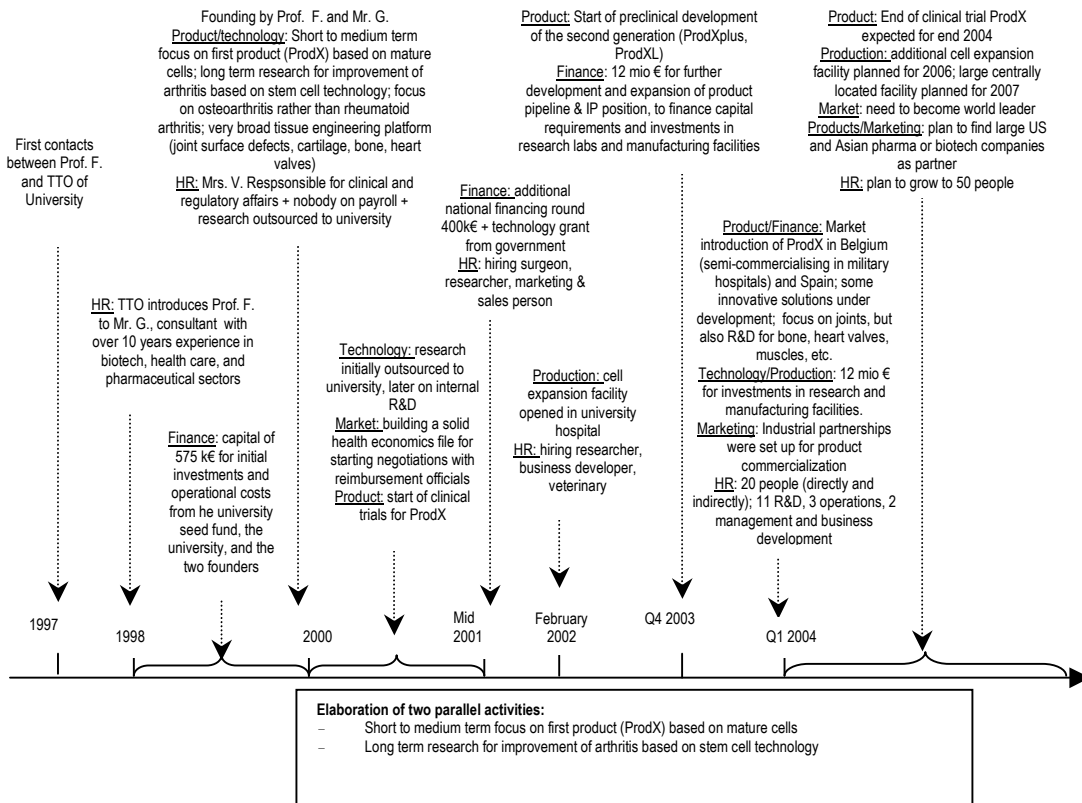


Figure 1g: Event history of RegMed

FINDINGS

Some ventures commit to one specific business model, thereby bracketing the acknowledged uncertainty.

We find that four out of seven companies in our case study (namely @Music, OOPs, SiS, and BIOCHEM) commit very early to one specific business model. After three months of brainstorming, @Music commits to a specific business model in December 1998, offering of an on-line B-to-C platform for worldwide independent music labels. The company sticks to this business model until the fall of 2000. Similarly, in mid 1999 the founders of OOPs discontinue their pre-existing service activities and commit to the development of the 'Spoot' product for B-to-C applications. They stick to it until 2003 even though many technical problems are encountered and sales do not materialize as planned. In 2000 –when sales are not improving according to plan - a lot of money is spent on reorganizing the structure of the company and on sales efforts, thereby committing further to the initial business model. SiS focuses on secured communication. After start-up of the company, the founders start with the development of a technology platform and web based services for professional users in the home market. The company sticks to this decision for more than two years. BIOCHEM, at its founding in 2000, decides to focus on RNA synthesis of isotopically labelled nucleotides and sticks to this until 2002.

Bracketing uncertainty.

This early commitment is not due to an unawareness of uncertainty with respect to the premises underlying the chosen business concept but rather a deliberate choice in the face of uncertainty. Founders and investors actually acknowledge at the start that many factors affecting the viability of the business model are uncertain; they decide nonetheless to commit early to the development of one specific and focused business model. By doing so, they opt for reducing uncertainty within the chosen option. As a consequence, they forego the option to reduce uncertainty between different options. They select commitment to an uncertain journey as opposed to maintaining flexibility across uncertain journeys. Before founding, the founders of @Music identify two main possible business models: becoming a platform for unsigned artists or for independent labels. Although it is at that time impossible to predict the success of both options, they commit exclusively to the latter business model. Similarly, SiS identifies 3 possible domains of activities in its original business plan (communication, storage and user-authentication on the basis of digital signatures), and immediately decides to focus solely on secured communication. In the case of OOPs, founders have developed profit-making service activities characterized by a low degree of uncertainty. However, they decide promptly to focus on the development of a product for which viability has not been proven.

Reasons for commitment.

From the case studies, two main reasons are advanced for committing early despite the presence of uncertainty. Firstly, interviews with founders show that they commit early in order to build up a first-mover advantage. One such example is the explicit objective of SiS to become the first European Application Service Provider to develop a new internet platform for secured communications and transactions on the basis of digital signatures. Likewise, @Music is among the first to offer an internet platform for independent labels and succeeds - by focusing on this sole option - in signing over 150 labels. In addition, our interviews with founders and investors show that focused commitment improves the clarity of the value proposition towards different stakeholders, including strategic partners, investors and employees. Investors endorse focus and commitment in the hope or belief that it will allow ventures to achieve growth as fast as possible. In all four cases, investors enter the investment agreement based on the company's commitment to a specific business model. In the case of SiS, commitment to one specific business model was decided upon at founding and capital was attracted 6 months later. Similarly, the founders and shareholders of BIOCHEM invest in one specific business model. Also OOPs successfully attracts new investors after it has decided to focus on product development. @Music's committed business model was decided upon in December 1998, and investors were attracted one month later. In 2000, additional investors join the company as the focused proposition turned out to be effective in terms of signing license agreements with numerous independent labels.

Consequences of commitment: developing organizational configurations.

The choice for one specific business model results in clarity, also on the level of developing the organization. Objectives and activities are being delineated in line with the adopted value proposition and more people join the ventures, whereby selected competencies reflect the objectives outlined in the envisaged business model. **@Music** hires additional people for contracting more independent labels and for developing and implementing appropriate communication and promotional activities, including opening a small branch in two major European cities. **OOPs** organizes itself in hierarchical departments, reinforces the sales organization, and installs a clear division between R&D and sales. **SiS** invests in staff and expertise in the field of secured communication. **BIOCHEM** starts to deploy competencies to produce and sell nucleotides. In addition to the two founders/scientists, one chemist and three people for the synthesis lab are hired. All these efforts result in consistent organizational configurations (Miller and Friesen, 1984) that reflect the adopted business model.

Consequences of commitment: uncertainty reduction with respect to the chosen business model.

At the same time, the focused efforts to develop the venture and the envisaged markets generate additional information. As such, entrepreneurial ventures by committing to one specific business model are able to reduce the uncertainty pertaining to the chosen value proposition and hence become able to assess more precisely to which extent the chosen option is indeed a viable one. In the cases under study, one observes that while in a first period such information is of a mixed nature; signals questioning the viability of the business model become stronger and stronger over time. In the case of **@Music**, sales are constantly lower than projected, but in a first phase the malfunctioning website is considered the main reason. By 1999, the website functions properly, but both the number of visitors and the sales remain low. The company reacts by launching relatively large promotion campaigns. Only by the summer of 2000, the company acknowledges that, although the number of visitors on the website rises constantly, these visitors are merely listening to the on-line tracks, and few are buying. As there are more signals in the wider market that e-commerce is not growing as fast as expected, InvestBank decides to withdraw from its investment agreement, creating a sudden need for cash. **@Music** starts to question the original B-to-C concept, and decides to try out new activities, related as well as relatively unrelated (including concerts, customized website development, syndication, and B-to-B custom CDs). In the case of **OOPs**, the prototype shows various shortcomings, an observation that inspires additional investment into product development. Technical improvements are made, but sales efforts fail to reach targets. It is then decided to invest in the creation of a professional sales organization and in departmental reorganization, which however lead to no improvement in sales. In the beginning of 2001, the company founders acknowledge that the company's sales and technical approach might be inappropriate, leading within a next phase to a radical business model change with respect to product, application and distribution. Also **SiS** discovers after engaging in market development efforts that competition on the home market – for secured communication – is fierce and that the assumed market potential for their value proposition is lower than expected. After two years, initial assumptions are being questioned, leading to the decision to switch to storage applications. **BIOCHEM** discovers that the market for isotopically labelled nucleotides is much smaller than expected, and also much more competitive. After two years of developing the business model, a reorientation of the value proposition is considered and decided upon.

Consequences of commitment: the inevitability of radical change when assumptions do not become reality.

By developing the chosen business model, uncertainty pertaining to the underlying assumptions is being reduced. This process can yield different outcomes ranging from full confirmation of initial assumptions to the complete opposite. In the four cases (**@Music**, **OOPs**, **SiS**, and **BIOCHEM**), crucial assumptions turned out to be too optimistic or incorrect. When confronted with the discrepancies between initial assumptions and the unfolding practices, change becomes inevitability for the venture's survival. In line with the propositions advanced by Miller and Friesen (1984), these change processes are of a radical nature. Redefining the business model requires changing the mindset of the entrepreneurial team and its stakeholders. Moreover, this process implies the choice for a different set of activities, skills and structures. Some of the developed competences may become obsolete, while others are missing.

When confronted suddenly with the need for rethinking its value proposition, **@Music** starts to experiment with a range of alternative activities. At the same time not all employees and investors

agree on the most viable directions for the venture. Certain options are met with scepticism and resistance. After appointing a new, internal CEO in the fall of 2000, the company reduces expenditures by firing a number of employees and letting some of the others work on a part-time basis. For other employees the search for a new sustainable business model results in new activities and roles while time for development is limited. Likewise, on the level of the board, one observes ambiguity in terms of which diversification efforts to pursue and which not. In addition, unsuccessful efforts to attract additional investors are undertaken. In the case of **OOPs**, the founders agree on the need to change their business model and to drastically restructure the venture by dismissing many employees and reorganizing the different departments. The founders however differ in their view on the right direction for the company and one of them leaves the company. The lack of sales and the departure of one founder weaken the trust of the investors. One of the investors proposes a merger, but the remaining founder does not agree. He initiates a new radical business model change in 2003. However, investors do not support this new direction and OOPs files for bankruptcy. Also in the case of **BIOCHEM**, staff is reduced after it becomes apparent that the chosen option is not sustainable and a new CEO is being appointed. After deciding on a new strategic direction, additional capital is attracted and used to re-engineer the venture. Similarly, **SiS** requires a new capital infusion to implement its business model change. Old and new investors provide 1.5 mio € of additional capital. The company also needs to develop new partnerships and to attract expertise for its new business model. A new external CEO joins the management team as the key person for the integration and business development of these new storage related services.

To sum up, committing to one specific business model holds the promise of realizing first mover advantages and is instrumental for mobilising different stakeholders, among which investors figure prominently. As a consequence ventures invest and develop a focused venture despite the presence of uncertainty, characteristic for emerging industries. If afterwards, initial assumptions on which the choice of the particular business model was based, turn out to be too optimistic or incorrect, then adaptation efforts - needed to survive - will be of a radical nature. As our cases testify, such radical change processes are hazardous and painful. In order to achieve these radical changes, the ventures first need to become flexible again as to the beliefs, assumptions, competencies ... they should develop, maintain and advocate. As documented in several research domains, ranging from organizational change processes to game theory research, solving this commitment – flexibility paradox is no small task. This raises the question whether alternative scenarios are imaginable and even preferred. As will become clear in the next section three of the ventures studied do opt for a different development path.

Some ventures actively deal with uncertainty by translating it into the entrepreneurial activities and decision making process of the venture.

In three ventures of our case study (namely **Image**, **L-goritm** and **RegMed**), uncertainty is not only recognized but also explicitly translated in the initial business plan and in the ventures' approach to business model development. These NTBVs do not commit early to one specific business model, but instead actively experiment with various business models simultaneously. They acknowledge the inherent uncertainty between different business models and opt for a flexible approach rather than a highly committed one. **Image** clearly stipulates in its initial business plan that the market is in an embryonic stage and that various applications should be considered. The venture initially engages in six projects situated in different industries. **L-goritm** initially experiments simultaneously with radically different business models (different products and services, different market segments, different techniques and various geographical markets). In 1995, the company offers software for Reverse Engineering, as well as services for Quality Control and this in a variety of sectors. In the period 1997-1998, it experiments with a combination of indirect and direct sales. Similarly, **RegMed** decides to develop a broad, multidisciplinary technological platform (including systems biology, biomaterials, and biosurgery) with multiple possible applications (including joint-surface defects, bone defects, and later on also heart valves). The venture opts for elaborating two parallel activities. In the short to medium term, it develops a first diagnostic product based on mature cells, while it simultaneously works on long-term research for arthritis based on stem cell technology. By 2004, a number of innovative solutions are under development and the company has developed a portfolio of R&D activities.

Reasons for enacting uncertainty

From interviews with stakeholders, we find that a portfolio of business model experiments is developed for two main reasons. Firstly, engaging in different activities is seen as instrumental to risk spreading. If one business model proves unviable, there is still a chance that one of the other options turns out to be more successful. In doing so, they maintain a significant degree of strategic flexibility. (de Weerd-Nederhof, forthcoming) Secondly, this diversified approach allows ventures to learn about a relatively broad range of business models. Moreover, learning about one option can also reduce uncertainty about other options if they are related. One observes that the ventures use the knowledge built up while exploring one option to re-assess and re-define the nature of and the priorities for the activity portfolio as a whole. **L-goritm** gathers knowledge and expertise from its service activities and thereon decides to add hardware components to its software offerings. **RegMed** uses its short-term activities to build up relevant experience, market knowledge, and market presence beneficial for the long term developments envisaged. **Image** chooses systematically which additional segments to explore based on the experience and knowledge that is being built up within prior projects. These ventures hence explicitly regard ‘learning by doing’ as instrumental for refining their business models.

Consequence of enacting uncertainty

Since these NTBVs acknowledge that different conceivable business models are all characterised by uncertainty, the choice for one option is postponed until more information with respect to a range of value propositions becomes available. As uncertainty is reduced, the portfolio of business models is gradually narrowed down until a viable business model emerges. Between 1984 and 1987, **Image** gradually discovers important user industries, clear customer profiles, and interesting applications identified, which leads to the identification of a successful business model. Similarly, **L-goritm** gradually narrows down its portfolio of activities between 1998 and 2001, and ends up with a successful business model. Selecting such a business model is then followed by a period of commitment to that business model.

Enacting uncertainty through the development of a portfolio of business model experiments implies that these entrepreneurial firms need to organize their activities accordingly. When looking at the development and organization of the human resources over time, we find that these evolve from unstructured, loose configurations resembling the project based nature of R&D departments to more elaborated structures as the portfolio of business models is narrowed down. **Image** evolves from a loose, horizontal structure to a 3-level organizational structure as the set of options under study becomes more limited. During the first year of **L-goritm**’s life, its two founders take care of all business activities themselves. After a while, three employees are hired but the structure remains limited. As the uncertainty regarding business models’ viability is reduced, more employees are hired. A German company is taken over to fully implement the remaining viable business model.

Combining a portfolio of activities with liabilities of smallness

From our cases we find that NTBVs try to reconciling their resource limitations with the financial implications of simultaneously pursuing multiple options. One approach adopted by the ventures studied consists of including activities with short term cash generating potential to support longer term development of other activities. **Image** starts by selling an educational text to potential users to raise customer awareness, generating in this way a limited amount of early income. **L-goritm** has the intention to develop software in the medium term, but from start-up provides services that generate cash on the short term. Similarly, **RegMed** has a dual business plan. The company considered it essential to start-up some business activity with short term cash generating potential as soon as possible and engaged in the development of a first diagnostic product based on mature stem cells. In short, these ventures enact spill-overs between the different activities undertaken. This is done in a conscious and planned manner as strategic flexibility requires a sufficient resource base to be present. Opting for experimentation across business models leaves the entrepreneurial team with very few options as to resources: the only way forward is one where sufficient resources are continuously being marshalled to live up to the requirements of the activity portfolio.

To sum up, ventures can actively deal with uncertainty by simultaneously experimenting with various business models. The development of a portfolio of business model ideas can be seen as a way to spread risk and to learn about a broad range of potential business models. As a consequence, ventures enacting uncertainty opt for a project based organization, and uncertainty is reduced with respect to a range of business models. This uncertainty reduction allows for gradually narrowing down the range of options until a viable business model is found. Spill-overs between the different activities

undertaken - both in terms of resources and in terms of knowledge – may enable an NTB to develop such a portfolio despite liabilities of smallness.

Table 2 – Summary of main findings

	<i>Focused commitment</i>	<i>Portfolio of activities</i>
<i>Range of business models</i>	<ul style="list-style-type: none"> ■ Commitment to one business model 	<ul style="list-style-type: none"> ■ Multiple options are explored simultaneously
<i>Rationale</i>	<ul style="list-style-type: none"> ■ Clarity of value proposition results in increased mobilizing power (towards investors and other stakeholders) ■ Promise of achieving first mover advantages 	<ul style="list-style-type: none"> ■ Pursuing multiple options is seen as a way to learn about a broad range of business models and to spread risk ■ Uncertainty reduction within emerging markets requires ‘learning by doing’
<i>Consequences</i>	<ul style="list-style-type: none"> ■ Uncertainty reduction with respect to the chosen business model. ■ Bracketing uncertainty implies the development of a corresponding organizational configuration 	<ul style="list-style-type: none"> ■ Uncertainty reduction with respect to a range of business models ■ Enacting uncertainty implies the development of a project based organization
<i>Business model change</i>	<ul style="list-style-type: none"> ■ Change will be of a radical nature when assumptions do not become reality. 	<ul style="list-style-type: none"> ■ Gradual narrowing down the range of options through uncertainty reduction and knowledge spill-overs between different activities until a viable business model is found
<i>Resources</i>	<ul style="list-style-type: none"> ■ Resource deployment of a focused nature ■ Committed expenditures often imply considerable cash outflows. 	<ul style="list-style-type: none"> ■ Resource deployment across a range of activities ■ Moderate, controlled expenditures.

DISCUSSION AND CONCLUSIONS

Some technology-based ventures in emerging markets bracket uncertainty and commit early to one specific business model. They see this as most appropriate for obtaining a first-mover advantage. In addition, focused commitment improves the clarity of the value proposition towards stakeholders including employees and investors. The latter support early commitment in the hope or belief that it will allow ventures to achieve growth as fast as possible. This committed mode is in line with the dominant investment model commonly used by outside investors. Investors often push the companies to focus on one specific business model. As noticed by Bhide (2002), ‘investors... prefer ventures with plausible, carefully thought-out plans to address well-defined markets. A solid plan reassures them about the competence of the entrepreneur and provides an objective yardstick for measuring progress and testing initial assumptions.’ Bracketing uncertainty by choosing one specific business model implies putting in place an organizational configuration aimed at the development of this business model. By developing the chosen business model, uncertainty pertaining to the underlying assumptions is reduced. This process can yield different outcomes ranging from full confirmation of initial assumptions to the complete opposite. And while Solow (1996) demonstrated that early good luck

might have a persistent effect in terms of economical performance, our cases studies indicate that in emerging industries, crucial assumptions often turn out to be too optimistic or incorrect. Change or adjustment of the business model then becomes inevitability for the venture's survival. In line with the propositions advanced by Miller and Friesen (1984), these change processes are of a radical nature. Redefining the business model requires changing the mindset of the entrepreneurial team and its stakeholders. Moreover, this process implies the choice for a different set of activities, skills and structures. Some of the developed competences may become obsolete, while others are missing. Abruptly reorienting the business therefore often implies problems within the founding team, as well as with existing employees and investors. Persuading investors to finance such radical change is difficult. As explained by Bhide (2002), in the prospect of a radical change, outside investors are not sure whether the initial business model was wrong or whether it was poorly executed. If the latter seems plausible to them, they will not take the risk of being fooled twice. As our cases testify, radical change processes are hence hazardous and painful. This raises the question whether alternative scenarios exist.

In this respect, Bhide (2002) promoted bootstrapping, i.e. launching ventures with modest personal funds. Bootstrapped ventures do not need to struggle with investors opposing radical change. This approach however poses problems in the sense that growth needs to be under strict control. However, our case studies point to the existence of an alternative – and perhaps more interesting – approach. We found that technology-based ventures in emerging markets can also actively deal with uncertainty by translating it into the entrepreneurial activities, the decision making process, and the financing of the venture. They can engage in simultaneous experiments with a range of different business models. The introduction of a portfolio of activities is inspired by the acknowledgment of the uncertainty related to the different options the entrepreneurial venture can possibly effectuate or enact (Sarasvathy, 2001, Weick, 1979). Rather than bracketing the implied uncertainty, the ventures under study are investing in uncertainty reduction by exploring different options simultaneously. Acknowledging that different conceivable business models are all characterised by uncertainty, the choice for one option is postponed until more information with respect to a range of value propositions becomes available. As a consequence, these entrepreneurial firms organize their activities within a first phase on a project base rather than elaborating a focused organizational configuration as observed when the choice for commitment is made. Different projects are carried out simultaneously within an organizational configuration that resembles the project based nature of R&D departments. As uncertainty is reduced, the portfolio of business models is gradually narrowed down until a viable business model emerges. Selecting such a business model is then followed by a period of commitment to that business model. Organizational configurations accordingly become more structured.

While similarities of this approach with the portfolio model adopted within R&D environments (Wheelwright & Clark, 1992, Roussel et al., 1991) are apparent, the entrepreneurial nature of the ventures does pose the challenge of reconciling liabilities of smallness with the resource implications of pursuing simultaneously the exploration of a range of options. Existing literature suggests using low-cost probing strategies, which imply that a company uses a wide variety of cheap experiments (including experimental products, futurists, and strategic alliances) to see what types of products and services markets are more responsive to (Brown and Eisenhardt, 1997, 1998). However, executing a large number of cheap experiments is still a relatively expensive effort for most new technology-ventures since - unlike established companies - they usually do not have much financial slack. Our case studies findings suggest that it is therefore beneficial to include activities with short term cash generating potential to support longer term development of other activities. Bhide (2002) made the same recommendation, since *'a business that is making money, elegantly or not, builds credibility in the eyes of suppliers, customers, and employees, as well as self-confidence in the entrepreneur'*. We also observe that ventures use the knowledge developed while exploring one option to re-assess and re-define the nature of and the priorities for the activity portfolio as a whole. In short, these ventures enact spill-overs, both in terms of resources and in terms of knowledge between the different activities undertaken.

Our case study findings show that the investors of Image, L-goritm and RegMed – when entering the investment agreement - are fully aware and supportive of the venture's intention to experiment with various business models. This results in a more flexible approach towards providing and monitoring resources in the new venture. In the original business plan of Image, which is used for attracting investors, it is clearly stipulated that the market is in an embryonic life stage and that various applications will be considered. Also in the case of RegMed, the investors are fully endorsing the dual business model when entering the investment agreement." Some investors are hence supportive of experimentation efforts and are willing to engage in entrepreneurial ventures that experiment with a portfolio of business models. Especially seed funds provided by universities and government

institutions can be expected to be more supportive in this respect, since they usually invest in earlier stages of the venture's life when market viability has not yet been proven.

It hence appears that if NTBVs want to develop their business without being limited by resource constraints (as is the case when bootstrapping), they can either commit to one specific business model or they can develop a portfolio of business models. For ventures committing to one specific business model, we witness that uncertainty resolution revealing the failure of that business model implies radical change. Significant efforts and investments are needed to change the mindset of all stakeholders and to dispose of organizational structures, ideas and competences that have become obsolete for the development of the new business model. This may imply restructuring and laying-off personnel. Entrepreneurs and investors must then ask themselves if it is not better to totally discontinue the existing venture and to start-up or invest in a completely new venture that develops this new business model idea. Refraining from this option – i.e. disinvestment in the existing venture and starting up a new one- only makes sense if not all previous investments are sunk costs, so that transfer of assets and expertise can compensate for the significant difficulties associated with crisis management. If such cost and knowledge spill-overs need to exist between consecutive business models, it would perhaps have been vigorous preferable to develop these activities in parallel from the outset. This final observation seems to suggest that developing a portfolio of experiments between which cost and knowledge spill-overs can be created is a preferred approach to business model development when uncertainty is prevalent, as is the case in emerging industries.

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NOTES

ⁱ Not all timelines map all seven business model attributes. Only the attributes that were modified over time are mapped.