PRACTICES TO INITIATE BUSINESS MODEL INNOVATION IN INCUMBENT ENTERPRISES

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<tr>
<td>ANSP</td>
<td>Air Navigation Service Provider</td>
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<tr>
<td>ATM</td>
<td>Air Traffic Management</td>
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<td>BM</td>
<td>Business Model</td>
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<td>BMI</td>
<td>Business Model Innovation</td>
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<tr>
<td>B&amp;TI</td>
<td>Business and Technology Intelligence</td>
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<tr>
<td>ICT</td>
<td>Information and Communication Technology</td>
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<tr>
<td>PEST</td>
<td>Political, Economic, Social, Technological</td>
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Keyword Index

VI.  Keyword Index

Air Navigation Service Provider
Air Traffic Management
Business Model
Business Model Innovation
Business Model Design
Business and Technology Intelligence
Innovation
Innovation Management
Regulated environments
Strategy
Tactics
Abstract

VII. Abstract

In both theory and practice, business model innovation is acknowledged as an important means to gaining a competitive edge. Business model innovation means entrepreneurial undertakings beyond product or process innovation, even beyond enterprise borders. Taking the correct actions critical for success, remains challenging due to the uncertainty and rigidity of the assumptions about the environment made before embarking on business model innovation. Hence, business model innovation may be hampered. Management sciences in the 21st century need to develop practices to master these challenges in order to gain a competitive edge. This research aims at supporting managers from incumbent enterprises to obtain a more rigid approach to business model innovation through a set of practices that initiate business model innovation.

This research is embedded in business model, innovation management and intelligence research in order to transfer concepts to the process of business model innovation and thereby develop a rigid understanding of the environment. It follows a qualitative research approach, drawing upon case studies from real world entities.

The research contributes to the concept of business model innovation through three main practices that show the potential to initiate business model innovation: Simplification, developing and sensing.

Simplification is the practice to analyze competitive information and display it in a simple manner. Its goal is to deliver the assumptions needed to embark on business model innovation. Developing is a practice to design a business model in a step by step approach. Its goal is to incorporate assumptions about the environment into the business model design process. Sensing is the practice to make use of an intelligence framework. Its goal is to monitor the environment to create timely and meaningful information about that environment.

The research contributes to the research of business model innovation by providing enabling practices to initiate and integrate business model innovation in incumbent enterprises. In doing so, it provides guidance to business model innovation.

Researchers may use the findings to study business model innovation from an enterprise transformational perspective. Practitioners may use the approaches to inject business model innovation as a corporate ability to engage with a changing environment, beyond product and process innovation.

Keywords: Business model innovation, business model, enterprise transformation
VIII. Summary


Die Forschungsergebnisse leisten einen Beitrag zur Forschung im Bereich Geschäftsmodellinnovation indem sie drei Praktiken auslegt: Simplifizierung, Entwicklung, Abtastung.


Forscher können die Resultate für das die Forschung im Bereich Unternehmenstransformation verwenden. Praktiker können die Resultate zur Initiierung von Geschäftsmodellinnovation in der Unternehmung verwenden, um Innovation ausserhalb von Produkt- oder Prozessinnovation zu betreiben.
Introduction

1. Introduction

This chapter introduces to the area of research and depicts the research focus around business model innovation.

1.1 Business model innovation in CEO agenda

The innovation of the business model is a central concern of managers from incumbent enterprises to address entrepreneurial challenges coming from environmental changes. Included in the drivers for business model innovation are the search for alternative competitive advantages that are distinct from the enterprise product strategy, such as customer orientation and value proposition, and the influence from environmental changes, such as new technologies, deregulation and changing economic conditions. Alternative competitive advantages and business model drivers need to be within the scope of the enterprise as the established business model is permanently at risk of losing competitive advantage under the pressure of environmental changes.

Enterprises typically engage in an innovation process once they have become aware of potential threats from the environment that might harm the business; however, success is not guaranteed. Success and failure in transformative business undertakings boils down to the enterprise’s ability to change its business model effectively with respect to the external business environment (Burgelman 1994). Whereas during times of relative environmental stability, the business model is less a subject of innovation, in times of environmental shifts, incumbents have a need to radically rethink the business model (IBM Global Business Services 2008).

The IBM CEO study 2008 (IBM Global Business Services 2008), which display the perception of more than 1000 CEOs and leaders of institutions across the public and private sectors, revealed that innovating the business model matters and is among their top priorities. Almost 70% of CEO’s intend to embark on extensive business model innovation. Enterprises consider changing their business models because it is increasingly difficult to differentiate on products and services alone. CEO’s are candid about the need to seek out new competitive differentiators, even if it means confronting a sacrosanct business model and the challenge of achieving business model innovation from within (IBM Global Business Services 2008).

Despite the urgency to innovate the business model from within, the gap between expected change and the ability to manage it has tripled (IBM Global Business Services 2008). The ability to initiate business model innovation needs to be established in incumbent enterprises.

In 2013, the global Innovation Barometer published by General Electric revealed business model innovation is gaining momentum within the context of today’s low-growth, resource-constrained world.
Introduction

and showed that 52% of executives reported the need for the development of a new business model to increase enterprise performance and assure competitiveness (StrategyOne 2013). Therefore, an increasing number of companies now are turning toward business model innovation as an alternative or complement to product or process innovation (Amit et al. 2012).

Business model innovation matters to managers, entrepreneurs and academic researchers. To managers as it is a potential underutilized, as yet unexplored source of value generation for gaining competitiveness. Business model innovation might translate to sustainable competitive advantage as imitation of a business seems to need more effort than a product or a process imitation. For competitive reasons, business model innovation can be a powerful tool, and incumbent enterprises must be attuned to the efforts of business model innovation within its industry (Casadesus-Masanell and Ricart 2007). To entrepreneurs as it is an approach to start competing against established industry players and a way to reshape entire industries. To academics as research starts to consider the business model as a dynamic asset of a company in its bid to innovate and compete.

Therefore, business model innovation is on the agenda of managers, entrepreneurs and academics.

1.2 Business model innovation in scholars’ agenda

In line with the growing attention to business model innovation in the industry, business model researchers have increasingly begun to study the business model as a separate unit of analysis, as enterprises find the need to not only compete through products and services, but also through their business models (Anthony 2012, Casadesus-Masanell and Ricart 2010). With regards to the changing environmental conditions, even incumbent business models operating successfully are not guaranteed to last forever (Chesbrough 2010, Lindgardt et al. 2009). Therefore, the business model is increasingly recognized as a source and subject of innovation as well as an important vehicle for business transformation and renewal (Zott et al. 2011, Mitchell and Coles 2003), rather than being a static concept. In this way, scholars focus on business model innovation as a means to transform enterprise and enterprise performance (Amit et al. 2012, e.g. Sosna et al. 2010, Johnson et al. 2008). There is an increasing consensus that the business model is key to enterprise performance (Zott et al. 2011), a promising approach for enterprises to respond to changing sources of value creation in times of environmental volatility (Pohle and Chapman 2006).

While business model innovation matters to managers (Amit et al. 2012) and is regarded as a crucial organizational ability for an enterprise to adapt to the environmental volatility (Zott and Amit 2010, Hamel and Valikangas 2003), theory is just beginning to evolve. Research on business model innovation is spread across various fields, including innovation management, strategic management, entrepreneurship
Introduction

and information technology (Veit et al. 2014, Schneider and Spieth 2013). The most relevant streams for this research are summarized in the following pages.

Prerequisites or enablers to business model innovation: Scholars describe prerequisites such as overcoming inertia, barriers and cognitive perception (Aspara et al. 2011, Chesbrough 2010, Amit and Zott 2001, Malhotra 2000) and the importance of gaining strategic agility (Doz and Kosonen 2010) in order to respond to opportunities. Business model innovation requires an enterprise to identify and anticipate relevant developments in its changing environment in a timely and effectively manner (Schneider and Spieth 2013). However, the initiative to innovate an established business model has been identified as highly challenging due to its complexity and inertia (Chesbrough 2010, Doz and Kosonen 2010).

This research stream to business model innovation revolves around how an incumbent enterprise can prepare for exploring opportunities through business model innovation.

Processes and elements of a business model innovation: Scholars describe the process and the elements of business model innovation. Business model innovation is characterized as an evolutionary process (Dunford et al. 2010), a continuous reaction to changes in the environment (Demil and Lecocq 2010) or as an on-going learning process (Chanal and Caron-Fasan 2010, McGrath 2010, Sosna et al. 2010). In order to support the understanding of the business model innovation process, similarities between product and business model innovation are also depicted (Bucherer et al. 2012). Others state that scenario techniques are applied (Gnatzy and Moser 2012, Pateli and Giaglis 2005). Also the role of leadership and decision-making to conduct business model innovation is described (Smith et al. 2010). In this way, this area contributes to an initial understanding of the elements and the process of business model innovation. However, core elements and processes of business model innovation remain largely undescribed. The research field revolves around the means enterprises can use throughout the process of business model innovation.

Effects achieved through business model innovation: Three main effects are discussed. First, the effects of business model innovation on industry and market structures; second, the effects on individual firm results, and third, the effects on conducting business model innovation on the enterprise capabilities.

Sabatier et al. (2012) approach the impact of business model innovations on dominant industry logic. Casadesus-Masanell and Zhu (2010) examine competitive reactions to business model innovation. Dewald and Bowen (2010) and Habtay (2012) research the effect of and response to disruptive forms of business model innovation. Gambardella and McGahan (2010) discuss the effects with regard to technological dynamics. The impact of business model innovation on the financial results of an enterprise is examined by Aspara et al. (2010), whereas Hall and Wagner (2012) analyze the impact of distinct types of business model innovation with regard to its sustainability management. To gain an understanding of
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Business model innovation as a means to enhancing strategic flexibility, the relationship between both areas is regularly emphasized (Markides 2013, Bock et al. 2012, Pohle and Chapman 2006, Osterwalder et al. 2005). This research domain focuses on gaining a deeper and more reliable understanding of how business model innovation impacts on company performance with regard to economic, social and ecological effects.

**Information technology enabled business model innovation:** The area covers the research about the impact of new IT on business model. It looks into value creation and value capture through digital business models (Teece 2010, Amit and Zott 2001). A business model is considered to be digital if changes in digital technologies trigger fundamental changes in the way business is carried out and revenues are generated (Veit et al. 2014). The current focus is on ecosystems (Burkard et al. 2012) and the changing role of the customer (Leimeister 2012, Reichwald and Piller 2009). Research in this area deals with the role of ICT as the driver of a new wave of industrialization (Barua et al. 2004) and ICT-enabled changes in product and service models, especially in retailing and in the media industry (Forman et al. 2009). Alternative revenue models (Wagner et al. 2013) as well as adaptive pricing (Hinz et al. 2011) are also in the focus of researchers. In addition, new technology, such as smart mobile devices lead to entirely new business models, considering location-based advertising enabling customers to become ‘prosumers’, producers and consumers of information services (Resatsch et al. 2008). Based on a design science research approach, new artefacts are delivered by researchers within that research field. The research stream revolves around the potential of IT developments on business model innovation.

**Information technology supported business model innovation and management:** The research focuses on the creation of a proper business model conceptualization in order to pave the way for adequate IT support for developing and managing business models (Teece 2010). Various IT approaches have been applied to conceptualize the business model, such as informal text (Kshetri 2008), structured text (Sosna et al. 2010), morphological representation (Kley et al. 2011), conceptual models with defined semantics and dedicated graphical representations (Gordijn and Akkermans 2003), also called business model representations (Zott et al. 2010). Despite these efforts, the concept of the business model still lacks a common and widely accepted language that would enable researchers to draw more effectively on the work of others (Zott et al. 2011).

The research is centered on a proper conceptualization of the business model with the idea of transferring business model innovation from a manual to a computer-aided business design process (Osterwalder et al. 2005). A proper conceptualization may lead beyond simple design tools and evolve into a high-level decision support tool (Osterwalder and Pigneur 2013) to facilitate the business model innovation process. IT supported design includes financial calculations and market data in order to evaluate business models.
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and deduce process models from a developed business (Di Valentin et al. 2012). The intention is the automatic translation of designed business models into consistent processes, services and enterprise models (Veit et al. 2014).

Although business model innovation is investigated from various domains, more research is needed to clarify the links between business model and organizational innovation as well as the mechanisms and processes of business model innovation (George and Bock 2011). Just as the use of the business model construct is relatively recent (George and Bock 2011), so too is the application and the research around business model innovation.

This research puts business model innovation under an entrepreneurial lens. Business model innovation refers to the endeavor of an enterprise to consider the uncertainty within its environment as a potential source of opportunities that need to be explored and exploited (Hitt et al. 2001).

With regards to the business model innovation research streams, this research deals with the area of prerequisites and supportive process elements of business model innovation; however, its academic foundation relies on the concepts of the business model, innovation management and the intelligence.

1.3 Motivation

Both big industry and single enterprises alike generally face two conditions: periods of relative stability and periods of relative instability, as seen in industry changes. During the periods of relative stability, incumbent enterprises can exploit their business model by simply adjusting their products, services or business model incrementally, thereby capturing the benefits of its value proposition. However, during periods of instability they need to consider taking rather more radical steps with a more entrepreneurial focus in order to explore or exploit opportunities. During periods of relative instability, the ‘dominant logic’ of an enterprise is rather to dynamically develop value propositions, whereas during periods of relative stability, it is rather to increase production efficiency, driven by standardization (Utterback 1994).

In this way, the environmental conditions influence the ‘dominant logic’ of an enterprise. The ‘dominant logic’ is the enterprise collective’s filtered cognition about the environmental understanding that reinforces the prevailing behavior of the organization (Bettis and Prahalad 1995).

The two phases can be described as follows.

*Periods of relative stability:* During periods of relative stability, an enterprise usually applies incremental business model adjustments to adapt to the changing environment. The enterprise might not be able to fully shift with the changing environment and only slightly adjust its business model, but it remains in the business. It emphasizes the status quo of the business model and focuses on adjustments and incremental innovations within the established business model (Schneider and Spieth 2013).
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To be successful, enterprises focus on efficiency, coordination and control. Management skills are required, rather than entrepreneurial attitude. Enterprises run on routines and rules to minimize costs of operations and interdependencies on organizational subunits increases. In general, the enterprise moderates its capacity to innovate, making it more difficult to incorporate radical innovations. This type of ‘dominant logic’ is referred to as mechanistic (Utterback 1994). The mechanistic ‘business logic’ is an appropriate ‘dominant logic’ in stable environments because of its increased potential to minimize inefficiencies and systematic management (Utterback 1994).

Periods of relative instability: During the period of relative instability, environmental factor change in a rather discontinuous manner and at a faster pace. As environmental factors change faster, incremental adjustments to the business model might no longer be sufficient and a more radical, disruptive approach is needed in order to compete. In this way, the probability of losing the balance between the assumptions about the environment and reality may increase. The enterprise realizes that the prevailing business logic, has become obsolete as economic consequences are recognized. The enterprise finds itself reactive and in search of a new business logic. As in times of relative environmental stability, assumptions and cognitive perceptions of an enterprise may have been sustainable, in times of relative instability, incremental adjustment may not be radical enough. Thus, in times of relative instability, enterprises are forced to fundamentally rethink their assumptions about their business environment, their enterprise mission and their enterprise competencies and weigh them up against reality. Techniques and the ability to innovate its business model then become important and radical business model innovation is necessary.

To be successful in a changing environment, enterprise must focus on making progress and individuals must closely work together. This type of ‘dominant logic’ is called organic (Burns and Stalker 1961). It emphasizes frequent adjustments and redefinition of tasks, limited hierarchy, empowered individuals and high lateral communication (Utterback 1994). The organic business logic is an appropriate ‘dominant logic’ in uncertain environments because of its increased potential to gather and process information for decision-making (Utterback 1994).

Drivers for relative instability are demographic changes, technology trends, deregulation, arrival of aggressive new entrants, the increasing cost of some resources or the emergence of substitutes that may require a change in its business model (Demil and Lecocq 2010).

A series of questions usually arises. Do the assumptions still hold true under the new conditions? How shall we transform? What do we need to change? How shall we approach the shifting conditions? Does one have the means and the knowledge to plan, design and implement a new business model? Not only is it a major challenge to abandon the prevailing regime of business assumptions and engage with the new realities, but it seems even more difficult to create rigorous new business assumptions that can serve as
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guidelines for a new business model. As these assumptions shape any organization’s behavior, dictate its decision-making process and define what organizations consider meaningful results (Drucker 1994), they play a substantial role in any enterprise transformation and hence, for the business model innovation. In fact, these assumptions act as the engine behind the transformational activities and the business model innovation.

Confronted with an increasingly complex business environment, enterprises are forced to change fundamentally (Purchase et al. 2011) and rethink the business model which reflects their business assumptions. Changing environments may require new business models (Silverman et al. 1997, Meyer 1980), as product and process innovation is no longer sufficient to transform the enterprise. However, the success of established business models may hamper innovation as it strongly influences the information that is routed to the decision-makers or filtered out of decision processes (Chesbrough 2010), which can lead to an incongruity between assumptions about the environment and reality. The dissonance may lead to ‘cognitive barriers’ that prevent the ‘dominant logic’ being challenged by pivotal business model innovation. Therefore, new capabilities are needed that equip incumbent enterprises with the ability to embark on business model innovation as because through business model innovation, the enterprise removes itself from the prevailing business model and focuses on opportunities within the external environment of the enterprise (Schneider and Spieth 2013).

1.4 Problem and roadmap for research

This thesis addresses the problem of gaining the ability to initiate business model innovation in incumbent enterprises.

Unlike new entrants or start-ups, the creation of a new business model in incumbent enterprise is not a green field approach (Schneider and Spieth 2013). An incumbent enterprise operates on prevailing assumptions about the environment and operates based on a ‘dominant logic’ that dictate the enterprise business model. The incumbent enterprise routinely executes its tasks in order to exploit the prevailing strategy and the prevailing business model, rather than spending time on exploring new opportunities. Incumbent enterprise operate based on a ‘dominant logic’ (Bettis and Prahalad 1995), which determines the mode of operation and its business model. Chesbrough (2010) refers to a corporate cognitive barrier coming from a ‘dominant logic’ and claims that incumbent managers are far from clear what the right business model of operation ought to be in order to overcome the barrier of the ‘dominant logic’. Hence, the ‘dominant logic’, as a cognitive perception, prohibits managers in incumbent enterprises from understanding the potential of alternative business models (Chesbrough 2010, Sosna et al. 2010, McGrath 2010). However, the cognition of management can play a critical role in shaping responses to
discontinuities (Kaplan et al. 2003). In fact, managerial cognition is a potential source of a new business model (Sosna et al. 2010). Shaping cognitive perception is crucial for business model innovation. Other barriers are the configurations of assets and processes or obstruction and confusion (Chesbrough 2010).

In incumbent enterprises, such locked-in effects set the boundaries to variations of corporate behavior (Johnson 2010, Sosna et al. 2010, Zott and Amit 2010) and, thus set boundaries to business model innovation. Such inertia is a key challenge faced throughout the transformation of a business model (Doz and Kosonen 2010). In addition, enterprises often have little if any ability to modify the business models (Chesbrough 2010) to take advantage of opportunities, provided by environmental changes, leaving space for new entrants operating a disruptive business model with the potential for large scale industry shift (Markides 2013). Therefore, enterprises face an extraordinary challenge when it comes to business model innovation as they lack cognitive readiness, experience and the ability to innovate while being in danger.

Although important to enterprises, only limited knowledge exists about how enterprises can prepare for exploring perceived opportunities through business model innovation (Schneider and Spieth 2013). In order to overcome the inertia and apply business model innovation, Chesbrough (2010) stresses the point that enterprises should strive to develop processes that provide high fidelity business models as quickly and cheaply as possible in order to discover a viable alternative business model. In fact, the lack of a process that allows incumbents to come up with entirely new and viable business model alternatives from which to choose seems to be the essential problem of today’s organizations with respect to strategic questions about their business models and their evolution (Osterwalder and Pigneur 2013). Also Zott et al. (2011) concluded that there is a need to develop a better understanding of how an existing business model can be innovated and a new business model can be designed.

In highlighting the need for guidance in business model innovation within incumbent enterprises, they confirmed the need for practices in business model innovation as an important roadmap for further research.

1.5 Object and research question

The object of the research is to respond to the call by industry and academics to support enterprises in establishing abilities that initiate business model innovation. For practitioners, this thesis aims at providing guidelines to reveal the potential of business model innovation in incumbent enterprises. For scholars, this thesis aims at advancing research about business model innovation, by tackling innovation challenges and sharpening the entrepreneurial view on business model innovation.
Introduction
The overall objective is to provide guidance towards business model innovation that strengthens the ability of an incumbent enterprise to react to circumstances that call for business model innovation rather than product or process innovation. In this way, this thesis goes beyond a self-contained understanding of the business model and aims at introducing practices that can initiate business model innovation. Therefore, it goes beyond techniques that facilitate the discussion about the business model and engages with the entrepreneurial view of the business model. It transfers concepts to business model innovation that can foster a proactive ability of an incumbent enterprise to act on environmental changes.

The following research questions are derived from the problem description and the object of this thesis.

1. How can an incumbent enterprise monitor its environment with regards to business model relevant changes?
2. How can an incumbent enterprise trigger business model innovation?

The research adopts triggering as an activity, similar to enabling, activating or inducing, as the verb, while agreeing that the trigger, the noun is an object that carries a potential triggering event (Joosten 1994). In our case, the objects that support the triggering event are the innovation sources (Drucker 1985, Schumpeter 1943, Schumpeter 1934), opportunities for innovation. However, only if the trigger is meaningful to an enterprise, can business model innovation be triggered. Hence, innovation sources do not trigger per se, but can become triggers in the specific context of an enterprise. Therefore, triggering is the activity that contextualizes the trigger within the enterprise as meaningful findings which can in turn initiate other activities, such as the designing of alternative business models. Therefore, we understand triggering as the ability to detect and act upon innovation sources. In other words, the enterprise ability to innovate on innovation occurrences. For instance, the detection of an occurrence of an innovation source causes an enterprise to start testing the assumptions of the business.

The research addresses the research questions from various angles. The publications cover areas such as innovation obstacles and enablers, application of intelligence frameworks, design of the business model, type of industry structure and relationships in the industry. In this way, cases and fragments of the phenomenon contribute to an evolving practice.

1.6 Structure of the thesis
The remainder of the thesis is structured as follows.
Introduction

In chapter two, the academic foundation is outlined. The research elements, business model, innovation and intelligence as well as their relationship are described. In chapter three, the empirical foundation is described. In chapter four, the research approach is explained. In chapter five, the summary of the publications and the contributions in the research field are highlighted. In chapter six, the conclusion is drawn. In chapter seven the publications are provided.
2. Academic foundation

This chapter frames the academic foundation of the thesis and links the areas of research that are brought together in this research.

2.1 Academic research framework

The aim of this thesis is to gain an understanding of how to monitor the environment and trigger business model innovation.

In order to complement the research on business model innovation, the research domains of business model, innovation management are further brought together and the discipline of intelligence is added to the context of business model innovation. In doing so, it underlines the explorative character of this research. The framework is depicted in figure below.

![Figure 2-1, Academic Research framework](image)

*Business Model:* This part deals with the concept of the business model and its prevailing academic understanding. The business model is understood to be an interrelated concept, incorporating environmental factors which trigger business model innovation.

*Innovation:* Innovation from an entrepreneurial point of view adopts business model as a separate subject of innovation. With this in mind, innovation management extends its understanding through the incorporation of the business model as an innovation discipline, beyond product and process innovation.

*Intelligence:* It is the framework that enables enterprises to deal with changing environments, the creation of new business assumptions and the use of collective intelligence for decision-making.
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Business model innovation: This part deals with the concept of business model innovation. It combines the understanding of business model with the entrepreneurial lens of innovation in order to introduce the concept of business model innovation.

Based on these initial settings and references, research activities are both linked to and guided by the academic foundation (Suddaby 2006). The remainder of this chapter introduces the research areas and highlights their connectivity.

2.2 Business model

2.2.1 Business model understanding

Research on the business model has become the focus of substantial attention from practitioners and academics in recent years. Yet, the concept of the business model still lacks a common and widely accepted language that would enable researchers to draw more effectively on the work of others (Zott et al. 2011). Literature still provides only little consensus on what a business model actually is (Casadesus-Masanell and Ricart 2011, Zott et al. 2011, Shafer et al. 2005, Bieger et al. 2002, Linder and Cantrell 2000, Timmers 1998). Also, C-level managers regularly fail to provide an explanation of the business model of their enterprise, as they do not know precisely what it is (Boutellier et al. 2010). As a consequence, researchers adopt idiosyncratic definitions, if there are any, that fit the purpose of the research (Zott et al. 2011) and managers are left alone with a call for concepts that enable them to deal with the gap between expected change and the ability to manage the business model.

According to (Zott et al. 2011), at a general level, the business model has been linked to a statement (Stewart and Zhao 2000), a description (Applegate 2001), a representation (Morris et al. 2005, Shafer et al. 2005), an architecture (Dubosson-Torbay et al. 2002, Timmers 1998), a conceptual tool or model (George and Bock 2009, Osterwalder et al. 2005, Osterwalder 2004), a structural template (Amit and Zott 2001), a method (Afuah and Tucci 2001), a framework (Afuah 2004), a pattern (Gassmann et al. 2013), or a set (Seelos and Mair 2007).

Referring to the previously described understandings of the concept of the business model, varying in granularity and delimitation, a business model seems to be not a single concept, but many concepts (Zott et al. 2011). As a consequence, research about the business model emerged in silos rather than in a convergent manner, and this may further hamper cumulative progress (Zott et al. 2011). However, most attempts define the characteristic of the business model in such a way that the concept neither limits its scope to enterprise internal elements nor external environmental factors, but rather provides a holistic
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perspective on an enterprise, which allows managers to take an integrated view on the business model (Schneider and Spieth 2013).

Despite the idiosyncratic business model understanding, Zott et al. (2011) derived emerging themes around business model:

**A business model**
- is a new unit of analysis that is distinct from product, company, industry, network and is centered on a focal company with boundaries wider than the enterprise
- is a holistic approach to explain how to “do business”
- is a set of activities around partners and the focal enterprise
- seeks to explain value creation and value capture

Literature provides consensus neither on the concept nor on the definition of the business model, and nor do practitioners propose an accurate understanding. This is why we believe that it is conducive to refer to an understanding that considers the emerging themes and fits the research approach within this thesis. However, before doing so, the term business model shall be differentiated from adjacent topics and be defined in order to delimit the term.

### 2.2.2 Delimitation of business model

**Business model vs. process model:** The business process model is about how a business model is implemented in terms of processes, while the business model is generally understood as a view of the company's logic for creating and commercializing value (Osterwalder et al. 2005). Hence, business models and business process models should clearly be distinguished (Gordijn et al. 2000) and not be mixed up with business process engineering process-orientated activities. The process model shows how “things get done around here” and is a representation of organizational structure to achieve organizational objectives (Jeston and Nelis 2014).

**Business model vs. strategy:** In general, strategy is a complete plan that facilitates decisions regarding the appropriate alternative in case of any contingency (Neumann and Morgenstern 1961). Therefore, a strategy is not fully observable to an external observer as it incorporates 'hidden' pre-defined business decision alternatives (Casadesus-Masanell and Ricart 2010). However, the business model is the observable part of a strategy and can be assumed by an external analyst (Casadesus-Masanell and Ricart 2010). It is a temporary reflection of the strategy with respect to the prevailing environmental conditions (Casadesus-Masanell and Ricart 2010, Shafer et al. 2005).

Although the business model seems to be different from strategy, scholars have also described the importance of the business model in the strategy of an enterprise. With regard to the business model, a strategy is a contingent plan as to how a business model should be configured, depending on
contingencies that may occur (Casadesus-Masanell and Ricart 2010), such as actions of other industry players (competitors, suppliers, new entrants etc.), governmental interventions (deregulation, regulations) or sudden economic shifts (economic downturn, recovery).

Another practical distinction describes business models as a system that shows how the pieces of a business fit together, while strategy also includes competitive aspects (Magretta 2002). Osterwalder et al. (2005) confirm that business model research focuses on describing the elements and relationships that outline how an enterprise creates and markets value (Osterwalder et al. 2005), rather than focusing on competitive positioning.

Hence, scholars agree that business models and strategy are linked but are not the same (Casadesus-Masanell and Ricart 2010, Mansfield and Fourie 2004, Magretta 2002).

2.2.3 Definition of the business model

As described in the preceding chapter, scholars do not agree on what a business model is (Zott et al. 2011) which leads to research that concerns various sub-domains. For this thesis, a theoretical and simple understanding is relevant.

A theoretical approach to define the term business model is taken by (Hoppe and Kollmer 2001). They simply split the term into business and model. In this way, a theoretical, but handy definition is created. A “model” is a simplified representation of the reality which is a compound of elements and their relationship to each other. A “business” is a venture that aims at making profits.

Following the proposed definition of Hoppe und Kolmar, a business model is a simplified representation of a profit-oriented venture (using a set of elements and their relationships to each other).

Acknowledging that the definition is a theoretical reflection, not empirically evolved and tested, it delivers integrity to the concept. It is also very suitable for a number of reasons. First, it serves as an overarching guide post, as the frame to this thesis. Second, it adds rigor within a research domain which is young, quite dispersed and theoretically underdeveloped (Zott et al. 2011), lacking common definitions and adopting various understandings. Third, it paves the way for an accurate understanding of business model innovation on the basis of the business model. Fourth, it serves as a reference to the empirical emerging themes (Zott et al. 2011) to which this research also refers. Finally, it provides guidance as to whether a theory overlaps or belongs to the concept of business model.
2.2.4 The theory of business

The theory of business is a narrative approach to describe the 'logic' of a business. It refers to a set of assumptions that an enterprise needs to make in order to do business. These assumptions conceptualize the business model of the enterprise and are a simplified representation about what a company is paid for, what are considered to be meaningful results and where an enterprise must excel in order to maintain leadership (Drucker 1994). These assumptions shape any organization’s behavior, dictate its decisions about what to do and what not to do (Drucker 1994). The theory explains both the success and the challenges of an enterprise (Drucker 1994).

The theory of business is characterized by three specifications and incorporates the following three parts (Drucker 1994):

1. Assumptions about the environment of the organization, i.e. the society and its structure, the market, the customer and the technology. Those assumptions define what an organization is paid for.

2. Assumptions about the specific mission of the organization. They define what an organization considers to be meaningful results.

3. Assumptions about the core competencies needed to accomplish the organization’s mission which define where an organization must excel in order to maintain leadership.

The theory is that an enterprise is designed on assumptions about the environment. As long as these assumptions fit reality, the enterprise prospers. However, if assumptions about the environment no longer fit reality, its way of doing business is outdated. Enterprises struggle if their assumptions about the environment become obsolete and lose validity over time due to changing environments. In this case, it is not that things in an enterprise are necessarily being done poorly or wrongly, but it is rather that they turn out to be fruitless as the enterprise refuses to acknowledge the need for more than just patching up what is not working (Drucker 1994). Instead, when a theory shows signs of weakening, it is time to think again, to ask which assumptions about the environment, mission and core competencies reflect reality most accurately (Drucker 1994). Every theory of business sooner or later becomes obsolete and then invalid (Drucker 1994) if not questioned and re-thought on a regular basis. No matter whether reality changes incrementally or radically over a short or a longer period of time, preventative care, early diagnosis and an effective cure need to be in place in order to stop the enterprise from becoming obsolete (Drucker 1994).
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In order to maintain competitive edge for the purpose of sustainable performance, the theory proposes three characteristics to which an enterprise should refer. The characteristics suggest constant verification of the rigor of its underlying assumptions, and maintaining awareness to ensure convertibility.

1. Rigor of assumptions: The assumptions about environment, mission, and core competencies must fit reality and one another.
2. Awareness of existence: The theory of business must be known and understood throughout the organization.
3. Convertibility of the business: The theory of business has to be checked constantly and adapted.

As both, the elements as well as some guide posts for handling the business are given in the theory, it proves to be an upright business model conceptualization for the scope of this thesis.

First, the conceptualization reflects the theoretical definition of the business model as it is a simplified representation of a profit-oriented venture and refers to a set of elements and their relationships to each other needed to innovate the business model.

Second, the conceptualization is one of the rare business model conceptualizations that takes an entrepreneurial lens as it refers to the exploitation of opportunities that arise when markets, technologies, and core competencies change (Drucker 1994).

Third, the conceptualization explicitly calls for control mechanisms and permanent balancing of the prevailing business assumptions which is in the focus of this thesis. Thoroughly systematic monitoring and testing of its theory of the business should be built into the organization to take effective action and steer innovation actively (Drucker 1994). Systematic monitoring facilitates the spotting of opportunities and sources of innovation that trigger business model innovation from both outside and within the enterprise. Monitoring allows entrepreneurial action to be taken upon potentials to restructure the prevailing assumptions of the business, the mission and the core competencies.

Fourth, the conceptualization shows sound analogies with the emerging themes (Zott et al. 2011) in business model research as it does not infringe on one of the highlighted topics. The emerging themes seem to have encompassing similarities to the theory of business as it describes a holistic understanding about doing business and the logic of the business, goes beyond enterprise boundaries and certifies enterprise innovation. The theory of business is a separate unit of analysis with boundaries wider than the enterprise, it is an explanation to how to “do business”, it emphasizes the importance of activities around that focal firm and its surroundings and addresses value creation in the form of enterprise competencies. Hence, solid congruence between the evolving themes and the theory of business is hard to deny.
Fifth, referring to business model research around business model components, high congruence is again evident. Drawing on Shafer et al. (2005) a list of 42 distinct business model components, high congruence is found for all of the components, apart from strategy (Boutellier and Eurich 2009). Scholars agree that business models and strategy are linked but are not the same (Casadesus-Masanell and Ricart 2010, Osterwalder et al. 2005, Mansfield and Fourie 2004, Magretta 2002). The encompassing conceptualization of the theory of business serves as a thorough business model definition (Boutellier and Eurich 2009).

2.3 Business model innovation understanding

Although literature does not agree on the definition of a business model and while literature about the business model developed in silos rather than in a converging manner (Zott et al. 2011), scholars adopted the concept of business model innovation in their research. Affected by the vague understanding and missing theoretical foundation of the business model concept itself, the research on business model innovation cannot build on an established definition and well-structured literature base (Schneider and Spieth 2013). However, as research about the business model adopted the business model itself as a unit of innovation, it acknowledges the separate unit of analysis. Hence, the business model became a subject of innovation. It is a unit of analysis, capable of simultaneously considering all relevant internal and external factors (Schneider and Spieth 2013, Zott et al. 2011, Teece 2010). In this way, while it does not provide a conclusive understanding about the business model, the research about the business model, paved the way to business model innovation.

A similar challenge can be seen with regard to the term business model innovation (Schneider and Spieth 2013). Although widely used across industries and disciplines, no prevalent common understanding of the dimensions underlying business model innovation has yet been established (Schneider and Spieth 2013). The perceived infant state of understanding about business model innovation is affirmed by the explorative character of academic literature (Schneider and Spieth 2013).

Though they have not provided a commonly applied definition, scholars have started to delimit business model innovation from adjacent concepts. In a rather general manner, business model innovation is an approach which goes beyond the established concepts of product and process innovation (Boutellier et al. 2010). It is a separate form of innovation (George and Bock 2011). In a more specific manner: business model development versus business model innovation. While business model development emphasizes the status quo of the business model of an enterprise and focuses on adjustments and incremental innovations within the established business model, business model innovation removes itself from the
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status quo and focuses on opportunities within the external environment of the enterprise (Schneider and Spieth 2013).

For the purpose of accuracy and due to the fact that the research domain is young and therefore no prevalent common understanding of the underlying dimensions of business model innovation has yet been established (Schneider and Spieth 2013), the definition of business model innovation should draw on the definition of the business model. In doing so, it relies on an accurate understanding of the concept and frames the research concerning business model innovation on the basis of a theoretical definition.

A business model is a simplified representation of a profit-oriented venture
(using a set of elements and their relationships to each other).

(Magretta 2002, on the basis of Hoppe and Kollmer 2001).

Innovation is the effort to create purposeful, focused change in the economic or social potential of an enterprise

(on the basis of Drucker 1985).

Drawing on these two theoretical definitions, this thesis understands business model innovation with regard to an incumbent enterprises as follows.

Referring to the activity view

Business model innovation is the effort to create purposeful, focused change in a profit-orientated venture with regards to the elements of the business based on a simplified representation

(Magretta 2002, on the basis of Hoppe and Kollmer 2001, Drucker 1985)

Referring to the ability view (Drucker 1985)

Business model innovation is a talent, an ingenuity, a (re-)combination of knowledge applied in a profit-orientated venture with regards to the elements of the business based on a simplified representation.

(Magretta 2002, on the basis of Hoppe and Kollmer 2001, Drucker 1985)
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Hence, the ability to create a new or different business model.

Overall, business model innovation refers to the creation, to the design and to the re-definition of the business as a whole. Applying the concept of business model innovation allows an organization to not only re-invent its products, but redesign the entire enterprise, creating competitive advantages beyond product portfolios or enterprise processes, considering topics such as profit formula, cost structure, processes and value proposition, or innovating its value network, even beyond the enterprise border. In simple terms, business model innovation is the task to reshape the logic of an enterprise.

2.4 Intelligence and business model

Intelligence revolves around the topic of information processing. It covers the art of gathering, processing, interpreting and communicating technical and business information that is needed in the decision-making process (Wilensky 1967). Its aim is to make information available at all levels of the enterprise with the goal to proactively trigger the business and protect it against threats.

Intelligence is the outcome of processed data and information. It involves a transfer of knowledge from the environment to the organization within established rules (Rouach and Santi 2001).

Intelligence is not synonymous with information, however. Information is factual. It is numbers, statistics, scattered data about people and companies. Intelligence is information that has been filtered, distilled and analyzed (Kahaner 1997). It is intelligence and not information that managers and decision-makers need in order to steer the enterprise. Intelligence is not synonymous with illegal activities either. It is not spying, stealing, or bugging. Put simply, it is analyzed information (Fuld 1995).

Intelligence research is divided into four streams (Rouach and Santi 2001, Deschamps 1995):

- **Market Intelligence.** Market intelligence focuses mainly on current and future customer trends. It provides a roadmap of customer needs and preferences, new market segmentation opportunities and major shifts in marketing and distribution.

- **Competitor Intelligence.** Competitor intelligence focuses mainly on competitor trends. It evaluates the evolution of competitive strategy over time through changes in competitors’ structure, new product substitutes and new industry entrants.

- **Technological Intelligence.** Technology Intelligence focuses mainly on technology trends. It assesses the cost/benefit of current and new technologies and forecasts future technological discontinuities.

- **Strategic and social intelligence.** Strategic and social intelligence focuses mainly on social trends. It observes regulations, financial and tax, economic and political issues, as well as social and human resources.
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Although literature reveals sub-domains of intelligence within enterprises, intelligence boils down to the active management of industry dissonance (Gilad 2003).

The purpose of an intelligence framework is to detect threats and opportunities as well as pave the way for alternative strategies in unknown areas. In this way, it not only triggers the innovation of the business model by revealing contextualized threats and opportunities, but also enables the enterprise to rethink the assumptions the theory of business refers to. Information becomes intelligence and intelligence triggers action. As proposed in the theory of business (Drucker 1994), an enterprise needs to monitor the environment and balance its assumptions about the business against the reality. Drucker (1994) calls for preventative action in order to prohibit the demise of the enterprise, while responding to environmental dynamics. These dynamics may become a significant threat when ignored by the enterprise, but they may also become valuable opportunities in anticipating events (Savioz and Blum 2002).

The problem is, however, the prevailing assumptions about reality. Executives who are trapped in their obsolete assumptions tend to refuse to believe in the intelligence about the environment which stems from their own people dealing with that (Gilad 2003). In the absence of formal structure, executives, while capable of challenging their prevailing assumptions and alerting to dissonant risk early enough, nevertheless jump into action only when confronted by crisis and reduced numbers (Gilad 2003). To this end, formalization is one solution to overcoming ‘dominant logic’ or the locked-in effects.

With regard to the environmental changes, a formalized intelligence framework can act as a proactive trigger to business model innovation, making use of information gathered through monitoring the environment, and processed through an internal formalized structure. In this way, it challenges the prevailing assumptions, the ‘dominant logic’, about the business as well as management perception and fosters the ability to initiate business model innovation. It is for that reason, that this thesis introduces intelligence to research on business model innovation. Intelligence provides the foundation for effective action-taking, making use of pieces of information that are put into the context of the enterprise and aggregated in a meaningful manner. Success and failure of transformative business undertakings boils down to the firm’s ability to change its business model effectively with respect to the business environment (Burgelman 1994). As timely and relevant information of the business environment are crucial to business model innovation, however not sufficient, it is the entrepreneurial ability of the decision-makers who ultimately determine the initiation of business model innovation from within.

2.5 Entrepreneurial view on innovation

The research employed an entrepreneurial lens that recognizes opportunities as a source for innovation. A business model narrows entrepreneurial thinking to a definable opportunity, establishes the relevant goal
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set that drives entrepreneurial action and organizational induction, and binds the implementation of organizational activities that utilize the opportunity (George and Bock 2011). In this context, the business model is a component of innovation commercialization based on an opportunity separate from product and process innovation (George and Bock 2011).

Utterback and Abernathy (1975) distinguish in their innovation model two subsequent innovation waves. The first wave describes product innovation, the second wave describes process innovation. Whereas product and process innovation are common for both early and subsequent production stages, business model innovation can be an addendum (Boutellier et al. 2010) and a single unit of analysis and innovation (Zott et al. 2010). However, innovation rarely springs from a flash of inspiration, it does not just happen, it is not a random task, but is based on specific opportunities and arises from a cold-eyed analysis of these opportunities (Drucker 1985). Management needs to actively focus their attention on innovation opportunities in a systematic manner so as not to miss the moment to act. It needs to highlight the moments an enterprise may need to rethink the prevailing assumptions about the business and potentially start to innovate the business model. Systematic innovation begins with the analysis of the internal and external sources of the opportunities (Drucker 1985), as highlighted by Schumpeter (1934, 1943) and Drucker (1985).

They describe the following domain and sources as innovation opportunities:

Schumpeter (1934, 1943) derives five domains where innovation can begin:

- A new good: creation of a new product or modification of product quality
- A new process: implementation of new production methods
- A new market: development of new markets to address new customers
- A new source of supply: development of new sources and contracting of new suppliers
- A new organization of any industry: development of new organizational structures

Drucker (1985) adds seven additional, partly complementary sources of innovation and divides them into internal as well as external sources:

Internal sources:

- Unexpected occurrences: Unexpected successes and failures are productive sources of innovation opportunities because most businesses dismiss them, disregard them, and even resent them
- Incongruities: between expectations and results, between industry assumptions and reality, between economic realities
- Process needs: adaptation that increase throughput
- Industry and market changes: Incumbents often neglect the potentials when industry changes because they may believe that the industry structure are ordained by the Good Lord
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External sources

- Demographic changes: most reliable external source as they have known parameters such as age distribution, education, occupations and geographic location
- Changes in perception: change of management perception of environmental shifts
- New knowledge: longest lead time and often a combination of elements of knowledge that suddenly converge

The Schumpeterian domains of innovation as well as the sources of innovation described by Drucker (1985) are qualified areas within and around enterprises which incumbents, and start-ups, should pay attention to and potentially respond to in an explorative or exploitative manner.

Innovation is the specific function of entrepreneurship, whether in an incumbent enterprise or with a start-up. From an activity perspective, Drucker (1985) defines innovation as the effort to create purposeful, focused change in an enterprise's economic or social potential. In terms of ability, he understands innovation as a talent, an ingenuity, a (re-)combination of knowledge (Drucker 1985) that can be performed in a systematic manner. Whatever the perspective, it is the means by which new value propositions enhance potential for creating wealth are created.

In this way, the innovation opportunities complement the foundation of this thesis as they provide guidance to incumbent companies when and against what business model innovation should be considered. For the understanding of this research, they are considered triggers (initiators of innovation) and therefore are references or sources that can stimulate business model innovation.

However, it remains with the enterprise to respond to changes through product, process or business model innovation.

2.6 Summary of the academic foundation

In summary, this thesis views business model innovation through an entrepreneurial lens as it refers to exploring and acting on opportunities as drivers for business model innovation. It adopts an innovation management position about the business model as it refers to the business model as an innovation subject, a separate unit of analysis. It draws on the ‘theory of the business’ (Drucker 1994) as a conceptualization of a business model. Finally, it considers the concept of intelligence to respond to the claim for the need for dynamic adaptation and continuous testing of the theory of business against a changing reality (Drucker 1994).
Empirical foundation

3. Empirical foundation

This chapter describes the main cases, highlights the key challenge and depicts the specific situation of the incumbent enterprises.

3.1 Introduction to the main cases

The research draws on two main cases and is complemented with smaller research cases. The main cases are briefly described to allow for a better understanding of the findings. The context of the smaller cases can be drawn from the publication in chapter seven.

One case is taken from the Air Navigation Service Provision Industry and the other from the Defense Industry. The cases describe incumbent enterprises operating historically in regulated environments of relative stability, preparing to enter less regulated environments, beyond the state protected environment. These environmental changes goes hand in hand with environmental instability that lead to a rethinking of the prevailing business logic.

In both cases, the CEOs understood the need for action and searched for approaches that would help to establish the ability to innovate the business model. Both enterprises understood the necessity to challenge the prevailing business logic, due to the fact that in a non-regulated environment, the present business model may not be sufficient to compete. The CEOs also understood that in order to maintain sustainability in non-regulated environments, the established business model has to be rethought and discussed beyond process or product innovation. Although they did not explicitly express the need to “innovate” the business model, they put on their agendas the aim for systemic and systematic action, rather than patching here and there. Their undertakings intended to start a process that allows for fundamental discussion and fundamental rethinking of the prevailing business logic. In doing so, a more strategic and entrepreneurial discussion about the business logic was launched.

3.2 The challenge

Regulatory bodies often act as buffers by protecting the enterprise from market and competitive forces (Mahon and Murray 1981). In this way, enterprises maintain the status quo while regulation provides a great deal of stability in the environment (Mahon and Murray 1981). As a consequence, competitive dynamics and innovation focus are often weakened. Under regulatory influence management tends to focus heavily on the regulatory body, rather than on innovation itself. The business model is generally adept at political topics and therefore tailored to smoothly align with regulation. While such enterprises possess management capability that help satisfy the regulatory body, management capabilities that
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Contribute to innovation and organizational change tend to be underdeveloped, unsystematic and sporadic in their functioning (Pettus et al. 2009). Such regulations exert great influence on the enterprise (Daft et al. 1988). Non-regulated environments differ from regulated environments in various ways, namely (Pettus et al. 2009).

- eliminated market entry and exit restrictions
- eliminated constraints on scale and scope
- eliminated regulatory controls
- eliminated dedicated market share

Regulatory changes affect an enterprise in a way similar to a 'Schumpeterian shock' that confronts enterprises with a different, often more dynamic environment which may demand new business models (Silverman et al. 1997, Meyer 1980). In fact, regulatory and other changes are at the core of reshaping whole industries and, in their course, the redistribution of profits (Casadesus-Masanell and Ricart 2011). Either when the regulatory body no longer dictates the industry dynamics or when no explicit regulatory body is there, old routines that satisfy the regulatory body and industry dynamics become obsolete. Instead, entrepreneurial capabilities become more important, if not the new source of competitive advantage.

Still, incumbents can compete successfully in new environments because the managers use their firm and industry-specific experience (King and Tucci 2002) which continues to be useful even in non-regulated environments. However, in the event of other regulatory conditions, new capabilities are required to understand and monitor the environment as well as develop new business models.

3.3 Case - Air Navigation Service Provision Industry

Research activities in the Air Navigation Provision Industry were embedded in an ICT project (Transformierung der Flugverkehrsmanagementindustrie: das “Common Controller Cockpit” und der „Blue Line Standard”) with Skyguide, the Swiss air navigation services provider. The project was funded by the Swiss Commission for Technology and Innovation CTI. It ran for 18 months. The research group was divided into expertise from innovation management and business model research.

3.3.1 Environmental conditions and impacts on business logic

The EU’s successful liberalization of the air transport industry ushered in a period of unprecedented growth in air transport and introduced many new entrants and business models into the market (European Low Fares Airline Association 2004). Air travel became much more accessible and affordable and stimulated tremendous growth in air transportation. Within four years of liberalization the amount of
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available seats during a particular week in July 2000 was just 750,000 but for the same week in 2004, a staggering 7.5 million (European Low Fares Airline Association 2004). During this period (2002-2012), European airports have increased passenger throughput at an average annual rate of 4.9% (MacDonald 2013).

With this in mind, the demand for air navigation services (ANS) increased across Europe, yet the amount of air navigation service provision barely changed. Innovation in ANS provisioning has been stagnating for decades and new technology and services have been sparingly introduced. The inactivity is now pushing the current information and communication technology (ICT) systems to their limits (Breitenmoser et al. 2014). The ICT in use became the bottleneck for cost-efficient and environmentally-friendly air transportation. ANS provider (ANSP) capacity restricts the amount of aircraft that can be served by ANS and the capacity limits have been reached, especially around busy airports such as London and Zurich for example.

The European Union (EU) gained competences in 2004 in air traffic management (ATM). The Single European Sky (SES) initiative was launched in order to cope with a sustained air traffic growth and air traffic operations. Its aim is to address the de-fragmenting of European airspace, the reduction of delays, the raising of safety standards and flight efficiency with the overall goal to reduce aviation’s environmental footprint and thereby reducing costs related to service provision. At its core, there is a series of technological innovations as well as the rearrangment of European airspace. Whereas the so-called functional airspace blocks (FAB) are to reduce flight times and the amount of airspace across Europe, technological innovation is to increase capacity and reduce overall air navigation service provision costs.

The deployment of the FAB concept will lead to a decrease in the amount of airspace blocks over Europe from more than 60 areas of control to nine functional airspace blocks. The Swiss ANSP is part of the FAB Central Europe which consolidates the airspace over France, Germany, Belgium, the Netherlands, Luxembourg and Switzerland. The consolidation of airspace directly affects the amount of ANSPs and the way of delivering services. This initiative indicates the increasing importance of economic reflection by regulatory bodies and a regime of new regulations.

ANSPs are expected to support the implementation of the latest incremental technology improvements that will pave the way for the planned airspace consolidation and the establishment of the new FAB. The future business logic of ANSPs, however, are unknown. Referring to the goal of the SES initiative, it is assumed that the industry will undergo huge additional changes in the next decades. New business models are required: Business models that serve the goals of the new reality under the SES.

In summary, Skyguide will face periods of extensive environmental change, including the rearrangement of airspace, the consecutive deregulatory tendencies of the SES and the new technologies that emerge.
Empirical foundation

Analyzing the tendencies, the Swiss ANSP, Skyguide, understood that its business logic will change and its business model will be challenged. In order to gain a deeper understanding of the implications of the SES for the prevailing ecosystem, it embarked on developing an in-depth understanding of the forthcoming business logic and engaged with ETH to complement their existing management capabilities with business model innovation research. In doing so, it intends to maintain its leading position as innovator and creator of the imminent industry transformation and remain in the industry with an adapted business model, tailored to the forthcoming industry dynamics. The creation of a series of assumptions and ideas about the business logic helped to create new managerial mental models and shape management perceptions in order to trigger business model innovation.

3.3.2 Prevailing business logic and analytical approach

Current business logic is determined by the geography of the service delivery, the order of the Swiss government and the technological trajectory of Skyguide. The area of service delivery is almost congruent with the national border with some slight exceptions to serve the airports that are close to the borders. Therefore, the provisioning of the service is steered locally under Swiss regulations. Service provisioning is paid according to a European-wide standardized pricing structure on which the ANSP have little influence. The pricing is subject to a regulatory process and is calculated with respect to the local cost structures of any ANSP. Across Europe revenues are centrally collected and distributed to the local ANSP based on a predefined allocation algorithm. Service provision is regulated and standardized. Regulatory requirements are relatively stable and predictable. Hence, maintaining organizational routines are at the center of operational tasks and help satisfy the regulatory agency. The routine focus is mainly triggered by safety reasons and long-term industry stability. The allocated airspace, in combination with the technical capacity of service provision, enables the calculation of theoretical service volume during a specific period of time, which helps to determine the potential revenue derived from service provisioning. Innovation so far is incremental and restricted to technological adaptation and incremental process improvements. The prime goal is safety and a high level of reliable service provision. “Economic success” is achieved, among other things, through the management of routines, the regulatory body, the political decision-making process, the labor unions and the happiness of the individual employee. Thus, the management focus is on political as well as social aspects in order to operate the business successfully.

In the dawn of increasing expectation by the European Commission to see SES deployed, ANSPs are pressured to cooperate and contribute to the achievement of the goals. Hence, they need to take action. They need to reposition themselves in the new environment. Economic and technological aspects will pop up on the agendas of ANSPs management and the business logic will gradually shift from a socio-political focus towards economic and technological aspects in order to remain in the industry. The
Empirical foundation
environmental factors are likely to transform and the assumptions about the theory of business will need to be checked. Skyguide recognized this and so it set about developing an understanding of the new business logics and a definition of its future business model. The creation of this understanding about its relevant business logic, its implication for innovation and the design of alternative business models are at the core of its undertakings. Analytical practices to develop an understanding about the challenges are required. Environmental changes, internal and external challenges to innovation, as well as the new role of Skyguide as an ANSP are to be a part of the analysis that sets the stage for creating new potential business models.

3.3.3 Creation of the new business logic and business model
Strategically, Skyguide opted for an explorative approach rather than trying to exploit and protect the current business logic. Its top priority is the mission statement for becoming the industry innovator. Though this, it intends to pave the way for the design of a new value proposition that withstands industry changes and is tailored to future business logic. As a result, a technological innovation initiative as well as a business model innovation initiative have been launched.

The technological innovation is an ICT-based approach (Common Controller Cockpit) that allows for simple inter-operability and harmonized service provision across FAB and Europe. The „Common Controller Cockpit“ (CCC), engineered by Skyguide, will pave the way for a European-wide standardized interface for air navigation services. With this in mind, a business model is also being discussed. At the center of the discussion are two main interests: The business model needed to commercialize the idea of CCC as well as the industry positioning of the ANSP after the installation of the new SES regime.

The role of the business model innovation initiative is to create the mental model for management and to shape their perception. Its goal is to create an idea about potential alternative business model that address the forthcoming industry shifts. Its existing business model remains in operation not only for the sake of the governmental obligation, but also to further elaborate business model alternatives as well as making use of the time that is still given. The business model design process incorporated the conclusions from simplification which delivered reference conditions to the business model innovation undertaking.

Internal and external challenges that hold Skyguide back from adapting quickly are summarized in a PEST framework in which technological enablers are also described. In addition, a business role relationship model was created in order to understand a potential future industry structure and the role of the ANSP. Both simplifying conclusions then served as reference conditions during a business model design approach. In doing so, the consecutive business models were challenged through conclusive reference conditions during both phases, the design and the qualification of the alternative business models.
Empirical foundation

In this way, it also linked the environmental factors directly to the business model alternatives. Besides the environmental constraints, safety remained the top priority in all undertakings. Safety comes first.

3.4 Case – Aerospace and defense industry

Research activities in the aerospace and defense industry were embedded in a project that aimed at creating a framework to monitor the enterprise’s environment. At its core it dealt with the creation of an intelligence framework that fosters environmental awareness. The project lasted around 12 months. The publications from this case are combined in part with findings from similar cases conducted in the department of technology and innovation management at the ETH.

3.4.1 Environmental conditions and impacts on business logic

In the course of liberalization, large former state-owned enterprises have been released into non-regulated market environments such as telecommunication or air transportation. Today, also smaller state-run entities and public service providers face being released into an open market (Vischer et al. 2010). After being privatized, RUAG, the Swiss state-owned aerospace and defense company has been released to the non-regulated civil and international environment. Its target is to increase its revenue share in the civilian environment, as national defense budgets in Europe declined and strengthen the international business as local deal volume decreased. Hence, RUAG needed to reflect the new realities to operate in new civil and defense environments. Having enjoyed long-term and quasi 'state guardianship' due to the sensitive nature of its work, its obligation became not only to deliver specific services to the Swiss government while respecting the overriding intrinsic public interest (Vischer et al. 2010) of its military product and services, but explore new geographic regions and alternative civil markets.

3.4.2 Prevailing business logic and intelligence

The prevailing business logic was determined by the historically local and defence focus. The largest customer so far is the Swiss government’s Federal Department of Defense, Civil Protection and Sport with a share of around 30% in revenue by 2014. Especially Defense goods and services were optimized to meet national needs, guided by national as well as international regulations. Within RUAG Electronics (today RUAG Defense), services are delivered according to service agreements. Service agreements provide an invoice for every hour of service delivered to the customer while maintaining a high level of standardization and customized service delivery. Long-term contracts and a reliable paying main customer, stabilize the business environment and reduces industry dynamics. The products are mature customized solutions for individual customers. Economic success is, among other things, achieved
Empirical foundation

through long-term and close working relationship with government, the obligation to maintain a certain amount of knowledge for the Swiss government and the ability to provide customized products and services. Due to the nature of the business, political as well as social aspects strongly influence the business logic. The vast majority of RUAG Electronic's business is generated nationally in the defense environment.

Yet, as the expectations of the owner of the enterprise increased to include delivery beyond Swiss borders and entry into the civil market, the enterprise took on business model innovation because for both undertakings the enterprise needed to go beyond process and product innovation.

Civil markets and internationalization meant competing with enterprises who understand non-regulated environments and international business while being more exposed to public attention than before. Due to different environmental dynamics, the prevailing assumptions about the environment were challenged.

The international as well as the civil business are environmental changes that mark a shift from the prevailing assumptions about the environment. The environmental factors are likely to be different and the assumptions about the theory of business need to be rethought.

In summary, RUAG Electronics (today a part of RUAG defense) faces environmental change by entering the civil market and going internationally. However, the prevailing assumptions about the business do not fully incorporate non-regulated civil environment and international business.

Analyzing the situation, RUAG Electronics understood that its business logic needed to adapt in order to survive in the new environments. In order to gain a deeper understanding about the implications of the civil and international business, it embarked on creating an intelligence framework and worked with ETH to complement their existing management capabilities with an approach to increase environmental awareness and effective management of the business model. The intelligence framework should provide assumptions about reality in order to support the creation of new managerial mental models and the shaping of management perceptions to then trigger business model innovation. Emphasis was given to intelligence about business relations, competitors and acquisition targets through a process of scanning, qualification and monitoring. The intelligence framework will support decision-making through information gathered, analyzed and processed in real time. The goal of the framework is to pave the way for an accurate redesign of the prevailing business model and to gain an in-depth understanding of the new environment and its reality. However, there was no such capability in place that could provide decision-makers with compelling arguments and analytically processed information as a decision basis.

A so-called "gatekeeper"-based intelligence framework was developed. The framework proposed making use of the existing informal network and increasing the capability of specific employees to operate as
Empirical foundation
gatekeepers. A gatekeeper is an employee who is in charge of scanning and monitoring allocated areas of
interest as well as forwarding information to decision-makers.

3.4.3 Creation of the new business logic and business model

RUAG Electronics intended to enter the civil environment with a new product while going international
with existing products and services. Both approaches call for the creation of assumptions about the
environment, as new realities will challenge the prevailing business model.

With this in mind the business model was discussed. At the center of the discussion were two main
interests: A new value proposition for a civil customer as well as the internationalization approach.

A technological innovation initiative was launched on assumptions about the new environment that will
pave the way for business in the civil environment. The assumptions were that police and special forces
have a need for a civil command and control system. Hence, the business model needed to enable the
commercialization of the idea of a command and control system for police and special forces.

Despite tremendous efforts in gaining intelligence in the civil market, a viable business model to
commercialize the technology could not be found. In 2011, following an internal strategic review, a
decision was taken to halt involvement with the product in favor of an operational command and control
system.

Based in an in depth analysis about the environment and potential value propositions, a new technology
has been developed; however, the challenge to innovate a viable business model through which the
technology could have been commercialized has hampered success.

With regard to the internationalization, new partnerships and relationships needed to be established. The
prevailing business model needed to be complemented, and assumptions about potential partners and
acquisition targets needed to be made in order to allow for an overall position of the enterprise under a
different international regulatory regime.

However, as it was recognized that an international customer base could be better served by a larger
entity, RUAG Defense was formed on 1 January 2011 as a new division following the merger of the core
businesses of the former divisions RUAG Electronics and RUAG Land Systems. This enabled the
division to offer optimized one-stop shopping for a broader product portfolio together with
complementary services In that sense, based on new environmental assumptions with respect to
internationalization a new business model was finally developed.
4. Research Approach

This chapter describes the research approach taken and links the research approach to the case studies.

4.1 Qualitative research

This thesis is based on qualitative research undertakings and follows an inductive logic. A qualitative research approach is suitable if the research questions starts with “how” (Maxwell 2005, Punch 2005) and is highly contextualized as well as embedded in a social system. As an enterprise is considered to be a social system, the research takes place in a social context where the participants’ perspective plays a crucial role. Therefore, the research objective is to understand the phenomenon from the perspective of the participants within their particular context. If textual data were to be quantified, the particular context of the participants would be largely lost (Kaplan and Maxwell 2005). Qualitative research, however, gathers its data from qualitative research approaches such as interviews, focus groups, workshops to gain an understanding of social phenomenon (Creswell 2009). As this thesis aims at gaining an understanding as to how to monitor the environment and trigger business model innovation, the approach is appropriate and purposeful.

The research follows an inductive research approach as illustrated in the figure below. In the first step, data is gathered in areas of interest, in this case business model, intelligence and innovation. In the second step, primary data is gathered through interviews, focus groups and workshops. In a third step, the data is analyzed and consolidated. In the fourth step, generalized patterns and trends are derived. In a fifth step, the findings are refined through feedback loops and review sessions with the participants from the interview series. If consensus could not be found, step three and four were repeated.

Figure 4-1, Inductive approach of qualitative research (on the basis of Creswell, 2009, p. 63)
4.2 Case Study Research and case selection

The case study is a research approach which focuses on understanding the dynamics present within single settings (Eisenhardt 1989). The research approach is an empirical inquiry that, on the one hand, investigates a phenomenon within its real-world context (Yin 2009, Eisenhardt and Graebner 2007, Myers 1997) and, on the other hand is an appropriate method that covers contextual conditions rather than isolated variables (Yin 2014, Denzin and Lincoln 2009, Stake 1995). As the context in real-world cases is not always absolutely sharply defined, one strength of the case study is to appreciate such blurring (Yin 2014) in order to keep the freedom to richly describe the existence of a phenomenon (Siggelkow 2007).

The research is conducted in a descriptive manner, whose purpose is to describe a phenomenon in its real-world context (Yin 2014). The cases were studied independently in order to allow the unique patterns of each case to emerge before generalizing across cases (Eisenhardt 1989). Applying such an approach is particularly suitable for business model innovation because the concept of the business model and its innovation potential has only recently occurred (Zott et al. 2011) and common understanding has not yet been achieved.

The case study is particularly suitable for illuminating relationships such as business model and business logics within business model innovation (Eisenhardt and Graebner 2007). The cases will offer extended theoretical insight into business model innovation conducted by incumbent enterprises with a strong regulatory influence. Therefore, the cases presented herein are extreme situations or polar types, selected for theoretical reasons (Yin 2014) that complement existing cases, and which deal with business model innovation. The access granted during the research, allowed for multiple levels of analysis (Yin 1984) such as the creation of reference conditions for business model design purposes or organizational approaches to establish a dynamic business model management structure.

To accomplish the research goals, single case and multi-case studies were conducted using similar and complementary data collection methods.

4.3 Data Collection

4.3.1 Qualitative data collection

In accordance with the qualitative nature of the thesis and the research question, data collection included and combined three qualitative data research techniques: semi-structured interviews, literature review and focus group workshops (Eisenhardt 1989).
Research Approach

With the focus on collecting well-founded data, the different types of data collection were partly combined within each case. In doing so, stronger substantiation of construct could be achieved (Eisenhardt 1989). Data collection was supported by multiple researchers, which increased confidence in the findings and increased likelihood of surprising findings (Eisenhardt 1989). This was achieved through team visits to the case study sites and whenever possible by two person teams during interview sessions. All the publications feature, at least to some extent, insights through semi-structured interviews, literature reviews and workshops. Since the detailed data collection approach can be drawn from the single publication, we only provide the cornerstones of the data collection activities.

4.3.2 Semi-structured interview

Interviews are a highly efficient way to gather rich, empirical data, especially when the phenomenon of interest is highly episodic and infrequent (Eisenhardt and Graebner 2007). The interviews were conducted in a semi-structured manner, employing a generally open-ended questionnaire. On the basis of a literature review, archival sources and research discussions with colleagues, interview guides were developed. In order to prohibit potential bias, research was complemented using numerous and highly knowledgeable informants who gave views on the phenomena from diverse perspectives. Interviews, whenever possible, were conducted by two person teams, with one researcher handling the research question and the other writing down the observations and answers in a face-to-face situation. If not otherwise possible, the interview was conducted by phone. Interviews conducted by co-authors were also incorporated into some of the publications. The advantage of qualitative interviews lies in that they quickly provide a holistic view and understanding of the situation (Yin 2014, Snow and Thomas 1994). In addition, they leave room for unexpected, but relevant new insights.

4.3.3 Literature review

The literature review provides an overview of the ongoing discussion in the literature and supports identifying research gaps (Creswell 2009). The literature review covered thematic analysis which involves the detection and definition of the key expressions to start with for the specific topic. As the thesis brings Business Model, Innovation Management and Business & Technology together, key expression search respected and included terms such as business model, business model innovation, business model design, business assumptions, business intelligence, technology intelligence etc. Key publications could be identified by means of the amount of citations and their journal ranking.

Referring to the key articles in the field, backward and forward citations were used. Backward citation started with the key articles and journals identified which lead to a broader basis of articles and forward citation. Forward citation is applied to identify articles that site the key article. This is done by means of
Research Approach

search engines such as Google Scholar or Web of Science. The relevant literature was selected upon reading the summaries and conclusions (Webster and Watson 2002). The decision as to which article to consider was determined by the degree of relevance to the research topic of this thesis.

4.3.4 Focus group workshops

Focus group workshops are simply group interviews. Focus group interviews are either guided or unguided discussions addressing a particular topic of interest or relevance to the group and the researcher (Edmunds 1999). A typical focus group session consists of a smaller number of participants under the guidance of a facilitator, usually called the moderator (Berg and Lune 2004). For complex topics, focus group size should not exceed seven participants (Krueger and Casey 1994). The job of the moderator is to draw out information from the participants regarding topics of importance to a given research investigation (Berg and Lune 2004). His role is similar to the role of the interviewer during face-to-face interview, but in this way, interviewing a group. The informal atmosphere during group discussion is intended to encourage subjects to speak freely and in detail about behaviors, attitudes, and opinions they have (Berg and Lune 2004). The potential of focus group discussion lies in the larger number of ideas, issues, topics, and even solutions to a problem that can be generated in comparison to the individual interview sessions. The group dynamic distinguishes focus group interviews from the ordinary interview, as opinions arising during focus group interviews are socially constructed rather than individually created (Berg and Lune 2004), which in turn can create more embedded results.

4.3.5 Data collection - Air Navigation Service Provision Industry

Interviews: In the case of Air Navigation Service Provision Industry, a set of 20 interviews were conducted to assess innovation topics and management perceptions about the industry changes in order to gain some insight into the environmental factors and opportunities in the industry. Interviewees came from across the ANSP industry and from across Europe: from the Netherlands, Switzerland, and the United Kingdom. System supplier interviewees came from France and Switzerland. Airspace-user interviewees, ATCO representatives and national airspace authority interviewees were from Switzerland. In addition, an external consultant was interviewed to complement the industry view with an external perspective. The interviews included questions related to the current state of the ATM industry, innovation procedures within and across the industry, business role relationships, innovation challenges, business model innovation and technological changes which are expected to result from SESAR and the introduction of FABs. In addition, questions were asked on ICT innovations in ATM and value creation processes. The interviews were recorded and responses to the major questions were transcribed.
Research Approach

**Workshops**: The interviews were complemented with a set of regular workshops spread over 18 months, dealing with the design challenges of an alternative business model, the creation of an alternative business model and the deployment of a Common Controller Cockpit under the regime of the forthcoming SES and tight safety regulations. The focus group workshops were moderated either by external consultants or the researcher. The focus group workshops considered a specific topic, a goal and were limited to a given time-frame. Participants were, in some cases, supplemental to the interview series conducted and explicitly included experts from specific area of interests. Participants came from within the ANSP.

**Literature review**: For the purpose of constructing alternative business models, an explicit and focused business model design literature review was carried out. In order to begin business model innovation, the ANSP looked for a design approach that would render assistance at a very early stage and incorporate a complex environment. The literature review about business model design techniques revealed shortcomings, however. First, the business model design techniques do not provide much comprehensive guidance on how to obtain the final design when starting from the initial problem and situation description. Second, most techniques tended to neglect the relevance of the environment of the organization. However, both aspects were crucial for the ANSP, since it is not used to encountering such major instabilities in its business environment as changing competitive position. The current techniques predominantly lead to concepts that focus on model-internal consistency, but do not foster an awareness of the specific business situation. Based on the literature review and the specific need for a more networked approach, an alternative business model design process was proposed and tested within the ANSP.

All the publications drawn from the Air Navigation Service Provider case feature, at least to some extent, insights from semi-structured interviews, workshops and literature reviews.

### 4.3.6 Data collection – Aerospace and defense industry

**Interviews**: In the case of defense industry, a set of 15 interviews were conducted to investigate what kind of intelligence framework is needed to sustainably scan the environment and conclude business assumptions for senior management. The interviews were accompanied by a questionnaire, and covered a larger internal community. Interviewees came from across the company, including senior management level, business development, sales, ad interim external management, external consulting and specialists. The interviews included questions related to business relationship management, internal intelligence capabilities, decision-making and market awareness with respect to the prevailing strategy to foster international business activities and enter the civil market. In addition, questions about technological awareness and competitiveness were asked and the responses were transcribed.
Research Approach

The findings and framework developed contribute to the organizational practice of business model innovation. The findings draw partly on a master’s thesis conducted in the ETH’s Department of Technology and Innovation Management (Breitenmoser 2009).

Workshops: The interviews were accompanied by a set of regular workshops during the first six months of the project, dealing with intelligence, organizational structure, decision-making, environmental scanning and internal processes. After an intensive initial six months, the workshops turned to a more need-driven mode. The focus group workshops were moderated by the researcher, followed a pre-defined agenda considering the specific topic, the goal and the mode and were limited to a specific time-frame. Participants were, in some cases, supplemental to the interview series conducted and explicitly included experts from the specific area of the topic. Participants came from within the aerospace and defense enterprise.

Literature review: For the purpose of constructing an intelligence framework and the master’s thesis, a literature review considering business & technology intelligence was conducted. In order to begin scanning and qualifying the environment, the aerospace and defense enterprise was looking for an organizational framework that would lend itself to a fast and qualified decision-making procedure. The literature review about business & technology intelligence provide only scant comprehensive guidance on how to obtain an efficient and effective decision-making foundation. The prevailing literature was limited to technology scanning, leaving aspects about the creation of business assumptions aside. Based on the literature review and the specific need of creating reliable business assumptions for decision-making, an alternative intelligence framework was proposed to RUAG Electronics.

All the publications drawn from the Aerospace and defense industry case feature, at least to some extent, insights from semi-structured interviews, workshops and literature reviews.
Summary of the publications

5. Summary of the publications

This chapter summarizes the publications and highlights the contribution of each article to this thesis. The contributions are drawn from the seven underlying publications and their findings. They are presented in light of the overall research question as to how business model innovation can be triggered and the environment can be monitored. Please refer to the appendix for complete articles.

This thesis is based on seven publications. They are listed according to the research areas that are brought together in the research and in descending chronological order:

- Table 1. Publications mainly on innovation and business model
- Table 2. Publications mainly on business model
- Table 3. Publications mainly on intelligence and business model

The publications refer to the cases presented here.

In addition, Table 4, 5, 6 list the working papers that have been written during the course of the research activities in the air navigation provision industry and the aerospace and defense industry.

The working papers in the air navigation provision industry are a part of the contribution to the ICT project (Transformierung der Flugverkehrsmanagementindustrie: das “Common Controller Cockpit” und der „Blue Line Standard“) with Skyguide, the Swiss air navigation services provider, during an 18 month industry project.

The working papers in the aerospace and defense industry are part of a 12 month industry project with RUAG Electronics. RUAG operates in the defense and aerospace industry.

The project-specific working papers to both enterprises are listed for the sake of completeness, but do not appear in a summarized form or in full length in chapter seven. However, those working papers include concepts as to how to engage with the shifting environment. The working papers are supplementary to the publications.

Publications on innovation and the business model

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Author</th>
<th>Published</th>
<th>Year</th>
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<tbody>
<tr>
<td>5.2</td>
<td>Why is innovation in air navigation services so difficult in Europe? – A study identifying current obstacles and potential ICT – enablers</td>
<td>Breitenmoser, P., Abraham, R. Eurich, M., Mettler T.</td>
<td>Proceedings of the 21st European Conference on Information Systems</td>
<td>2013</td>
</tr>
</tbody>
</table>

Table 1 Publications on innovation and the business model
Summary of the publications

**Publications on innovation and the business model forthcoming**

<table>
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<th>Title</th>
<th>Author</th>
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<tbody>
<tr>
<td>5.3</td>
<td>Early stage technology investments of pre-seed venture capitalists</td>
<td>Festel, G., Breitenmoser, P., Würmscher, M., Kratzer, J.</td>
<td>Int. J. Entrepreneurial Venturing</td>
<td>2015 accepted</td>
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</table>

Table 2 Publications on innovation and the business model forthcoming

**Publications on the business model**

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<th>Section</th>
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<th>Author</th>
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Table 3 Publications on the business model

**Publications on intelligence and the business model**

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<tr>
<th>Section</th>
<th>Title</th>
<th>Author</th>
<th>Published</th>
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<tbody>
<tr>
<td>5.6</td>
<td>Gatekeeper-based Business Intelligence</td>
<td>Breitenmoser, P., Vischer M., Boutellier R.,</td>
<td>Io new management, Januar/Februar 2012, pp. 20 – 23</td>
<td>2012</td>
</tr>
<tr>
<td>5.7</td>
<td>Implementation of a gatekeeper structure for business and technology intelligence</td>
<td>Vischer M., Boutellier R., Breitenmoser, P.</td>
<td>Int. J. Technology Intelligence and Planning, Vol. 6, No. 2, pp. 111- 127</td>
<td>2010</td>
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Table 4 Publications on intelligence and the business model

**Deliverables on innovation and the business model to the industry partner**

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<th>Section</th>
<th>Title</th>
<th>Author</th>
<th>Published</th>
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<tbody>
<tr>
<td>N/A</td>
<td>Catalogue of Requirements: Obstacles to and Requirements for Innovation in the ANS Industry</td>
<td>Eurich M., Mettler T., Abraham R., Breitenmoser P., Füllemann M.</td>
<td>Working paper</td>
<td>2013</td>
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Table 5 Deliverables on innovation and the business model to the industry partner
Summary of the publications

Deliverables on the business model to the industry partner

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<th>Author</th>
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<tbody>
<tr>
<td>N/A</td>
<td>CCC Business Modeling and Value Creation</td>
<td>Eurich M., Mettler T., Breitenmoser P.</td>
<td>working paper</td>
<td>2013</td>
</tr>
<tr>
<td>N/A</td>
<td>CCC Implementation aspects</td>
<td>Breitenmoser P., Lüthi M., Abraham R., Mettler T., Eurich M.</td>
<td>working paper</td>
<td>2013</td>
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Table 6 Deliverables on the business model to the industry partner

Deliverables on intelligence and the business model to the industry partner

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<th>Author</th>
<th>Published</th>
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<tbody>
<tr>
<td>N/A</td>
<td>Framework für das Scanning, die Qualifikation und das Monitoring von potentiellen Geschäftsbeziehungen, Wettbewerbern und Akquisitionszielen</td>
<td>Breitenmoser P.</td>
<td>working paper</td>
<td>2009</td>
</tr>
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Table 7 Deliverables on intelligence and the business model to the industry partner
Summary of the publications

5.1 Innovation and business model

Innovation rarely springs from a flash of inspiration, it does not just happen, it is not a random task, but is based on specific opportunities and arises from a cold-eyed analysis of these opportunities. (Drucker 1985). Management needs to actively focus their attention on innovation opportunities so as not to miss the moment to act. The following publications perceive one goal: the creation of reference conditions in the form of purposeful business assumptions that serve as a discussion, design and solution framework in the business model innovation approach to take advantage of the opportunities. Purposeful, systematic innovation begins with the analysis of the sources of innovation opportunities (Drucker 1985). Consequently, these reference conditions simplify and form the foundation of any activities that can lead to business model innovation from within. Its outcome is to create purposeful assumptions about the new business logic and to draw attention to the opportunities and for business model innovation.

Unlike start-ups which have no prior history, incumbent enterprises are embedded in a working ecosystem, a historical path and in their own internal and external environment that shape the ability to engage with business model innovation.

The contributions are to provide guidance to break with and to tackle the locked-in effects, the dominant logic, the prevailing assumption of the incumbent enterprise which set boundaries to variations of corporate behavior (Johnson 2010, Sosna et al. 2010, Zott and Amit 2010). It is to shape the intangible trigger for business model innovation, the cognitive meaning structures that exist in the minds of people in the organization (Kaplan et al. 2003, Tripsas and Gavetti 2000). The belief framework is determined as the final driver of corporate decision-making and, subsequently, engagement (Tripsas and Gavetti 2000, Barr et al. 1992).

While not the center of attention, the reference conditions may also have the potential to define the mission statement of the enterprise, as one aspect on the road to transforming the business model.

The following publications shed light on the approaches that aim at gathering assumptions about the environment and therefore show the potential to create a set of reference conditions that simplify the complex environment and can be used during initial communication, design process and final assessment of the business model.
Summary of the publications

5.1.1 ICT-induced Changes to Business Relationships in Air Traffic Management

Citation

Synopsis
The European air navigation service provision industry is about to undergo major transformation. The Single European Sky (SES) initiative has been launched by the European Commission (EC) in response to the expected increase in airplane movements across Europe. Its goal is to thoroughly overhaul the European airspace.

With this in mind, technological and regulatory changes as well as airspace redesign are taking place, forcing the industry to transform with respect to the envisioned modification of the underlying information and communication technology (ICT). While information and communication technology innovations and airspace redesign activities are underway, the envisioned changes need to be accompanied by modifications to the business roles involved. This publication outlines a potential new value creation network and potential new players in the industry.

Therefore, the goal of this publication is to complement the ICT innovation undertakings of SESAR with a business role perspective and with a particular focus on the value creation network across the different roles in the ANSP industry. A series of proposals have been formulated that have the potential to facilitate the transformation.

Findings
The findings are driven by two new industry paradigms:

- Technological paradigm: information is digitally shared between ANSPs and ICT infrastructure facilitating service provision beyond the current national airspace and breaking down the formerly vertically integrated monolith of ICT infrastructure in combination with a higher level of modularization and standardization.

- Service paradigm: ANSPs serve larger airspace (Functional Airspace Blocks) to guarantee lower service costs.

The findings show three new roles that may come into industry transformation:
Summary of the publications

- **Data repository provider**: is a data center that stores, maintains, exchanges and deals with data. Its presence directly affects the ICT infrastructure as well as the business model of the ANSP.

- **Data processor**: is a hub that compiles and exchanges data. It allows ANSPs to purchase standardized services.

- **Functional Airspace Block Authority**: is designed to monitor and regulate the airspace when airspace sovereignty is no longer bound by national borders.

With the three potential new roles in the value network, new value streams may occur and the creation of the value may shift significantly. Such a shift would have a direct impact on the business model of the ANSP.

However, due to high investments costs, there is no first mover advantage to change the business model for the existing ANSPs. The same holds true for external new players. Due to high market entry barriers such as process understanding and high financial investments, external players may not engage without an incentive scheme. A participation dilemma is identified which prevents the industry from transforming. However, this publication reveals that the current business role relationships might see significant changes, not only to ANSP, but to the entire value-creation chain.
Summary of the publications

Research approach

An exploratory research design was applied in order to gain insights into the cognitive beliefs, perceptions and plans of experts and decision-makers in the European ATM industry. The exploratory research design was taken from semi-structured interviews. This was accompanied by an analysis of the existing literature and the current discussion on SES and SESAR.

A total of eleven interviews were conducted with executives from Switzerland, the United Kingdom, the Netherlands and France representing different roles in the industry. Based on the interviews, personal observation field notes and secondary material, the intuitive logics methodology was applied as one of the three main classes of a scenario technique. One focus was given to stakeholder analysis in order to research the roles and relationships within the industry. Two models were outlined. One describes the current roles and relationships in air navigation service provision in Europe and the other represents the envisioned future of the European ATM market.

Contribution to this thesis

The contribution of this publication to the core research question is the creation of reference conditions to deliver the assumptions and constraints needed before embarking on business model innovation, as described in the first step of ‘the theory of business’ (Drucker 1994). In doing so, this approach contributes to the understanding of an industry trend and provides guide posts for the current or future industry assumptions. While making use of an industry-wide view which transcends the scope of the single company, it delivers relevant reference conditions for decision-makers. This publication highlights the potential of becoming aware of the environmental shifts that create internal motivation to engage with business model innovation. This publication also refers to business model innovation as it draws attention to simplification through a reference framework that can act as a design guide as well as design control parameter.

5.1.2 Why is innovation in air navigation services so difficult in Europe? – A study identifying current obstacles and potential ICT enablers

Citation

Summary of the publications

Synopsis

The European air navigation service provision industry is about to undergo major transformation. The Single European Sky (SES) initiative has been launched by the European Commission (EC) in response to the expected increase in airplane movements across Europe. Its goal is to thoroughly overhaul the European airspace.

With this in mind, technological and regulatory changes as well as airspace redesign are taking place, forcing the industry to shift with respect to the envisioned modification of the underlying information and communication technology. However, industry shift does not seem to be progressing as scheduled and it is not understood what exactly is preventing ANS providers from introducing novel ICT.

A PEST framework was applied to analyze key challenges from political, economic, social and technological obstacles to business model innovation. PEST is an analysis framework of macro-environmental factors, also referred to as STEP (Clulow 2005, Costa 1995). The framework revealed various obstacles on the way to business model innovation. An ICT approach is proposed that can serve as a boundary object for establishing a shared understanding within the enterprise, but obstacles need to be taken into account when promising business model innovation.

Findings

The findings show that the stagnation in industry shift cannot be ascribed to one single obstacle, but rather to a fabric of political, economic, social and technological aspects (Breitenmoser et al. 2013):

- **Politically**: strong rules and regulations, governments’ fear of losing control over their airspaces, strong unionized employees fear of losing bargaining power
- **Economically**: lack of liquidity, low bargaining power of ANSPs, lack of a unique selling proposition
- **Social**: high demand for continuous ANS supply, limited pool of qualified personnel
- **Technological**: lack of inter-operability, high safety standards and high reliability, oligopolistic structure of the ANS software market

This study concludes by proposing ICT approaches that have the potential to facilitate the technological obstacles:

- **ICT enablers**: In order to gain inter-operability among ANSPs, establishing a federated data provision layer where all connected ANSPs act as both data producers and data consumers might address the goals of SES.
Summary of the publications

![Figure 5-2, ICT enabler federated data provision layer](image)

However, ICT approaches alone do not seem to be enough to initiate a shift in the ANSP industry, as targeted by the SES initiative. Additionally, enablers for economic, political and social obstacles need to be defined. Since no emphasis has been put on considering the interfaces between stakeholders in the ANS industry, enterprise transformation should be discussed under these aspects. With this in mind, business roles might become subject to innovation. Therefore, business model innovation and the potential change in business role relationships might become a major topic for the ANS industry. This publication paved the way to analyze the shift in the business roles and relationships in the industry, as presented above.

**Research approach**

A total of over 30 hours of semi-structured interviews were conducted with management and strategy experts from different levels of the Swiss ANSP. Data was augmented by a multitude of technical reports, internal presentations, project documents, annual reports and press releases. Based on that data, the PEST analysis was applied to allocate the identified obstacles to the different classes of environmental aspects in order to simplify the complex challenge and pave the way for a discussion about business model innovation. Rogers' (1995) theory about diffusion of technology is used to incorporate the cognitive aspect of technology diffusion and gives an explanatory model to buy in stakeholders.

**Contributions to the research**

The contribution of this publication is the creation of reference conditions that deliver the assumptions and constraints needed before embarking on business model innovation, as described in the first step of ‘the theory of business’ (Drucker 1994). Applying PEST at an early stage of business model innovation shows the potential in proposing a series of obstacles to be taken into account when embarking on a
design approach. The publication found that creating the parameters for the prevailing business logic was crucial to starting the discussion about the challenges and creating commonly acknowledged boundary conditions. The specific focus on potential obstacles and enabler-provided reference conditions according to the business model innovation can be verified.

The derived reference conditions not only fertilize the initial discussion about business model innovation, but contribute to business model innovation at various stages. First, at a very early stage, when gathering environmental assumptions, they create a starting point for the internal communication about the prevailing business model and highlight the potential areas of intervention that may arise during corporate innovation. Second, during the design process, the initial conclusions can be revisited and the accuracy of the intermediate results verified. Third, to qualify the final business model against the reference conditions in order to guarantee the accuracy of the final business model against the business assumptions.

A PEST-based environmental analysis supports decision-makers, managers and persons concerned with business model innovation in the creation of business assumptions about the environment and identifies areas of future interventions. In this way, it triggers business model innovation.

5.1.3 Early stage technology investments of pre-seed venture capitalists

Citation

Synopsis
The component-based business model analysis approach was carried out during a multi-case study research in the pre-seed venture capital (PSVC) industry. The goal of the component-based business model analysis approach was to find types of business models by comparing similarities and dissimilarities of the business model in the industry with each other. PSVC business models were typified and prevailing business logics in the industry described.

A structured analytical approach allows corporations to compare their business models to those of their competitors (Osterwalder et al. 2005). However, they need to be defined and understood in the same way. A component-based business model definition (Johnson 2010, Osterwalder and Pigneur 2010) provides a common language and simplified picture of the business models. Therefore, component-based business models can be used to structure and compare the business models (McNamara et al. 2013). The approach can support companies in benchmarking the prevailing business model, but also help to understand its competitive positioning within the industry.
Summary of the publications

Findings

The findings conclude that, based on the technological scope and the financial source of the investment activity, four different types of PSVC business models can be identified and described.

- **PSVC type I** with a narrow technological scope using private financial sources
- **PSVC type II** with a broader technological scope using private financial sources
- **PSVC type III** with a narrow technological scope using public financial sources
- **PSVC type IV** with a broader technological scope using public financial sources

![Figure 5-3, Separation of the business models of PSVCs into types I to IV](image)

Research approach

PSVC enterprises operating in the bio-technology and nano-technology areas and with a broader technology approach were analyzed within multi-case study research. Information was retrieved from a variety of sources (e.g. websites, press releases) and condensed. During the analysis each case was analyzed by describing it and carrying out a short case analysis with the focus on the business model. Analyzing their business approach using Johnson’s framework enabled the standardized analysis of all case studies through pattern matching (Yin 2009). Afterwards, all cases were compared to each other by a cross-case analysis. The result was the classification of PSVC activities based on similarities and dissimilarities across the case studies. Johnson’s (2010) business structure describes four independent aspects: “customer value proposition”, “profit formula”, “key resources” and “key processes”.
Summary of the publications

The multiple enterprise analysis approach provided insights into the industry using the similarities and dissimilarities of the cases as a system of replication logic (Eisenhardt 1989). In doing so, the findings resulted in an attempt to categorize the industry in four different patterns of business models.

Contributions to this research

A structured analytical approach allows corporations to compare their business models to those of their competitors (Osterwalder et al. 2005). However, they need to be defined and understood in the same way. A component-based business model definition (Johnson 2010, Osterwalder and Pigneur 2010) provides a common language and simplified picture of the business models. Therefore, component-based business models can be used to structure and compare the business models (McNamara et al. 2013).

The practice can support companies in benchmarking their prevailing business logic with those in the industry. In doing so, it also describes a company's competitive position within the industry and sheds light on both the more successful business models as well as the less successful business models.

The conclusions can be used during the business model innovation process as well as to qualify the business model in the final stage by appraising the adequacy of the future business model while comparing its own business model to others in the industry.

It therefore contributes to business model innovation by providing assumptions about the industry structure. Conclusions contribute to business model innovation in three ways:

1. They provide a means of comparing competitors. Comparing its own business model to competitors’ business models can contribute to the reasoning of the current challenge.
2. They facilitate benchmarking economic success. Benchmarking the economic success of oneself against competitors and the industry can reveal insights about what kind of models are more likely to succeed.
3. They help to define the limits for business model design. Understanding the range of business models operating in the market supports a focused business model innovation approach while reducing the risk of ending up with a model that already exists, yet is not successful. Complementary or even disruptive business logic can be developed.

During a business model design approach, they can act as industry benchmark and support decision-making about alternatives. Hence, it supports business model innovation from its initial problem detection through to the design approach.
Summary of the publications

5.2 Business model

The business model represents the potential to innovate beyond product or processes while focusing on how the pieces of a business fit together (Magretta 2002). From a strategic perspective it is a temporary reflection of the strategy with respect to the prevailing environmental conditions (Casadesus-Masanell and Ricart 2010, Shafer et al. 2005). Therefore, the innovation of alternative business models triggers strategic reflection about potential business alternatives. However, the quality of potential alternative business models needs to achieve only a minimum of fidelity.

A systematic design approach is a response which provides guidance to the innovation of high fidelity business models in order to discover a viable alternative business model (Chesbrough 2010).

The following publications perceive the goal as providing a systematic approach to business model innovation that can serve as guide post to integrate environmental factors into the design process. The integration of environmental dynamics to the business model design process paves the way for systemic thinking and contextualized business model innovation. Its outcome is to innovate purposeful business model alternatives that are aligned with the conclusions from the environmental analysis.

The contributions are to provide guidance to business model innovation that has the potential to break with corporate boundaries through the creation of alternative business model.

5.2.1 A six step approach to business model innovation

Citation

Synopsis
This publication draws upon the conference publication ‘Networked thinking approach to business model design’. A literature review of the term business model innovation was conducted and revealed two shortcomings. It proposed a guided approach to business model innovation. The goal of the publication is to address the two shortcomings and propose a guided business model design approach.

Against this background, the article proposes a six step approach to business model innovation and stresses the potential of the “networked thinking” approach as a design AND decision process. In this way, it refers to the principles of ‘networked thinking’ (Probst and Gomez 1991) and draws upon Drucker’s (1994) ‘theory of business’. A proof of concept and refinement of the presented six-step approach was conducted empirically by applying it to the business model innovation approach of the Swiss ANSP.
Summary of the publications

Findings

The six identified business model innovation techniques were classified according to their strengths and weaknesses and then allocated to three identified characteristics. The characteristics provide initial guidelines for business model designers to choose from when embarking on business model innovation. Additionally, a list of strengths and weaknesses assist in the process of actively choosing and not only applying an adequate business model design technique.

The proposed business model innovation approach incorporates the theory of business as well as networked thinking, and is constructed as an a priori step-by-step approach (Eisenhardt, 1989) which offers more guidance during the design process.

The business model innovation approach consists of the following steps:

<table>
<thead>
<tr>
<th>Step</th>
<th>Results and actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Determination of the mission and business environment</td>
</tr>
<tr>
<td>2</td>
<td>Analysis of interdependencies</td>
</tr>
<tr>
<td>3</td>
<td>Determination and analysis of design alternatives</td>
</tr>
<tr>
<td>4</td>
<td>Creation of business model design alternatives</td>
</tr>
<tr>
<td>5</td>
<td>Selection of one business model innovation</td>
</tr>
<tr>
<td>6</td>
<td>Test and realization of the business model</td>
</tr>
</tbody>
</table>

Table 8 Six step approach to business model innovation

The six step approach provides for design with respect to assumptions about the business environment and business model primacy as a starting point: the mission. The strengths of the proposed approach are as follows. First, it makes it possible to design a new business model from scratch (instead of adapting existing business models to the existing problem). Second, it rigorously refers to the business ecosystem (interdependencies). Third, it fosters the generation of a business model (in-process evaluation). And finally, it fosters collaborative problem-solving.
Summary of the publications
This publication extends and complements the findings presented in „A 'Networked Thinking' Approach to Business Model Design” (Eurich et al., 2013).

Research approach
By drawing upon a thematic literature analysis, as well as forward and backward citations, a set of 137 potentially relevant publications were identified. These publications were then screened in the light of their usefulness for practitioners in the process of (re)designing a business model, leading to a final set of 29 relevant publications in six categories and three comprehensive characteristics that highlight the applicability of the design techniques and revealed the shortcomings. The prevailing techniques predominantly lead to concepts that focus on model-internal consistency and do not foster an awareness of the specific business situation. Against the identified shortcoming, a six-step approach is proposed. As a proof of concept and as a refinement of the initial theoretical construct, the approach was empirically tested by applying it to a real-world case within the ANSP industry.

Contributions to this research
The strength of the six-step business model innovation approach is its starting point as well as set of reference criteria which the business model designer and involved stakeholder can refer to during and at the end of the design process. The first step does not consider the business model itself, but focuses on the creation of relevant frame conditions determined by the environmental conditions and drivers. The conditions then allow the designer to draw a line between a promising business model solution domain and an inflicting business model solution domain. In this way, in the business model design process, more guidance is given to business model innovators. A more rigorous business model may appear at the end of the design process.

Additionally, the proposed approach has the potential to help decision-makers and business model designers to follow a design path on which it is possible to revisit the previous step at any time, if, for instance, new conclusions call for a rethink of the present intermediate solution draft. Finally, the single steps make it possible to visualize, communicate, discuss and evaluate various business model design solutions internally during the process and among all stakeholders, before a final decision is made. By doing so, it acknowledges the iterative nature of business model innovations.

As incumbent enterprises rarely find themselves in situations in which they can design or innovate a business model on a green field, connections and dependencies need to be considered. The complexity is therefore rather high, especially when compared to a start-up environment. There are connections and dependencies between business model elements, between the business models of the focal company and
Summary of the publications

those of partner companies, between the business model and the market and so on. Therefore, in complex business situations, for which the proposed approach may be most justifiable, the business model design process is rather slow, but manageable. Cognitive beliefs of the various professionals involved need to be addressed during the business model design process. In contrast, for straight-forward or trivial solutions, the proposed approach is rather too time-consuming and simpler design techniques would be more applicable.

The reference conditions should be used to guarantee purposeful and meaningful design. With regard to reference conditions, design is benchmarked at a conceptual stage, rather than during transformation. This does not contradict radical innovation, but prevents it from neglecting the real world conditions and becoming consistent solely within the model.

5.2.2 A 'Networked Thinking' Approach to Business Model Design

Citation


Synopsis

A scientific literature review revealed that science provides business model designers with a spectrum of supporting techniques: cases, component-based approaches, taxonomies, conceptual models, causal loop diagrams and design patterns. However, these techniques provide valuable support only during specific steps of the design process. There is also a tendency towards focusing on model-internal consistency, while neglecting the organization's internal dynamics and external business environment. The current techniques predominantly lead to concepts that focus on internal consistency, but do not foster awareness of the business assumptions.

Against this background, a complementary approach to business model innovation, which draws upon the principles of ‘networked thinking’ and ‘theory of the business’, was proposed. The business model innovation approach was applied to a real case in which a series of business model alternatives for an ANSP has been designed.

Findings

The "networked thinking" approach

- fosters the creation of business model design alternatives
Summary of the publications

- fosters the qualification of a business model against the agreed assumptions about the environment
- strives to accomplish a business mission or strategic objective
- fosters the understanding of the organization’s situation
- facilitates communication among the involved stakeholders

In this way, the "networked thinking" approach is more than a business model design technique. It is a design AND decision-making process, strongly linked to its primary concern, the mission as an overarching objective to achieve. The theory of business provides

- the mission statement as business model design primacy
- the mission statement as a starting point for business model innovation

The role of a mission statement has the potential to be used not only as the design purpose, but as a guide throughout the entire business model innovation process: it helps the designers to stay focused. The business mission statement comes first, and all actions are consequences of accomplishing this mission.

The outlined design approach incorporates the mission as well as considers the concept of business assumptions from the theory of business (Drucker 1994) and relies on the networked thinking theory (Probst and Gomez 1991) to acknowledge collaborative problem-solving from within the enterprise.

Research approach

After an assessment of existing approaches to business model design in the light of incumbent companies, two shortcomings were discovered. First, when starting from the initial situation that needs to be taken into account, they fail to provide much comprehensive guidance on how to obtain the final design. Second, techniques tend to neglect to incorporate environmental conditions such as market dynamics, demographical changes, technology trends or deregulation. To address those shortcomings, the principles of ‘networked thinking’ (Gomez 1998) as well as the ‘theory of business’ were included in the business model design process. Based on these theories, a step by step approach was constructed (Eisenhardt 1989) which provides guidance to designing a business model. The theoretical approach was then tested and refined with a company from the ANSP industry.

Contributions to this research

The incorporation of networked thinking extends the business model innovation techniques into a more holistic problem-solving approach, focusing on identifying relevant factors and their interdependencies, rather than looking for model-internal consistency.
Summary of the publications

In doing so, the prevailing assumptions about the environment become an integral part of the initial discussion regarding a potential new mission statement. In guiding the discussion at the earliest stage of a business model design process towards the assumptions about the environment, the prevailing business logic is questioned. Stakeholders are forced to confront their business perception. This in turn, sets the stage to reveal contrasting points of view and allows for an early fundamental discussion about the business logic. Networked thinking and the focus on the assumptions about the environment enable the barrier of the ‘dominant logic’ to be overcome.

5.3 Intelligence and business model

Intelligence is a response to the call of the theory of business (Drucker 1994) that claims the need for preventative care and early diagnosis as well as for building systematic monitoring and testing of its theory of business into the business operations. Monitoring connects the creation of assumptions about the environmental changes to internal decision-making processes. It is, however, more than a simple technique or a process, it is a formalized organizational setup linked to a decision-making process. It is an approach that allows the creation of continuous scanning of the environmental changes around the enterprise. It enables the enterprise to dynamically create and test the business assumptions and, if needed, initiate a design process to adjust its business model to meet the new business logic it encounters. Solid monitoring can pave the way to sustainable business model management, one that can be dynamically adapted to the changing environment while preventing unwanted deviation between assumptions about the environment and reality itself. Over time, an enterprise that can create, utilize and maintain knowledge more effectively than its competitors will have a distinct and sustainable advantage over those competitors (Tselekidis et al. 2003).

The contributions are to provide guidance to formalize the environmental understanding that dominates the prevailing behavior of the organization (Bettis and Prahalad 1995) and allow for systematic monitoring, testing and early diagnosis to rethink a theory that is stagnating so that a company can take effective action to change organizational behavior in line with new realities of the environment (Drucker 1994).

5.3.1 Gatekeeper-based business & technology intelligence

Citation

Summary of the publications

Synopsis
The publication describes the elements of a gatekeeper-based intelligence network to formalize an informal communication network. It highlights the key components: a process structure, an organizational structure, results and roles, and sheds light on implementation. The components draw on two analogous cases in the defense industry. Aiming at gaining a detailed understanding of their environmental dynamics, an internal project was set up. The aim is to validate and implement an intelligence network to prevent the theory of business from becoming obsolete. Opportunities and threats should be identified and processed early. Both enterprises opted for a gatekeeper-based Business and Technology Intelligence (B&TI) framework.

Findings
The key elements of a gatekeeper-based intelligence framework are the intelligence process, the organization, the results, the role and the implementation.

- Process: Formalization of the integration of the intelligence process in the management system as well as the definition of the process steps. Three process steps have been identified: Gathering, Qualifying, Allocating. These steps act as an accumulator of intelligence.
- Organization: Organizational structure enables the responsibilities and work content to be regulated and distributed among the gatekeepers.
- Results: Definition of reporting, tools, information distribution and deliverables. Results can include the range and scope of the reports for the decision-makers.
- Role: Since gatekeepers remain in their original function, employees desire a clearly formulated job description; however, this changes constantly. A description helps to prevent too great an overlap with gatekeeper tasks.
- Implementation: Four steps support the proper installation of the intelligence network. First, the foundation. It set the constraints. Second, the process. It assures a standardized procedure. Third, the integration. It includes the identification and nomination of gatekeepers. Fourth, the ability. It is the introduction of the gatekeeper to his new tasks.

Research approach
Based on two cases in which a gatekeeper-based intelligence network was chosen, the publication describes the components of such a framework. The enterprises selected the framework after a series of over 40 in-depth validation process examination interviews and workshops, as well as a comparison of alternatives. Drawing on the final concept proposals, an in-depth review of the key components was
Summary of the publications
conducted. The overlapping elements were identified and the findings described in condensed form. The
components of the gatekeeper-based intelligence framework as well as the embedment of such a
framework is described.

Contributions to this research
The publication describes the components and the embedment of a gatekeeper-based intelligence
framework within medium-sized companies. Establishing a B&TI framework can support managers to
stay alert with regard to environmental changes and recognize implications for their respective business
model and the imperative to innovate it. The availability of information from the environment helps to
align product portfolios, processes and also the business model with both the current and foreseeable
situation. In this way, it enables an enterprise to trigger innovative undertakings and take preventative
care in response to the environmental conditions.
The original article, written in German (Breitenmoser et al. 2012), supplements the findings presented in
‘Implementation of a gatekeeper structure for business and technology intelligence’ (Vischer et al. 2010).

5.3.2 Implementation of a gatekeeper structure for business and technology
intelligence

Citation
111- 127

Synopsis
This publication describes the motivation for using a formalized gatekeeper setup in a mid-size Swiss
aerospace and defense organization. Based on the systems engineering methodology, it displays a
validation and implementation framework for finding and installing an adequate intelligence framework
with regards to the corporate needs and possibilities.
Small and medium-sized companies can successfully increase their environmental awareness by using
business and technology intelligence solutions that draw on existing company resources. One such
approach is based on the gatekeeper concept. A gatekeeper is a person acting as both a communication
node in the corporate communication network and a gateway for external information and knowledge to
flow into the organization. Opening up gateways facilitates information flow, thereby gauging
Summary of the publications

assumptions about the business against reality. A business and technology intelligence framework is one way to implement such a capability.

The publication highlights the value of such an intelligence network for decision-makers and links B&TI to the development of enterprise knowledge and business assumptions.

Findings

Based on a systems engineering approach, the following validation and implementation agenda has been developed and pursued by the organization.

A five step approach to launch a B&TI framework:

1. **Foundation**: Checking the preconditions
   
   Preconditions, such as the right timing or manager needs, are essential to the success in validating an intelligence framework. Economic pressure may be a sign of the right timing. In our case, the timing of these activities could be understood in the light of the systemic change in the company's business environment. Exploring the needs for intelligence revealed management readiness.

2. **Fitting**: Evaluation of specific structures and processes
   
   Evaluating the business intelligence framework using questionnaires and interviews is essential. It is to find out what framework fits the enterprise the best and ensures involvement of current and future stakeholders. More than two thirds of the managers in our case, preferred the gatekeeper-based intelligence framework to other intelligence frameworks. Involved employees saw themselves as potential gatekeepers and thus supported the implementation of a gatekeeper-based intelligence framework.

3. **Structuring**: Preparing the organizational structure and processes
   
   Establishing a formal gatekeeper network with regards to proposed involved functions. Definition of the information flow processes in order to bundle the strategic intelligence activities into one process. It is how information once gained is processed, judged and ultimately disseminated.

4. **Enabling**: Enabling the gatekeeper model
   
   The gatekeeper model needs formalization. Accurate task description should be prepared that defines the work expected from the gatekeepers, such as a definition of personal freedom, responsibility for one's own budget, possibilities to establish external contacts and accessibility to top management information.

5. **Assigning**: Assignment of specific gatekeeper tasks
   
   Definition of areas of observation, for instance, a concrete tool to perform intelligence tasks as well as obtaining relevant and meaningful results make up the opportunity landscape. The
Summary of the publications

‘Opportunity Landscape’ (Savioz 2006, Savioz and Blum 2002) is a tool that enables specific areas or subjects needing to be observed to be assigned to gatekeepers.

The findings can support small and medium-sized enterprises. They can increase their market awareness by installing a B&TI framework that draws on existing enterprise resources.

Research approach

A systems engineering approach (Züst and Troxler 2006, Haberfellner et al. 2002) to design an intelligence framework was selected to seek out an appropriate intelligence setup within the enterprise. The first step, a desktop research program, including systematic research focusing on business & technology intelligence, was conducted by drawing upon thematic analysis. In order to gain insights into the current situation regarding intelligence in the enterprise, a series of semi-structured qualitative interviews was conducted. It focused on gaining an understanding of the prevailing conditions as well as the potential activities which may be used to monitor the environment. Once this was achieved, a set of intelligence frameworks was quickly developed and drafted. To qualify the adequacy of the proposed intelligence framework, a questionnaire was handed out to interviewees and also to a broader internal audience not involved in the interview series. The questionnaire was designed to assess the various proposed intelligence frameworks.

An intelligence framework that draws on existing enterprise resources and makes use of existing knowledge nodes was selected by the company employee. The framework as well as the implementation were then tested in a pilot.

Contributions to this research

The described approach paves the way for the installation of a B&TI framework that can provide decision-makers with a constant and relevant flow of information. The approach connects business-relevant environmental information with decision-makers through a formalized network and process that allow for preventative care and early diagnosis. An installed intelligence network monitors the environment and compiles information to form conclusions in a strategic context. While balancing assumptions about reality and the prevailing assumptions about the business, it helps organizations to engage with business model innovation proactively rather than reactively when the numbers are down. It supports enterprises in detecting and taking advantage of the innovation areas and sources which business model innovation can be designed for. With this in mind, the B&TI framework has the potential to shape the concept of the business model by complementing the prevailing assumptions about the
Summary of the publications

environment with an integral understanding of the environmental reality. In so doing, the intelligence network becomes a trigger for business model innovation.

5.4 Practices in business model innovation

This chapter draws upon the publication and consolidates the contributions of the single publication in practices for business model innovation.

As we found in our cases, gaining an understanding about the environmental situation seems to be a primary need for an incumbent enterprise embarking on business model innovation. Rather than trying to draft the business model “out of the blue” using any business model design technique at hand, an in-depth understanding of the environment is meaningful for a proper start of business model innovation. In addition, a holistic business model design approach, incorporating environmental assumptions, seems to be of considerable advantage for supportive guidance during a business model design process. Environmental assumptions, acting as guide posts, can support both a rigor design approach and an increase in fidelity.

Finally, monitoring can not only prevent a company from being surprised by environmental changes, but also add the ability to dynamically act on changing assumptions. In doing so, the prevailing business logic is constantly being tested against reality.

In search of business model innovation in incumbent enterprise, we asked the questions as to how incumbent enterprises can monitor its environment with regards to business model innovation relevant changes as well as how incumbent enterprises can trigger business model innovation.

The findings set out three business model innovation domains that are referred to, namely, simplification, developing and sensing:

Simplification: Simplification means the creation of a set of innovation reference conditions to break down complexity. Innovation reference conditions are a structured description of the prevailing environmental conditions. By breaking down the overall environmental situation before taking any decisions or starting any experimentation, the complexity of the enterprise inertia on which basis the enterprise can deploy a structured discussion is reduced. A simplification of the real world environment as a first step allows for a guided start to business model innovation. Managers' perceptions can be activated and the prevailing ‘business logic’ challenged. Potential concerns to overlook critical aspects and historical implications can be reduced. Three approaches showed potential to create purposeful reference conditions.
Summary of the publications

First, by grouping enablers as well as obstacles to innovation, prevailing competencies and environmental factors in a PEST framework, it was simpler and easier to understand the specific areas for future intervention for business model innovation.

Second, Business Role Relationship analysis increases the understanding of the potential future business logic in an industry context and can support the formulation of the business mission.

Third, business model comparison increases the chance to innovate beyond industry standard business models and create business model embedded competitive advantages. Therefore, it adds direct competitive aspects into the business model innovation undertakings.

Simplification paves the way to define constraints in the form of reference conditions that can be applied during the business model design process. The use of constraints during a potential design process can lend strong support to quick qualification of business model alternatives and prevent time-consuming discussion. Simplification therefore acts as a quality gate as well as a money-saver during the business model innovation process.

Simplifying helps to overcome defensive attitudes (Drucker 1994) and corporate cognitive barriers, and clarifies which business model ought to be implemented (Chesbrough 2010). The goals of simplification are:

a. Reduction of the entry barrier to start the discussion about business model innovation and enhance the probability of starting with a common understanding about the task
b. Definition of the understanding of the environment through the creation of a set of constraints
c. Increase in flexibility during the business model design process through an understanding of the span of change and readjustment potential of the business model

Developing: Developing means to make use of networked thinking as the basis of a business model design approach. It links the environment with the business model. In this way, it bridges the gap between environmental constraints and the business model innovation process. As incumbent enterprises with a background in regulated environments are used to performing in environments of certainty and stability, their performance heritage has a direct impact on business model innovation. The former obligations and regulations shaped constraints that cannot be overlooked during a business model design process and therefore need to be considered throughout the business model innovation approach. Hence, the environmental constraints need to be taken into consideration during a business model design process and solution qualification. The constraints can be identified through simplification. Networked thinking strengthens the credibility of the activities concerning the business model and can reduce the likelihood of designing inadequate business models. Networked thinking addresses the shortcomings of the prevailing
Summary of the publications
design approaches by bridging the gap between the environmental constraints that incumbent enterprises face and providing guidance at the very beginning of business model innovation. In addition, it deals with the point that enterprises should strive to develop processes that provide high fidelity business models (Chesbrough 2010). The goals of developing are:

a. Providing guidance when starting from a real world problem
b. Fostering an awareness of the prevailing business environment and its implications for business model innovation
c. Preventing the designing of an undesired business model which neglects environmental constraints

Sensing: Sensing is continuous scanning and monitoring of the environment and its dynamics. The environment in non-regulated markets is rather stable and certain, whereas the non-regulated environments are characterized by dynamics that need to be taken into account when operating in such environments. Acting in non-regulated environments requires dynamic capabilities that constantly test the assumptions about the environments against reality. However, for incumbent enterprises used to regulated environments, scanning and monitoring are unfamiliar tasks that require special attention. Sensing can be conducted through the installation of an intelligence framework, a gatekeeper-based business and technology intelligence framework. As seen in our case, the intelligence can be fully embedded in the prevailing organizational structure in order to limit expenditure and utilize existing knowledge. The gatekeepers act as a formalized, integrated and low cost information transmitter. The gatekeeper-based intelligence network helps to monitor and scan the environment in real time. In doing so, the environmental factors and internal decision-makers are constantly aware of environmental dynamics. Sensing addresses the creation and shaping of managerial perceptions and the formation of new mental models that enable an organization to adapt to new environmental conditions (Hambrick 1982). It enables managers to perceive external events and to learn about capabilities that are necessary for effective transformation (Castanias and Helfat 2001). Sensing facilitates situational awareness for managers through real time information processing. The goals of sensing are

a. Ensuring continuous transmission and interpretation of information as an essential part of monitoring environmental conditions
b. Allowing the decision-makers to be furnished with real-time information in order to make decisions for the future positioning of the enterprise within its environment
c. Benefiting from a “thermostat” by means of which the prevailing business logic can be dynamically balanced and compared with the reality
Summary of the publications

Whereas simplification reflects a snapshot of the assumptions and realities, the sensing approach is more of a dynamic view of the assumptions. Sensing is like a movie, telling the story about the assumptions and the reality while simplification is a picture taken from this movie. Sensing assures the information flow, simplification snapshots a specific point in time. Sensing requires the enterprise to actively commit to monitoring the environment and the testament to constantly challenge the business assumptions through the establishment of an intelligence structure that is able to scan, qualify and transfer information into knowledge. Simplification requires the company to develop the ability to create a common mindset, a common perception of the assumptions as a foundation to trigger business model innovation. Developing on the other hand, provides the stakeholder with more guidance throughout the design process, incorporating both the static inputs from simplifying as well as the dynamic inputs from sensing.

Overall, simplification, developing and sensing sharpen the ability to conduct business model innovation from within an incumbent enterprise, making the enterprise both more precise and accurate in its initial design and decision-making activities. They explicitly contribute to making an enterprise more alert and aware of their environment before taking any action and aligning aspirations and interests of decision-makers. In this way, they have the potential to not only help to achieve collective commitments within the enterprise leaders, but to involve the potential stakeholders at an early stage to ensure real engagement during business model transformation from all parties of the enterprise.

These practices are drawn from cases of incumbent enterprises with a background in regulated environments and supported through an approach to typify an industry. Nevertheless the cases refer to environmental drivers such as regulatory shifts or technological waves, the practices may also assist in the proactive creation of alternative business models in the absence of external obligations.

Although not in the scope of this research, the following understanding of two key concepts about business model might support future research endeavor unexpectedly emerged while conducting the research.

Practices for business model innovation are practices that help leaders to dynamically manage the business model. These practices are capabilities to keep the gap between the assumptions about the theory of business and reality as narrow as possible, constantly rethinking and innovating the business model. Consequently:

Business model management is about monitoring internal and environmental parameters and the dynamic adjustment of the business model to the encountered new realities through a set of practices.
Conclusion

6. Conclusion

This chapter highlights the contributions and implications and discusses the limitations as well as potential future research.

6.1 Contributions to the theory and implications

The object of the research is to assist incumbent enterprises in establishing practices that trigger or enable business model innovation from within as well as find ways to monitor the environment. For practitioners, the thesis aims at providing guidance to strengthen the ability of an incumbent enterprise to respond to opportunities that call for business model innovation rather than product or process innovation. For academics, this thesis aims at facilitating and improving the dialogue about business models and business model innovation.

The underlying publications deal with areas such as innovation obstacles and enablers, the application of intelligence frameworks, the design of the business model, the type of industry structure and business role relationships in the industry.

Major contributions of this research include the provision of the understanding of how to monitor the environment, trigger business model innovation and moreover, how to enable incumbent enterprises to conduct business model innovation. The research sets out three business model innovation practices that are referred to as simplification, developing and sensing. In this way, it offers analytical, design and organizational practices to trigger business model innovation. The application of one or a combination of the proposed practices enables business model innovation.

Simplification: We believe that, without a detailed understanding about the prevailing environmental conditions, business model innovation in incumbent enterprises may lack an important component in the form of reference conditions to innovate the business model. Three analytical concepts are applied in the context of business model innovation. First, using business roles and business role relationships. Through a business role and business role relationship approach, the potential role and its implication for a potential business model can be identified. The conclusions can serve as reference conditions during the business model design process. Second, using PEST as a mental model to locate innovation hurdles as a basis to creating innovation enablers. The conclusions expose the areas to be managed during business model innovation. Third, using a component-based business model as a tool to typify the business models in an industry through pattern-matching. The conclusions emphasize the dominant business models in the industry and serve as guide posts for the competitive positioning during business model innovation.

Structured management practices fertilize the process of business model innovation in incumbent enterprises. They have the potential to provide a limited but pre-qualified set of business model
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alternatives, to trigger an internal discussion about the business model and, finally, prevent companies from being caught in the barriers to business model innovation. In addition, fidelity in alternative business model creation can be increased if critical environmental factors are known before embarking on business model innovation.

Developing: A holistic business model design approach is described. The design approach goes beyond the self-contained design of the business model but recommends referring to environmental factors as reference conditions during business model innovation. Systematic and systemic thinking, such as networked thinking is explained. Systemic thinking is important in business model innovation as an innovative business model may include new collaboration within the environment. Systemic thinking is important as the solution domain of an incumbent enterprise may be limited due to its prevailing business situation.

Sensing: The concept of the gatekeeper as an informal intelligence framework is translated from the established research domain of informal communication streams within an enterprise to a formalized intelligence network. The intelligence network provides permanent monitoring of the environment. Smart management of the business model includes a dynamic understanding of the business model and an intelligence framework to improve the ability to take preventative action. An intelligence framework enables business model innovation to be a continuous, dynamic process instead of a sporadic reactive undertaking.

Beyond these domains, this thesis contributes to the discussion about business model and business model innovation in the following manner. First, the thesis includes a delimitation and contextualization of the business model with regard to strategy and process. Second, this thesis includes a clarification about business model innovation and its contextualization with regard to product and process innovation as well as an indication that business model innovation is a task to explore and exploit relevant opportunities in the environment of the enterprise. Third, it provides a first attempt to conceptualize the term “business model practices” and “business model management”. Fourth, by adding pole case studies to the research of business model innovation, the role of regulated environments is touched upon and business model innovation case study approaches are complemented. Finally, by referring to the theory of business (Drucker 1994) as a reference for a business model, important new aspects were included in the business model design process. Its strength is to provide guidance at an early phase of business model innovation and in ensuring that the final design is in line with reality.

For practitioners, the proclaimed practices can help to reveal the potential of business model innovation from within the enterprise. Managers may use the findings to improve their understanding of the relationship between intelligence, innovation and the business model as well as how business model
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innovation can be triggered through the practices described. This thesis allows managers, entrepreneurs, game changers and decision-makers to have a clearer picture about what might be needed to explore business model innovation and to understand industry shifts and deregulations as opportunities for corporate response. The practices, including results from environmental monitoring and analytically collected assumptions about the environment, could support managers in actively addressing the gap between expected change and the ability to manage it (IBM Global Business Services 2008).

For academics, the contributions of this research are a first response to the call for the need for guidance on business model innovation within incumbent enterprises (Osterwalder and Pigneur 2013, Chesbrough 2010, Zott et al. 2011). The described practices are a step to bridge the gap between the understanding of business model innovation as a concept and the actual operationalization through practices that enable execution and implementation.

The findings complement the research undertakings in the larger body of business model innovation conducted in the non-regulated or the start-up environment, as we know less about the dynamics of the business model in established enterprises (Demil et al. 2015).

While revealing a series of practices and transferring concepts and methods to the context of business model innovation, the process of business model innovation in incumbent enterprises calls for further research. A set of potential research areas are presented in the following chapter.

6.2 Limitations and future research

While the purpose of the research is to support enterprises in establishing practices that trigger business model innovation from within, this thesis has also limitations which can serve as a basis for the following areas of research activities in future.

Five main limitations are highlighted which deserve particular emphasis and may lead to further research potentials.

First, this research does not deal with long-term effects of systematic and systemic business model innovation. While the applicability of networked thinking to business model innovation was empirically tested, its impact on the enterprise ability to act upon the design outcome could not be empirically evaluated. In particular, research may look at the effects that enterprises see when embarking on business model innovation which relies on networked thinking. Such an approach could yield insights into the long-term effects of systematic and systemic business model innovation approaches and their impact on performance.

Second, this research so far provides promising hints as to how to define industry types, however, the value of industry structuring on the basis of business model types needs confirmation. While having
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applied a component-based business model to type an industry, its context as a strategic tool to map an industry was not investigated further. In particular, research may look at the application of component-based business model concepts as a complementary strategic management tool to “type” an industry and trigger business model innovation. Academically, the concept of the business model is mentioned in and linked to strategic management literature, but barely discussed in the context of a technique to gain insights into competitive positioning. In addition, academics can draw upon this analysis approach and use it to identify further business model typologies in other industries.

Third, this research provides guidance in the form of practices for business model innovation within incumbent enterprises, but does not cover the differences and similarities between practices in incumbents versus practices in start-ups. While drawing on incumbent enterprises, practices for enterprises other than incumbents are not dealt with. In particular, research may look at the differences and similarities of business model innovation practices in incumbent enterprises versus enterprises without liabilities, such as start-ups. Such a study could reveal insights into the different business model innovation activities depending on the stage of development of an enterprise.

Fourth, this research conducted activities within enterprises that were about to embark on business model innovation, but does not emphasize the tipping point for embarking on business model innovation. While the research is conducted in enterprises that knew they needed to adapt, but were searching for the how, the timing aspect of business model innovation was not covered. In particular, research may look into the interrelation of environmental trends and business model innovation. Such research could highlight timing and activity aspects of enterprises with regard to environmental changes.

Fifth, the data collection is based on semi-structured interviews and research in which we were personally involved. Due to the nature of the qualitative approach, including semi-structured interviews and action research, our conclusion process could be biased by our perception and personal experience. Still, as we are among the first to incorporate regulated enterprises into the research about the business model and the granted access is unique, a qualitative approach is an appropriate research approach.
7. Publications

This chapter provides the publications in full length.

7.1 ICT-induced Changes to Business Relationships in Air Traffic Management

Citation

Abstract
Technological innovations and process redesign are underway in order to increase efficiency in air traffic management (ATM). However, full value appropriation is only possible by additional modifications to the fundamental model of the ATM business. The goal of this study is to complement the technological research with a business perspective on value creation, particularly on the relationships of ATM business roles in Europe. On the basis of eleven expert interviews, this study reveals that the current business role relationships need to change. However, there is no first mover advantage and a participation dilemma hinders the transformation. New entrants, like data repository providers and data processors, may enter the ATM market. The results can support decision makers of ATM service providers and representatives of legal and regulatory bodies to enable and motivate change for an efficient and safe future air transportation system in Europe.

Keywords
Air Traffic Management; Air Navigation Service Provision; Business Ecosystem; Business Model; Change Management; Innovation Management; Strategy; Technology Management; Value Creation Network.

Introduction
Daniel Yergin (Dias, 2011), a Pulitzer-Prize winning author, declared: "Every day, the airline industry propels the economic take-off [...]. It is the great enabler, knitting together all corners of the country, facilitating the movement of people and goods that is the backbone of economic growth." The modern aviation industry is enabled by sophisticated air traffic management (ATM). ATM refers to all processes, procedures and resources that assist an airplane to depart from an airport, is guided through the airspace, and finally lands at its destination in safety. Air traffic controllers (ATCOs) safely guide airplanes and are,
therefore, responsible for thousands of human lives each day and play an important role to keep the aviation industry running. However, the ATM systems with which they work are outdated in Europe. ATM information and communication technology (ICT) systems of European air navigation service providers (ANSP) were not subject of many fundamental changes in the last decades. Currently, the systems are monolithically integrated, locally installed, heavily customised and not designed for interoperability. Consequently, the current ATM ICT infrastructure is reaching its limits and will hardly be able to cope with a further increase in flight movements (Breitenmoser, Abraham, Eurich, & Mettler, 2013). In addition, the European airspace is highly inefficiently fragmented. The challenge is to increase flight capacity and efficiency with safety as an inviolable basic condition: all changes that could reduce the level of safety are utterly unacceptable.

In order to tackle this challenge, the European Commission has launched an initiative, called Single European Sky (SES) with the goal of thoroughly overhauling the European airspace (SESAR, 2012). Within this initiative, the SES ATM Research (SESAR) program aims to introduce a new wave of technological innovations on the air navigation service (ANS) market. Another branch of the SES initiative pursues the goal of clustering European airspace into functional airspace blocks (FAB) in order to counteract current inefficient airspace fragmentation. Technical standardisation is a prerequisite for these endeavours. Standardised technical interfaces pave the way to more interoperability and data exchange, which in return allows the deployment of the concept of FABs.

While ATM ICT innovations and airspace redesign activities are underway, the envisioned changes have to be accompanied by modifications to the value creation network and its business roles. However, the impact on the ATM value creation network and its business roles and its challenge during an industry change has thus far not received much attention.

Since the industry does not regularly provide access to researchers, prior research is scarce. A focus to this point has been given to institutional reforms in the ATM industry, which mainly entail a variety of efforts to inject greater commercialisation (Button & McDougall, 2006). The findings show that despite a more commercially orientated approach, the quality of service remains or increases. Additional research in the context of commercialisation of public institutions and private public partnership confirmed that effective service provision with less public control is possible (Goodliffe, 2002; Lewis & Zolin, 2004). Beside the commercial research approaches, ATM specific studies, researching the usage of ICT (Athènes, Averty, Puechmorel, Delahaye, & Collet, 2002; Erzberger, 2004; Metzger & Parasuraman, 2005) revealed, that ICT enables smoother and more efficient service handling. There is some anecdotal evidence that technology-induced industry transformations can support companies in creating sustainable value (Bjørn-Andersen, 2003; Elliot, 2006); particularly, in geographically dispersed industries, information-intensive
industries in combination with high transaction costs profit from technology application (Porter, 2001). After deregulation in the industry, technology induction leads to innovative business behaviour. The financial service industry in Australia e.g. has gone through a transformation process (Darlington, 1998). Today, it is regarded as a forerunner in the design of technology for financial markets. In other industries, such as the telecommunication service industry (Elliot, 2006) or the media and entertainment industry (Elliot, 2006), similar outcomes are observed.

The goal of this study is to complement the technological research and airspace redesign endeavours with a business perspective on value creation, especially the relationships of ATM business roles. The study seeks to foster the understanding of the ATM industry transformation and the necessary changes in the business role relationships among ATM service providers in order to support the realisation of the SES mission. In this course, potential new business roles and the consequences of their appearances on the ATM service market are discussed.

Research Design
An exploratory research design was applied in order to get first-hand insights into the cognitive beliefs, perceptions, and plans of experts and decision makers in the European ATM industry (Dalkey & Helmer, 1963). The exploratory research design was drawn upon semi-structured interviews (Schultze & Avital, 2011). This was accompanied by an analysis of the existing literature and the ongoing discussion on SES and SESAR.

Between February and August 2013, eleven expert interviews from distinct areas of the European ATM industry were conducted. A total of 34 hours of interview recordings was collected. Purposive sampling was used in order to identify and select relevant stakeholders (Marshall, 1996). ANSP interviewees were from the Netherlands, Switzerland, and the United Kingdom. System supplier interviewees were from France and Switzerland. Airspace user interviewees, ATCO representatives’ and national airspace authority interviewees were from Switzerland. The interviews included, questions related to the current state of the ATM industry; innovation procedures within and across the industry; and technological changes which are expected to result from SESAR and the introduction of FABs. In addition, questions were asked on ICT innovations in ATM, value creation, and innovation management. All interviews were recorded and responses to the major questions were transcribed.

Based on the interviews, personal observational field notes, and secondary material, we applied the intuitive logics methodology as one of the main three classes of a scenario techniques (Bradfield, Wright, Burt, Cairns, & Van Der Heijden, 2005; Rhyne, 1974; Van Notten, Rotmans, van Asselt, & Rothman, 2003). The flexibility of the intuitive-logics methodology lends itself to a wide range of scenario purposes.
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(Bradfield et al., 2005). We mainly focused on stakeholder analysis in order to research the roles and relationships within the industry (Bradfield et al., 2005; Huss & Honton, 1987).

A business role relationship model was sketched that describes the current roles and relationships in ATM service provision in Europe. It is used as the basis of comparison, or "baseline" (Coates, 2000), to extrapolate a possible future state building on past and present experiences. The second business role relationship represents the envisioned future of the European ATM market. It is important to notice that both business role relationship models are strongly based on the perceptions, expectations, and cognitive beliefs of the interviewees (Coates, 2000). Thus, we acknowledge the possible subjectivity of answers from the experts. The goal of our research is not evaluative or prescriptive, but rather descriptive and explorative in nature.

Business Role Relationship Model
In this study, a relationship model refers to a simplified picture of reality or an envisioned future state that depicts the connections between different roles and that features the following elements:

*The business role*
A business role provides a specific assignment to the overall value creation process. Roles are hubs in the business role relationship model and are connected via business relationships.

*The business relationship*
A business relationship describes the connection between two (or more) business roles. The business relationship can be represented by either a value or a money stream. Value streams (dotted line, blue, in Figure 1 and 2) represent the flow of data, information, services, or products (V1–V4). Monetary streams (dashed line, green) symbolise the flow of one-time fees, recurring fees, or pay-per-service (M1–M3).

*The regulatory role*
The regulatory role acts as an authority that sets boundary conditions and regulatory restrictions to the business roles' activities.

*The regulatory relationship*
A regulatory relationship refers to the influence that a regulatory role has on a business role or on another regulatory role. Regulatory relationships (straight line, black) can either be of regulative or influencing nature (R1–R2).

The business role relationship model explicitly excludes military interests, security-political aspects concerning the current airspace usage and allocation, and airport operators.
Current Business Role Relationship Model

Figure 1 is a sketch of the current business role relationship model of the European ATM industry. It includes three frameworks; an economic framework, a regulatory and legal framework, and an interest framework.

Air Navigation Service Provider (ANSP)

The ANSP is the core entity that delivers ATM services and is the key role for both the economic as well as the regulatory and legal framework.

The ANSP is linked to the airspace user, the regulatory authorities, the external data provider, the ATM system provider, and self-referentially to itself (i.e. to other ANSPs). The ANSP provides service to the airspace user and shares service relevant information with other ANSPs. The ANSP purchases external data from the external data provider, aggregates and processes data for service provisioning and procures ICT infrastructure from the ATM system supplier.

The ANSP is strongly regulated by national and international authorities. Service provision is based on human-to-human communication, relying on telephone and radio control. It is not exposed to any competition but only to regulations. Its ICT system is predominantly monolithically integrated with little technical interoperability.
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Airspace User
The airspace user interacts with the ANSP to receive ANSs. It pays a predefined service fee to a financial intermediary. Only little data is delivered from the airspace user to the ANSP or other entities. The airspace user is the end customer of the value chain.

Financial Intermediary
The financial intermediary is responsible for a centralised collection of service fees. It is linked with the airspace user and the ANSP. Pricing and invoicing follow a standardised process and a fixed pricing model.

External Data Provider
The external data provider is linked to the ANSP and provides the data needed to create ANS. Defined local standards for information distribution assure the quality of the data.

ATM System Supplier
The ATM system supplier provides monolithically integrated and predominately customised ICT systems. The ATM system supplier is directly linked to the ANSP. The ATM system supplier mainly sets de facto ICT standards and specifications. The high purchase cost and its monolithically integrated ICT structure ties the ANSP to the ATM system supplier. The result is a high dependency on the ATM system supplier and limited its possibilities to develop the system.

International Regulator
The international regulator defines boundary conditions and industry standards, e.g. for aviation safety, security standards, and environmental protection. It is responsible for enforcing the regulations. The international regulator interacts directly with the ANSP and is linked to the national authorities.

National Supervisory Authority
The national supervisory authority is responsible for a specific area of control (mostly within national boundaries) as well as for the specification and control of national regulations. It is also within its responsibility to enforce international regulations and to grant certifications to the national ANSP.

National Airspace Authority
The national airspace authority is responsible for the national airspace. Its responsibility is to manage the national airspace and manage airspace allocation.

Air Traffic Controller Representative
An ATCO operates the local ATM system in order to provide ANSs. High training costs, along with little options for an ANSP to take advantage of the labour market, puts them into a strong position. The ATCO representative serves the interests of the ATCO. ATCO representatives are able to determine the
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ANSP service provision by using their direct influence on the employees. The commitment of the ATCO representative is important in order to facilitate the introduction to the SES.

Envisioned Business Role Relationship Model

Figure 2 is a sketch of the envisioned business role relationship model. However, it shall be noted that it only represents one possible scenario. We would like to stress that the presented findings are the result of an exploratory approach and deliberately represent a rather radical innovative perspective in order to evoke discussions. We acknowledge the subjectivity of answers from the experts.

![Figure 2 Envisioned business role relationship model](image)

**Data Processor and Data Repository Provider**

There are two new business roles: the data processor and the data repository provider.

The data processor is a hub that aggregates and exchanges data. The business role of the data processor is new in the business role relationship model. It allows ANSPs to purchase standardised services.

The data repository is a data centre that stores, maintains, exchanges, and deals with data. The business role of the data repository provider is new in the business role relationship model. Its presence directly impacts the ICT infrastructure as well as the business model of the ANSP. An international regulator supervises the data repository provider to ensure secure data handling.

Both business roles are intended to support the centralised data exchange model as proposed by the System Wide Information Management (SWIM) [3]. SWIM allows for the producers of information to be decoupled from the consumers, thus increasing flexibility and agility in responding to business needs.
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[8]. SWIM strives to decouple data provision and data consumption by introducing a centralised protected cloud, making access to data possible at any time. The respective roles then provide and consume data to and from the cloud. Defined and public standards allow for interoperability and a common information model enables data exchange and service definitions.

**FAB Authority**

In addition a new regulatory role is expected: the FAB Authority. It is designed to control and regulate the airspace when airspace sovereignty is no longer related to national borders, which is a major focus of the SES initiative. In the course of the realisation of the FABs, the span of an area of control can include several countries. The FAB authority deals with political, economic, social, and ecological interests. Since a FAB authority needs to deal with the interests of different countries, its competence is crucial for the smooth operation within a FAB. The FAB authority is directly linked to the ANSP and is regulated by the international regulator.

**Air Navigation Service Provider (ANSP)**

The role of the ANSP as a service provider to airspace users remains, but ICT integration and ANS provision changes. The ANSP provides ANSs to the airspace user, exchanges data and information with the data processor, receives ATM systems from the ATM system provider, and shares service-relevant information with other ANSPs (self-reference).

Due to the new role of the data processor, ICT infrastructure is designed less monolithically. ANSP’s vertical integration of its ICT infrastructure is reduced and human-machine-interfaces are standardised. Open standards ensure smooth data exchange. Due to the open standards, data for ANS provision is no longer aggregated and processed by each single ANSP. The services is instead procured from a centralised business role like the data processor. In addition, the service portfolio may change from a defined general ANS provision to a more customer specific, on-request service provision, such as prioritised handling or shorter routes.

In contrast to the current situation, more tasks and decision making processes is supported by the ICT than today. ATCO see more technical support during service provisioning. The standardised human-machine-interface allows for a more centralised training approach with lower initial training costs. The ICT is no longer purchased, but rented. Based on a shift towards a rental-based ICT infrastructure and data or service procurement from a centralised data processor, a capital intensive one-time investment is replaced by a more continuous capital expenditure. The rented ICT infrastructure will allow for a quicker and cheaper shift to the latest and most reliable ICT.

The current national or sector orientated ANS provisioning is replaced by a international FAB-orientated service provision.
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The ANSP will be regulated by the international regulator and influenced by the ATCO representative.

Airspace User
The airspace user is still the consumer of ANS. It still interacts with and is linked to the ANSP. The ANS consumed are predominately paid directly to the ANSP. The financial intermediary plays a smaller role than in the current economic framework. The role of the airspace users extends from a simple service consumer to a data provider and sensor information provider. The airspace user can e.g. contribute local meteorological data to the data provider.

Financial Intermediary
The importance of the financial intermediary decreases. Service provision is directly paid to the ANSP. Pricing and service provision see more varieties, such as pay-per-service, flat rates, or fixed prices.

External Data Provider
The external data provider exchanges data with the data repository provider in order to complement the service provision towards the ANSP. Since external data is exchanged via standardised interfaces, it is stored centrally and purchased when needed. While external data is still produced locally, its distribution reaches to any ANSP that requests the data. Quality standards and data quality assurance is supervised. The external data provider is directly connected to the data repository.

ATM System Supplier
In comparison to today's monolithic and predominately standalone systems, a modular ICT landscape has come about. Due to hardware and interface standardisation, more competition between ATM system suppliers takes place. Less customisation needs to be done for the ANSP. Consequently ANSs can be produced at lower cost. The modular ICT structure and standardisation in combination with a centralised data repository and data processing lower industry barriers: new actors might see the chance to enter the industry.

International Regulator
The international regulator still sets industry standards that are the foundation for international rules and regulations. Apart from a potential reallocation of responsibilities towards more technical standards, not much change is identified.

National Supervisory Authority
The national supervisory authority is responsible for a specific geographical space of control (mostly nations) and for enforcing the specific regulations. The authority sees a lower workload and reduced competencies due the FAB authority responsibilities. The national supervisory authority is directly regulate the ANSP and is connected to the international regulator.
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*National Airspace Authority*

The national airspace authority is responsible for the national airspace. It is directly linked to the ANSP and to the international regulator. Its responsibility is to manage the national airspace and to enforce airspace allocation.

*Air Traffic Controller Representative*

No changes are envisioned for this role.

**Discussion**

The comparison of the current and the envisioned relationship models reveals that there is one new role in the new regulatory and legal framework and two new roles in the economic framework. In the regulatory framework the new role “FAB authority” appears. The FAB authority is supposed to be authorised to manage the airspace as well as the ANS within its FAB. The FAB authority manages the air traffic within its FAB with a focus on reducing flight delays, environmental impact, and enabling direct flight routes.

Within the economic framework, two new roles appear: the data repository provider and the data processor. The data repository provider is expected to consolidate data from different sources. The data processor will transform the data into information; it aggregates and interprets data and provides the option to launch query requests on particular flights or sectors.

Overall, it can be assumed that none of the current business roles can benefit from a new business and regulatory structure in the first place. Our interviews and analysis reveal that there may be business opportunities for new market entrants, but the current roles do not have an incentive to transform. A participation dilemma is likely, and the change to a new business role relationship setup may lower market barriers to entry and, thus, increase competition.

The current ATM system supplier and ANSP could be affected as follows: today they create revenues from selling next-generation ATM systems. In the envisioned future ATM business environment, ATM system suppliers are likely to face a ‘threat of new entrants’ and a ‘threat of substitute products or services’ (Porter, 2008). In the course of a breakdown of the formerly vertically, monolithically integrated ICT infrastructure, new players, who are specialised in a particular level of the overall IT stack may be able enter the market. These new entrants may have a long-term track record of providing ICT components and systems that are similar, but not specifically dedicated to ATM services. So far, the monolithically organised ICT system stack, in combination with the high safety and reliability standards, has deterred lateral entrants from entering the ATM market. However, the future ICT landscape will be based on a higher level of modularisation and more specific roles, which will only have to guarantee the safety and
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reliability of their specific modules and not of the overall system. In parallel, there may be substitute products or services such as automated data communication, based on standardised data links for routine ground-to-air or air-to-ground communication in order to complement the two-way communication for ATM service provision.

The ANSPs (including ATCOs) are at the very heart of the ATM service provisioning process. In the course of an overhaul of the European airspace and its underlying technological transformation, this role deserves attention, not only because of its key role in the value creation process, but also because of a potentially missing motivation and incentives to invest into new ICT infrastructure. The degree of ICT-enabled business transformation theoretically correlates with the range of potential business benefits (Venkatraman, 1994). In the ATM industry, safety comes first: therefore, radical changes are regarded with suspicion and incremental innovations are preferred. In addition, most European ANSPs lack an incentive to boost their business benefits.

On this basis, ANSPs and national governments find themselves in a participation dilemma: different parties must contribute to create or maintain an overall good, but there is no negative consequence for non-contribution. In the situation of the envisioned overhaul of the European airspace and an improved ground-to-ground and ground-to-air communication, all countries and their associated ANSPs must agree to airspace redesigns and invest in new-generation ICT systems. From a pan-European perspective, airspace redesign and improved communication leads to an efficiency boost in terms of more direct flights, less emission, fewer delays, and a potential to increase capacity while maintaining or even increasing safety. From an ANSP perspective, an airspace redesign means that they will lose sovereignty and competence, but not gain anything directly in return.

Without an incentive scheme, the transformation towards SES might face a free rider problem: a country (and its affiliated ANSP) that does not participate decreases the overall efficiency because of poor communication standards or less direct flights than otherwise possible. Still, the country and its economy could benefit from overall shorter flights and the ANSP would still earn the same amount of money in its own airspace territory. Since participation in the SES relies on ANSPs to heavily invest in its infrastructure upfront while subsequent revenue will probably be spread over decades, early participation does not pay off. No first mover advantages are expected. On the contrary, late participation pays off because late participators are able to immediately benefit from the higher efficiency in the surrounding system. This leads to a late mover advantage that not only results from the current pricing structure, but also the capital-intensive upfront investments that are needed to shift towards the SES vision.

Consequently, the current ATM service provider business model needs to be reconsidered: there should be an incentive to make a flight as direct as possible. In other words, the money allocation formula needs
be changed in order to reflect the desired business role relationship model. Furthermore, legal, political, and regulatory bodies need to adjust and steer the transformation of specific business roles in order to deal with the above mentioned participation dilemma and the resulting late mover advantage.

**Conclusion**

This study is one of the first that describes changes in the business role relationship model enforced by the need to increase airspace capacity in Europe. Our analysis shows that legal, regulatory, and political authorities are essential for accomplishing the mission of a SES. The study proposes that the introduction of incentive schemes could facilitate the acceptance and the speed of ATM transformation, particularly by counteracting late mover advantages. More precisely, our results provide insights into the innovation management of the European ATM industry.

First, this study expands upon previous research about information-intensive industries (Darlington, 1998; Elliot, 2006) by examining a pan-European innovation effort in the ATM service provision industry. By doing so, we extend the previous research to the context of ATM service provision. ATM service provision is thus far a nationally controlled public service that becomes an international undertaking. In addition, the ATM service provision is very critical due the high reliable nature of its service. Therefore, service provision cannot be shut down during implementation of innovative ICT. Safety dominates the innovation approaches and the creation of business relationships. New roles, as described in this study, can break up existing value streams and thus reshape service provision and cost structure. Additionally, the ICT-induced changes pave the way to open the market for new entrants.

Second, we present an innovation management case that is burdened with a participation dilemma. Different parties must contribute to create an overall service, but there is no negative consequence for non-contribution. From a pan-European perspective, airspace redesign promises an efficiency boost in terms of more direct flights, less emission, fewer delays, and a potential to increase capacity while maintaining or even increasing safety. From an ANSP perspective, an airspace redesign means that ATM service providers may lose competence and become more dependent on internationally defined standards. Therefore, the individual ATM service provider cannot be kept alone with its innovative undertakings, but should be synchronised within the network and incentivised in order to be able to contribute to the industry transformation.

Third, revealing the envisioned business role relationship model can support regulators and ATM service providers to start a discussion on what should be contributed and from whom. The given business role relationship model is essential for further innovation management activities such as launching a virtual ATM centre. A virtual ATM centre will connect different ATM service provider with each other via
standarised interfaces in order to enable a large-scale data exchange. The business role relationship model can be used as a basis for business strategy development.

Future research could focus on the challenge of how to overcome the participation dilemma and look out for further ATM innovation enablers. The emphasis of this study is not on safety aspects, but it would prove worthwhile to analyse the industry transformation regarding this aspect. Even if there may be only few experts in this domain, the implications of research results can affect thousands of people and impact on the economy.

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References


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7.2 Why is innovation in air navigation services so difficult in Europe? – A study identifying current obstacles and potential ICT enablers

Citation

Abstract
The Air Navigation Service (ANS) industry has not experienced many major technological innovations in the last decades. Despite its indisputable contribution to economic welfare, it relies on Information and Communication Technologies (ICT) that lag way behind their current technological potential. Yet, it is not well understood what exactly restrains ANS providers from introducing novel ICT systems despite the legacy ICT in use which reaches the end of its life-cycle. On the basis of an interview series with managers in the ANS industry, this study sheds light on the various barriers that hinder the diffusion of technological innovation. Our findings suggest that the stagnation in technological innovation cannot be ascribed to one single obstacle, but rather to intertwining political, economic, social and technological aspects. This study concludes by proposing ICT approaches to tackle the identified barriers. The analysis of obstacles and potential ICT enablers can support decision makers of ANS providers and can enable business transformations in the ANS industry. ICT researchers can use this study as a help for developing ANS technologies, and business researchers can focus on specific incentives to foster innovation.

Keywords
Introduction

It may be unsettling to realize that while several airlines have recently launched in-flight Wi-Fi internet for their passengers, their pilots still communicate by analogue radio with ground staff. The discrepancy between passenger entertainment services and air navigation services (ANS) has one minor and one major reason. The minor reason is the reaction of the airlines to the sudden wide-spread use of smart phones and tablets: by offering wireless internet, they hope to gain more passengers based on the introduction of the new technology. The major reason is that technological innovation in ANS has been stagnating for decades. This stagnation is pushing the current information and communication technology (ICT) systems to its limits. The forecasts of the European air traffic management organisation Eurocontrol predict an annual growth rate of flight movements in Europe of 2.6 per cent until 2030, i.e. flight movements are assumed to double by 2036 (SESAR Joint Undertaking, 2012).

To deal with the projected increase in traffic, the ANS information systems will have to undergo technological improvements (SESAR Joint Undertaking, 2012, p. 30). The ICT in use restricts the amount of aircraft that can be served with ANS: the capacity limits have been reached, especially around busy airports (London, Zurich, etc.). The resulting queues inevitably lead to delays, additional environmental pollution and higher costs (European Commission, 2012).

In the light of such ICT limitations and the increasing demand for ANS, there is a strong need to transform the industry towards more adequate ANS provision. Since ANS is crucial to sustaining the economic welfare in Europe, air navigation service providers (ANSP), airlines, airports, and governmental, organizational and legislative bodies have started to discuss this problematic situation, but progress is slow. Yet, it is not well understood what exactly restrains ANS providers from introducing novel ICT systems. It is also not clear which ICT transformations would be able to foster effective innovation in the European ANS industry.

The goal of the study is to reveal obstacles that make innovation in ANS so difficult and to contribute to the understanding of the technology diffusion process in the ANS industry. We applied an empirical approach by conducting an interview series with representatives of the Swiss ANSP skyguide to identify innovation obstacles in ANS. On the basis of the identified obstacles, we propose ICT-based techniques to overcome some of these barriers. This techniques can contribute to actively push for changes of in the perception and behaviour of stakeholders with the goal to pave the way for enterprisetransformations.

Organizations in the ANS industry are prime examples for High Reliability Organizations (HRO) – organizations, for which failures could have catastrophic consequences. In HROs, failures (e.g., plane crashes) affect multiple innocent bystanders and receive high media coverage. Therefore, safety is a paramount objective that is pursued via a systemic approach. HROs are constantly searching for ways to
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improve their safety. Before a (technological) change can be introduced to an HRO, it must pass comprehensive tests to ensure that it does not negatively affect system safety, availability and reliability. There are few, if any, studies that investigate enterprise transformation in HRO. This study is one of the first of its kind to address this challenge in an HRO and particularly in the ANS industry. Up to now, there is hardly any related work, because the ANS industry does seldom grant access to researchers.

Innovation in the Air Navigation Services Industry

The European Commission (EC) launched the Single European Sky (SES) initiative to handle the projected increase of flight movements. The SES ATM Research (SESAR) programme was launched as part of SES with the goal to develop a new generation of ANS that will be able to ensure the safety and fluidity of air transport in Europe and subsequently on a global scale.

The fragmentation of the European airspace has been identified as a major obstacle to achieve these goals. The formation of Functional Airspace Blocks (FAB) is planned to tackle this issue. FABs will lead to a different type of sectorisation: the airspace will be divided according to traffic flows and no longer according to national borders. Since a single FAB covers several countries, individual ANSPs (which are affiliated to a country) will have to collaborate more closely than they did in the past. This creates a high demand for interoperability between all the different ICT components and ANSP architectures that are now in use. Today’s ANSP are monolithically integrated – both in their organizational as well as in their technological systems architecture – due to the slow development during the last decades.

Progress in implementing this transformation has been slower than expected. Besides technological obstacles, transformation in this industry is also hampered by political barriers like the fear of uncontrolled airspace infringements and the loss of national sovereignty; economic barriers, like the lack of liquidity for investments; and social barriers, like the loss of power of the unionized air traffic controllers (ATCO). In addition, the liberalization of the industry has led to different legal forms under which the ANSP of today operate. The legal form can range from traditional state ownership, through a variety of corporatized structures, to regulated private companies. Although legal setups have partially changed, the liberalization has not led to more innovation.

ANS industry studies about enterprise transformation are usually looked at on a case-by-case perspective. Case study evidence is organized as an intellectual capital portfolio and links are drawn to business outcomes for other organisations.

Scholars who have studied the impact of transformation, such as Button and McDougall (2006), assess the implications of the ANSP structure in correspondence with managerial approaches. Lewis and Zollin (2004) use management boards as a proxy for the correlation between the type of company (public vs.
private) and its performance. Arvidsson et al. (2006) conducted a study, in which they determine the organizational climate with respect to transformation and innovation in order to investigate the organization’s capacity to cope with transformation. These case studies contribute to understanding ANSP management in the light of “transformation”, but do not provide information about barriers.

From a technological perspective, innovation in the ANS industry has a strong focus on optimizing Man-Machine Interaction, i.e. air navigation systems that heavily rely on human involvement. In the following, we identify the major subsystems and whether there are industry standards available for the information objects they process:

1. Flight Data Processing (FDP): FDP processes flight plan data and is the biggest subsystem of the ANSP infrastructure. A flight plan is a standardized document that contains information such as aircraft origin, destination and planned trajectory (ICAO, 2001). The flight plans are filed before departure, but may be changed during the flight by an ANSP (e.g., to circumnavigate hazardous weather conditions). There is no defined common standard, yet development efforts of the SESAR program are underway towards a Flight Object Interoperability Specification (ED-133).

2. Radar Data Processing (RDP): This system processes incoming radar data from several sources (which indicate an aircraft’s altitude and speed) and presents the information to the air traffic controllers (Eurocontrol, 1997). With ASTERIX (All Purpose Structured Eurocontrol SuRveillance Information EXchange), a standard is available.

3. Environmental Data Processing (EDP): This system processes environmental data such as meteorological data to ATCOs. With the Aeronautical Information Exchange Model, a standard is available.

4. Communication (COM): This system provides air-to-ground (Pilot to ATCO) and ground-to-ground (ATCO to ATCO) communication capabilities. Communication may either be performed between humans (voice link), or between systems (data link). Standards for both communication types are available from the International Civil Aviation Organization (ICAO).

Transformational Perspective on ANSP Industry Innovation

In order to achieve a sustainable transformation of the ANS industry, there is a need, both to transform the ANS service provision and to address the needs of the single ANSP so that it can provide its service in the intertwined industry. The decision of whether to adopt or reject new IT architecture components is fundamental to ANSP enterprise transformation and the transformation of the industry. There are obstacles which hamper this process and which, to a certain degree, impede innovation and its diffusion.
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For the sake of revealing obstacles to the introduction of innovations, we refer to the technology diffusion model of Rogers (1995) as an explanatory model. Given the lack properly publicly documented technological innovations in the ANS industry (SESAR, 2012), the model of Rogers provides an appropriate framework: It highlights the diffusion process of technological innovations, while also taking the effects of social factors into account; in this way, it does not represent a solely technocratic view. The technology diffusion model describes innovation diffusion by dividing the process into four specific stages (Fig. 1).

i. The knowledge stage defines the phase of learning of the existence of a certain new technology. This knowledge motivates an individual or an organization to learn more about how the innovation can be used in its environment. Finally, one’s knowledge of the technology is to be extended in order to gain an understanding of how and why it works.

ii. The persuasion stage is characterized by exploiting the information of the technology. It is an emotional phase, in which people and organizations conceive an opinion on an innovation. In this stage the involved party considers using the technology within its particular environment.

iii. The decision stage is the point where a technology is either adapted or rejected. This decision is based on the analysis of the potential political, economic, social and technological consequences of the innovation.

iv. The confirmation stage is the phase in which habits and practices change due to the adoption of the technology. Reinvention also occurs during this stage, with the goal of improving overall compatibility (Rogers, 1995).

![Simplified Technology Diffusion Model](image)

Figure 1. Simplified Technology Diffusion Model (Rogers, 1995)
Method

Not much related work has been done so far since the industry does not regularly provide access to researchers. The goal of this study is not only to understand the obstacles towards technology innovation that ANS enterprises face, but also to actively influence the perception and behaviour of stakeholders in the long run. Therefore, the study is based on a pragmatic epistemological approach, which is aiming for constructive knowledge that can be applied usefully in action (e.g., Goldkuhl, 2012; Goles and Hirschheim, 2000; Wicks and Freeman, 1998). The essence of pragmatic qualitative research lies in the interplay between actions and intervention: in order to alter certain aspects of reality, actions are required (Blumer, 1969). Knowledge (e.g., natural laws, social norms, empirical evidence) is essential to change reality into a desired end-state. In this sense, actions and their impact can also contribute to further cognitive clarification and development (Goldkuhl, 2012). This is in contrast to, for instance, positivist research which exclusively seeks to explain reality by using models (or a structure of relations) and which uses methods that emphasise the discovery of new knowledge and verify existing (structural) knowledge without actively distorting reality (Denzin and Lincoln, 2000).

As a first step in a larger research endeavour, we started our inquiry by getting a deeper understanding of the cognitive beliefs, perceptions, and plans of senior management and other personnel responsible for innovation and technology management at Skyguide, which is the ANSP of Switzerland. Skyguide has about 1,400 employees, including more than 540 civil and military air traffic controllers. Over 300 engineers, technicians and IT-experts are responsible for the development and maintenance of the complex technical installations and facilities. The operators of aeronautical data manage information to assure smooth air traffic.

Data was gathered by means of semi-structured interviews. In total, eight managers were interviewed which result in 30 interview hours (Table 1). Each interview began by asking broad questions about the status quo of the ANS industry, followed by asking more specific questions about the future development of the industry and the role of ICT to enable and support this change. A combination of focussed and open-ended questions was used. The latter were asked in order to ensure that a comprehensive understanding was attained. In doing so, we adhered to the approach advocated by Bouchard (1976), who explicitly calls for re-focussing during an interview. This provides a greater flexibility than completely structured interviews. To prepare for the interviews, we analysed a multitude of technical reports, internal presentations, project documents, annual reports, and press releases (Table 1).
<table>
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<td>Vision and business model of future ANS industry</td>
<td>Annual report, internal presentations, press releases</td>
</tr>
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<td>Chief operations officer (2h)</td>
<td>Vision of future ANS industry and organizational change</td>
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<td>Third-party commissioned technical report (impact of SESAR)</td>
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<td>Chief executive officer (Skysoft) (2h)</td>
<td>Standardized HMI and service delivery for future ANSP</td>
<td>Project documentation, internal presentations</td>
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Table 1. Interview series (note: h = hour).

Data obtained was first analysed using open, axial and selective coding techniques (Urquhart, 2001). The extracted main statements and assertions were then grouped using STEP / PEST analysis (Political, Economic, Social, Technological) as a mental model (e.g., Mettler and Eurich, 2011) to determine specific areas for future interventions. In order to add to our findings, we led a focus group discussion involving key actors concerned with driving enterprise transformation and technological innovation at Skyguide. This included verifying the statements from the semi-structured interviews and the allocation of obstacles with the key actors in view of completeness and applicability for future work.

Findings

To group the statements and assertions, we use the concept of PEST / STEP as an analysis framework of macro-environmental factors. Peng and Nunes (2007) proposes the use of PEST analysis as a tool to identify narrower contexts and focus research questions around feasible and meaningful regional contexts. According to Mettler and Eurich (2011), STEP can be used as a mental model for determining specific areas of future interventions. We found a total of 11 obstacles to enterprise transformation in the ANS
Industry: Three political, three economic, two social and three technological obstacles that could be assigned to the knowledge phase and the persuasion phase.

In Fig. 2, we map the identified obstacles to the technology diffusion model of Rogers (1995).

The study revealed that in all parts of STEP, the diffusion of innovation is bristled with obstacles to overcome. The mental states of the stakeholders that are described in the model of Rogers (1995) are generally influenced by one or several dimensions of STEP.

**Politically**, regulators need to understand how and why a technology works to build trust in the innovation and to get able to deal with changes in regulations (see section 5.1).

**Economically**, ANSP need to learn and understand what it means to operate under competitive conditions. Employees and management face change in the current mode of financing and purchasing (see section 5.2).

**Socially**, the creation of an idea how one could innovate under the highest expectation (safety) for continuous service provision while facing a limited pool of personnel is supposed to be aligned with political, economic and technological obstacles (see section 5.3).
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Technologically, the study places the most emphasis on showing that ANS can be innovated to significantly increase capacity (see section 5.4) while maintaining or even exceeding current system reliability and safety levels.

Political obstacles to innovation

First, the strong rules and regulations: Historically, the ANSP are predominantly differentiated from one another according to national borders. Since this is the case for most ANSPs within Europe, they are regulated by both international and national rules and regulations. The obstacles are twofold. First, the rules and regulations in ANSP are complex. Being able to understand all the interrelated consequences an enterprise transformation could bring along is time consuming and would require a huge amount of domain knowledge in financial, political, as well as technological aspects. Second, the regulations include an explicit mission of an ANSP, which typically does not mention innovation.

Second, the fear of governments to lose control over their airspaces: Keeping sovereignty of its own airspace is historically a strategic political issue of highest interest. The government has the responsibility of dealing with airspace infringement. This is codified by the ICAO legal framework, which holds national states ultimately responsible for offering ANS services over their respective territory. Two questions will have to be answered before any nation would enter a discussion about its sovereignty: First, how will airspace control within a new functional airspace look like and second, what needs to be regulated if airspace sovereignty is not related to national borders. As the CIO remarked: "There are no big bang changes in our industry".

Third, the strong unionized employees fear losing bargaining power: Operating procedures are highly formalized and firmly anchored into ATCO. These factors put employees and unions in a very powerful position. Thus, ANSP unions are particularly interested in maintaining the status quo, which provides its members with safe jobs and a strong negotiating position with employers. Salaries of ATCO are very high compared to local average salaries. Therefore, enterprise transformation is regarded very sceptically and the fear of job loss and the loss of privileges, such as early retirement is present.

Economic obstacles to innovation

First, the lack of liquidity: ANSPs are often not-for-profit organizations (due to national regulations). Therefore, ANSPs operate close to the break-even point, with low profits. ANSPs are neither allowed to retain cash for future investments nor do they have access to the capital market for financing purposes. Therefore, ANSPs constantly lack liquidity for innovation and enterprise transformation. Investment for
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Enterprise transformation must come from outside the industry and according to the present regulations, it can only come from governments.

Second, the low bargaining power of ANSPs: There are only few suppliers which dominate the market. Against the background of high investment and education costs, an ANSP will not purchase its infrastructure from another supplier once it has chosen its technology and its vendor. The ANSP is at the mercy of the decisions of its provider while the provider has little incentive to innovate. However, our informants are well aware of the dependency of their company from the big vendors, and they would like to see the situation changing. A project manager expressed this concern: "We want to buy components instead of systems". Currently, legislative bodies foster efforts to increase interoperability between systems from different technology vendors. Given the long system life cycles in the ANS industry, our informants expect the impact from these efforts to materialize only after considerable time.

Third, the lack of a unique selling proposition: An ANSP operates as a "connector and consolidator of information" with almost no unique selling proposition compared to other ANSPs. Currently, ANSs are almost interchangeable from the service perspective. In case of market liberalization, ANSPs will face difficulties in differentiating themselves from each other, which is likely to result in a reduction of ANSPs within a FAB.

Social obstacles to innovation

First, the high demand for continuous ANS supply: The need for continuous ANS provision leads to high pressure on ANSP management to ensure service supply with a very high reliability. Entire economies are affected when air traffic is interrupted, e.g. due to strikes. Service interruptions gain immediate and intense media coverage and are highly visible to the general public. Therefore, enterprise transformation can only take place if absolutely no negative effect to the continuous ANS supply can be guaranteed.

Second, the limited pool of qualified personnel: Applicants are either put off by unfavourable working conditions, e.g., shift duties on nights and weekends or they do not pass the recruiting tests due to the high cognitive demands: figures from Eurocontrol indicate a passing rate of around 6 per cent, not including medical conditions that may further reduce the candidate pool. Air traffic controllers cannot be easily recruited either, as they generally require a minimum of 2.5 years training. This makes it typically difficult for managers to take out ATCOs for strategic projects such as enterprise transformation.
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Technological obstacles to innovation

First, the lack of interoperability: Every ANSP has its own monolithic infrastructure. To a large extent, this can be attributed to highly localized data provision which results in a limited data exchange. Currently, ANSPs in Europe run monolithic systems that integrate local data provision (e.g., meteorological, flight plan and surveillance/radar data) with ANS functionalities (e.g., conflict detection or flight trajectory planning). This results in tightly coupled systems at each ANSP which have very limited capabilities for automated data interchange. Existing systems have not been designed for interoperability and for taking advantage of modern communication infrastructure. This lack of interoperability reduces the area of enterprise transformation to the internal structure. As the CEO put it: “The passengers aboard an airplane see some data, for example time-to-destination, on their in-flight screens sooner than we do”

Second, high safety standards and high reliability: Modifications have to be thoroughly tested before implementation in order to meet safety requirements. They must be designed for backward compatibility and integration into existing ICT. Therefore, enterprise transformation is an incremental and time consuming process.

Third, the oligopoly structure of the ANS software market: Since integrated systems demand a great deal of industry know-how, the market is shared between few highly specialised enterprises. Entrance barriers for new vendors are high due to heavy investment (and certification) cost. As one of our informants pointed out, the oligopoly structure is compounded by the fact that ANS is a niche market. Therefore, enterprise transformation does not stem from technology providers.

ICT approach to enable transformation in the ANS Industry

Although we stress that the technological implications must be seen in the overall industry context with all of its political, economic and social factors, based on our interviews, we pursue a technological approach to describing the barriers that need to be overcome or the obstacles that need to be avoided for enterprise transformation. Technology enablers help create the “knowledge” according to the diffusion model (Rogers, 1995), which represents the knowledge about an innovation in its earliest days and creates motivation to learn more about it. It seems that technology is the biggest driver of change in the field.

In order to gain interoperability between ANSPs, establishing a federated data provision layer where all connected ANSPs act as both data producers and data consumers is recommendable. Currently, data between ANSPs are exchanged primarily by voice communication (radio) and paper progress strips (physical paper strips that are printed out at each ANSP whenever an aircraft enters its airspace in order to track the aircraft). With centralized data provision, data available to one ANSP – e.g., the position and
travel parameters of an aircraft such as speed and altitude – would become available system-wide immediately, instead of the time-delays as with the current architecture. The current, sequential data exchange model (Fig. 3 a) with a cloud-based, centralized data exchange model as proposed by the System Wide Information Management (SWIM) concept (SESAR Joint Undertaking, 2011) (Fig. 3 b).

Figure 3. Sequential versus centralized data exchange

SWIM implements the following principles: (1) Chronological decoupling of data provision from data consumption: As soon as data is available to any participant, it is fed into the protected cloud, where possible consumers can access it at any time later. All participants act as both data producers and data consumers. (2) Loose coupling between participants: Each participant feeds and receives data via predefined and publicly available standards (see section 2 for the standards defined for the data processing subsystems). (3) A common information model is used to enable data exchange and service definitions.

With standardization, electronic data interchange between aircrafts and different ANSP can be increased instead of relying on transmitting information via voice communication. This eventually paves the way for increasing automation and finally freeing capacity: For example, applying conflict detection components (support ATCO to avoid conflicts in the airspace), the capacity of a given sector could be increased. This would move the role of human ATCOs from handling routine tasks to managing exceptional situations.

Security requirements are paramount in any ANS technical system. In addition to providing the highest levels of system availability and data integrity, unauthorized access must be prevented at any time via adequate authentication components. In a network-centric model, unauthorized access naturally poses a higher risk than in offline systems. However, these challenges can be overcome, for example, by introducing trusted third parties or by relying on proven cryptography algorithms (Kandukuri et al., 2009; Sabahi, 2011; Zissis and Lekkas, 2012).

Eventually, the data cloud paves the way for a service-oriented architecture (SOA) (Huhns and Singh, 2005). This could break up the oligopoly structure of the ANS software market (Mueller et al., 2010).
For technology providers, this means that the market entrance barrier regarding know-how would be lowered: In-depth expertise in monolithic integrated IT architecture would no longer be required. New technology providers could enter the field of ANS software, specialising on a single component like the Human Machine Interface (HMI). ANSPs would have the option of buying specific services instead of fully-integrated systems, which would decrease their dependency on monopolistic ANS software vendors, thus increasing an ANSP’s bargaining power towards technology providers.

A service-oriented architecture (SOA) for ANSPs includes local ATC centres and site-depending infrastructure components (e.g. surveillance/radar equipment), connected via a (logically) centralized data layer (Fig. 4 a). By moving certain services to a centralized layer while retaining local centres, this architecture would not explicitly require any closing of a physical ATC centre.

Fig. 4 (b) shows a possible system architecture for an ANSP. The ANSP could use on-site HMI components, which may consists of a frontend (ATCO interface) and a backend (communication component) that receives RDP, EDP, FDP (connecting a legacy system via an adapter) as well as conflict detection services from external providers (Fig. 4b). Note that the conflict detection service can consume information from other cloud-based services such as FDP over the communication backbone. The enablers of such an architecture are centralized data provision as proposed by the SWIM concept (SESAR Joint Undertaking, 2011), and a communication backbone that defines interfaces for data exchange, to which all components adhere in an ATM system, including HMI and Data Processing Services.

In addition to cost-saving potential due to better systems maintainability and extendibility, SOA enables a greater degree of specialization: ANSPs can focus on a particular component of an overall ANS system.
and build specialized know-how in this area, while acquiring other system components from third parties. This may reduce the overall heterogeneity in ANS systems. For instance, if the diversity of HMIIs is reduced to a few interfaces that are accepted and used by a great number of ANSPs, ATCOs working procedures and ATCO training could be standardized to a greater degree.

The key advantage of this architecture is that each ANSP can implement it within a timeframe that suits its own legacy situation. In other words, an ANSP can decide which components are to remain on-site, as an integrated system, and which services can be provided from the cloud. ANSPs with legacy systems, e.g. FDP systems, may be at the beginning of the transition to a SOA: FDP system would then receive RDP and EDP services from third-party providers, which would enable FDP to move from an integrated FDP component to a cloud-based FDP service. The separation of the integrated, on-site system parts from services provided via the cloud, and can be adjusted individually by each ANSP, as long as interoperability between ANSPs is provided via the communication backbone and the centralized data cloud (Fig 4b). Thus, existing investments can be protected and systems can be replaced only when they are approaching the end of their lifecycle. Safety and availability issues are less severe with an evolutionary change approach than with big changes.

In the diffusion model of Rogers (1995), providing an architectural blueprint of a SOA for ANS systems increases knowledge about technological innovation potential. By showing how technological obstacles can be overcome with a concrete architectural proposal that takes specific industry requirements (e.g., security and the need for evolutionary change) into account, the perceived characteristics at the persuasion stage are likely to be convincing from a technological point of view. This increases the likelihood of an adoption in the decision stage. ANSPs who reject the transition for the time being, e.g. due to financial constraints, have the possibility to opt for a later adoption.

The proposed ICT innovation has some implications for the business model of ANSPs: For instance, interoperability between ANS systems enables dynamic sector allocation, which, as a consequence, would allow for temporary shutdown of an ATC centre when other ANSPs are capable of managing this sector. Even though the dynamic sector allocation is a cornerstone to achieve SES cost-efficiency, it means that ANSPs are likely to lose some of their revenues, especially since their services would become increasingly interchangeable. Especially ANSPs of smaller states may have to look for new business opportunities, since they might be faced first with the threat that at least parts of their currently controlled airspace might be managed by a neighbouring ANSP in the future. For example, a new business model could focus on providing training services to external ATCOs from other ANSPs.
Conclusion and Outlook

The goal of this study is to reveal obstacles that make innovation in ANS so difficult and to contribute to the understanding of the technology diffusion process in the ANS industry. On this basis, ICT approaches are proposed to tackle the identified technological obstacles with the intention to actively influence the perception and behaviour of stakeholders. The findings show that reaching a decision point where technology is accepted (or rejected) in the ANS industry is bristled with obstacles to overcome different mental states of the involved stakeholders that are described in the model of Rogers (1995).

This study is one of the first to identify obstacles to innovation in an HRO. Whether the findings are generalizable to other HROs (e.g., nuclear power plants or hospitals) has to be investigated in further research. Still, the study provides a better understanding of technology adoption and diffusion in an under-researched domain and renders some new insights for both, industry ANSP decision makers and scientists. The identified obstacles may help practitioners define ICT strategies not only to tackle technical challenges, but also to consider the influence of political, economic and social stakeholders. Practitioners of the field may use the findings as an entry point to the creation of knowledge towards the development of ICT that enables enterprise transformation in the ANS industry.

The study has its limitations. It does not reflect the intertwining aspects of political, economic, social and technological aspects. Since this paper mainly focuses on ICT architecture to overcome technological obstacles, the implications of ICT architecture on the other PEST dimensions need further analyses. The concrete architectural proposal provides the discussion and negotiation vehicle to do so. Interview partners are members of one internationally recognized, yet small-sized ANSP. In order to validate the findings, interviews with other stakeholders from the ANS industry, for example representatives of ANS system providers and regulators, are needed.

Further research is required to better comprehend the industry-wide process of technology diffusion. In this sense, future work should also include the identification of additional innovation obstacles and look out for further enablers in the entire ANS industry. Additionally, enablers for economic, political and social obstacles need to be defined. Since no emphasis has been made considering the interfaces between stakeholders in the ANS industry, enterprise transformation aspect should be discussed under these aspects. Describing how incentive schemes could influence the ANS industry and its stakeholders could be a basis to describing requirements for increasing diffusion of innovation in this industry.

Finally, some more findings about successfully implemented solution designs would be of extraordinary value for deducing efficient and generalizable enterprise transformation mechanisms in an HRO environment. For these potential future endeavours this study can provide a substantial first step towards structuring the delicate and tricky situation of innovation management in the ANS industry.


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SESAR (2012). The European ATM Master Plan.


7.3 Early stage technology investments of pre-seed venture capitalists

Citation


Abstract

Although technology transfer offices at universities are widely installed, in many cases, inventions made in academia still struggle to be commercialised. This so-called technology transfer gap can be overcome by professionalised pre-founding activities. Whereas, prevailing investment models, like business angels or traditional venture capitalists, usually tie up their business activity on already founded companies, pre-seed venture capitalists (PSVC) attempt to align inventions made at academia with entrepreneurship by founding start-ups. Against this background, this study aims at examining the perceptions of deficiencies of the prevailing investment models and the role of the PSVCs in the pre-founding phase. PSVC companies operating in the biotechnology and nanotechnology area, and with a broader technology approach have been analysed within a multi case study research. The results show that, based on the technological scope and the financial source of the investment activity, four different types of PSVC business models can be identified and described. Technology transfer offices at universities and research
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Institutions supporting the founding process of start-ups can use the findings to develop and execute specific partnership strategies with these PSVC types.

Keywords

New ventures, start-ups, spin-offs, venture capital, business angels, founding angels, early stage investments, business model

Introduction

Technological innovation includes the organisation and direction of human capital resources towards effectively 1) creating new knowledge (which is, in this case, the invention from scientific work), 2) generating technical ideas aimed at new and enhanced products, manufacturing processes and services, 3) developing those ideas into working prototypes and 4) transferring them into manufacturing, distribution and use (Roberts, 2007). Technology transfer is a key aspect in linking these steps towards an integrated process. Although many universities and research institutions have established technology transfer capabilities in the last decade, there is still a technology transfer gap which has to be bridged for effective and efficient technology transfers in order to create industrial applications out of academic research and development (R&D) results. Start-ups created out of universities and research institutions can close this technology transfer gap by facilitating the transfer of R&D results into products and services (Di Gregorio and Shane, 2003; Grandi and Grimaldi, 2005; Markman et al., 2005a; Lynskey, 2008). An important reason being that start-ups are usually more flexible and faster than established companies, given their lean structure and absence of any prior track record. Since inventions are difficult to predict and commercialisation requires industry specific knowledge and contacts, technology transfer offices (TTOs) have been established at universities and research institutions which act as liaison between academia and entrepreneurs to foster start-up activities.

Besides these efforts of academic institutions to stimulate the commercialisation by creating start-ups, there are other different investment models supporting start-up companies. Whereas, early stage investment models after the foundation of a start-up, like business angels (BAs) and traditional venture capitalists (VCs), are well known and intensively described in the academic literature (Mitter and Kraus, 2011), investment models before the foundation of a start-up are fairly unknown. Two pre-founding approaches that align entrepreneurial activities with scientific inventions and take an active role in the very early stage of a business are described in the literature: The surrogate entrepreneur (SE) model (Radosevich, 1995; Franklin et al., 2001; Lockett et al., 2003) and founding angels (FAs) who act as co-
founder together with academic scientists, and bring in own money (like BAs), business experience and networks together with technical understanding (Festel, 2011; Festel and De Cleyn, 2013a).

<table>
<thead>
<tr>
<th>Financial source</th>
<th>Pre-seed venture capitalists (PSVCs)</th>
<th>Traditional venture capitalists (VCs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own money</td>
<td>Surrogate entrepreneurs (SEs)</td>
<td>Business angels (BAs)</td>
</tr>
<tr>
<td>Foreign money</td>
<td>Founding angels (BAs)</td>
<td></td>
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</tbody>
</table>

Before foundation | After foundation

**Figure 1 Investor categories differentiated by time of investment and financial source**

Figure 1 shows investor categories differentiated by the time of investment (before vs. after foundation) and source of investment (own vs. foreign money) described by Festel and De Cleyn (2013a). Whereas both of the above mentioned pre-founding concepts focus on an external entrepreneur as an individual investing own money, there are also pre-seed venture capitalists (PSVCs) as investment model where institutional teams, similar to traditional VCs, invest foreign money in pre-founding projects. The term PSVC is used in practice to demonstrate the difference to traditional VC and there are, mainly in the United States, examples of these very early stage technology investments by institutional teams. Festel and Boutellier (2008) as well as Festel and Kratzer (2012) have described examples, especially in the nanotechnology area, and shown some distinct characteristics of this pre-seed investment model.

The PSVC business model showing operational aspects to realise this model in practice has not been described in academic literature. This was done within the research work described in this paper: 11 case studies showing PSVCs in Europe and North America with investment activities primarily in the biotechnology (including pharmaceuticals) and nanotechnology area or a broader technological focus were developed and analysed using the business model framework suggested by Johnson (2010). The purpose of the paper is to shed light on the business model of PSVC especially in the context of technology transfer in high technology areas based on the following research questions.

RQ_1: What is the business approach of PSVCs and how is a classification in different PSVC types possible?
RQ 2: What is the value added of PSVCs for universities and research institutions and what recommendations can be formulated?

In section 2, this paper provides an overview of entrepreneurial efforts at universities, followed by an overview and a discussion of business models focused on the commercialisation of new technologies, like VC and BAs, SE and the FA model. This section ends with the introduction of Johnson’s business model framework used for the purpose of classification. Section 3 describes the qualitative research approach. The results are shown and discussed in section 4 and finally, the conclusions and implications are drawn in section 5. The paper concludes with a description of the contribution, limitations and suggestions for future research.

Theoretical background

Entrepreneurial efforts at universities

Entrepreneurship is an activity that involves the discovery, evaluation, and exploitation of opportunities to introduce new goods and services that previously had not existed (Shane and Venkataraman, 2000). The importance of entrepreneurship is seen by universities and research institutions and their activities related to entrepreneurship have steadily increased during the last decades (Shane, 2002; Astebro and Bazzazian, 2011; Astebro et al., 2012). This is accompanied by a change in government policies that encourage universities and research institutions to commercialise their R&D results.

The increase of university R&D exploitation was initiated by the emergence of university technology transfer activities after the adoption of the Bayh Dole act of 1980 in the US (Powers and McDougall, 2005). The purpose was to commercialise inventions funded by federally sponsored R&D (Friedman and Silberman, 2003). As a consequence, besides teaching and R&D, the role of universities was broadened by the commercialisation of the output of basic R&D through licensing and the creation of start-ups (Etzkowitz et al., 2000; Etzkowitz, 2003). The aim is to support economic and social development (job creation, structural change and regional/national development) through more entrepreneurship based on academic research results.

An entrepreneur faces several challenges in order to develop the technology and generate revenue as early as possible (Baron, 1998), among which are industry know-how and commercialisation experience. Before and even after the founding of the company, the scientist is often absorbed by his daily duties and challenges in R&D and has quite often a biased view on how his R&D output could be used (Jousma and Scholten, 2009). In most cases the academic is expected to remain as a full-time employee of the university with a role that involves more advisory functions, especially technical ones, than hands-on day-
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to-day management. Since academic researchers neither have the knowledge nor the experience to commercialise their R&D results additional support is necessary.
To enable the commercialisation of science by facilitating technology transfer from academic R&D to industrial applications, many universities and research institutions have established TTOs, entrepreneurship centres and incubators (Goldfarb and Henrekson, 2003; Bercovitz and Feldmann, 2006; Rasmussen et al., 2006). Most TTOs recognise start-ups as a viable method of technology transfer and thus assist scientists in their entrepreneurial efforts (Feldman and Feller, 2002; Markman et al., 2005b; Meyer, 2006), mainly during the pre-founding phase. As a result, there has been a substantial increase in the number of academic start-ups (Chiaroni et al., 2005; Clarysse et al., 2007). Acquiring enough capital as well as industry knowledge is a serious challenge for many start-ups. Particularly for high-tech start-ups, the necessary resources are relatively high in the first stages, due to the steep cost of R&D and product development. TTOs can only manage that part to a certain extent and external investors are necessary.

Venture capital and business angels
Traditional VC companies are so-called formal investors (Fried and Hisrich, 1994; Kaplan and Strömberg, 2001). They usually invest only in companies that have at least proceeded beyond the product development stage (Branscomb and Auerswald, 2002; Wright et al., 2006) and they even prefer to invest when the technological potential is demonstrated by the working together with first customers. For scientists in search for first funding of a business idea, traditional VCs are not an option.
In contrast, BAs are vital for early stage high-tech companies (Wetzel and Freear, 1996) and since the early nineties, politicians and researchers have increased their interest in understanding how the engagement of BAs work and how it can be optimised. For example, in the US and the United Kingdom (UK), the largest source of risk financing comes from BAs (Mason and Harrison, 1996). Globally speaking, the BAs’ investment in new technology based firms is twice the size as formal VC investments (Bygrave and Quill, 2007). Having been financed by BAs raises the credibility of the company in the eyes of potential partners and thus increases the chances of the company receiving further investment from VC. Ideally, BAs complement traditional VC companies, especially with regard to the size of the investment, the value added and the investment phases, and provide a deal flow for traditional VC funds (Madill et al., 2005).
Besides capital, new technology based companies very often lack business know-how, as the founders are usually highly R&D orientated scientists. In order to be successful, a start-up, besides having enough financial capital, also heavily relies on operational assistance (Baum and Silverman, 2004; Festel and De
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Cleyn, 2013b). Thus, the working relationship between founders and BAs is important and it should ideally start as early as possible in the company life cycle (Landström, 1998). In reality, however, BAs as well as traditional VCs, normally do not have sufficient time to identify and familiarise themselves appropriately with a potential start-up project (Mason and Rogers, 1997; Mason and Harrison, 1999; Mason and Harrison, 2002) and to build a solid relationship with the founders.

BAs choose to invest in specific sectors based on their previous experience and their strong network in that sector (Van Osnabrugge, 2000). However, many investors do not possess the necessary technical knowledge required for investing in high-tech areas. This is why BAs normally only invest in existing companies rather than potential start-up projects from universities (Mason and Harrison, 2002; Smith et al., 2010). In addition, for non-specialised investors, investment opportunity takes much effort due to a lack of access to the academic researchers and the long selection process (Mason and Harrison, 1992). Because of this time consuming procedure, more and more investors have neglected small investments in order to focus on bigger deals (Murray, 1999). This theory is confirmed by Mason and Harrison (1995) who attribute the equity gap to the high search cost of BAs seeking investment opportunities. The BAs approach does not bridge the gap between academic R&D and industrial application, if an insufficient number of start-ups are founded.

Surrogate entrepreneurship

Surrogate entrepreneurship involves an individual from outside universities, who acquires the rights to the technology and assumes the role of entrepreneur, whereas the originators maintain their positions at the university (Radosevich, 1995; Franklin et al., 2001; Lockett et al., 2003). According to Kassicieh (2011), a SE “is a person with expertise in business who works on bringing a new technology to the marketplace with or without the support of the originator of the scientific discovery or technology”. Although not mandatory, it is, however, important that the scientists provide technical support to the start-up and have a general interest in the ongoing further technical development and commercialisation of their invention. This is especially true in the early stages when technology transfer from the academic environment into the new venture is a pivotal business activity. In principle, there may be additional benefits from maintaining a link with the resources at the university to develop further technology (Radosevich, 1995). The close relationship between the SE on the one hand and the scientists on the other seems particularly important with regard to their characteristics and their different focus. According to Kassicieh (2011), the academic scientist is an expert in the specific technological area acting in the development phase, whereas the SE has business expertise and comes into play in the market development phase, when other skills around markets and customers become increasingly essential for the commercial success of the new
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venture. In addition, evidence suggests that ventures created by SEs with faculty assistance become somewhat larger on average than those created only by academics (Chrisman et al., 1995). This could be a largely viable and potentially underutilised alternative to prevailing support initiatives provided by universities that are often based on inventor entrepreneur models (Radojevic, 1995; Franklin et al., 2001).

The results of a recently published empirical research study by Politis et al. (2012) suggest that external entrepreneurs have a different mindset that makes them better equipped to deal with opportunities and obstacles related to financing and developing university start-ups. Surrogate entrepreneurs may also be involved in the identification of opportunities, particularly where expertise is lacking within TTOs (Franklin et al., 2001). Hence, several authors (Roberts, 1991; Heirman and Clarysse, 2004; Stam et al., 2009) conclude that SE activities are important for innovation processes and act as an accelerator of economic growth, especially in high-tech areas, targeting markets with high growth potentials.

**Founding angels model**

A potential barrier, however, is that as outsiders, SEs may be faced with information asymmetries (Robbie and Wright, 1996; Wright and Robbie, 1998; Wright et al., 2006; Manigart et al., 2006) between themselves and the technical originators regarding technological aspects and their commercial implications. For very early stage investment opportunities, this may impede the identification and selection of potentially profitable projects by the SEs. As outlined by research from Wright et al. (2006) and Lockett et al. (2002), these asymmetric information problems in early stage technology ventures pose significant upfront search costs by potential financial providers and may prevent them from an engagement in an actually promising project.

This can partly be avoided within the FA business model. FAs found, together with scientists, high-tech start-up companies to successfully commercialise the results from academic research. The background of the FAs is an education in natural sciences or engineering with a professional career as manager with solid strategic and financial experience (Festel and De Cleyn, 2013a). They complement the scientific team members, coming mainly from universities and research institutions, with business expertise (Festel, 2011). Besides initial funding in the pre-seed phase, FAs are operationally very much engaged bringing in their expertise from other successful start-up projects (Zhang, 2009). Because of their very early and much more operational engagement they have more the role of a founder and entrepreneur and less that of an investor complementing the later engagements of BAs and VCs (Festel and De Cleyn, 2013b). Because FAs work very closely with the founders, they acquire a deep knowledge of both the financial and the technological potential of the company. When facing important decisions FAs will decide differently to
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BAs or VCs, due to their deeper and more complete information on the company, giving them an advantage.

The investment volume is between 10,000 and 50,000 Euros per investment. This is significantly lower than in the case of BAs with an average of about 65,000 Euros (Mason and Harrison, 1997; Festel and De Cleyn, 2013a). The typical investment size for VCs is more than €500,000 (Bottazzi and Da Rin, 2002). FAs own a higher proportion of the company ranging from 10 to 50% directly after the foundation of the start-up, compared to BAs who normally receive only a few percent for their investment. Like BAs and VCs, FAs are also engaged with their investments up to an exit. Like BAs, they invest their own money and are more flexible regarding the exit strategy and holding period than VCs (Freear and Wetzel, 1990). The average exit horizon of FAs is usually longer than those of BAs, because of the earlier investment stage and hence the longer development trajectory of investment projects towards potential exits.

Johnson’s business model framework

All business activities possess either explicitly or implicitly a specific business model (Teece, 2010). In its essence, a business model embodies nothing less than the organisational and financial architecture of a business (Chesbrough and Rosenbloom, 2002). It is a structural template of how companies transact with the surrounding environment (e.g. customers, partners, vendors) or more generally, how they choose to connect with factor and product markets (Zott and Amit, 2008). Interestingly, there is no generally accepted definition of the concept of business models. As outlined in literature reviews by Amit and Zott (2010), Zott et al. (2011), Schaltegger et al. (2012) and Serrat (2012), there are various business models that can be used as framework of analysis and which focus basically on the economics of a business or even take a tremendous broad scope including almost every aspect of business strategy and organisation.

Johnson (2010, p. 22) states that by this lack of shared vocabulary “most leaders even don’t sufficiently understand their company’s existing business model”. To resolve the situation he proposes a four box business model framework in order to provide a structure to reveal and categorise all of the issues that must be addressed within a company. The basic architecture of Johnson’s business structure are the four independent aspects “customer value proposition”, “profit formula”, “key resources” and “key processes”. The following definitions of the four aspects are directly retrieved from Johnson (2010, p 24).

- “Customer value proposition: An offering that helps customers more effectively, reliably, conveniently, or affordably to solve an important problem (or satisfy a job-to-be done) at a given price.” (Johnson, 2010, p. 25)
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- “Profit formula: The economic blueprint that defines how the company will create value for itself and its shareholders. It specifies the assets and fixed cost structure, as well as the margins and velocity required to cover them.” (Johnson, 2010, p. 31)

- “Key resources: The unique people, technology, products, facilities, equipment, funding, and brand required to deliver the value proposition to the customer.” (Johnson, 2010, p. 39)

- “Key processes: The means by which the company delivers on the customer value proposition in a sustainable, repeatable, scalable, and manageable way.” (Johnson, 2010, p. 39)

Due to the fact that the Johnson business model framework is designed to describe the structure of a company, it fulfils the claim to be useable as an adequate analysis framework. Johnson (2010, p 46) states “With the blueprint it (the four aspects) provides, you can diagram your existing core business model”.

Methodology

Research approach

A qualitative research approach is particularly recommended in the field of entrepreneurship when seeking concepts that enhance the understanding of social and economic phenomena, with the emphasis on the experiences, meanings and views of all participants (Neergaard and Ulhoi, 2007). A multiple case study approach was applied as the results are more convincing, trustworthy, and robust than those from a single case study (Yin, 2006). The multiple case study method compared cases and highlighted resulting insights through similarities and dissimilarities between the cases using a system of replication logic, with each case treated as an independent experiment (Eisenhardt, 1989). Given the exploratory nature of the research, different data collection methods were used, like literature research and interviews (Flick, 1995; Yin, 2009).

Starting with a narrative interview approach (Polkinghorne, 1988; Czarniawska, 1998; Pentland, 1999), the interviews were conducted in an unstructured, open-end way without any formal questionnaire. The interviewees were asked to describe his or her involvement with a minimum of interruption by the interviewer. In a subsequent interview round a reference set of questions was developed as a guideline for the interviews, leaving enough room for spontaneous requests and answers, which gave a semi-structured nature to the interviews.

All the collected information sources were used for reasons of data triangulation to obtain a more holistic view of the case studies (Eisenhardt, 1989). By combining the different sources of information and collecting information over a longer period of time an in-depth description of the case studies was
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obtained. The theory was developed by recognizing patterns of relationships among constructs within and across cases and their underlying logical arguments (Eisenhardt and Graebner, 2007).

Data collection and analysis

The collection and analyses of the data were conducted in multiple iterations following three steps. The first step was an initial literature analysis on technology transfer around universities and research institutions within the biotechnology (including pharmaceuticals) and nanotechnology area in order to set the academic background and to understand technology transfer approaches based on entrepreneurial activities in the selected areas. These areas were chosen as they are science-based technologies that are still in the early stages of their technological life cycles (Niosi and Reid, 2007). This literature analysis was done by searching relevant combinations of keywords like “technology transfer” and “biotechnology” or “nanotechnology” in academic and practice oriented journals.

The second step was based on interviews with a broad diversity of institutions in the field of biotechnology (including pharmaceuticals) and nanotechnology (Table 1). Depending on the type of associated institutions, the interviewees were technical directors in the case of interviews with industrial companies, the head of division in the case of governmental institutions, professors in the case of academic institutions, and partners or managing directors in the case that the interviewee represented an investor. Before each interview, the authors had gathered in-depth information on the company or institution through various public sources (e.g. databases, website, press releases), enabling an efficient conduct of the interviews. All the interviews were carried out face-to-face, ranged from one to two hours, and were conducted by the same single interviewer.

In a first round between 2005 and 2007, in order to gain a better insight into technology transfer approaches within the pharmaceutical and biotechnology industry, narrative interviews were conducted with 41 experts from 19 pharmaceutical companies, 12 pharmaceutical service providers and 10 biotech companies. In a second round between 2006 and 2008, 35 nanotechnology experts from industry, government, academia and the finance sector were interviewed using a semi-structured approach with an interview guideline to learn more about mechanisms to successfully transfer nanotechnology R&D results into applications and how entrepreneurial approaches can support that. The questions were structured around different thematic groups comprising 1) basic data (about the represented institution and technology owner, involved parties), 2) background (reasons behind engagement in new ventures, relevance of technology transfer aspects), 3) realisation (conceptual design of the business activities, engagement of investors, start-up process) and 4) results (actual experiences of the development of the new venture, achievement of technology transfer goals). The interview guideline was tested with around 5
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interview partners and then modified based on the feedback of the first interview partners with respect to understandability. After conducting all the interviews, they were transcribed and condensed over several iteration steps.

Within the third step, additional literature research from 2009 to 2011 was focused on the 11 identified PSVCs as case studies, which were identified during the interviews (Table 2). Starting with PSVCs focused on biotechnology (including pharmaceuticals) and nanotechnology, PSVCs with a broader technological scope were later also included to increase the sample size. Information was retrieved from different sources (e.g. websites, press releases) and rewritten in a condensed manner. During the analysis, each case was analysed by describing it and performing a short within case analysis with focus on the business model. Analysing their business approach using Johnson’s framework enabled the standardised analysis of all case studies through pattern matching (Yin, 2009). Afterwards, all cases were compared to each other by a cross case analysis. Result was the classification of PSVC activities based on similarities and dissimilarities between the case studies.

Results and discussion

*Business approach of analysed PSVCs*

The business approach of all PSVCs is quite similar. Project opportunities are evaluated to identify those which have the highest potential and the best fit to the existing portfolio. This means also the identification of interesting markets with high potential. Important for PSVCs is the understanding of the value chains and identification of bottleneck technologies with focused investments in order to develop these technologies. Most PSVCs work together with industry and technology experts to identify and pursue these new opportunities in targeted industries. For example, Precede works together with technology experts from academia and industry to identify and pursue new opportunities in the cleantech and renewable energy area. If necessary, PSVCs finance early stage research at universities or research institutions in exchange for intellectual property (IP) rights. Arrowhead Research Corporation, as an example, sponsors early stage nanotechnology research at universities in exchange for rights to commercialise the results. Normally, together with the scientists from universities or research institutions, a business concept is developed very early and later a business plan. In some cases, external experts, hired by PSVCs, work closely together with the scientists.

When the technology is ready (e.g. proof-of-concept in the laboratory), a start-up company is established and the scientists usually act as co-founders. If a technology expert works closely with the scientists to develop the business plan and the start-up company is established, the technology expert sometimes becomes a co-founder. An agreement with the university or research institution is signed based normally
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on the exclusive rights regarding all relevant IP. In exchange, the academic partner receives a pre-agreed payment and/or equity stake of the start-up. Preset milestones are used to assess the progress of the projects with regard to continued investment, redirection of funds or withdrawal of investment. A highly competent management team, which harmonises well, is an important factor for the success of the start-up and PSVCs create these teams based on their experience and network. Within the team building process, PSVCs bring in additional, mostly business oriented, team members to complement the scientific team. In some cases a completely new management team, which is often hired by the PSVC, will take over responsibility from an interim management organised by the PSVC.

In the early stage financing of the start-up the money generally comes from the PSVC. In some cases PSVCs partner with BAs and traditional VC companies to increase funding and especially to bring in additional competencies. Intensive technical and non-technical advice from the PSVCs is provided to the start-ups. This includes conducting market research, supporting product development and establishing market entry strategies. For example, Angle Technology provides financial, administrative, corporate and strategic resources. PSVCs, like Sanderling Ventures, also help the start-up to obtain access to additional academic research laboratories and manufacturing facilities should this be required. During the build-up of the start-up the research focus is on applied research up to the development of a working prototype. In parallel, business development is established to generate revenues for the start-up by acquiring co-operation partners and customers, e.g., through the sale or licensing of the technology.

The PSVC normally supports the portfolio company also in the planning and execution of the later stage financing rounds by securing additional financing from either the traditional VC community or capital markets. If necessary, a broader investor syndicate for a follow-on financing round is organised by the PSVCs. Some PSVCs, like Arrowhead Research Corporation or the XL TechGroup, maintain a controlling stake until the exit. In most cases a trade sale to existing industrial co-operation partners of the start-up company is realised. The exit enables PSVCs and the other investors to get paid off. Universities or research institutions also profit, if they have an equity stake in the company.

Business model analysis and classification

The structured analysis and comparison of the case studies was performed with the framework of Johnson along the four aspects 1) “customer value proposition”, 2) “profit formula”, 3) “key resources” as well as 4) “key processes” and the results are consolidated in Table 3. Based on this table, the similarities and dissimilarities between the case studies were identified and are presented in Table 4. In addition to a long list of similarities, two major dissimilarities between the case studies were obvious: the broadness of the covered technologies and the sources of the invested money. Using the two dimensions “technological
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...scope” (with narrow and broad technological scope, i.e. focusing on biotechnology/pharmaceuticals, nanotechnology or also on other scientific fields) and “financial source” (with public and private financial source) allows accordingly the separation of the business models of PSVCs into types I to IV (Figure 2).

- PSVC type I with a narrow technological scope using private financial sources, like Molecular Manufacturing Enterprises with focus on nanotechnology or Paramount BioSciences, Sanderling Ventures and Symphony Capital with focus on biotechnology and pharmaceuticals.
  
- PSVC type II with a broader technological scope using private financial sources, like Arch Venture Partners, Precede Technologies and ProSeed Capital.
  
- PSVC type III with a narrow technological scope using public financial sources, like Advance Nanotech and Arrowhead Research Corporation focused on nanotechnology.
  
- PSVC type IV with a broader technological scope using public financial sources, like Angle Technology and XL TechGroup with a broader technological scope.

![Figure 2 Separation of the business models of PSVCs into types I to IV](image)

Similar to the specialisation among BAs and traditional VC teams (Gupta and Sapienza, 1992; Van Osnabrugge, 2000; Gompers et al., 2009), PSVCs either specialise within specific technological environments or have a broader technological scope according to their experience. Private financial sources are typical VC investment funds or private investors financing the activities of PSVCs with no
Publications

general differences to investment funds of traditional VC. Public financial sources means, PSVCs, like Advance Nanotech and Arrowhead Research Corporation with a narrow scope on nanotechnology or Angle Technology and XL TechGroup with a broad technological scope, which are listed on the stock exchange.

Taking a closer look at this financing source gives some interesting insights, as the concept of PSVCs is in strong contrast to the common investment behaviour at public stock markets. Investors focus normally on fast returns, but technology start-ups need “patient” money with an investment horizon of at least five years. Additionally, investors in public stock markets need transparency and the information asymmetry between investors and management is generally overcome through detailed financial statements. But early stage technology start-ups generally have no positive cash flows and the balance sheet consists mainly of intangible assets, such as patents and knowledge, which are hard to value due to technological novelty and complexity. This intransparency is even necessary for these start-ups as they do not want the public and competitors to know what kind of technological edge they have.

It is challenging for PSVCs to raise money on public markets to finance their business model. This explains why only two of the four PSVCs are still listed. Advance Nanotech and XL TechGroup are meanwhile delisted. Also Arrowhead Research Corporation has not been really successful; after the execution of its initial public offering in 2003 with a share price of 70 US-Dollar, the share price at the end of April 2014 was around 13 US-Dollar. Only Angle Technology was able to prevail against the challenges at the stock market to some extent. The current share price is 0.94 Pound Sterling compared to 1.5 Pound Sterling, after going public in March 2004.

Comparison with other investment models

The results derived from the case study analysis accompanied with the literature review on other approaches to develop academic start-ups enabled the deduction of some important differences between these approaches (Table 5). One aspect for comparison is the stage when start-ups or planned start-up projects are funded. BAs and traditional VC companies are usually focused on already founded companies. Especially traditional VC companies do not play an important role in early stage technology investments. This gap in the pre-seed phase, before start-ups are founded, is closed by the PSVCs as well as the SE and FA business model. Comparing PSVCs, BAs und traditional VCs shows that these approaches complement each other: PSVCs are engaged in very early stage projects (pre-seed phase), BAs in early stage projects (mostly seed and start-up phase) and traditional VC companies more in later stage projects (mostly growth phase and only a few specialised companies in the start-up phase).
The typical investment size of PSVCs in an early stage investment round with a few 100,000 Euros is between the investment size typically made by BAs with around 100,000 Euros and traditional VCs with a few million Euros and is thus significantly higher than the investment volumes of FAs. If PSVCs invest in later investment rounds, the amounts are significantly higher and comparable to traditional VCs. Due to this fact and the relatively low initial investment volume needed for the pre-seed phase with a few 100,000 Euros, PSVCs can make a large number of early stage investments. The limit here is not due to the financial resources but more the human resources to support the projects operationally.

BAs as well as SEs and FAs invest their own money and this is the reason why there is flexibility regarding exits, i.e. there is no pressure to realise an exit at a certain amount within a set number of years. PSVCs, like traditional VCs, invest their investors' money so they must achieve attractive exits within their investment horizon to pay the money including the promised profits back to their investors. This performance pressure is even higher, if the PSVCs are listed on the stock market. Nevertheless, PSVCs have an important advantage compared to traditional VCs. Because PSVCs are engaged in pre-seed projects, their average exit horizon is much longer than their traditional VC counterpart's. Due to this long exit horizon, PSVCs have enough time to increase the value of the start-up, which results in higher valuations when additional funding is sought from traditional VC funds in a later stage. Increased value also translates into a smaller dilution of stock ownership in future rounds, an important consideration for PSVCs.

**Conclusions and implications**

*Added value of PSVCs in technology transfer*

The basic business model of PSVCs is that they finance research in high technology sectors, like biotechnology or nanotechnology, at university and research institutions in exchange for IP rights. PSVCs provide business expertise and operational day-to-day support to found and develop a new company which includes developing the business plan, conducting market research and the building of the management team, when technologies are ready to leave the laboratory. Additional financing is provided and, if necessary, a broader investor syndicate for a follow-on financing is organised. Because they work very closely with the founders, the PSVCs will acquire a deep knowledge of the technological potential and financial situation of the company. When facing important decisions such as whether a large investment should be made, a PSVC can make good decisions due to his deeper and more complete information of the company.

After analysing PSVCs as early stage technology investors, they can be described as an emerging investment model with the potential to significantly foster start-up activities at universities and research
institutions. With this business model, support is given to interesting business concepts before start-ups are founded, whereas most of the established investors usually enter in already founded companies. Due to their profound knowledge of technologies and markets, PSVCs contribute to broaden the view of scientists in terms of commercial potential. They keep an eye out for new scientific breakthroughs which have the potential of being commercialised. With the engagement of PSVCs, unrecognised commercial potential can more often be identified which otherwise would stay undiscovered within science. PSVCs have a “pull” function in the venture business and they can help to overcome the technology transfer gap between academic research and the commercialisation of research results.

**Recommendation for universities and research institutions**

TTOs at universities and research institutions should work more together with PSVCs and other very early stage investors, like SEs and FAs, because these can help to increase the start-up foundation activities supporting the technology transfer mission of TTOs. Working together with SEs and FAs could be the first step to be engaged with PSVCs, so that the PSVC concept can be seen as is an advancement of the SE and FA approach.

The different types of PSVCs require different strategies of universities and research institutions. Working together with PSVCs type I and II enables TTOs to realise early stage projects which are too early for BAs and traditional VCs. Due to private financial sources there are no significant differences to traditional VCs. PSVCs type I with a narrow technological scope normally have a deeper industrial background so that this investor type fits better to application oriented projects which need co-operation partners from the industry. PSVCs type II with a broader technological scope are the right partners to finance projects looking later for more VC money. With PSVCs types I and II, equity deals, i.e. giving IP rights for an equity stake in the start-up company, is attractive due to the financial upside potential in the case of an exit. Working together with PSVCs types III and IV is more risky as these PSVCs have more short-term performance pressure due to their listing on the stock markets. Instead of equity deals the better strategy for universities and research institutions would be licensing deals with larger upfront payments.

The learning effects described in this article enables to formulate also recommendations for policy makers. They should take this topic seriously, as an effective and efficient technology transfer helps to achieve economic growth. Policy makers should support the business activities of PSVCs through incentives regarding successful technology transfer. These incentives could be tax advantages for PSVCs (e.g. preferred depreciation models for R&D expenses or reduced tax rates for licensing and sales of technologies) and co-investors (e.g. reduced tax rates on exit profits).
Contributions, limitations and need for future research

This study contributes to the existing literature twofold. First, this investigation focuses on an increasingly important topic that has not yet been thoroughly examined. In this way the study provides new insights in terms of engagement approaches of very early stage technology investments, it embeds the PSVCs model into the surrounding environment of prevailing approaches and opens it for further research. Secondly, the study contributes to theory development in business modelling applying a suggested methodology in order to classify types of PSVCs business models and, with this, enhances and complements existing theories.

This study is not without limitations. The multiple case study research, like others that involve the collection of data in a small number of cases, limits the range of findings and conclusions. This limitation would be lessened by completing a number of similar studies in different industries and different countries, economies and cultures. More research has to be done to understand more the differences between the various PSVC types and their engagements in different industries. During the process of research and analysis, the hypothesis was developed that the PSVCs' business model increases the rate of successful start-ups by providing more stable and well organised, ready to invest start-up companies. The quality of these start-ups (growth rate, survival chance) compared to start-ups without the engagement of a PSVC has to be investigated in a constitutive research approach.

Besides the PSVCs' approaches presented in this study, more fundamental research is needed to obtain additional insights into the ‘why’ and ‘how’ questions relating to the involvement of external entrepreneurs in the very early stage of an academic start-up process and to investigate the key hurdles related to the PSVCs' model in the later stages of the company life cycle. In addition, the development of start-ups to fully fledged and successful enterprises is most often a long process taking many years. Although this study reflects the processes over a certain period, a longitudinal research design with measurement points distributed over several years would enhance the understanding of early stage technology investments by PSVCs over time, particularly at later stages in the company life cycle.

With regard to business networks as one of the essential success factor of new ventures, further research is necessary to understand how these networks are created and how PSVCs use them in comparison with BA networks. Other topics for further research are the relationships and potential synergy effects of the PSVCs' model with BAs, traditional VCs and also TTOs. To assess the attractiveness of the PSVCs' model compared to BAs and traditional VCs, the financial performance of the PSVC investment models could be analysed through comparative studies. In the same context, also the risk profile of PSVCs' engagements and their correlation with the number of engagements could be analysed and compared with BAs and traditional VCs.
<table>
<thead>
<tr>
<th><strong>Country</strong></th>
<th><strong>Biotechnology/pharmaceuticals</strong></th>
<th><strong>Nanotechnology</strong></th>
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<tbody>
<tr>
<td></td>
<td><strong>Start-ups</strong></td>
<td><strong>Industrial companies</strong></td>
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<td>Germany</td>
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<td>Switzerland</td>
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<td>Rest of Europe</td>
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<td>4</td>
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<tr>
<td>USA</td>
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<tr>
<td>Rest of world</td>
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Table 1

<table>
<thead>
<tr>
<th><strong>Name</strong></th>
<th><strong>Internet</strong></th>
<th><strong>Locations</strong></th>
<th><strong>Technology areas</strong></th>
<th><strong>Financial sources</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Advance Nanotech</td>
<td><a href="http://www.advancenanotech.com">www.advancenanotech.com</a> (not working)</td>
<td>Montebello (US)</td>
<td>Nanotech</td>
<td>Was listed on the US OTC market</td>
</tr>
<tr>
<td>Arch Venture Partners</td>
<td><a href="http://www.archventure.com">www.archventure.com</a></td>
<td>Chicago, Seattle, Austin, San Francisco (all US)</td>
<td>ICT, lifesciences, physical sciences, nanotech, biotech</td>
<td>Investment fund</td>
</tr>
<tr>
<td>Arrowhead Research</td>
<td><a href="http://www.arrowsres.com">www.arrowsres.com</a></td>
<td>Pasadena (US)</td>
<td>Nanotech, nanomedicine</td>
<td>Is listed on NASDAQ Capital Market</td>
</tr>
<tr>
<td>Molecular Manufacturing Enterprises</td>
<td><a href="http://www.mnie.com">www.mnie.com</a></td>
<td>Saint Paul (US)</td>
<td>Nanotech</td>
<td>Private investors</td>
</tr>
<tr>
<td>Precede Technologies</td>
<td><a href="http://www.precedecoi">www.precedecoi</a></td>
<td>Ramat Hasharon (Israel), San Mateo (US)</td>
<td>Cleantech, renewable energy</td>
<td>Private investors, investment fund</td>
</tr>
<tr>
<td>ProSeed Capital</td>
<td><a href="http://www.proseedcapital.com">www.proseedcapital.com</a></td>
<td>Brussels (Belgium), Boston (US), Tel Aviv (Israel)</td>
<td>Biotech, lifesciences, ICT</td>
<td>Private investors, investment fund</td>
</tr>
<tr>
<td>Sanderling Ventures</td>
<td><a href="http://www.sanderling.com">www.sanderling.com</a></td>
<td>San Mateo, San Diego (all US)</td>
<td>Lifesciences, biomedical</td>
<td>Investment fund</td>
</tr>
<tr>
<td>Symphony Capital</td>
<td><a href="http://www.symphonycapital.com">www.symphonycapital.com</a></td>
<td>New York (US)</td>
<td>Lifesciences, pharm</td>
<td>Investment fund</td>
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<tr>
<td>XL TechGroup</td>
<td><a href="http://www.xltg.com">www.xltg.com</a></td>
<td>Melbourne (US)</td>
<td>Biotech, ecotech, medtech</td>
<td>Was listed on London stock exchange AIM</td>
</tr>
</tbody>
</table>

Table 2
<table>
<thead>
<tr>
<th>Name</th>
<th>Customer value proposition</th>
<th>Profit formula</th>
<th>Key resources</th>
<th>Key processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advance Nanotech</td>
<td>• Well structured nanotech&lt;br&gt;• Specific investment process&lt;br&gt;• Provide investment opportunities for other investors (BAs and VCs)</td>
<td>Revenues&lt;br&gt;• Sale of portfolio companies&lt;br&gt;• Consolidation of income of the company as majority shareholder&lt;br&gt;• Listing companies on the stock market&lt;br&gt;Costs&lt;br&gt;• Capital commitment for portfolio companies (one company/three years)</td>
<td>• Financial, operational, legal advice&lt;br&gt;• Rights for commercialisation&lt;br&gt;• Broad portfolio of promising technologies&lt;br&gt;• Well-defined capital commitment&lt;br&gt;• Partnership with academic institutions&lt;br&gt;• Resource (human, infrastructure) leveraged project to lower cost based on the partnership approach&lt;br&gt;• Equity stake participation</td>
<td>• Identifying proprietary and patented technologies at leading universities&lt;br&gt;• Funding of further technology development&lt;br&gt;• Assessment process to check the commercial potential of technologies&lt;br&gt;• Milestone based investment process&lt;br&gt;• Setup of product roadmap and business plan&lt;br&gt;• Forming of technology related subsidiaries&lt;br&gt;• Structured process for sale or licensing of technology</td>
</tr>
<tr>
<td>Angle Technology</td>
<td>• Selective portfolio with small numbers of investments&lt;br&gt;• Well-structured and trustworthy start-ups for direct investments&lt;br&gt;• Start-ups for financial investors at a later stage</td>
<td>Revenues&lt;br&gt;• Sale of portfolio companies&lt;br&gt;• Management services&lt;br&gt;Costs&lt;br&gt;• Capital commitment for portfolio companies</td>
<td>• Access to universities and research institutions&lt;br&gt;• Merge scholars with industry experts&lt;br&gt;• Bring new partners with their investments on board&lt;br&gt;• Combining experienced start-up managers with capital&lt;br&gt;• Experience in early stage technology management</td>
<td>• Detailed, transparent venture process&lt;br&gt;• Creation, development and operation of early stage companies&lt;br&gt;• Management of risks and uncertainty&lt;br&gt;• Specialist in commercialisation of IP developed at universities</td>
</tr>
<tr>
<td>Arch Venture Partners</td>
<td>• Ready to take over companies for investments&lt;br&gt;• Large experience with more than 120 investments</td>
<td>Revenues&lt;br&gt;• Sale of portfolio companies&lt;br&gt;• Listing companies on the stock market&lt;br&gt;Costs&lt;br&gt;• Capital commitment for portfolio companies</td>
<td>• Close contact and collaboration with academic institutions and healthcare organisations&lt;br&gt;• Focus on areas under served by seed investment capital&lt;br&gt;• All employees have themselves managed entrepreneurial operations&lt;br&gt;• Access to non equity capital</td>
<td>• Co-founding with leading scientists and entrepreneurs&lt;br&gt;• Commercialisation of inventions&lt;br&gt;• Innovation investment, before other capital is available&lt;br&gt;• Competence in building companies from products originating in academic research&lt;br&gt;• Assistance of companies within portfolio at the early stage&lt;br&gt;• Collaborate in investments</td>
</tr>
<tr>
<td>Arrowhead Research Cooperation</td>
<td>• Provide investment opportunities for BAs and VCs&lt;br&gt;• Provide acquisition opportunities for larger companies as strategic investors</td>
<td>Revenues&lt;br&gt;• Sale of portfolio companies&lt;br&gt;• Listing companies on the stock market&lt;br&gt;Costs&lt;br&gt;• Funding the launch of companies&lt;br&gt;• Potential additional own investment during development</td>
<td>• IP rights from sponsored research&lt;br&gt;• R&amp;D expenditure paid by universities&lt;br&gt;• Work close with universities&lt;br&gt;• Fast access to public money&lt;br&gt;• Incentives such as stock options to attract the most talented people&lt;br&gt;• High ethical standards&lt;br&gt;• Every technology platform is housed in its own subsidiary</td>
<td>• Sponsoring of research at universities&lt;br&gt;• Commercialisation of IP rights&lt;br&gt;• Support services (financial, administrative, corporate, strategic) for founded companies&lt;br&gt;• Management teams stay focused on core activities&lt;br&gt;• If necessary include broader investment community&lt;br&gt;• Structured evaluation process before entering a commitment&lt;br&gt;• Communicated strategic focus</td>
</tr>
<tr>
<td>Molecular Manufacturing Enterprises</td>
<td>• Bring the right people on board&lt;br&gt;• Receiving specialised not in-house available knowledge&lt;br&gt;• Creating a growing company through structured approach</td>
<td>Revenues&lt;br&gt;• Consulting on hourly base or on project base&lt;br&gt;• Sale of portfolio companies&lt;br&gt;Costs&lt;br&gt;• According to consulting mandate</td>
<td>• Wide knowledge pool and capabilities&lt;br&gt;• Long-term experience of key people&lt;br&gt;• Extremely well known people including Nobel prize winner</td>
<td>• Investing in nanotechnology&lt;br&gt;• Consulting on strategic and operative approach&lt;br&gt;• Connecting people from within the industry&lt;br&gt;• Recruiting and merging the right people&lt;br&gt;• Effective project management</td>
</tr>
<tr>
<td>Paramount BioSciences</td>
<td>• Bring the right people on board&lt;br&gt;• Creation of financial transparent take-over targets&lt;br&gt;• Well structured investment ready companies</td>
<td>Revenues&lt;br&gt;• Sale of portfolio companies&lt;br&gt;• Revenues from operative businesses&lt;br&gt;Costs&lt;br&gt;• High fixed costs due to 80 in-house professionals&lt;br&gt;• Variable costs according to companies direct investment</td>
<td>• Consulting&lt;br&gt;• Financial support&lt;br&gt;• Access to academic centres and biotech/pharma companies&lt;br&gt;• 80 in-house professionals&lt;br&gt;• Broad knowledge on drug development covering the whole process&lt;br&gt;• Affiliate financial professionals&lt;br&gt;• Affiliate company with focus on company transactions</td>
<td>• Structured candidate assessment&lt;br&gt;• Incubating technologies&lt;br&gt;• Management recruiting&lt;br&gt;• Structured candidate portfolio management</td>
</tr>
</tbody>
</table>

Table 3
<table>
<thead>
<tr>
<th>Name</th>
<th>Customer value proposition</th>
<th>Profit formula</th>
<th>Key resources</th>
<th>Key processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precede Technologies</td>
<td>- Well funded companies&lt;br&gt;- Large entrepreneurial experience</td>
<td>Revenues&lt;br&gt;- Sale of portfolio companies&lt;br&gt;- Costs&lt;br&gt;- Low fixed costs&lt;br&gt;- Additionally portfolio company investments</td>
<td>- Provide financial, managerial, entrepreneurial resources&lt;br&gt;- Team of accomplished entrepreneurs&lt;br&gt;- Backed with VC funds&lt;br&gt;- Expertise, funding and staffing&lt;br&gt;- Provide pool of highly-capable technology and industry experts</td>
<td>- Handling IP intensive technologies&lt;br&gt;- Structured investment approach&lt;br&gt;- Partners with inventors and scientists&lt;br&gt;- Structured market potential research&lt;br&gt;- Finding follow-up financial possibilities</td>
</tr>
<tr>
<td>ProSeed Capital</td>
<td>- Start-up companies for later stage investments&lt;br&gt;- Screening mechanism and preselection</td>
<td>Revenues&lt;br&gt;- Sale of portfolio companies&lt;br&gt;- Costs&lt;br&gt;- Low fixed costs&lt;br&gt;- Additionally portfolio company investments</td>
<td>- Various backgrounds of employees (law, finance, technology, operational business)&lt;br&gt;- Graduates from top scientists&lt;br&gt;- Diversified strategic approach (geographic, region technology sector, type of investments)&lt;br&gt;- Network of analysis and alliances</td>
<td>- Financial investor and supporter for pioneering technological innovation&lt;br&gt;- In-house screening, evaluating, investing and monitoring approach&lt;br&gt;- Low price per share and low capital investments&lt;br&gt;- Engagement beyond capital investments&lt;br&gt;- Assistance in further fund raising, contact establishment, recruitment for key positions</td>
</tr>
<tr>
<td>Sanderling Ventures</td>
<td>- Bring the right people on board&lt;br&gt;- Creating investment opportunities for third parties&lt;br&gt;- On average two years earlier filings than other VC backed biomedical companies&lt;br&gt;- Lower dilution investments due to less financing rounds</td>
<td>Revenues&lt;br&gt;- Sale of portfolio companies&lt;br&gt;- Revenues from operative businesses&lt;br&gt;- Costs&lt;br&gt;- Fixed costs for running the investment business&lt;br&gt;- Variable according to companies direct investments</td>
<td>- Own professionals with skills useful to the needs of start-ups&lt;br&gt;- Sanderling management takes on executive positions&lt;br&gt;- Proven track record with success stories&lt;br&gt;- Seed and early stage direct financing&lt;br&gt;- Employed professionals in all relevant start-up fields&lt;br&gt;- Relationship with outside resources (academic research laboratories, contract manufacturing facilities)&lt;br&gt;- Access to private and institutional investors&lt;br&gt;- Reducing start-up burn rate due to central services</td>
<td>- Support based on employed professionals with all relevant expertise&lt;br&gt;- Support up to the first two years&lt;br&gt;- Follows its structured partnership approach&lt;br&gt;- Long term commitment (if necessary)&lt;br&gt;- Creating investment syndicates&lt;br&gt;- Helping raise private funds&lt;br&gt;- Remove management burdens from start-up to let them focus on commercialisation</td>
</tr>
<tr>
<td>Symphony Capital</td>
<td>- Acceleration of product pipeline&lt;br&gt;- Well established product lines&lt;br&gt;- Increase shareholder value&lt;br&gt;- Increase competitiveness of collaborative biotechnology company</td>
<td>Revenues&lt;br&gt;- Sale of portfolio companies&lt;br&gt;- Revenues from operative businesses&lt;br&gt;- Costs&lt;br&gt;- Capital commitment for portfolio companies</td>
<td>- Exclusive access to resources ensuring up-to-date clinical development and regulatory approval&lt;br&gt;- Network to leading scientists, physicians and experts from academic institutes&lt;br&gt;- Advisory committee with decades of experience&lt;br&gt;- Experienced investment team&lt;br&gt;- Close collaboration with biopharmaceutical companies&lt;br&gt;- Collaborative companies retain more value and reduce dilution</td>
<td>- Structured target finding process&lt;br&gt;- Structured target finding process&lt;br&gt;- Support company’s internally developed clinical programmes&lt;br&gt;- Acceleration of product development&lt;br&gt;- Tailored support for every company&lt;br&gt;- Support to avoid premature out-licensing</td>
</tr>
<tr>
<td>XL TechGroup</td>
<td>- Clear structured screening process&lt;br&gt;- Investment ready start-up companies for later stage investments</td>
<td>Revenues&lt;br&gt;- Sale of portfolio companies&lt;br&gt;- Costs&lt;br&gt;- Fixed costs for running the investment business&lt;br&gt;- Variable according to companies direct investments</td>
<td>- Cooperation with Fortune 100 global multinationals to discover unmet market needs&lt;br&gt;- Use of these big players for rapid uptake of breakthrough solutions&lt;br&gt;- Access to universities and government laboratories&lt;br&gt;- Core members are experienced and have background in science, business, operations and strategy&lt;br&gt;- Broad technology partner network&lt;br&gt;- Experienced managing team&lt;br&gt;- Provide significant financial support in order to reduce dilution</td>
<td>- In-house proven systematic methodology to invent, build, fund, manage and grow companies&lt;br&gt;- In-house company building methodology (no commercialisation of IP, but building new market changing businesses)&lt;br&gt;- Rigorous potential assessment procedure&lt;br&gt;- Leverage strength of large corporations with the agility of a smaller company</td>
</tr>
</tbody>
</table>

Table 3 continued
Publications

<table>
<thead>
<tr>
<th>Type</th>
<th>Name</th>
<th>Similarities</th>
<th>Dissimilarities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I</td>
<td>Molecular Manufacturing Enterprises</td>
<td>• Partnership with academic institutions</td>
<td>• Focus on nanotechnology or biotechnology and pharmaceuticals</td>
</tr>
<tr>
<td></td>
<td>Paramount Biosciences</td>
<td>• Sourcing of projects directly at universities and research institutions</td>
<td>• Investment of private money (including investment funds)</td>
</tr>
<tr>
<td></td>
<td>Sanderling Ventures</td>
<td>• Well structured engagement process</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Symphony Capital</td>
<td>• Actively support of the founding of start-ups</td>
<td></td>
</tr>
<tr>
<td>Type II</td>
<td>Arch Venture Partners</td>
<td>start-ups</td>
<td>• Broader technological scope</td>
</tr>
<tr>
<td></td>
<td>Precede Technologies</td>
<td>• Equity stake participation</td>
<td>• Investment of private money (including investment funds)</td>
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<tr>
<td></td>
<td>ProSeed Capital</td>
<td>• Co-operation with other investors in later stages</td>
<td></td>
</tr>
<tr>
<td>Type III</td>
<td>Advance Nanotech</td>
<td>• Operational support of the management team</td>
<td>• Focus on nanotechnology or biotechnology and pharmaceuticals</td>
</tr>
<tr>
<td></td>
<td>Arrowhead Research Cooperation</td>
<td></td>
<td>• Public money (listed on the stock market)</td>
</tr>
<tr>
<td>Type IV</td>
<td>Angle Technology</td>
<td>• Administrative support</td>
<td>• Broader technological scope</td>
</tr>
<tr>
<td></td>
<td>XL TechGroup</td>
<td>• Exit driven strategy (development and execution of an exit strategy together with the management team)</td>
<td>• Public money (listed on the stock market)</td>
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</table>

Table 5

<table>
<thead>
<tr>
<th></th>
<th>Business angels (BAs)</th>
<th>Surrogate entrepreneurs (SEs)</th>
<th>Founding angels (FAs)</th>
<th>Pre-seed venture capitalists (PSVCs)</th>
<th>Traditional venture capitalists (VCs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage of funding</td>
<td>Early stage</td>
<td>Very early stage</td>
<td>Very early stage</td>
<td>Very early stage</td>
<td>Later stage</td>
</tr>
<tr>
<td>Typical investment size</td>
<td>Around 100,000 Euros</td>
<td>n/a</td>
<td>A few 10,000 Euros</td>
<td>A few 100,000 Euros</td>
<td>A few million Euros</td>
</tr>
<tr>
<td>Source of money</td>
<td>Own money</td>
<td>Own money</td>
<td>Own money</td>
<td>Foreign money</td>
<td>Foreign money</td>
</tr>
<tr>
<td>Flexibility regarding exit</td>
<td>Flexible</td>
<td>Flexible</td>
<td>Flexible</td>
<td>Less flexible</td>
<td>Less flexible</td>
</tr>
<tr>
<td>Operational support</td>
<td>A few days per year</td>
<td>A few days per month</td>
<td>A few days per month</td>
<td>A few days per year</td>
<td>A few days per year</td>
</tr>
</tbody>
</table>

References


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7.4 A six step approach to business model innovation

Citation

Abstract
In both theory and practice, business model innovation is acknowledged as an important means to gain a competitive edge. Designing a new business model, however, requires profound knowledge, experience and skills. To support the task, practitioners can rely on a set of techniques, namely cases, component-based approaches, taxonomies, conceptual models, causal loop diagrams and design patterns. We argue that these techniques only provide valuable support during specific steps of the design process. In addition, there is a tendency towards focusing on model-internal consistency while neglecting the
Publications organisation’s actual mission and external business environment. Therefore, this study proposes a complementary six-step approach to business model innovation, which is based on the principles of ‘networked thinking’. This holistic and systemic approach comprises features of established techniques and explicates assumptions about the organisation’s specific business situation. It gives entrepreneurs, decision makers and managers a better handle on structuring, communicating and evaluating different business model designs.

Keywords business model; business model innovation; decision-making; innovation management; networked thinking; strategy; entrepreneurship.

Introduction Management sciences in the 21st century need to develop models and methods to handle recent entrepreneurial challenges such as entering untapped markets or competing in an environment of economic slowdown. These challenges are accompanied by globalisation, technological change and deregulation, which cause a reshaping of whole industries and a redistribution of profits (Casadesus-Masanell and Ricart, 2011). In this context, innovative business models matter: the manner in which business ideas are commercialised is the deciding factor for the economic outcome of the firm (Chesbrough, 2010; Lindgardt et al., 2009). In establishing a powerful position and redefining the competitive space, an innovative business model is a likely source of sustainable advantage (Schindehutte and Morris, 2010). Entrepreneurs who employ imagination and boldness by means of invention and innovation introduce commercial concepts that have never been tried before (Kantarelis, 2009). While some of them have a clearly formulated model when undertaking a venture, many others start with partially formed models and incomplete strategies. A process of experimentation may be involved as the model emerges (Morris et al., 2005). In this process, the business model is at the core of transforming the entrepreneurial idea or opportunity into its organizational implementation (George and Bock, 2011).

A business model describes the design or architecture of an organisation’s value creation, delivery and capture mechanisms (e.g., Teece, 2010). The notion that these mechanisms themselves can be the object of an organisation’s systematic innovation activities has received growing attention over the past years (e.g., Amit and Zott, 2012; Schneider and Spieth, 2013; Matzler et al., 2013). Business model innovation refers to creation or reinvention and thus to the introduction of something new or different in doing business (Björkdahl and Holmén, 2013). This means that at least one of a business model’s constituting elements is changed. The design (i.e., creation and description) of business model alternatives, their
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communication and their evaluation is at the core of the business model innovation process. A number of tools and techniques for supporting entrepreneurs, decision makers and managers in these tasks have been proposed. Based on a systematic review of extant literature in the business model domain, we argue that some aspects of the business model design process are neglected by current approaches and leave room for complementary and more integrated techniques.

The goal of this study is to propose an approach that combines and supplements the established business model design techniques. It addresses two major points: the first is to provide step-by-step guidance from the very early ideas of the new business model to its final design; the second is to consider the business mission as well as the firm’s internal dynamics and external business environment, both of which are essential for designing a well-reasoned and stable business model.

We propose that the principles of ‘networked thinking’ (Vester, 1989; Probst and Gomez, 1991) should be introduced into the business model design process since this holistic problem solving technique focuses on identifying relevant factors and their interdependencies. Its origins can be traced back to Frederic Vester, who is commonly considered a pioneer in combining cybernetics and systemic ideas. The basic concept of ‘networked thinking’ understands a system as a network of interrelated effects. In the context of business model design, this network aspect implies that a change of one constituent element of a business model can have an effect on its other elements. With respect to the anticipated or desired changes in the business environment of an organisation, it is important to identify and evaluate the relevant levers to comply with future market changes or to even enforce new rules on the market.

Appreciating interrelated effects, in terms of the consequences of the business assumptions and decisions, is a helpful – yet often underrated – cornerstone in making a business model innovation fit reality from the very beginning. Business model fit can be described in terms of both internal and external consistency, where the former is concerned with a coherent configuration of key activities within the firm and the latter addresses the appropriateness of the configuration given external environmental conditions (Morris et al., 2005).

The research questions are:

1 How can a business model be designed systematically under consideration of the business mission, the organisation’s internal dynamics and its external business environment?
2 How can ‘networked thinking’ support decision makers in the business model design process?

Research design

To answer these research questions we conducted a systematic literature review of the ongoing discussion of business model design by drawing upon a thematic analysis (Webster and Watson, 2002), which is
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selecting literature in accordance with previously defined themes such as ‘business model’, ‘business model transformation’, ‘business model innovation’. After additionally considering forward and backward citations, we determined a set of 137 potentially relevant papers, which we screened in the light of their usefulness for practitioners in the process of (re)designing a business model. The search scope in this stage was wide to avoid exclusion of relevant material: we did not only consider articles explicitly presenting approaches to business model innovation (e.g., Casadesus-Masanell and Ricart, 2011), but also thoroughly studied results and implications of differently focused articles to determine their relevance for our purpose (e.g., the single case study of Sosna et al. (2010), provides valuable insights concerning influencing factors of business model innovation and the iterative nature of the process). In some areas, such as approaches to componentising business models, we had to reduce the abundance of very similar papers to a representative sample in mutual agreement. The screening process was supported through open, axial and selective coding techniques (Urquhart, 2001; Webster and Watson, 2002), leading to a final set of 29 relevant papers in six categories, which we present in the following section. Reviewing these papers helped us identify weak spots and produce results, which reasonably amend the body of literature [Creswell, (2009), p.25].

After the assessment of existing approaches to business model design, we searched for methods to overcome the identified shortcomings. We included principles of ‘networked thinking’ (Gomez and Probst, 1998) into the business model design process and drew upon Drucker's (1994) ‘theory of the business’. By incorporating these two theoretical underpinnings, business assumptions and their consequences could be more completely included into the business model design process. Based on the theories, we constructed an apriori step-by-step approach (Eisenhardt, 1989), which provides guidance in designing a business model.

A proof of concept and refinement of this approach was conducted empirically by applying it to a real-world case: we were given the chance to develop new business model alternatives in partnership with an air navigation service provider (ANSP). Since organisations only rarely provide access to delicate issues such as business model innovation, we employed ‘flexible and opportunistic data collection methods’ [Eisenhardt, (1989), p.533]. We were given opportunities to conduct focus group workshops and interviews on tightly defined topics. These were complemented with focused interviews with selected experts and potentially affected stakeholders [Bryman and Bell, (2007), p.511; Creswell, (2009), p.181]. Feedback from the participants after reviewing the documentation provided further insights. Deep involvement in the design process helped us produce relevant knowledge (Coghlan, 2011). Data collection overlapped with data analysis, which resulted in a refined and enriched construction of a ‘networked thinking’-based approach to business model design (Eisenhardt, 1989).
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Current understanding

Our literature review on tools and techniques supporting practitioners in the business model design process revealed a number of distinct approaches, rendering their support in different ways and phases. In the process of digesting the relevant literature, we grouped the approaches by similarity, which resulted in six archetypes:

1. cases and lessons learned
2. component-based approaches
3. taxonomies
4. conceptual models
5. causal loop diagrams
6. design patterns.

Cases and lessons learned

The contributions in this field provide an in-depth presentation and analysis of cases such as my Fab and Zara (Girotra and Netessine, 2011), Grameen (Yunus et al., 2010), or Naturhouse (Sosna et al., 2010). They typically use natural and case-specific language to describe business models, thus building on Magretta (2002) who defines business models as “stories that explain how enterprises work” (p.87). The strength of this approach lies in focused insights into specific aspects such as business model development and adaption over time (Sosna et al., 2010) or consideration of risks (Girotra and Netessine, 2011). These insights are a rich source of information to a business model designer in a similar situation, in which the presented case can directly serve as a template. The generalised implications typically derived from the case as lessons learned have a broader potential in that they concisely present empirical business model design knowledge. Overall, however, the case approach does not represent or compare different business model options. In addition, it does not enable the designers to quickly grasp a specific model or to reuse it in a different context. As there is no guidance in terms of content and structure from a natural-language representation of a business model, cases and lessons learned do not provide structural guidance for the business model design process either.

Component-based approaches

Component-based approaches provide a predefined set of constituent components which, instantiated and combined, describe a concrete business model (e.g., Afuah and Tucci, 2001; Chesbrough and Rosenbloom, 2002). Different components, such as the value proposition, the revenue model and the network of relationships (Zott et al., 2011), are to be specified by the user. Scholars do not agree on the
components and breakdowns: four (Johnson et al., 2008), six (Morris et al., 2005), or even 20 (Shafer et al., 2005) different components are seen as being required to define a business model. On the one hand, the rigid structure of a component-based approach provides guidance in designing business models: instantiating the constituting components one-by-one is a structured task. A modular business model is also easy to compare, communicate and discuss. On the other hand, flexibility and explanatory power is lost as interrelations and dependencies between the components are not made explicit. Factors such as the focal firm’s mission and environmental dynamics cannot easily be integrated.

**Taxonomies**
Taxonomies develop typologies of business models by classifying them based on predefined criteria, whereby different types can be distinguished. For instance, Timmers (1998) uses the degree of integration and innovation to classify eleven generic e-business models. Tapscott et al. (2000) propose taxonomy of value networks according to the degree of value integration and company control. Rappa (2004) classifies nine different e-business models based on the type of customer relationship.

Taxonomies allow for a quick description of business models and the reuse of existing analytical work (e.g., Rappa, 2004). Although taxonomies seem to provide an easy to understand way of designing business models, their generic and abstract description reduces its practical use. A generic business type is not suited for design tasks such as comparing and evaluating different options, which might only differ in their details. It also does not explicitly contain or describe firm-specific dynamics. For these reasons, taxonomy can provide a good starting point, but it is not suited to structure and support the entire design process.

**Conceptual models**
Like component-based approaches, conceptual models identify business model components, but also explicitly address interrelations and interdependencies between them (Pateli and Giaglis, 2004; Johnson et al., 2008). Interrelations are often shown graphically, e.g., by arrows (Osterwalder and Pigneur, 2010). Other conceptual models aim to define a ‘language’ to represent business models formally. Osterwalder (2004), for instance proposes business model ontology that links components through relationships such as ‘is part of’, ‘is related to’, or ‘inherits from’. Andersson et al. (2006) present a reference ontology, which also includes exchange relationships between actors.

As some further approaches in the area show (e.g., Al-Debei and Avison, 2010; Samavi et al., 2009), conceptual models are useful because they provide a way to achieve consistency among the components and thus support the design of coherent business models. Their rigid structure and limited vocabulary is
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however, both strength and weakness. The formal representation limits expressiveness and may lead to important aspects being overlooked due to the designer’s reliance on the framework that the conceptual model provides. The focus on consistency does not encourage fitting the business model to reality, such as on an organisation’s mission or environment.

Causal loop diagrams

The causal loop diagram focuses on the mechanisms of a business model and describes its underlying interactions (e.g., Seelos and Mair, 2007; Kiani et al., 2009). A similar form of presentation, which is frequently used for strategy analysis, is the ‘activity-system map’ (Porter, 2002). Casadesus-Masanell and Ricart (2010) use the analogy of a machine to explain the link between the key choices of the business model and their consequences. The interrelations of choices within and between business models are made explicit, revealing feedback loops that can lead to virtuous cycles.

As their applications show, the diagrams are a good way of identifying the core logic of a business model. During business model design, however, the user is left alone to identify the key choices, their consequences and the influence strength and direction. No process or other form of guidance supports the creation of a causal loop diagram of a business model option. However, once done successfully, the explanatory power and visualisation provided by a causal loop diagram is strong despite the rather formal representation.

Design patterns

Design patterns can be understood as a formal means of documenting the generic logic behind a business model, fostering the systematisation and reuse of knowledge in the form of basic structures which describe parts of business models (Osterwalder and Pigneur, 2010; Gassmann et al., 2012; Mettler and Eurich, 2012; Abdelkafi et al., 2013). The approach is led by the observation that, very frequently, existing business models serve as ‘recipes’ (Baden-Fuller and Morgan, 2010) or ‘templates’ (Doganova and Eyquem-Renault, 2009) for new business models.

Employing patterns in business model design brings proven structures into the process, which can be recombined and adapted flexibly. The approach naturally comes to its limits when novel, complex, or specific business model characteristics are to be modelled. Current proposals also lack guidance on how different design patterns relate to each other and how many patterns are needed to describe a business model. Furthermore, through its focus on commonalities, the approach entails the risk of missing organisational specifics and situational dynamics.
Summary of current understanding

Six distinct types of approaches to support business model designers have been revealed; they each have their strengths and weaknesses (see Table 1). In the context of business model design, it has become apparent that the various approaches differ with respect to several characteristics:

- **Rigidity**: causal loop diagrams, design patterns and cases emphasise flexibility and explanatory power; component-based approaches, taxonomies and conceptual models provide structure and guidance.
- **Empirics**: cases, taxonomies and design patterns bring empirics into the design process; component-based approaches, conceptual models and causal loop diagrams leave the grounding in the real world to the business model designer.
- **Task support**: taxonomies and cases allow for a quick characterisation of business models; conceptual models, design patterns and causal loop diagrams support their construction; component-based approaches lie in between.

Because of these differences, a business model designer is well advised to find a good balance by relying on a combination of different techniques.

<table>
<thead>
<tr>
<th>Approach</th>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cases and lessons learned</strong></td>
<td>• rich insights into specific design details</td>
<td>• not generally applicable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• low structural guidance through verbal representation</td>
</tr>
<tr>
<td><strong>Component-based approaches</strong></td>
<td>• structured process, ensuring completeness</td>
<td>• interdependencies between components not considered</td>
</tr>
<tr>
<td></td>
<td>• discussion and comparison of business model options facilitated</td>
<td>• no assumptions about external factors and dynamics visualized</td>
</tr>
<tr>
<td><strong>Taxonomies</strong></td>
<td>• systematic representation of options and parameters</td>
<td>• guidance on high level, lack of details</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• low flexibility</td>
</tr>
<tr>
<td><strong>Conceptual models</strong></td>
<td>• highly structured and formal</td>
<td>• limited expressiveness, hard to extend</td>
</tr>
<tr>
<td></td>
<td>• interdependencies between components considered, internal consistency</td>
<td>• consistency of the model potentially overemphasized</td>
</tr>
<tr>
<td><strong>Causal loop diagrams</strong></td>
<td>• explicate core logic, decisions, and dynamics</td>
<td>• no guidance as to which factors to include and to analyze</td>
</tr>
<tr>
<td></td>
<td>• concise representation</td>
<td></td>
</tr>
</tbody>
</table>
Design patterns
• reuse of proven structures
• flexible recombination
• new options and firm specifics not present
• no guidelines regarding recombination logic

Table 1. Overview of techniques, strengths and weaknesses

While the identified methods are helpful in many ways, we spot two shortcomings in their applicability to new business model design. First, they hardly provide comprehensive guidance on how to obtain the final design when starting from the initial problem and situation description. Most approaches render assistance at a rather late stage of the design process when the business model designer already has some basic ideas of the future design. Second, most techniques tend to neglect the relevance of the environment of the organisation such as market dynamics, demographical changes, technology trends, or a changing competitive position. The current techniques predominantly lead to concepts that focus on model-internal consistency, but do not foster an awareness of the specific business situation.

Six steps to business model innovation
Against the background of the two shortcomings, we propose a six-step approach to business model innovation based on the principles of ‘networked thinking’ (Gomez and Probst, 1998) and Drucker’s (1994) ‘theory of the business. These two theoretical underpinnings may fill the identified gaps in the current business model design approaches.

Drucker’s (1994) ‘theory of the business’ comprises three parts:
1 assumptions about the environment of the organisation, which define what an organisation is paid for
2 assumptions about the mission of the organisation, which define what an organisation considers to be meaningful results
3 assumptions about the core competencies needed to accomplish the organisation’s mission, which define where an organisation must excel in order to maintain leadership.

Drucker’s theory does not explicitly address the design of business models but describes the important pieces to be included into the design process. Its contribution can be seen as providing guidance in the early phases of business model innovation and in assuring that the final design fits reality.

In their application to business model innovation, the principles of ‘networked thinking’ (Gomez and Probst, 1998) are important in ensuring that the business mission, business assumptions and their consequences are incorporated into the business model design process. However, the ‘networked thinking’ approach goes beyond the integration of Drucker’s (1994) ‘theory of the business’ which in principle could also be realised by means of the causal loop technique. The ‘networked thinking’ approach also fosters the
creation of business model design alternatives and the selection of one business model innovation. In this way, the ‘networked thinking’ approach is more than a business model design technique. It is a design and decision-making process, into which other techniques could be integrated and which strives for accomplishing a business mission or strategic objective. In this study, this objective is the design or transformation of a business model. Probst and Gomez (1991) demonstrate the application of the principles of ‘networked thinking’ to strategic management, value creation and business modelling endeavours of a magazine publishing house as well as to the generation of a mission statement for the management of a hospital. Deiss and Dierolf (1991) apply ‘networked thinking’ to facilitate strategic planning at Hewlett-Packard. Gausemeier et al. (1998) show the importance of principles of ‘networked thinking’ in the context of scenario management while Steiner (2009) appreciates ‘networked thinking’ for its contribution to foster collaborative problem solving in the generation of product, process, or service innovation. Similar to these studies, we propose the application of the principles of ‘networked thinking’ to the creation of business model design alternatives and the selection of one business model design.

A key assumption is that a business model is understood as a network. Therefore, each change to one of the constituent elements of a business model may have an impact on the other elements. As a consequence, it is important to identify and evaluate what the relevant levers are to comply with future market rules or even to change the game by enforcing new rules on the market by means of a superior business model. This goes along with the construction and discussion of several alternatives as an intermediate result, which is again relevant for assessing the consequences of any potential actions and to ensure a fit to reality.

On this basis, we propose a six step approach, whereby these steps are based on the procedure that Probst and Ulrich (1988) advise for ‘networked thinking’. Table 2 summarises the steps and their results.

1 Determination of the mission and assumptions about the business environment: the assumptions concerning the organisation need to be determined (Drucker, 1994). The environment can include market dynamics, demographical or regulatory changes, technology trends, or a changing competitive position. The goal here is to agree on the (new) business mission and to identify the assumptions and constraints that could have an impact on the business model.

2 Analysis of interdependencies: the business assumptions, their consequences and potential connections are determined and visualised in a ‘networked thinking’-based illustration, which fosters the understanding of the organisation’s situation and facilitates communication between the involved stakeholders (cf., Figure 1). The visualisation concentrates on the future business environment. Thereby, future assumptions and the difference between current and future assumptions are shown, which marks a feasible starting point for business model transformation.
3 Determination and analysis of design alternatives: this step includes an assessment of the consequences of the business assumptions and decision options. It results in a description of different future scenarios, in which the different factors are given different weights.

4 Creation of business model design alternatives: based on different future scenarios, alternatives are drafted. At this point, existing business model design techniques like conceptual models could be used. Design patterns and taxonomies can help inspire the creation of alternatives. Yet it is important to note that drafting business model alternatives takes place at this late stage building on the analysis of the organisation’s current, predicted and desired situation (steps 1–3). This procedure protects designers from falling into the model-internal consistency trap.

5 Selection of one business model innovation: the alternatives from step 4 must be evaluated from different perspectives such as power distribution, dependencies on business partners, intervention possibilities and alignment with strategic objectives. We suggest basing this evaluation on a holistic approach such as the STEP approach (Peng and Nunes, 2007; Mettler and Eurich, 2011). The different business models should be assessed from a social, a technological, an economic and a political and legal perspective. The result of this step is the selection of the most promising business model alternative.

6 Testing and realisation of the business model: the assumptions that underlie the selected business model need to be tested, for example by addressing the lead users or a test market. The visualisation from step 2 can be used to ensure the agreement of the assumptions and the consequences in reality. This leads to a further refinement of the business model. Finally, measures are developed to realise this model.

<table>
<thead>
<tr>
<th>Step</th>
<th>Result and Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Determination of the mission and business</td>
<td>Mission statement; list of assumptions about the organization’s business environment and its internal dynamics</td>
</tr>
<tr>
<td>environment</td>
<td>Mission statement; list of assumptions about the organization’s business environment and its internal dynamics</td>
</tr>
<tr>
<td>2. Analysis of interdependencies</td>
<td>Visualization of the business assumptions (step 1), their consequences and interdependencies</td>
</tr>
<tr>
<td>3. Determination and analysis of design</td>
<td>Assessment of potential future developments; set of likely future scenarios</td>
</tr>
<tr>
<td>alternatives</td>
<td>Assessment of potential future developments; set of likely future scenarios</td>
</tr>
<tr>
<td>4. Creation of business model design alternatives</td>
<td>Set of drafts of business model design alternatives</td>
</tr>
<tr>
<td>5. Selection of one business model innovation</td>
<td>Criteria catalogue against which the most promising business model design is selected</td>
</tr>
<tr>
<td>6. Test and realization of the business model</td>
<td>Plan to examine underlying assumptions and refine the business model design; strategies and measures to realize the business model</td>
</tr>
</tbody>
</table>

Table 2. Six steps to design a business model
Both, as a proof of concept and as a refinement of the initial apriori construct, we applied the six step approach to a real case. We were given the chance to design future business model alternatives for an ANSP. The application of the proposed construct demonstrates its applicability. By describing this case, we also intend to help business model designers better understand the different roles involved as well as the useful techniques at each step.

5.1 Step 1: determination of mission and business environment

The business mission is stated to be ‘a focused innovator and act as a creative cooperator’. Spurred by the single European sky (SES) initiative to reduce cost while maintaining safety and increasing capacity, the ANSP is facing a changing environment. Factors that affect the future of the ANSP include (Breitenmoser et al., 2013):

- Increase of flight movements: The future service demand cannot be satisfied with the current information systems. The underlying assumption is that aircrafts are regularly queued before being served by the airport.
- Formation of functional airspace blocks (FAB): The SES initiative aims to convince states and ANSPs to cluster into FABs. As a consequence, fewer ANSPs might be needed.
- Standardisation: The new generation of air navigation services is assumed to be interoperable and standardised. Consequently, all ANSPs may act as both, a data provider and a consumer. New information and communication technology (ICT) will facilitate service provisioning.
- Reduction of operational expenditure (OPEX): The SES intends to reduce air navigation service cost by means of an ICT-supported service provision.

Assumptions about the business environment and the business mission were gathered by means of semi-structured interviews at C-level, i.e., with the CEO, CTO and CIO.

5.2 Step 2: analysis of interdependencies

At this stage, insights from the interviews are depicted. The assumptions and their consequences are connected. Figure 1 is a simplified visualisation: arrows depict the direction of influence. A plus (+) refers to a positive influence, i.e., the more A the more B, respectively the less A the less B. A minus (−) stands for negative impact, i.e., the more A the less B and vice versa. It must be kept in mind that reality is always more complex and requires a simplification.
In our case, we produced a first draft of the visualisations and then came back to the ANSP. A focus group workshop was conducted with participants from middle management who were in charge of the business re-design process.

5.3 Step 3: determination and analysis of design alternatives At this stage, potential changes of the business environment, feasible decision options and their consequences need to be understood. In the case of the ANSP, future industry scenarios developed include ‘keeping the status quo’, ‘ICT standardisation will facilitate service provisioning’ and ‘there will be a ‘SES’ with FABs’. The scenarios can either be described from the organisation’s or the market’s perspective. Assessing the influence of different factors in order to depict future scenarios can be done on a scale or can be based on the decision makers’ intuitions (Gigerenzer, 2008).

5.4 Step 4: creation of business model design alternatives
On the basis of the different scenarios, business model design alternatives are drafted. The ‘keeping the status quo’ scenario was ruled out due to an incompatibility with the business mission. Without infringing on confidentiality, three of the business model alternatives involve:
1 ancillary revenue through ANSP-specific software development on the basis of standardisation and a closer cooperation within one FAB
2 ancillary revenue through training services provisioning under the assumption that workplaces will become identical within one FAB
establishment of a single data centre in order to decrease the operating costs in a potentially more competitive environment.

These three examples are all in line with the assumptions and the envisioned future mission.

We conducted a workshop in which business model alternatives were drafted by small groups of middle managers, each elaborating on one or more future scenarios (inline with Figure 1). In our case, taxonomies and existing design patterns did not suffice. However, these two techniques might elsewhere be a good resource for drafting business model alternatives.

5.5 Step 5: selection of one business model innovation

In order to select the most promising business model design alternative, we relied on the STEP approach (Mettler and Eurich, 2011; Peng and Nunes, 2007) and a criteria catalogue was created (Breitenmoser et al., 2013):

a Social: unions are very strong and decisions may need their approval, which is one criterion. Air traffic controllers have substantial responsibility; hence, another criterion is whether a future business will still meet their needs.

b Technological: the current system reliability and safety levels must be met or exceeded and the competence to meet this requirement is necessary. Reliability is an essential factor: wrong decisions can have fatal consequences, so it is important to allocate liability. Another criterion is estimating when and if at all, which standards will be introduced.

c Economical: the consequences of competitive conditions must be understood. Air traffic services are currently protected by governments, making the consequences difficult to determine. One of the major criteria is whether the business model alternative will be sustainable. Business cases might need to be detailed.

d Political: ANSPs are typically non-profit-organisations by law and this domain is highly regulated. The task is to evaluate which alternatives are in line with the current regulations and to determine under which conditions a business model design could work. A change of regulations may be necessary.

In addition, specific intervention possibilities as well as the alignment with strategic objectives were discussed with C-level managers. In the end, one alternative was selected.

5.6 Step 6: testing and realisation of the business model

The realisation of the chosen business model or, more specifically, its changed parts will be performed by the implementation partner, i.e., the ANSP. At this point, we can only refer to the theoretical remarks described in the previous section.
Conclusions
This study aims to advance the discussion on techniques for the business model innovation and business model design process. A six-step approach is proposed that builds upon the principles of ‘networked thinking’ (Gomez and Probst, 1998) and on Drucker’s (1994) ‘theory of the business’. This ‘networked thinking’-based approach complements existing techniques in five aspects and provides the following benefits: first, it provides a step-by-step approach which spans the entire process of designing a new business model, respectively a business model innovation. Second, it allows for designing a new business model from scratch (instead of adapting existing business models to the existing problem). Third, it provides the designer with a starting point and it clarifies what problem the new business model intends to solve (mission). This aspect may be particularly important to entrepreneurs as the mission not only supports decision-making but guides the entire business model innovation process. This is an important benefit of the proposed approach: it helps the designers stay focused, i.e., the business mission comes first and all actions are consequences of accomplishing this mission. Fourth, the approach explicitly requests designers to consider the business model’s embedding in the business ecosystem (interdependencies). Business model design or innovation is not a green field approach. Even entrepreneurs of newly started ventures cannot ignore the business environment. A benefit of the approach is that it points to potential consequences of decisions. Fifth, it fosters the generation of alternatives, which are evaluated against the background of the consequences drawn from the initial business assumptions. By doing so, it acknowledges the iterative nature of business model innovations.
This approach may be particularly useful for entrepreneurs who do not need to struggle with legacy issues and who have relatively many choices to set up a business model design from scratch. For them, it guides the process of transforming an entrepreneurial idea to its organisational implementation (cf., George and Bock, 2011). The approach is also recommendable to managers and decision makers of established organisations who anticipate major changes in the business environment impacting the organisation’s profit or who proactively seek to change the rules of their industry. As the proposed process starts with the business fundamentals (mission), it allows both the challenging of existing paradigms in established organisations and the support of a truly innovative entrepreneurial approach to business model innovation. The approach qualifies best for designing a completely new business model or for thoroughly innovating an existing business model in a complex business environment. It should be considered when decisions regarding the business model (re-)design cannot be revised later or when it is expensive to adjust the design afterwards. This may particularly be the case for business models in business-to-business relationships.
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The difficulties of the proposed approach go along with the complexity of the business model design. As pointed out previously, decision makers rarely find themselves in situations in which they can design or innovate a business model on a green field. There are couplings and dependencies between business model elements, between the business models of the focal company and those of partner companies, between the business model and the market and so on. Therefore, in complex business situations, for which the proposed approach may be most justifiable, the business model design process is slow. It requires a variety of people with a sound knowledge about several domains, including: the market, customers, the competitors, the product and service portfolio and current trends. In contrast, the proposed approach is just too time and resource consuming when there is a straight-forward or trivial solution for the design and transformation of a business model. In this case, an easy design technique would be preferred.

In a sense, the proposed six-step approach could be placed on a meta-level that mediates between specific tools and techniques at single steps in the business model design process and the overall realisation of the design process, respectively the accomplishment of the final design. In other words, the approach ensures that the applied techniques fit smoothly into an overall target-oriented design process and contribute to accomplishing the business mission. In this regard, the proposed approach provides less hands-on guidance than specific tools and techniques at a single step in the design process. However, this lack of specific guidance has to be sacrificed for the sake of reaping the full range of the aforementioned benefits. Therefore, we strongly recommend the integration of the presented tools and design techniques into our proposed six-step approach.

By means of applying the ‘networked thinking’-based approach to a case in practice, empirical evidence for its applicability to innovate an existing business model in the light of external changes was gathered. Without a claim to generality, this case shows that each step is needed and viable in a complex business environment. Therefore, this case can be regarded as a first proof of concept.

It is a noteworthy limitation that empirical evidence was collected based on a single application of the proposed approach only. It has to be acknowledged, however, that organisations only rarely grant access to internal, strategically relevant processes. This may be one reason why literature does not provide many other cases in which business model design techniques were applied in real-world settings. Still, it would be desirable for future research to gather data from further applications, which may lead to the discovery of cross-case patterns and could enable a higher level of generalisation. In future research, scholars can draw upon the proposed ‘networked thinking’-based approach and apply it in other contexts. The findings should also encourage the integration of different decision options, their consequences and the interactions beyond the boundaries of a single organisation into the business model design process.
Discovering interdependencies and the consequences of decisions in a transparent way strengthens entrepreneurs’ and managers’ understanding of business model (re-)design in two ways: first, it facilitates their understanding of the current or predominant business logic and its interactions with the surrounding ecosystem. Second, it allows them to scrutinise the business logics behind different options and to use new levers for further refinement. Although the proposed approach, if done precisely, tends to take quite some time, it is worth the effort. Creating or rethinking the business mission, defining or proofing business interdependencies and determining alternatives before heading for implementation, helps innovate and design a more embedded business model, which will more likely succeed.

This study can provide a substantial first step towards the goal of turning business model innovation into a more holistic and structured design process.

Acknowledgements

This paper partly describes work undertaken in the context of the CTI project ‘Transforming the air traffic management industry: the ‘common controller cockpit’ and the ‘blue line standard’, contract number: 14036.1 PFES-ES. We would like to thank Prof. Roman Boutellier for his valuable recommendations.

References


Publications


Publications


7.5 A 'Networked Thinking' Approach to Business Model Design

Citation

Abstract
Crafting a viable business model for an organization requires profound knowledge, good decision making skills, and intuition. Scientific literature provides business model designers with a spectrum of supporting techniques: cases, component-based approaches, taxonomies, conceptual models, causal loop diagrams, and design patterns. However, these techniques only provide valuable support during specific steps of the design process. There is also a tendency towards focusing on model-internal consistency, while neglecting the organization’s internal dynamics and external business environment. Against this background, this study proposes a more integrated approach which spans the entire design process and comprises assumptions about the organization’s specific business situation. This six step approach is based on the principles of networked thinking. It has the potential to help decision makers, business model designers and entrepreneurs to structure the business model design process and visualize, communicate, discuss, and evaluate different business model designs.

Keywords
Business Model; Decision Making; Innovation Management; Networked Thinking; Strategy
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Introduction

A business model describes the design or architecture of an organization’s value creation, delivery, and capture mechanisms (e.g., Teece, 2010). The notion that these mechanisms themselves can be the object of an organization’s systematic innovation activities has received growing attention over the past years (Amit and Zott, 2012, Schneider and Spieth, 2013). The design (i.e. creation and description) of business model alternatives, their communication, and their evaluation is at the core of the business model innovation process. A number of tools and techniques for supporting managers in these tasks are proposed. Based on a systematic review of extant literature in the business model domain, we argue that some aspects of the business model design process are neglected by current approaches, leaving room for complementary, more integrated techniques.

The goal of this study is to propose an approach that combines and supplements the established business model design techniques. It addresses two major points: the first is to provide step-by-step guidance from the very early stages of the business model to its final design; the second is to consider the business mission as well as the firm’s internal dynamics and external business environment, both of which are essential for designing a well-reasoned and stable business model. We propose that the principles of "networked thinking" (Gomez and Probst, 1998, Vester, 1989) should be introduced into the business model design process since this holistic problem solving technique focuses on identifying relevant factors and their interdependencies. Its origins can be traced back to Frederic Vester, who is commonly considered the pioneer in combining cybernetics and systemic ideas. The basic concept of networked thinking is to understand a system as a network of interrelated effects. Appreciating interrelated effects, in terms of the consequences of the business assumptions and decisions, is a helpful - yet often underrated - cornerstone to make a business model design fit reality.

Our research questions are:

1. How can a business model be designed systematically, under consideration of the business mission, the organization’s internal dynamics, and its external business environment?

2. How can "networked thinking" support decision makers in the business model design process?

Research design

To answer these research questions we conducted a systematic literature review of the ongoing discussion of business model design by drawing upon a thematic analysis (Webster and Watson, 2002), which is selecting literature in accordance with previously defined themes such as “business model”, “business model transformation”, “business model innovation”. After additionally considering forward and backward citations, we determined a final set of relevant papers to which we applied open, axial, and
selective coding techniques (Urquhart, 2001, Webster and Watson, 2002). Reviewing these papers helped us find weak spots and produce results which reasonably amend the body of literature (Creswell, 2009, p.25).

After the assessment of existing approaches to business model design, we searched for methods to overcome the identified shortcomings. We included principles of "networked thinking" (Gomez & Probst, 1998) into the business model design process and drew upon Drucker’s "theory of the business" (1994). Based on these theories, we constructed an a-priori step-by-step approach (Eisenhardt, 1989), which provides guidance to designing a business model.

A proof of concept and refinement of this approach was conducted empirically by applying it to a real-world case: we were given the chance to develop new business model alternatives in partnership with an air navigation service provider. Since organizations only rarely provide access to delicate issues such as business model innovation, we employed "flexible and opportunistic data collection methods" (Eisenhardt, 1989, p.533). We were given opportunities to conduct focus group workshops and interviews on tightly defined topics. These were complemented with focused interviews with selected experts and potentially affected stakeholders (Bryman and Bell, 2007, p.511, Creswell, 2009, p.181). Feedback from the participants after reviewing the documentation provided further insights. Deep involvement in the design process helped us produce relevant knowledge (Coghlan, 2011). Data collection overlapped with data analysis, which resulted in a refined and enriched construction of a "networked thinking"-based approach to business model design (Eisenhardt, 1989).

**Current Understanding**

Our literature review revealed six established approaches to support the business model design process: (1) cases and lessons learned; (2) component based approaches; (3) taxonomies; (4) conceptual models; (5) causal loop diagrams; and (6) design patterns.

*Cases and lessons learned*

The contributions in this field provide an in-depth presentation and analysis of cases such as myFab and Zara (Girotra and Netessine, 2011), Grameen (Yunus et al., 2010) or Naturhouse (Sosna et al., 2010). With their verbal descriptions, they build on Magretta (2002), who defines business models as "stories that explain how enterprises work" (p.87).

The strength of this approach lies in focused insights into specific aspects, such as business model development and adaption over time (Sosna et al., 2010) or consideration of risks (Girotra and Netessine, 2011). These insights are a rich source of information to a business model designer in a similar situation.
However, the approach does not represent or compare different business model options. In addition, it does not enable the designers to quickly grasp a specific model or re-use it in a different context. As there is no guidance in terms of content and structure from a natural-language representation of a business model, cases and lessons learned do not provide structural guidance for the business model design process either.

### Component-based approaches

Component-based approaches provide a pre-defined set of constituent components which, instantiated and combined, describe a concrete business model (e.g., Afuah and Tucci, 2003, Chesbrough and Rosenbloom, 2002). Scholars do not agree on the components and breakdowns: four (Johnson et al., 2008), six (Morris et al., 2005), or even 20 (Shafer et al., 2005) different components are seen as being required to define a business model.

On the one hand, the rigid structure of a component-based approach provides guidance in designing business models: instantiating the constituting components one-by-one is a structured task. A modular business model is also easy to compare, communicate and discuss. On the other hand, flexibility and explanatory power is lost: interrelations and dependencies between the components are not made explicit. Factors such as the focal firm’s mission and environmental dynamics cannot easily be integrated.

### Taxonomies

Taxonomies develop typologies of business models by classifying them based on predefined criteria. Tapscott et al. (2000), for example, propose a taxonomy of value networks according to the degree of value integration and company control. Rappa (2004) classifies nine different e-business models on the type of customer relationship.

Taxonomies allow for a quick description of business models and the re-use of existing analytical work (e.g., Rappa, 2004, Timmers, 1998). Although taxonomies seem to provide an easy-to-understand way to design business models, their generic and abstract description reduces its practical use. A generic business type is not suited for design tasks such as comparing and evaluating different options. It also does not explicitly contain or describe firm-specific dynamics. For these reasons, a taxonomy can provide a good starting point but is not suited to structure and support the entire design process.

### Conceptual Models

Like component-based approaches, conceptual models identify business model components but explicitly address interrelations and interdependencies between them (Johnson et al., 2008, Pateli and Giaglis,
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Interrelations are often shown graphically e.g., by arrows in Osterwalder and Pigneur (2010). Andersson et al. (2006) present a reference ontology which also includes exchange relationships between actors.

As some further approaches in the area show (e.g., Al-Debei and Avison, 2010, Samavi et al., 2009), conceptual models are useful because they provide a way to achieve consistency among the components and thus support the design of coherent business models. Their rigid structure and limited vocabulary is, however, both strength and weakness. The formal representation limits expressiveness and may lead to important aspects being overlooked due to the designer's reliance on the framework which the conceptual model provides. The focus on consistency does not encourage fitting the business model to reality, such as on organization’s mission or environment.

Causal loop diagrams

The causal loop diagram focuses on the mechanisms of a business model and describes its inherent interactions (e.g., Kiani et al., 2009, Seelos and Mair, 2007). Casadesus-Masanell and Ricart (2010) use the analogy of a machine to explain the link between the key choices of the business model and their consequences. The interrelations of choices within and between business models are made explicit, revealing feedback loops that can lead to virtuous cycles.

As their applications show, the diagrams are a good way of identifying the core logic of a business model. During business model design, however, the user is left alone to identify the key choices, their consequences, and the influence strength and direction. No process or other guidance supports the creation of a causal loop diagram of a business model option. However, once done successfully, the explanatory power and visualization provided by a causal loop diagram is strong, despite the rather formal representation.

Design patterns

Design patterns can be understood as a formal means of documenting the generic logic behind a business model, fostering the systematization and reuse of knowledge in the form of basic structures which describe parts of business models (Gassmann et al., 2012, Mettler and Eurich, 2012a, Osterwalder and Pigneur, 2010). The approach is led by the observation that, very frequently, existing business models serve as "recipes" (Baden-Fuller and Morgan, 2010) or "templates" (Doganova and Eyquem-Renault, 2009) for new business models.

Employing patterns in business model design brings proven structures into the process, which can be recombined and adapted flexibly. The approach naturally comes to its limits when novel, complex, or
specific business model characteristics are to be modeled. Current proposals also lack guidance on how different design patterns relate to each other and how many patterns are needed to fully describe a business model. Furthermore, through its focus on commonalities, the approach entails the risk of missing organization specifics and situational dynamics.

**Summary of current understanding**

Six distinct approaches to support business model designers have been revealed: they each have their strengths and weaknesses (see Table 1). A business model designer is well advised to find a good balance by combining different techniques.

<table>
<thead>
<tr>
<th>Approach</th>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases and lessons learned</td>
<td>• rich insights into specific design details</td>
<td>• not generally applicable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• low structural guidance through verbal representation</td>
</tr>
<tr>
<td>Component-based approaches</td>
<td>• structured process, ensuring completeness</td>
<td>• interdependencies between components not considered</td>
</tr>
<tr>
<td></td>
<td>• discussion and comparison of business model options facilitated</td>
<td>• no assumptions about external factors and dynamics visualized</td>
</tr>
<tr>
<td>Taxonomies</td>
<td>• systematic representation of options and parameters</td>
<td>• guidance on high level, lack of details</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• low flexibility</td>
</tr>
<tr>
<td>Conceptual models</td>
<td>• highly structured and formal</td>
<td>• limited expressiveness, hard to extend</td>
</tr>
<tr>
<td></td>
<td>• interdependencies between components considered, internal consistency</td>
<td>• consistency of the model potentially overemphasized</td>
</tr>
<tr>
<td>Causal loop diagrams</td>
<td>• explicate core logic, decisions, and dynamics</td>
<td>• no guidance as to which factors to include and to analyze</td>
</tr>
<tr>
<td></td>
<td>• concise representation</td>
<td></td>
</tr>
<tr>
<td>Design patterns</td>
<td>• reuse of proven structures</td>
<td>• new options and firm specifics not present</td>
</tr>
<tr>
<td></td>
<td>• flexible recombination</td>
<td>• no guidelines regarding recombination logic</td>
</tr>
</tbody>
</table>

Table 1. Overview of techniques, strengths and weaknesses
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While the identified methods are helpful in many ways, we spot two shortcomings in their applicability to new business model design. First, they hardly provide comprehensive guidance on how to obtain the final design when starting from the initial problem and situation description. Most approaches render assistance at a rather late stage of the design process, when the business model designer already has some basic ideas of the future design. Second, most techniques tend to neglect the relevance of the environment of the organization, such as market dynamics, demographical changes, technology trends, or a changing competitive position. The current techniques predominantly lead to concepts that focus on model-internal consistency, but do not foster an awareness of the specific business situation.

A ‘Networked Thinking’ Approach to Business Model Design

Against the background of the two shortcomings, we propose a six step approach to business model design based on the principles of "networked thinking" (Gomez and Probst, 1998) and Drucker's "theory of the business" (1994). These two theoretical underpinnings may fill the identified gaps in the current business model design approaches.

Drucker's "theory of the business" (1994) comprises three parts: (1) Assumptions about the environment of the organization, which define what an organization is paid for. (2) Assumptions about the mission of the organization, which define what an organization considers to be meaningful results. (3) Assumptions about the core competencies needed to accomplish the organization’s mission, which define where an organization must excel in order to maintain leadership. Drucker’s theory does not explicitly address the design of business models but describes the important pieces to be included into the design process. Its contribution can be seen as providing guidance in the early phases of business model innovation and in assuring that the final design fits reality.

The principles of "networked thinking" (Gomez and Probst, 1998) are important to ensure that the consequences of the business assumptions are incorporated into the business model design process. This goes along with the construction and discussion of several alternatives as an intermediate result, which is again relevant for assessing the consequences of any potential actions and to ensure a fit to reality.

On this basis, we propose a six step approach (Table 2), whereas these steps hark back to the procedure that Probst and Ulrich (1988) advice for networked thinking.

1. Determination of the mission and assumptions about the business environment: The assumptions concerning the organization need to be determined (Drucker, 1994). The environment can include market dynamics, demographical or regulatory changes, technology trends, or a changing competitive position. The goal here is to agree on the (new) business mission and to identify the assumptions and constraints that could have an impact on the business model.
2. Analysis of interdependencies: The business assumptions, their consequences, and potential connections are determined and visualized in a ‘networked thinking’-based illustration, which fosters the understanding of the organization’s situation and facilitates communication between the involved stakeholders (cf. Figure 1). The visualization concentrates on the future business environment. Therefore, future assumptions are shown as well as the difference between current and future assumptions, which marks a feasible starting point for business model transformation.

3. Determination and analysis of design alternatives: This step includes an assessment of the consequences of the business assumptions and decision options. It results in a description of different future scenarios, in which the different factors are given different weights.

4. Creation of business model design alternatives: Based on different future scenarios, alternatives are drafted. At this point, existing business model design techniques like conceptual models could be used. Design patterns and taxonomies can help inspire the creation of alternatives. Yet, it is important to note that drafting business model alternatives takes place at this late stage, building on the analysis of the organization’s current, predicted, and desired situation (steps 1-3). This procedure protects designers from falling into the model-internal consistency trap.

5. Selection of one business model design: The alternatives from step 4 must be evaluated under different perspectives, such as power distribution, dependencies on business partners, intervention possibilities, and alignment with strategic objectives. We suggest basing this evaluation on a holistic approach e.g., the STEP approach (Mettler and Eurich, 2012b, Peng and Nunes, 2007). The different business models should be assessed from a social, a technological perspective, an economic, and a political and legal. The result of this step is the selection of the most promising business model alternative.

6. Testing and realization of the business model: The assumptions that underlie the selected business model need to be tested, e.g., by addressing the lead users or a test market. The visualization from step two can be used to ensure an agreement with reality of the assumptions and the consequences. This leads to a further refinement of the business model. Finally, measures are developed to realize this model.

<table>
<thead>
<tr>
<th>Step</th>
<th>Result and Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Determination of the mission and business environment</td>
<td>Mission statement; list of assumptions about the organization’s business environment and its internal dynamics</td>
</tr>
<tr>
<td>2. Analysis of interdependencies</td>
<td>Visualization of the business assumptions (step 1), their consequences and interdependencies</td>
</tr>
<tr>
<td>3. Determination and analysis of design alternatives</td>
<td>Assessment of potential future developments; set of likely future scenarios</td>
</tr>
</tbody>
</table>
Table 2 Six steps to design a business model

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.</td>
<td>Creation of business model design alternatives</td>
</tr>
<tr>
<td>5.</td>
<td>Selection of one business model innovation</td>
</tr>
<tr>
<td>6.</td>
<td>Test and realization of the business model</td>
</tr>
</tbody>
</table>

Designing a Business Model in Practice

Both as a proof of concept and as a refinement of the initial a-priori construct, we applied the six step approach to a real case. We were given the chance to design future business model alternatives for an air navigation service provider (ANSP). The application of the proposed construct demonstrates its applicability in a use case. By describing this case we also intend to help business model designers to better understand the different roles involved as well as the useful techniques at each step.

Step 1: Determination of Mission and Business Environment

The business mission is stated to be "a focused innovator and act as a creative co-operator". Spurred by the Single European Sky (SES) initiative to reduce cost while maintaining safety and increasing capacity, the ANSP is facing a changing environment. Factors that impact the future of the ANSP include (Breitenmoser et al., forthcoming):

- Increase of flight movements: The future service demand cannot be satisfied with the current information systems. The underlying assumption is that aircrafts are regularly queued before being served by the airport.

- Formation of Functional Airspace Blocks (FAB): The SES initiative aims to convince states and ANSPs to cluster into FABs. As a consequence, fewer ANSPs might be needed.

- Standardization: The new generation of air navigation services is assumed to be interoperable and standardized. Consequently, all ANSPs may act as both a data provider and a consumer. New information and communication technology (ICT) will facilitate service provisioning.

- Reduction of operational expenditure (OPEX): The SES intends to reduce air navigation service cost by means of ICT-supported service provision.

Assumptions about the business environment and the business mission were gathered by means of semi-structured interviews at C-level, i.e. with the CEO, CTO, CIO, etc.
Step 2: Analysis of Interdependencies

At this stage, insights from the interviews are depicted. The assumptions and their consequences are connected. Figure 1 is a simplified visualization: arrows depict the direction of influence. A plus (”+”) refers to a positive influence, i.e. the more A the more B, respectively the less A the less B. A minus (”-”) stands for negative impact, i.e., the more A the less B and vice versa. It must be kept in mind that reality is always more complex and requires a simplification.

![Visualization of business assumptions and potential consequences](image)

In our case, we produced a first draft of the visualizations and then came back to the ANSP. A focus group workshop was conducted with participants from middle management who are in charge of the business re-design process.

Step 3: Determination and Analysis of Design Alternatives

At this stage, potential changes of the business environment, feasible decision options, and their consequences need to be understood. In the case of the ANSP, future industry scenarios developed include "keeping the status quo", "ICT standardization will facilitate service provisioning", and "there will be a 'Single European Sky' with FABs".

The scenarios can either be described from the organization’s or the market’s perspective. Assessing the influence of different factors in order to depict future scenarios can be done on a scale or can be based on the decision makers’ intuitions (Gigerenzer, 2008).

Step 4: Creation of Business Model Design Alternatives
On the basis of the different scenarios, business model design alternatives are drafted. The "keeping the status quo" scenario was ruled out due to a misfit with the business mission. Without infringing on confidentiality, three of the business model alternatives involve (1) ancillary revenue through ANSP-specific software development on the basis of standardization and a closer cooperation within one FAB; (2) ancillary revenue through training services provisioning under the assumption that workplaces will become identical within one FAB; (3) establishment of a single data center in order to decrease the operating cost in a potentially more competitive environment. These three examples are all in line with the assumptions and the envisioned future mission.

We conducted a workshop in which business model alternatives were drafted by small groups of middle managers, each elaborating on one or more future scenarios (in line with Figure 1). In our case, taxonomies and existing design patterns did not suffice. Elsewhere, these two techniques might be a good resource for drafting business model alternatives.

Step 5: Selection of one Business Model Design

In order to select the most promising business model design alternative, we relied on the STEP approach (Mettler & Eurich, 2012b) and a criteria catalogue was created (Breitenmoser et al., forthcoming):

a. Social: Unions are very strong and decisions might need their approval, which is one criterion. Air traffic controllers have a high responsibility; hence another criterion is whether a future business will still meet their needs.

b. Technological: The current system reliability and safety levels must be met or exceeded and the competence to meet this requirement is necessary. Reliability is an essential factor: wrong decisions can have fatal consequences, so it is important to allocate liability. Another criterion is estimating when, and if at all, which standards will be introduced.

c. Economical: The consequences of competitive conditions must be understood. Air traffic services are currently protected by government, making the consequences difficult to determine. One of the major criteria is whether the business model alternative will be sustainable. Business cases might need to be detailed.

d. Political: ANSPs are typically non-profit-organizations by law and this domain is highly regulated. The task is to evaluate which alternatives are in line with the current regulations and to determine under what conditions a business model design could work. A change of regulations may be necessary.

In addition, specific intervention possibilities as well as the alignment with strategic objectives were discussed with C-level managers. In the end, one alternative was selected.
Step 6: Testing and realization of the Business Model

The realization of the chosen business model will be performed by the implementation partner, i.e. the ANSP. At this point, we can only refer to the theoretical remarks described in the previous section.

Conclusion

This study aims to advance the discussion on techniques for the business model design process. A six step approach is proposed that builds upon the principles of networked thinking (Gomez and Probst, 1998) and on Drucker’s theory of the business (1994). This ‘networked thinking’-based approach complements existing techniques in four aspects: First, it provides a step-by-step approach which spans the entire process of new business model design. Second, it allows for designing a new business model from scratch (instead of adapting existing business models to the existing problem). Third, it provides the designer with a starting point, and it clarifies what the new business model intends to solve (mission). It also explicitly shows the model’s embedding in the business ecosystem (interdependencies). Fourth, it fosters the generation of alternatives, which are evaluated against the background of the consequences drawn from the initial business assumptions.

By means of applying the ‘networked thinking’-based approach to a real case, empirical evidence for its applicability was gathered. Without a claim to generality, this case shows that each step is needed and viable in practice. Therefore, this case can be regarded as a first proof of concept.

A limitation is that empirical evidence was collected based on a single application of the proposed approach. However, organizations only rarely grant access to internal, strategically relevant processes. This may be one reason why literature does not provide many other cases in which business model design techniques were applied in real-world settings. Still, it would be desirable for future research to gather data from further applications, which may lead to the discovery of cross-case patterns and could enable a higher level of generalization. In future research, scholars can draw upon the proposed ‘networked thinking’-based approach and apply it in other contexts. The findings should also encourage the integration of different decision options, their consequences, and the interactions beyond the boundaries of a single organization into the business model design process.

Discovering interdependencies and the consequences of decisions in a transparent way strengthens the managers’ understanding of the business model (re-)design in two ways: First, it facilitates their understanding of the current business logic and its interactions with the surrounding ecosystem. Second, it allows them to scrutinize the business logics behind different options and to use new levers for further refinement.
Publications
This study can provide a substantial first step towards the goal of turning business model design into a more holistic and structured design process.

Acknowledgment
This paper partly describes work undertaken in the context of the CTI project "Transforming the Air Traffic Management Industry: The 'Common Controller Cockpit' and the 'Blue Line Standard'", contract number: 14036.1 PFES-ES.

References
Publications


Publications


7.6 Gatekeeper-based business & technology intelligence

Introduction
When a company focuses on its internal informal networks it is possible, even with only little effort, to operate efficient «Business and Technology Intelligence».

In principle, Business Intelligence (BI) and the processes associated with it, pursue one goal: they assist management to make strategic and operative decisions by delivering information on time. BI and the subsequent knowledge resulting from it enable companies to quickly react to fluctuations in market trends, in that they adapt to the current business model or boost their research and development activities for example.

Based on the ability to learn, the «absorption capacity», the «gatekeeper concept» and current studies in the field of «Business and Technology Intelligence», a BI concept, which expands on the use of existing informal networks within companies, will be introduced in this article. In the heart of this co-operation on the first level are the gatekeepers. This refers to the staff members who demonstrate an above-average amount of networking both in and out of the company. This BI concept offers the advantage that those who possess a wide knowledge of the business are supported in their integration into the collection, qualification and supply of information. The BI approach presented here is an interesting one as it uses existing company structures and is thereby readily implemented without high investment costs.

Whether Business Intelligence is actually useful to a company depends on the quality of the information available. Only when the information is timely, relevant/important and understandable is it possible to derive the recommendations for action for management.

In two projects involving the Swiss KMU, and in co-operation with the employees, a gatekeeper-based BI structure was defined. At Ruag Electronics AG (PLC) and Rheinmetall Air Defence AG (PLC), the implementation process and the frame of reference of a gatekeeper-based BI were closely examined in a series of over 40 interviews and seminars.

Skilling up
At Ruag Electronics the motivation lay in strengthening the international position of the company. Internally, there was no structured BI approach to qualify either the general market situation or the
relative strength of the market players. While the knowledge was available, it was neither centralized nor standardized. There was the danger that strategically wrong decisions could result from information gaps. At Rheinmetall Air Defence the existing innovation process was designed to implement specifically expressed customer requirements. This led to incremental innovation on the basis of technology already in place. Because of this, there was the danger of not only missing the boat with regard to new technologies but also losing market share due to substitutions.

In both companies, the BI structures to be created needed to address the following tasks and achieve the following goals:

- recognize changes in technology and market trends
- track technological developments in order to steer their own research and development
- identify acquisition goals and potential partners
- distinguish networking among market players
- determine competitor activities early in order to reduce reaction time
- react promptly to political changes and legal adjustments

Separate the sheep from the goats

The potential of a company’s own staff to be BI analysts and gatekeepers is constantly underestimated. Who better to evaluate the relevance of new products, processes and business models to a company than the company’s own employees?

Not all staff members are willing to take on such a job, however, and for that reason, gatekeepers need to be carefully selected. Employees who operate as important communication channels in the informal network, are basically qualified for such a role. They often distinguish themselves in that colleagues seek them out for advice. In addition, these workers often tend to have a wide network of contacts both in and outside of their department and even the company. These conditions facilitate the finding of potential gatekeepers by means of staff questionnaires. Typically, gatekeepers display the following characteristics:

- profound technical knowledge (often engineers or scientists)
- high level of individuality, creativity and social standing
- five or more years in the company
- well informed about the technological background of the company
- own wide network of contacts in and outside of the company
- deep knowledge of the most important competitors

In order to implement a gatekeeper-based BI, the following four point framework has proven to be useful:
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Process structure
Documenting and establishing the BI process is important, in order to prevent the processed information from getting lost in the company. The beauty of this is that the formalized process is built directly into the company's own management system. This gives the parties the authority and backing to tackle the new tasks with determination. Clear processes, responsibilities and task allocations facilitate an efficient flow of information from the gatekeepers to the decision-makers.

Organizational structure:
The organizational structure enables the responsibilities and work content to be regulated and distributed among the gatekeepers. Those employees designated as gatekeepers remain active in their function, but they are given the task of also using their informal network.

Results
By employing a defined reporting system using documents, a mailing list and requests, the processing and formalization of information can be achieved in a reasonable time: the tasks of a gatekeeper can be stored in a specification record.

Role
In both companies it was revealed that the employees desire a clearly formulated job description; however, this changes constantly. A description helps to prevent too great an overlap with gatekeeper tasks.

Sorting and weighting information
Creating an information advantage involves actively gathering, verifying and streamlining information and information sources.

The sheer amount of available information today means that simply gathering and archiving data requires the necessary overview and quality of the information to be guaranteed. Therefore, information must be «refined». The «refining» takes place through the classification of the observations according to importance for the specific company. The consequent findings lead, on the one hand, to a reduction of the quantity of information and, on the other, to an early detection of information gaps. On this basis, management can formulate their additional communication (information) needs on time.

The process is divided into three sub-steps: gathering, qualifying and allocating. Qualification plays a central role here. This step leads to the refining of the gathered information. When the lessons learned are communicated to the decision-makers, then the information ultimately gains operative and strategic relevance. It is advisable to anchor the process in the company's own process landscape before initiating the practical implementation. In this way, the process gains additional weight.
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All-out commitment required

The time needed for such a project should not be underestimated. The implementation can take some years. In both cases, Rheinmetall Air Defence and Ruag Electronics, it was clear after the initial steps how important it is to first record the information needs of management and then, in a second step, to define the required outcomes. It is therefore advisable to create a position which will plan, support and co-ordinate the implementation process, and later, with full authorization and an allocated budget, oversee the interface between gatekeepers and management. The main task of this position consists in channelling the information needs and steering the BI. It assists the gatekeepers with reporting and giving feedback on their observations.

To implement the BI processes, four steps have been successfully identified (Figure 1):

1. Foundation: The constraints are identified and the tasks defined
2. Core Process: The information processing is defined
3. Integration: Gatekeepers are identified and appointed
4. Ability: The gatekeepers are introduced to their new task

![Figure 1 Implementation framework business and technology intelligence](image)

The advantage of accompanying the gatekeepers in the first few months is that the employees can get used to their new function and still maintain their motivation. Valuable means of support have been
derived from the experiences gained with Ruag Electronics and Rheinmetall Air Defence which help to reduce possible dangers during implementation. They have been summarized in a table on this page.

The availability of information from the market environment helps to align product portfolios, processes and also the business model with both the current and foreseeable situation. This facilitates strategic decisions.

### Dangers and solutions during implementation

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<td>2. Core process</td>
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<td>Conducting interviews and surveys about BI</td>
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<td></td>
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<td>Establishing consensus with decision-makers and those employees who may be involved in the future</td>
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<td></td>
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<td>Unsuitable gatekeepers</td>
<td>Triangulation for the utilization of a variety of perspectives</td>
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7.7 Implementation of a gatekeeper structure for business and technology intelligence

Citation

Abstract
Small and medium sized companies can successfully increase their market awareness by using business and technology intelligence solutions that draw on existing company resources. One such approach is based on the gatekeeper concept. It has been progressively modified to fit into today’s understanding of technology intelligence by opening up gateways of information into a company. Up to now efforts to formalise such an informal network have been rare. This paper describes the motivation for using a formalised gatekeeper setup in a mid-size Swiss industrial company and introduces an implantation framework based on the systems engineering methodology.

Keywords
business and technology intelligence; gatekeeper model; knowledge management; Swiss industrial company; systems engineering.

Introduction
In today’s constantly changing and evolving markets liberalisation and globalization demand an agile and timely response from company management. While the age of large state run industrial companies is long gone, today also smaller state run entities and public services providers must face being released into an open market. This is especially true in the European aerospace and defence industry. As national defence budgets in Europe decline and international cooperation becomes paramount, aerospace defence
companies must react to market forces. This even if they have over decades enjoyed a quasi state guardianship due to the sensitive nature of their products or due to an overriding intrinsic public interest.

This paper describes RUAG Electronics’ quest to strengthen its international focus. The company, based in Switzerland, develops and sells training facilities using simulation technology for armed forces and is about to enter the homeland security market as a first mover within the field of operational command systems for police forces. It has, after careful deliberation, chosen a formalised gatekeeper approach to strengthen its business and technology intelligence framework. Until now its client base has been predominantly Swiss. It sees itself as a technology driven company, being an expert in high-precision manufacturing technologies. The RUAG Technology Group, of which RUAG Electronics AG (RUAG E) is part, emerged from the former Federal production and maintenance facilities. Since 1 January 1999, the RUAG Technology Group has been organised as a private corporation. All 100% of the holding’s shares belong to the Swiss Confederation.

To achieve its aim RUAG E decided to work together with the Swiss Federal Institute of Technology. The Chair of Technology and Innovation Management was chosen as a partner. Results of this preliminary action research, evaluation and verification of an adequate intelligence framework, encouraged the company to move on and implement a formalised gatekeeper model directly into its process framework. The gatekeeper concept was initially introduced by Thomas J. Allen in the late 1960s (Allen and Cohen 1969). It has since then been closely linked to the innovation process. In its formalised form it has been developed into a tool for small and medium sized companies to reduce their market adaptation time through an effective application of business and technology intelligence (B&T intelligence) (Savioz, 2004).

There is a noticeable lack of ‘lessons learnt’ material for business intelligence practitioners who wish to implement the concept of a formalised gatekeeper based business intelligence framework. This paper hopes to help bridge the gap between theory to the real world by describing an actual case in which a company has embarked on implementing the concept. From the ‘lessons learnt’ some pitfalls and managerial implications can be deduced.

**Research setting**

**Intelligence**

Like many items of daily life, technologies and markets are subject to trends, fashions and evolution: managing technologies and their associated knowledge is obviously crucial, if not vital, for the survival of the company in the middle and long term perspective. In this context business intelligence can be defined as the collection and analysis of information on markets, customers, competitors and broad social trends.
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(Ghoshal and Kim, 1986; Savioz, 2004). Technology intelligence can be understood to have much the same aims concerning technological trends and new technology. Both business and technology intelligence, therefore, have always been of interest for companies.

In a more recent development, companies are looking for a systematic approach to both (Davis and Botkin, 1994; Gerybadze, 1994; Lichtenthaler, 2004a, 2006). Indeed, one might argue that the word ‘intelligence’ already denotes a systematic and planned course of action. “High-quality intelligence designates information that is clear because it is understandable to those who must use it; timely because it gets to them when they need it; reliable because diverse observers using the same procedures see it in the same way; valid because it is cast in the form of concepts and measures that capture reality (the tests include logical consistency, successful prediction, congruence with established knowledge or independent sources); adequate because the account is full (the context of the act, event, or life of the person or group is described); and wide-ranging because the major policy alternatives promising a high probability of attaining organisational goals are posed or new goals suggested.” (Wilensky, 1967, viii, italics in original)

If, therefore, intelligence covers the art of gathering, processing, interpreting and communicating the technical and business information needed in the decision making process as Wilensky formulates it, it must, by its very nature, be a systematic and integrative process. This holistic understanding and definition of the intelligence process has lead to classifying the efforts of company intelligence efforts by using three generation steps (Lichtenthaler, 2003). As the perception, self-esteem and integration of the intelligence setup increases, it evolves towards a modern third generation process. Once this third level has been reached, technology intelligence can help exploit potential opportunities and defend against potential threats (Lichtenthaler, 2006).

A multitude of methods and tools pertinent to implementing B&T intelligence are discussed in the literature. This is not surprising since gathering, processing, interpreting and communicating all can be accomplished using various methods. Time horizons, intelligence depth (and breadth), financial considerations and pre-existing corporate culture are only some of the numerous contingency factors found in literature (Lichtenthaler, 2005).

A study of this vast body of literature does point to one recurring theme and problem associated in dealing with B&T intelligence: The problem of understanding the information collected and being able to assess its relative importance for the intelligence effort. The ability to evaluate and utilise external knowledge is largely a function of the level of prior knowledge (Cohen and Levinthal, 1990). On a very basic level the problem of understanding can be as simple as using a common language. As pointed out by the “Absorptive Capacity Theory” (Cohen and Levinthal, 1990) this basic level of prior knowledge includes basic skills and a shared language. Some literature even points out that this problem can lead to a
paradox: “The evolution of local languages and coding schemes helps the unit deal with its local information processing requirements; yet it also hinders the unit’s acquisition and interpretation of information from external areas.” (Tushman and Katz, 1980, p.1072). This much generalised view is, none-the-less, an accurate description of the problem. In an epistemological context the paradox is underlined by Ludwig Fleck’s observations on the ‘Denkkollektiv’ leading him to postulate that scientific facts are socially constructed (Freudenthal and Löwy, 1988). Knowledge is, therefore, what makes people able to make distinctions in their observations (von Krogh et al., 1994).

Pure B&T intelligence specialists will often not have the necessary detailed knowledge of technology and its application to identify new trends. These can often only be spotted by researchers having sufficient prior knowledge of the technology field (Lichtenthaler, 2004a, 2005). On the other hand, even though engineers, scientists and researchers usually have a very good knowledge about the state-of-the art in their technologies (Lee and Allen, 1982; Lichtenthaler, 2006), they may not be as good at communicating their knowledge to decision makers in a company (Lichtenthaler, 2004b). Most engineers find it easier to express themselves using blueprints, steel or concrete (i.e., thru the tangible products of their normal work) than in words (Kranzberg and Davenport, 1972).

In our view this communication problem is at the root of many issues surrounding the organisational layout (decentralised vs. centralised (Brockhoff, 1991) and operation (dedicated vs. informal) of the B&T intelligence effort. Bridging the gap between all players and stakeholders in the B&T intelligence community is paramount and starts by recognising the importance of key individuals in the company’s communication network (Allen, 1977; Holland, 1972; Jervis, 1973; Tushman, 1977; Lichtenthaler, 2005).

The gatekeeper

By mapping communication and personal routes and routines in R&D laboratories Thomas J. Allen discovered special nodes in these networks (Allen, 1977; Allen and Cohen, 1969; Allen et al., 1979; Allen and Lee, 1982). Often, Allen simply asked who talks to whom in a research laboratory. Thus he began to collect data on communication channels. If the communication habits and channels are then visualised by drawing lines between the members these special nodes are readily visible by the greater number of lines leading to and away from them. These special members, that Allen at first named ‘stars’ due to their radiant communication profiles, are describes as being able to keep in touch with nearly everyone else in the organisation (Allen and Cohen, 1969).

Allen’s research coincided with a growing interest and research into informal communication and personal networks in companies. Sparked off by the rapid advance of communication and data handling technologies during the 1960s (Goldmark, 1972; Pierce, 1972), many researchers felt that informal routes
of information had been overlooked and undervalued. “Our knowledge of coding, handling, storing and retrieving information has far outdistanced our understanding of the relation of information to the research process and to the working patterns and requirements of individual researchers.” (Rubenstein, 1961, p.28). Numerous studies conducted during this time unearthed and named informal networks or special communicators in companies. These special roles, some with exotic names (such as the ‘Scientific Troubadour’), are neatly summarised in Holland’s 1972 article (Holland, 1972).

After surveying the communication channels, Allen introduced the term ‘technology gatekeeper’, postulating these besides being the nodes of the informal internal communication networks would also exhibit a degree of contact outside of their organisation that was significantly greater than that exhibited by their colleagues (Allen, 1977). Allen formulated his hypothesis as follow; “Individuals who occupy key positions in the communication network of the laboratory, that is, those to whom others in the laboratory most frequently turn for technical advice and consultation, will show more contact with technical activity outside of the laboratory.” (Allen and Cohen, 1969, p.13). In this sense a gatekeeper is a node in the company communication network, but also a gateway for external information and knowledge to flow into the company. What makes him special is his deep technical knowledge that permits him to understand the way in which outsiders differ in perspective. This allows him to understand external technical developments that are relevant to his organisation and translate them into terms understood by his fellow co-workers (Allen et al., 1979). Later work, predominantly by Tushman (Tushman, 1977; Tushman and Katz, 1980), sees the gatekeeper as a sub-group of boundary spanning individuals. The distinction is that the gatekeeper has a strong connection to internal colleagues and external information sources at the same time. In this function he also plays a part in the innovation process (Allen and Lee, 1982; Mcdonald and Williams, 1992; Savioz, 2004).

Identifying gatekeepers

According to Allen (1977) it can be assumed that any larger organisation of engineers or scientists will have potential gatekeepers among its employees. It is important to note that not all those that have a profound technical knowledge and understanding are also potential gatekeepers. Nor can it be assumed that boundary spanners are automatically gatekeepers (Tushman and Katz, 1980; Nochur and Allen, 1992). What does seem to be the case is the fact that the gatekeeper is an identifiable individual in several different kinds of organisations (Holland, 1972).

Based on our literature survey (Allen, 1977; Taylor and Utterback, 1975; Tushman, 1977; Mcdonald and Williams, 1992; Lichtenthaler, 2002, 2005, 2006; Rothwell and Robertson, 1973; Savioz, 2004) following characteristics of gatekeepers have been found:
profound professional knowledge (qualifications predominantly in science or engineering)
• high social reputation (standing)
• high technical performers (possibly many patents and papers)
• reads more specialist literature than their colleagues
• at least five years of affiliation with the company
• high degree of individuality and creativity
• lower ranks in the hierarchy, but can be a first-line supervisor
• an academic degree is not necessary, but significantly more often encountered
• are, in general, very busy employees.

They must be accepted by their co-workers and are easily identified by them. Indeed, the most common method of identifying gatekeepers in the studies described in literature seems to involve interviews of the employees (Allen, 1977; Allen et al., 1979; Taylor and Utterback, 1975; Mcdonald and Williams, 1992). This can be a simple question such as asking each professional to specify those individuals with whom he had work-related oral communication on a given sampling day. Not surprisingly, gatekeepers themselves are very good at identifying other gatekeepers around them (Taylor and Utterback, 1975).

**Formalising the gatekeeper network**

The logical next step is to try and utilise these special communicators by formalising their roles and networks. This raises the question about the extent to which informal relationships can be formalised without destroying them. Allen himself points out that effective gate keeping cannot be achieved by assigning any given people to fill the role (Nochur and Allen, 1992). He further points out that informal networks need time to develop and must be cultivated and he goes as far as describing the process as a natural occurrence and a spontaneous phenomenon. This is a view shared in almost all papers about gatekeepers. “Although the manager can never hope to completely control informal information transactions, his best hope for positively influencing informal networks lies in the identification and motivation of the special communicators in his organisations.” (Holland, 1972, p.44). Nochur and Allen (1992) do venture into giving some thought on conducting formalisation. They concluded that gatekeepers should be found and not made and that they should be given the responsibility for, and bestowed with, resources (their work should also be rewarded) to disseminate useful new technologies from external sources for technical professionals in their organisation. The ‘Opportunity Landscape’ (Savioz and Blum, 2002; Savioz, 2004) goes one step further in trying to use gatekeepers as an active part of a B&T intelligence setup by assigning them to specific areas or subjects to observe. Savioz does point out that the name ‘gatekeeper’ was chosen for want of a better title and that many of the
communicative skills of the gatekeeper, as defined by Allen, are not used in the context of an 'Opportunity Landscape'. Furthermore Savioz does not provide for added resources or time for the gatekeeper. “Basically a gatekeeper keeps doing her or his job as usual, she or he just formalises knowledge about her or his issue” (Savioz and Blum, 2002, p.96). We feel that this view is too narrow and that this approach will even be detrimental to the intelligence effort.

In our research we take the view that formalisation of gatekeeper networks must be a question of support and motivating their already existing natural tendencies to network. But any attempt to make gatekeepers write reports or overburden them with formal intelligence tasks may wear down their interest in participating in formal structures. This may also be the reason that there is very little literature or studies of actual cases where the formalisation of gatekeeper networks is described.

Besides the fragility of the informal network there may be systemic reasons why gatekeeper networks stay informal. Pettigrew (1972) points out that both, gatekeepers and management alike have reasons for preventing formalisation. Management may distrust a too strong network of gatekeepers or boundary spanners and fear a self-interested filtering of information by them. Indeed managers often revert to the age old maxim of 'divide et impera' in running a company. This will impede any effort of braking down organisational boundaries. On the other hand the gatekeepers themselves, sitting at the crossroads of information, may resent institutionalisation of their personal networks and surrendering their knowledge. “Information is a principle source of power and recognition in an organisation” (Ghoshal and Kim, 1986, p.50).

B&T intelligence and corporate epistemology

Beside questions surrounding implementation, our research is looking into added benefits of B&T intelligence and formalised gatekeeper networks for a company's knowledge management and in particular its institutional memory. A company that can create, utilise and maintain knowledge, over time, more effectively than its competitors, will have a distinct and sustainable advantage over its competitors (Tselekidis et al., 2003). Besides the benefits already mentioned in the area of a company's absorptive capacity tools, methods and procedures of B&T intelligence are ideally suited to manage a company's knowledge needs.

Institutionalising the intelligence process will further allow to constantly review and monitor its own knowledge. This should help to prevent eroding the companies' organisational memory over time (Simon, 1991). As Simon points out this erosion follows from the turnover of personnel, but this is by no means the only reason, since also explicit and formalised knowledge is prone to get lost over time. There is a strong feeling that for securing in-company knowledge the introspective use of the intelligence setup
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(and its institutionalised processes) is not only possible but advisable.

Looking at the formalised gatekeeper model in particular, one can easily see the potential benefits for classical knowledge management. Often gatekeepers are the key holders of tacit knowledge in a company (Holland, 1972; Allen et al., 1979; Mcdonald and Williams, 1992). Tacit knowledge can be understood to be knowledge, skills, insights and experiences embedded in individuals (Polanyi, 1966; Nonaka and Takeuchi, 1995; Connell et al., 2003). Being embedded in us, this knowledge is difficult to transmit to other individuals and is often only seen in action as know-how, motor skills or craftsmanship.

Interestingly enough, in an epistemological context, the tacit/explicit dichotomy may, in its purest form, actually speak against the possibility of conducting any meaningful intelligence form external sources by using information only. This is in part the message that Nonaka’s seminal book “The Knowledge – Creating Company” conveys; collecting and distributing solely information and explicit knowledge (and not tacit knowledge) is not enough. In general, a more holistic approach to this issue is taken in the paper by Connell et al. (2003): It manages to break out of the tacit/explicit deadlock and reach for other usable solutions in knowledge transfer. The paper offers a number of new solutions to the knowledge transfer problem by postulating knowledge as a system property and not as a stand-alone property of the human mind. Under this assumption tacit knowledge is replaced by a cybernetic process. This means a control process that is based upon cycles of actions moderated by feedback loops. Knowledge is systematically embedded within processes and actions rather than seen as a separate knowledge module in the mind of an individual.

The difficulties encountered in getting a sustained B&T intelligence effort up and running in a company (Lichtenthaler, 2006; Krebs, 2008) are to some extent linked to the intricate nature of knowledge. “Therefore technology intelligence more and more resembles a process of organisational intelligence, based on an understanding of the company as a distributed knowledge system” (Lichtenthaler, 2006, p.320). By recognising these epistemological pitfalls and taking a balanced holistic view on the intelligence process, success may not be guaranteed but total failure can be avoided.

Methods and data
Our research in this paper is based on an in-depth case study and the later implementation of a gatekeeper model at RUAG E. Case studies, in general, are part of a research strategy which focuses on understanding the dynamics present within specific settings. Case studies combine data collection methods such as archives, interviews, questionnaires and observations (Eisenhardt, 1989). Also, according to other sources (Yin, 2003), it is a useful method to cover contextual or complex multivariate conditions and not just isolated variables.
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Using this approach our research at first focused to analyse the current state of business and technology intelligence at the company. This involved making semi-structured qualitative interviews with the company managers and employees. The strength of these qualitative interviews lies in that it permits a holistic view and understanding of the current situation at the company.

This case study was flanked by desktop literature research and profited from other projects involving the gatekeeper model at the Chair of Technology and Innovation Management. These other projects most often include a master thesis and are almost all based on industry participation. One such project involving the Oerlikon Contraves AG (OCAG) (part of Rheinmetall Defence) explored potential applications of the gatekeeper model as a technology intelligence tool. The aim of that project was to safeguard the company and its innovation process from an unexpected rise of a substitution technology.

As a result of this assessment process at OCAG an approach based on technology gatekeepers was selected for further elaboration. As with RUAG E this process is still ongoing.

As with most projects at the Chair, a system engineering approach (SE) is used as a basis for the project. This, in part, is also because people are notoriously poor processors of information (Eisenhardt, 1989). The risk is always present to reach premature, and even wrong, conclusions as a result of information-processing biases (Eisenhardt, 1989). Using a structured approach will help counteract these tendencies. The basic SE steps are described in the literature and have the following aims (Simon, 1948; Haberfellner et al., 2002; Zuest and Troxler, 2006):

- understand the problem
- define the intervention possibilities and the degree of freedom for new concepts and measures
- create a basis of information for the next steps.

The SE methodology initially developed for large scale projects also lends itself to ostensibly simple company projects. The RUAG E case benefited greatly from using a structured approach. As it became apparent that the gatekeeper model would be formalised, SE methodology was used as a template for decision steps during the implementation.

Implementation of the formalised gatekeeper model

In the course of the year 2009 RUAG E wished to select a concept for scanning, monitoring and qualifying market players in the field of business interdependencies and market presence as part of a larger overall reorganisation of its entire business process framework. The information gathered and analysed is directly intended to serve decision makers by highlighting business opportunities and thus strengthen its strategic business development. The timing of these activities can be understood in the light of the systemic change of the company’s business environment mentioned in the introduction. For most
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companies a changing business environment can entail an increase in global competition, fast changing technologies and market needs and shorter product life cycles (McDonough, 1993). Paradoxically, product life cycles are becoming much longer in the aerospace and defence industry despite fast changing technologies and market needs.

As will be seen, the timing and embedding in a bigger reorganisation process created a favourable environment for adoption and later implementation of the chosen solution. The following implementation framework was used and developed during the course of this project. It is contrasted to the classical SE methodology from which it has been developed:

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<th>Modified framework used in our case</th>
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<tr>
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<td>5 Validate chosen solution</td>
<td>4 Enabling the gatekeeper model</td>
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<td>5 Assignment of specific gatekeeper tasksed</td>
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Figure 1 visualises the five phases and highlights the key actions involved in each of them. Phases 1 and 2 are independent of what tools or model is chosen to be implemented. From phase 3 onwards the actions are centred on the gatekeeper model.

First phases

It quickly becomes apparent that, like in all intelligence operations, the actual collection of information is only one of the many steps towards a usable system. In the end the success of an intelligence setup must be measured by its ability to deliver time critical and relevant information to company decision makers. Therefore, the needs and specifications for the intelligence setup must also be dictated by the end users of the information.
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The precondition phase must thus, first and foremost, explore the needs of the company management. Also, a clear understanding of the company's strategy and existing organisational framework must be gained. These tasks can be seen much like laying the foundation and frame of the future work. Interviews with employees and managers are very important in gaining a first impression of attitude and expectations towards the project.

Solutions discussed in this area are often based on ideas found in literature (Wilensky, 1967; Ghoshal and Kim, 1986; Brockhoff, 1991; Lichtenthaler, 2003, 2005, 2006). These included using the current setup augmented by external reports (open source), dedicated intelligence teams (internal or outsourced) as described by Savioz (2004), or dedicated technology and market databases. After a cost-benefit and acceptance analysis, themselves also involving numerous interviews, in our case the gatekeeper model was chosen, since it promised to be an efficient market research tool and was the most accepted tool by the managers and potential gatekeepers it was intended to be used by.

The validation process at RUAG E was achieved by defining and establishing a core gatekeeper setup on a small scale and running it for some time, in order to analyse a specific business intelligence question. The validation phase indicated that, as assumed, the actual data collection process was not nearly as difficult as the post collection analysis.

Preparing the organisational structure

The key questions are all related to how information once gained is processed, judged and, ultimately, disseminated. At RUAG E this phase led to define a new information flow processes in order to bundle the strategic intelligence activities into one process. Thus also responsibilities and roles were clarified and described in the new business process model.

At this stage it is also helpful to define deliverables and Key Performance Indicators (KPI). These can include defining the range and scope of the reports the management wishes to receive. KPIs are more difficult to define since they should allow the company management to assess the success of the gatekeeper model. RUAG E has at present chosen to measure the time needed to assess new market opportunities.

These steps have taken the better part of a year and were heavily supported by top management. Thus, one year after deciding to go ahead and work on its intelligence capabilities RUAG E is now ready to start up its gatekeeper setup.
Enabling the gatekeeper model and assignment of gatekeeper tasks

The gatekeeper setup is characterised by formalising the gatekeeper model and launching it. Accurate and detailed task sheets and templates should be prepared that define the work expected from the gatekeepers. These standing orders and tools can be given to the new gatekeepers. Following points are to be addressed and describes for the gatekeepers:

- definition of personal freedom
- competence for own budget
- possibilities to establish external contacts
- access to top management information
- training possibilities.

Currently, RUAG E is at the stage of selecting the gatekeepers and empowering them.

Discussion

The setup chosen by RUAG E comes close to a third generation technology intelligence setup (Lichtenthaler, 2003). Technology and R&D strategies are integrated into business unit strategies and a strong link between technology strategy and strategies on corporate and business unit level for all time horizons is observed (Lichtenthaler, 2003). A globalisation of intelligence activities is promoted. As in a second generation intelligence setup RUAG E wants to use information collected through internal networks. One might point out that by trying to use an internal, albeit formalised, network the setup chosen by RUAG E may only qualify as a generation two plus model. Still, we feel that the efforts of RUAG E to integrate the B&T intelligence directly into its decision making process justify a classification on par with a third generation intelligence setup. This view is also supported by the “new paradigm” of the third generation R&D management that goes hand in hand with a third generation intelligence setup as postulated by Gerybadze (1994). This new paradigm emphasises the integrative nature of B&T intelligence on all levels of decision making and the need for using face to face contacts.

The gatekeeper model exudes a fascination and is, at least at the beginning, readily accepted in most companies. Indeed, it seems that many employees see themselves as potential gatekeepers and thus enthusiastically support the project. This was also observed in the study conducted during 2008 at OCAG (Krebs, 2008). In the course of the study 37 managers from the development, production and sales departments of the company were questioned about their preference towards the gatekeeper model as a tool for technology intelligence. More than 50% preferred it over dedicated external or internal intelligence teams. This positive outcome was also observed at RUAG E. More than two thirds of the managers preferred the gatekeeper solution to other tools. What remains open is the question bout
whether the potential gatekeepers are acting altruistically or if they sense that they may gain more influence (Pettigrew, 1972) from their new role. In any case is vital to sustain and build on the first wave of enthusiasm that the introduction of a new intelligence tool can generate. The inevitable delays and trepidation that follow the implementation of any new tool must not destroy the interest and personal commitment and motivation of the employees involved.

Interestingly enough the gatekeeper setup does not, despite its high appeal, automatically fare best in the cost-benefit analysis. Both at RUAG E and OCAG its operating cost was judged to be much the same as other more dedicated business and technology intelligence tools, such as a technology intelligence team. Since it was assumed that the dedicated tools, in both cases a dedicated team, would be more effective (at least on paper) these fared better in the cost analysis. At OCAG for example, it was assumed that the potential gatekeeper, often being a senior engineer, would spend 20 full working days per year serving his additional function. But the high acceptance, motivational aspects and perceived fringe benefits of the gatekeeper model won out in the end. It is of course arguable whether the cost assumptions made during these projects are accurate or justified.

The cost of a working setup should not be neglected. Both RUAG E and OCAG have seen that the gatekeepers must be given time and support to work on their intelligence tasks and that their network must be managed: not every engineer will be willing to spend time writing a report or filling a database with information that he has collected. On the one hand he has enough day to day work; on the other hand the information may be time critical. By the time he has compiled his report it may already be obsolete. He must, therefore, be able to pass on information rapidly with as little effort to himself as possible.

From a knowledge management point of view the implementation process has helped identify key holders of tacit knowledge. It is hoped that improving companies’ internal knowledge sharing and creation can lead to innovation and, in turn, to company growth. (Back et al., 2006). Since outsourcing policies, worker fluctuation or pending retirements of key personal can quickly drain operational knowledge RUAG E hopes that the gatekeeper networks will also help managers preserve their companies’ knowledge base.

By implementing the concept ‘top-down’ RUAG E and OCAG hope to circumvent the question whether an informal network of gatekeepers can be formalised. We have on purpose not tried to delegate or create gatekeepers but tried to support them.

Managerial implications

Our managerial implications are best summed up in Table 1:
<table>
<thead>
<tr>
<th>Implementation stage</th>
<th>Major pitfalls</th>
<th>Managerial implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Checking the preconditions</td>
<td>Lack of top management commitment</td>
<td>Check actual readiness of the company and its top management</td>
</tr>
<tr>
<td></td>
<td>Insufficient background company specific knowledge</td>
<td>Understand the company intelligence needs and strategy</td>
</tr>
<tr>
<td></td>
<td>Start without receiving a clear assignment to the task</td>
<td>Clearly define assignments</td>
</tr>
<tr>
<td>Evaluating the business intelligence</td>
<td>Failure to participate with employees</td>
<td>Conduct interviews and surveys</td>
</tr>
<tr>
<td>framework</td>
<td>Work based on theory and literature only</td>
<td>Design different alternatives and present them to the executive board (check financial, personal, time impact and acceptance)</td>
</tr>
<tr>
<td>Design of the organisational structure</td>
<td>Failure to integrate with existing company business processes</td>
<td>Involve future key players of the framework for design process</td>
</tr>
<tr>
<td></td>
<td>No clear task description and assignment</td>
<td>Define templates, KPI’s and management cockpits</td>
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<tr>
<td></td>
<td></td>
<td>Allocate responsibilities</td>
</tr>
<tr>
<td>Enabling Gatekeeper</td>
<td>Failure to provide clear task description and tools</td>
<td>Use templates</td>
</tr>
<tr>
<td></td>
<td>Failure to allocate time for Gatekeepers to work for network</td>
<td>Setup specific budget</td>
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<tr>
<td></td>
<td>Choosing the wrong gatekeepers</td>
<td>Triangulation: use many views</td>
</tr>
<tr>
<td>Assignment of specific gatekeeper tasks</td>
<td>Failure to support gatekeepers</td>
<td>Regular meetings with top management</td>
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<td></td>
<td>Failure to use information provided</td>
<td>Face to face meetings</td>
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<tr>
<td></td>
<td>Slow reaction to failing network</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Overview of pitfalls and managerial implications

One point of interest is that work takes much longer than is expected. To a certain degree this was anticipated but it shows that sustained effort must be made to see the implementation through. At RUAG E the first project phase took much longer than the following phases. We are sure that this is time well spent, since this should allow the setup to really deliver the intelligence generated.
Conclusion

What remains to be seen is whether the effort put into implementing the concept ‘top-down’ pays off and if the informal network can be sustained. We think that by working backwards from the actual intelligence needs and information channels the gatekeeper concept is embedded properly in the company business processes, without crushing it. We feel that this is a more promising approach than first finding the gatekeepers and then building up the intelligence setup around them and on their backs.

It can be expected that the gatekeeper setup at RUAG E will be operational from the end of 2010. We hope that it will be able to deliver the intelligence needed to scan, monitor and qualify market players to the decision makers and thus allow timely and successful action.

References


Publications


Publications


Curriculum Vitae

8. Curriculum Vitae

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German: mother tongue, English: fluent, French: fluent
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