VINNOVA

VINNOVA REPORT
VR 2009:25

THE INNOVATION PLATFORM

ENABLING BALANCE BETWEEN GROWTH AND RENEWAL

NIKLAS ARVIDSSON & ULF MANNERVIK

Title: The Innovation Platform - Enabling balance between growth and renewal
Author: Niklas Arvidsson & Ulf Mannervik - NorrmannPartners
Series: VINNOVA REPORT VR 2009:25
ISBN: 978-91-85959-82-2
ISSN: 1650-3104
Published: October 2009
Publisher: VINNOVA – Verket för Innovationssystem / *Swedish Governmental Agency for Innovation System*
Photo: Bruno Ehrs

About VINNOVA

VINNOVA, Swedish Governmental Agency for Innovation Systems.

VINNOVA´s mission is to *promote sustainable growth*
by funding *needs-driven research*
and developing *effective innovation systems*.

Through its activities in this field, VINNOVA aims to make a significant contribution to Sweden´s development into a leading centre of economic growth.

Internationally strong research and innovation milieus (R&I milieus) are one of the most important competitive factors in the face of global competition. This is why all of VINNOVA's activities are guided by the ambition to develop and further develop strong research and innovation environments. For small and internationally dependent countries like Sweden, the need to focus its efforts on a number of strong, internationally distinguished R&I milieus is a critical factor in the effort to promote growth. It is a question of creating a number of globally-recognised spearheads so that Sweden can become an attractive partner for both companies and R&D investments. In strong R&I milieus, cutting-edge research, development and innovation operations are conducted and there is an effective interplay between these operations. VINNOVA runs a number of programmes, several in co-operation with other players, that aim to promote the development of strong R&I milieus in different ways.

The VINNOVA Report series includes external publications and other reports from programmes and projects that have received funding from VINNOVA.

Research and Innovation for Sustainable Growth.

The Innovation Platform

Enabling balance between growth and renewal

by

Niklas Arvidsson & Ulf Mannervik

NormannPartners

Foreword

VINNOVA's tasks are to fund needs-driven research required by a competitive business and industrial sector and a flourishing society, and to strengthen the networks that are such a necessary part of this work. Understanding the dynamics of such networks is the key to effective development of innovation systems that can generate sustainable new growth platforms. And we are living in a time when our societies are facing considerable challenges in fields such as sustainable development, social cohesion and healthcare, challenges which at the same time contest the ability of industry and innovation system governors to achieve long term successful systemic renewal.

Growth and renewal processes are well established mechanisms for promoting development of lasting value creating innovation systems. Building on the work by the late Richard Normann, Niklas Arvidsson and Ulf Mannervik have developed a comprehensive analytical framework that helps us to better understand the interplay between growth and renewal processes. It is work that has been conducted in interaction with VINNOVA and which has enabled us to reflect on our approaches to stimulate both growth around existing growth platforms as well as search for tomorrow's growth platforms, and - in particular - how to foster value creating collaboration between industry, academia and those innovation policy makers.

This book presents the study that generated the conceptual framework for how to understand the interplay between growth and renewal, with specific attention to the important social network dynamics behind that interplay. It also goes further beyond that and presents how the framework has been deployed in innovation policy analysis and formation in regional and international settings. It shows how innovation can address large scale system failures, and be spearheaded by action in small constellations of actors – driven by continuous dialogue with policy makers.

The study shows that innovation policy makers have both opportunities and obligations to help create the conditions that stimulate new business and technology to be explored and to emerge as new growth areas. By sharing the framework with a wider audience of innovation

policy governors in industry and governmental bodies at regional, national and international levels, we hope that readers will find it usefulness, challenges and inspiration for their work.

VINNOVA in October 2009

Anne Lidgard
Director and Head of
Innovation Actors Division

Marit Werner
Programme Manager
Innovation Actors Division

Acknowledgements

We would like to express our gratitude to those who in various ways have enabled the explorative intellectual journey and work behind this book. First of all we would like to thank VINNOVA, for supporting the initial study, publishing of this book, and also collaboration in deployment of the framework. We thank Marit Werner, Göran Andersson, Kjell-Håkan Närfeldt, Karin Markides, Lars Eklund, Jens Erik Lund and others at VINNOVA for their contributions. We also want to express our gratitude to all those who participated in our case studies, and who generously shared their time and insights. Their views did not always correspond with more official "edited" versions of developments, and we are indebted to them for their open sharing of their experiences. We also benefitted from a close collaboration with the County of Stockholm and especially want to thank the previous County Governor Mats Hellström, the present County Governor Per Unckel and Mats Ehrshammar who is governing innovation policy formation. It was also valuable with opportunities to present and discuss the conceptual framework with policy makers in a larger European setting, including from large European urban regions in the Innovation Alliance, and Margot Wallström, vice-president of the European Commission who gave special priority to challenges of sustainable development. We are also indebted to collaborators in industry, who have collaborated in analysis of system failures and idealized designs, in particular Christoph Vitzthum and Eirik Linde at Wärtsilä Power Plants, and Tomas Wallin at Veolia Transport Sweden. Constructive criticism was provided by colleagues in academia, foremost Rafael Ramirez at Oxford University, Mikael Paltschik at Swedish School of Economics and Business Administration, Fredrik Lavén at the Gothenburg Research Institute, Kees van der Heijden at Oxford University, Åsa-Karin Engstrand at the University of Linköping, Ivo Zander at the University of Uppsala and Kent Eriksson at the Centre for Banking and Finance at the Royal Institute of Technology in Stockholm. The study has emerged in a context of clinical applied research, for which we are indebted to colleagues at NormannPartners, in particular the late Richard Normann. We would also like to express a special thanks to photographer Bruno Ehrs, for conceptual images with which he skilfully captures the essence of what this book is about. Much of what may be considered as good in this book is in-

spired by interacting with the individuals above, and we feel privileged for having been given the opportunities to do so. All errors are the sole responsibility of the authors.

Stockholm in August 2009

Niklas Arvidsson *Ulf Mannervik*

Contents

1 Are we getting better at the wrong things?

> *"Don't only focus on preserving of the old, leaving the creation of the new on the backyard."*
> Esko Aho, President of SITRA, European Presidency Conference on Innovation and Clusters, 2008

Why is innovation policy for renewal needed? How is it different from getting better at what you are already good at? How can we avoid getting better at the wrong things? These are questions of high relevance today, as we are standing with established industrial and service sectors, large clusters, many ill equipped to serve our societies well in managing the transition from the industrial economy to an ecologically and socially sustainable society, with sufficient economic growth to provide for a high level of quality of life. This dilemma is of critical importance for the developed world, but even more so for the developing and under-developed world, which face challenges on an overwhelming scale.

This is a book about innovation policy. It does not claim to encompass all what innovation policy is or should be about. But what it does is to provide a framework that explains what renewal is, how it differs from every-day continuous improvement, how it happens, and what it means for innovation policy. The framework is helpful for balancing innovation policies that foster existing growth platforms with innovation policies that foster strategic renewal for tomorrow's growth platforms.

Also, whereas much of the existing innovation policies focus on existing and emerging clusters, this book gives more attention to fostering new growth areas in connection with large, complex socio-technological and ecological challenges that cut across industrial and service sectors and clusters, such as sustainable energy, transportation, mobility and health. These are global challenges, of global concern, even though solutions have to be sought partially on the local level.

Storms ahead

There is good reason to talk of storms ahead for industries and our societies at large. Industries and societies have gone through periods of remarkable change in the past, when new structures have been created and changed the rules of the game. The 20th century had several such periods. As we write this, the global financial crisis is still shaking the world and has led to new ways of managing risks, banks and financial markets. The outcome, the structure and effectiveness of new solutions are yet to be seen.

But if we look ahead, we face enormous challenges of other kinds, in particular if we are to achieve an ecologically and socially sustainable society. We note this not only in our capacity as researchers, but also from our parallel experience as scenario advisors, developing and exploring scenarios on global level and in regions such as North America, the Middle East and Europe. In particular our assignments in the energy and power fields reveal not only the tremendous challenges the world faces in fields as energy, water, food and health, but also how strong and conserving the existing technology and business ideas and industrial structures often are, and how policy makers often fail when trying to foster renewal of such structures.

The challenges coming at us from the future are mounting up, but we are at the same time prisoners of the solutions from the past. There are more storms that will hit us, and we can either embrace them proactively and seek solutions that help us deal with them in a constructive and sustainable way – or we can neglect the storm warnings, and be ill prepared once they put devastating pressure on industrial and societal structures.

Balancing growth and renewal

If we are to proactively foster renewal of industrial system, there is a need for a good understanding of what renewal is, how it differs from everyday continuous improvements, how it happens and how it coexists with growth processes. The framework for balancing growth and renewal, proposed in this book, is a result of a long term historical study of regional innovation systems that underwent strategic renewal (see Mannervik & Arvidsson, 2005).

By using the framework for balancing growth and renewal, we want to stop treating innovation as a black box. We must see that there

are two different but complementary innovation processes in all innovation systems and that both must be functioning well over time. There are some processes that strengthen and create growth based on business and technology ideas which already exist, and there are other processes that break the mold, challenge institutions, renew the system and create new growth platforms. These two types of processes are very different, and sometimes compete for scarce resources.

Growth processes or efficiency processes around existing capabilities are fostered by measures as strengthening the existing institutions, increasing transparency in knowledge areas, building critical mass in terms of competences, economies of scale and specialization. Current growth platforms are exploited.

Renewal processes on the other hand, the seeking of the new, are fostered by pragmatic entrepreneurial collaboration by visionary individual actors, persons within companies and academia who are by default threatening existing institutions. This is an exploration of new future growth platforms.

The study we present in this book informs us that innovation systems have a built-in tension between exploration and exploitation. They both exist at the same time, even though one of them may dominate the system at some point in time. Some actors in the system embark on exploration if there are external or internal tensions in the current growth platform due to perceived or real misfit with changing customer demand, societal needs, and competition from new and more effective technological solutions, et cetera. This tension can also come from such actors' vision of more effective technology and business ideas, or simply a personal ambition and vision of creating new, frame-braking and superior solutions. And actors in exploration aspire for establishing their technology and business ideas as new growth platforms, shifting over to exploitation and growth when there is fit with ever larger parts of markets, complementary technologies, and so forth.

We believe it is important to understand the difference between these two processes, in particular for innovation policy makers. With the framework, we can critically evaluate innovation policy efforts in terms of fits between ambitions and activities.

It is important to acknowledge what we call the *innovation paradox* in innovation policy making. When we have reviewed innovation policies on regional, national and EU-levels, further described later on

in this book, we have seen that there is often an ambition of renewing the system and creating new growth platforms. But when you look at the actual innovation policy tools used or prescribed, these often focus on strengthening existing institutions. They tend to involve large program committees, and focus on improvement of the existing business and technology ideas, more than on exploration of new ideas, and ignore links that are between clusters and between global sectors – and in particular between individual actors who belong to different clusters and sectors. We mean that we need to acknowledge the existence of the innovation paradox, and that ambitions of renewal can't be met with activities for growth. We should stop hoping for A while rewarding B.

Figure 1. The innovation platform for balancing growth and renewal

The innovation policy toolbox must contain methods both for growth and renewal. We need methods for strengthening existing clusters and sectors. But we also need methods for seeking the new business and technology ideas that will become tomorrow's growth platforms by allowing for exploration and experimentation over time. To ensure action, these methods must have an actor perspective, not a cluster perspective.

The framework for balancing growth and renewal is effective for analysis of innovation systems, and has foremost been used in large regional contexts. It has also guided the establishment of a pan-European innovation alliance of large European urban regions with research and business in leading positions in high technology fields. We will describe how the framework was deployed for that purpose. Lastly in this book, with a basis in the framework, we suggest an ap-

proach for innovation policy aiming at strategic renewal and fostering of tomorrow's growth platforms.

A call for innovation policies for renewal

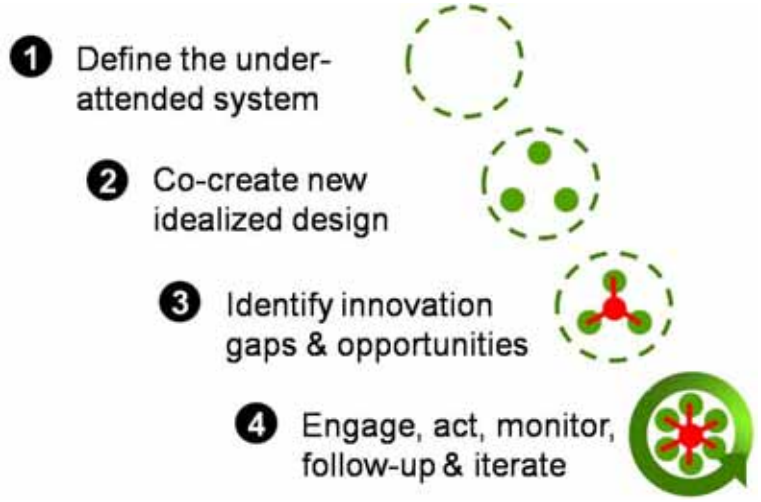
We argue that we need innovation policies for renewal, which should aim to mobilize forces than can contest the current systems and their ways of operating. Such contesting is arguably not most effectively lead by politicians and technocrats, but by collaborating individual actors in companies – in dialogue with leading expertise in academia and enabling politicians - aiming for creation of new business and technology ideas. It is these actors that can mobilize resources on a sufficient scale and make change happen. Renewal has to be applied and action led.

We will show how this approach was deployed for an international initiative on *Sustainability in Cities*. The approach to innovation policy for renewal is based on challenging existing sector structures, with a small set of industrial actors pursuing research and real business development in continuous dialogue with policy makers. The applied and action led approach is in stark contrast to the often high level generic approaches that are common in innovation policy formation today, and that often favor existing industrial structures.

The action-lead approach to innovation policy for renewal starts by identifying an under-attended need in a social and economic system which cuts across industrial sectors. This can be an applied holistic system such as health, energy or transportation. This is followed by the forming of a constellation of actors who wish to challenge existing solutions for how the need is served, or not, today. These actors develop an idealized design of a more effective system. Based on the idealized design, the actors identify bottlenecks or innovation gaps in the current system, if the idealized design is to be realized. The actors actually explore business opportunities that can lead to the closure of gaps and realizing higher system efficiencies. The fourth step is a long term, mutual learning process, where the actor constellation, possibly enlarged, act to realize the identified opportunities, in dialogue with policy makers who explore what innovation policy tools can support the renewal process. The constellation monitors the progress and adjusts the emerging solutions in a stepping stone approach to development, where solutions emerge in dialectic with a vision or idealized

design of the systems. It is this process that gradually develops and changes the solutions to accommodate what is possible and can be realized.

Figure 2, An action-lead approach to innovation policy for renewal



In our work on policies for renewal with the County of Stockholm and VINNOVA, we selected the applied theme *Sustainability in Cities*. The reason behind this choice was that our previous experience had led us to the insight that innovation policies benefit from being applied, concrete and effective. Furthermore, sustainability in cities is not only a real and profound challenge to society and mankind. It is also a good example of large, cross-sector and complex field. It has established intra-sector structures around existing business and technology ideas, which tend to be unsustainable, ineffective and slow to change. It is a field in which a holistic view and systems thinking – transcending cluster and industry borders – is very much in need. And as such, it is a good example of where we all need to break out of existing innovation policy inertia, and facilitate the emergence of new sustainable growth platforms.

Now, as a reader you may argue that if renewal seems to result from constellations of individual actors, which lead entrepreneurial visionary and pragmatic processes in tension with existing institutions, why not leave renewal to these constellations and suggest policy makers to refrain from involvement?

It is not that renewal doesn't happen without policy efforts that foster it. But firstly, if there is a great need for renewal, it is problematic if innovation policies are only preserving the old structures. Secondly, policy makers have some powerful tools that can be effective for fostering renewal if wisely deployed. These may include lead market initiatives through public procurement as well as regulation and deregulation that favor new solutions or create tensions that the existing industry structure need to react to and that may trigger renewal efforts. Such tools have to be deployed in an insightful and effective way, if we are to proactively meet the storms ahead and turn threats and challenges into opportunities for sustained social stability, quality of life and prosperity.

2 Setting sails for a new conceptual sea

> *"Sometimes a normal problem, one that ought to be solvable by known rules and procedures, resist the reiterated onslaught of the ablest members of the group within whose competence it falls. On other occasions a piece of equipment designed and constructed for the purpose of normal research fails to perform in the anticipated manner, revealing an anomaly that cannot, despite repeated effort, be aligned with professional expectations. In these and other ways besides, normal science repeatedly goes astray. And when it does – when, that is, the profession can no longer evade anomalies that subvert the existing tradition of scientific practice – then begin the extraordinary investigations that lead the profession at last to a new set of commitments, a new basis for the practice of science".*
>
> Thomas S. Kuhn (1962: 5-6).

We often say that the world change in a rapid pace – sometimes it is even argued that change has never been as swift as it is today – but it is at the same time true that certain things change slowly. Understanding novelty rests more on the ability to seeing something old in new ways than actually detecting something never before seen by mankind. If we are not able to see a new interpretation of old things, we are doomed to be stuck in an old – and perhaps outdated – understanding of the world. Conceptual models that help us understand certain aspects of our society during a specific time turn into mental prisons if society changes in a way that makes the old conceptual model – and tools derived from it – less useful. New times may demand new conceptual models. That time has come for innovation, where the old dominant models and their tools are losing in relevance and effectiveness, and becoming outdated. It is our ambition to provide a model that better helps understand innovation processes in the new networked and service-based business world.

The old industrial logic of innovation

Innovation has traditionally been modeled as a process where scientists or researchers try to solve well-defined problems by performing experiments in confined arenas such as laboratories or test sites. The problem or challenge is well defined and whether the experiment is successful or not is not thought of as being a problematic. If we are to innovate in order to "*cure cancer*" or "*develop a CO2-emission free engine*" both the challenge and the measure of degree of success is obvious. Given this, the people aiming to innovate have a straightforward however still very difficult job to do. Once the innovation challenge is met and a new treatment or engine is perfected, it is often assumed that the product will be sellable as long as customer research is done and competitive marketing and pricing strategies are developed. Or, as the old saying goes, "*a good product sells itself*". This view on innovation is a product from the industrial economy which during the post-WW2 period was driven by strong demand for technological solutions to the challenges business firms as well as consumers met. This approach meant that industry barriers and products in relation to a pre-defined demand structure were key factors for strategy and innovation.

This technology and product-centric view on innovation has been manifested in the product life cycle concept where evolution of competition is possible to analyze by focusing on industries and value-chains (Porter, 1980; Porter, 1985). The industry approach has been questioned, however, since an industry include many different types of products and services where some may be highly competitive and others non-competitive which leads to very different evolutionary patterns for different parts of an industry (Lambkin & Day, 1989). The idea that innovation is best understood as a diffusion process where ideas and inventions are formed – more or less in isolation from the external world – within firms or by entrepreneurs is therefore somewhat problematic. This approach leads to ideas that innovation success is determined by the ability to "*cross the chasm*" (Moore, 2002) in the diffusion process that occurs after early adopters have tried a new product and it is time for the early majority to catch on. Given this approach, the secret to successful innovation and commercialization is about convincing customers and users that the "*innovation*" is good for them.

Industrial strategies – tools to maximize the share of the pie

Michael Porter's work on strategy and innovation builds on this tradition. His model of firms' competitive advantages points out that competitive strength is based on the ability to create protected positions in segmented markets via differentiated products and services and/or efficient production economies (Porter, 1980). Value – or rather profitability of the producer – is created via incrementally adding new features to raw material and products in a sequential value-chain process (Porter, 1985). Starting from natural resources and other raw materials, this incremental process creates value by gradually adding sophistication and in the end delivering and selling products to customers. The profit for a firm – the margin (Porter, 1985) – is then calculated by subtracting costs from revenues. Given that change occurs, any firm wanting to stay competitive must of course also be innovative and renew itself which can be stimulated by linking oneself to a cluster or innovative arena of organizations (Porter, 1990).

Porter's cluster concept sees competition as a dynamic process where each firm's source of competitive advantage constantly is challenged. Porter's cluster model analyze factor (or input) conditions, the context for firm strategies and rivalry, demand conditions as well as related and supporting industries to explain the economic strength of a region. Even if the cluster concept does not have to be strictly related to an industry, this is what has been seen when the concept is used to analyze innovativeness and develop innovation policies. Innovation arenas based on the cluster concept are defined around a pre-existing technology and industry such as, for instance, digital media, consumer electronics, automotives or textiles (Porter, 1990; Sölvell et al., 2003).

The industry and product focus also implies that the analysis is limited to factors already present within an industry and therefore has a bias towards analyzing static forces of competition. If the analysis focuses on rivalry within a pre-defined industry there is an assumption that firms' strategies are formed reactively as external factors and forces changes the competitive game. This approach also tends to lead to cases where strategy and innovation are ruled by head-to-head competition and a "race to the bottom" between stable firms (Kim & Mauborgne, 1999). We believe it is time to re-think concepts and models for innovation, especially given changes in the global business world as Internet, open source innovation, increased use of projects

within firms as well as within actor constellations or networks, and increased importance of service-based value creation.

A call for new models

Porter's models of industry analysis (1980) and value-chain systems (1985) were well suited to the business logics of the industrial era, but less so today given that the global business landscape has changed dramatically during the last 30 years. We are now facing a new era in the economic development. Some prefer to call it a post-industrial society (Touraine, 1971; Bell, 1976) while others use the terms information society or knowledge society (Machlup, 1962; Drucker, 1969) or service economy (Normann, 2001). This change has been labeled a 2nd industrial divide (Piore & Sable, 1984). Whichever term we prefer to use, it is evident that the economy has undergone significant changes in the last decades. The thinking on firms, sources of competitive advantages and organization of value-adding processes that underlie Porter's model are not coherent with the actual characteristics of today's economic reality (Normann & Ramirez, 1993, 1984/1998). As explained by Moulaert and Sekia, Porter's (1990) model:

> *"emphasizes market and competition rather than networking and social interaction as success factors for clusters of innovation, and showed only a marginal interest in regional dimensions of innovation"*
> (Moulaert & Sekia, 2003:293).

We therefore argue there is a need for models of innovation systems that acknowledge a socio-technical approach, are dynamic, do not view people as only being driven by maximizing their economic gains and that are built on a view of firms that reflect the economic and business realities of the 21st century. Our aim is to build on insights of how the business landscape looks today to develop a model for how we can understand dynamic innovation processes in systems and actor constellation.

Innovation in a service-based logic

One way to describe the business landscape in the early 21st century is to focus on which value firms' offerings, i.e. combinations of products and services, provides for customers when these offerings are co-created by a firm and its customer (Normann, 1975/1977; Normann, 1984/2000: Normann, 2001; Normann & Ramirez, 1993; Normann &

Ramirez, 1984/1998; Ramirez & Wallin, 2000). This view of the business landscape sees innovation as a learning process where actors co-create new offerings, i.e. combinations of products and services, in ways that create value. This view on innovation, upon which we base this study, means that a firm – regardless whether the most important part of the offering is manifested in a product or a service – cannot focus only on their own internal processes, but must also organize and be attentive to both their suppliers' as well as their customer's internal processes. Both the seller and the buyer play important roles in the innovation process; a process which aims to improve the value for customers when using an offering. This process may include others, and is not restricted only to buyers and sellers.

Even if Porter's cluster concept has been useful in many instances we must acknowledge there are alternative approaches to explaining innovation systems in a new business landscape. Moulaert & Sekia (2003) outline and discuss alternative approaches and their theoretical backgrounds by categorizing six different approaches to territorial innovation. They label Porter's approach as a model of spatial clusters of innovation, which is based on a number of researchers' work (Porter, 1990; Saxenian, 1994; Sölvell et al., 1999). Other approaches are described as innovative milieus (Ratti, 1989; Ratti, 1992; Camagni, 1991), industrial districts (Bagnasco, 1977; Brusco, 1986; Brusco, 1992; Dei Ottati, 1994a, 1994b), regional innovation systems (Edquist, 1997), local production systems (Bouchrara, 1987) and learning regions (Cooke, 1998; Morgan, 1997; Lundvall, 1992 & 1994). The study by Moulaert and Sekia (2003:294) emphasizes that there is semantic coherence and unity between many of the approaches but it is evident that there is conceptual ambiguity as to what innovation in industrial systems is and how it works.

According to Moulaert and Sekia (2003:295) the main weaknesses of many of these models – including Porter's – relates to their view on innovation processes and culture. The models treat innovation as almost entirely being based on technological breakthroughs. Some of them – the models called new industrial spaces, local production systems and regional innovation systems – build on a technological approach where investments in R&D and production methods are assumed to be the main way to create innovation. Other models – innovative milieus and industrial districts – stress the systemic characteristics and relationships as the main explanatory factors. The learning

regions model, on the other hand, starts from a technology perspective but adds the importance of institutions and especially the co-evolution of technology and institutions. We conclude that an important key to improve our understanding of innovation processes in the new business landscape is to understand innovation processes from a socio-technical perspective (Geels, 2004) and not only focus on technological innovation.

Innovation happens via collaborative action in business networks

Our point of departure is that innovation processes occur in business networks (Schilling & Werr, 2009). The idea here is that actors co-create offerings that generate value in value constellations (Normann & Ramirez, 1993; 1984/1998), suggesting that innovation activities are organized not only within but also across firm boundaries. However, what distinguishes our approach from traditional network perspectives is that we focus on the actions of the actors that are enrolled in value constellations and offering development, as opposed to taking actors and their positions in innovation systems for granted (Lavén, 2008; Arvidsson, 2008). The offering serves, amongst other things, to organize the continuous learning process in which typically both buying and selling actors are involved (Normann, 2001).

Grönroos define services as being dependent on interaction between actors where: “the consumers are actively taking part in shaping the service offering, i.e., in product development” and that: “the consumer himself can be considered part of the service he buys and consumes” (Grönroos, 1978: 596). This means that customers co-create services but also that other actors influence the offering via their simultaneous actions (Normann, 2001; Normann & Ramirez, 1984/1998; Grönroos, 1982). Based on this view services can therefore be defined as: “processes that consist of a set of activities which take place in interactions between a customer and people, goods and other physical resources, systems and/or infrastructures representing the service provider and possibly involving other customers, who aim at solving customers’ problems” (Grönroos, 2006: 323). This implies that management of service innovation processes must aim to deliver customer value that exceeds customers’ currently experienced needs, that the final manifestation of this innovation process is a combination of products, services and infrastructure (Normann, 2001), and that apart from the direct customer there are also other actors in the system

that play important roles (Normann & Ramirez, 1984/1998; Ramirez & Wallin, 2000).

To understand innovation dynamics, it is vital to study innovation actions and activities. This choice of perspective lies at the forefront of contemporary organization theory, furthered by advocates of organizing (Weick, 1979; Czarniawska, 2004), suggesting that there is much to gain from studying organizations as processes rather than as structures. Otherwise we risk focusing on rational representations of organizational structures rather than on the actual organizing activities. Indeed, similar results are seen in Lavén (2008) who studied how innovation policies were translated into practice in a Swedish innovation initiative. His study showed how a focus on innovation structures may in fact lead to a *structural precedence* which results in inertia rather than innovation activities. Again, this reinforces the idea that action and not structures lies at the heart of understanding innovation phenomena.

Creative destruction in innovation systems

Our approach implies that we do not limit ourselves to a life cycle model of evolution in an innovation system as Porter (1990) and Carlsson & Jacobsson (1997) did. We do not ex ante limit the analysis to existing industries and technologies and their life cycles. For methodological reasons we will start from some sort of manifestation of an innovation system, such as an industry, but we want to free ourselves from these boundaries in the analysis. Given that Schumpeterian dynamics is a central characteristic of a regional innovation system it may of course be the case that one particular industry is strongly threatened by exploration and may consequently act as a barrier for this process. We want to acknowledge resources as such and the possibility that they are deployed in alternative uses as existing technologies and business ideas deteriorate. We do not limit the analysis to a particular industry and its surrounding cluster. Instead, we want to focus on the innovation system as such which may include several industries and does not limit the analysis to the birth, growth and decline of one particular industry or cluster.

Our approach is consistent with critique on the cluster model and other innovation system approaches. According to Moulaert and Sekia (2003:295) the main weaknesses in many models of innovation systems is that they treat innovation as almost entirely being based on technological breakthroughs and that the models could benefit from

understanding innovation processes in a socio-technical perspective (see Geels, 2004). Many models tend to assume managers and firms are governed by a business culture that is mainly instrumental to the capitalist market logic and do not reflect non-monetary value in terms of, for instance, "*quality of life in local communities or territories*" (Moulaert & Sekia, 2003:295). In the same line of reasoning, Martin and Sunley (2003) ask for models of territorial innovation that addresses dynamics and evolutionary dimensions of innovation processes.

The models also tend to assume managers and firms are governed by a business culture that is mainly instrumental to the capitalist market logic (Moulaert & Sekia, 2003). All of the models focus their discussion on improvement in terms of economic value and do not reflect non-monetary value in terms of, for instance,

> *"quality of life in local communities or territories"*
> (Moulaert & Sekia, 2003:295).

The authors conclude that models of territorial innovation must acknowledge that people are not strictly governed by economic motives but also influenced by non-monetary rewards, and that models of territorial innovation must be dynamic in their nature. In the same line of reasoning, Martin and Sunley (2003) ask for models of territorial innovation that addresses dynamics and evolutionary dimensions of innovation processes.

There is a need for models of innovation systems that acknowledge a socio-technical approach, are dynamic, do not view people as only being driven by maximizing their economic gains and that are built on a view of firms that reflect the economic and business realities of the 21st century.

A new understanding of innovation systems

Firms in today´s global economy base their actions on collaboration and service based components when developing new strategies. Today a company like the Finnish Telekom giant Nokia relies on open source innovation and also creates customer-based communities in order both to develop their products and services but also to grow a stronger brand name and better customer relations. Nokia has created a lead-user community called *Nokia Beta Labs* that are given an opportunity to pre-test and give feedback to new products and services that are not launched on the public market and still are under development. This

not only provides Nokia with critical and valuable information on new offerings that are developed but also strengthen the customer relationship with those customers that are qualified to become part of the community. The old secret and hidden R&D-labs where virtually none could gain access are forgotten. Innovation processes today relies on communication and interaction with critical actors outside the own company. A new understanding of dynamic processes in innovation system must build on this new reality.

The fundamental focus of business activities in a service-based economy is to create offerings that generate value for the customers that purchase them. Value can be of different types – for example when a firm relieves another actor from having to operate certain activities or when an offering enable the customer to achieve results that otherwise would have been impossible (Normann, 2001) – but is best understood and analyzed from the customers' perspective. The profitability of an offering should therefore be analyzed by understanding the value for the customer in relation to the costs for the firm (of firms) providing the offering. Another important part of today's business world is also the importance of specialization and coordination in networks and value-constellations which means that the provider of an offering has to lead and organize a constellations of actors to make the offering attractive (Ramirez & Wallin, 2000). And, given that we have moved into the service economy, value for customers is realized in a collaborative process between the seller and the buyer.

Co-creation of value is the name of the game. It is the offering that organizes action in the collaborative process where learning is the most important driver. IKEA's offerings are not only described in terms of a furniture but also in terms of what is expected from IKEA and what is expected from the customer if the offering is to become valuable for both parties. As IKEA tell their customers:

> *"You do your part. We do our part. Together we save money."*

Their offerings rely on customers performing certain activities like transportation and assembly, and in this way design the interaction process in a very specific way. Customers that are not willing to accept this process simply do not purchase from IKEA. Another way to understand offerings is therefore to see them as organizers of collaborative learning processes where sellers and buyers are the main actors. Offerings, value, value-constellations and collaborative learn-

ing processes are therefore the key features if we are to understand dynamics in innovation systems.

Given this, a new understanding of innovation systems needs to acknowledge today's social and economic realities and dynamics. Eliasson (2000) has developed and outlined clear characteristics of experimentally organized economies based on the notion of open systems and creative destruction. He follows Schumpeter's (1934) view on innovation and creative destruction, which implies an open system approach (Katz & Kahn, 1966) and that economic actors operate in turbulent environments (Emery & Trist, 1965).

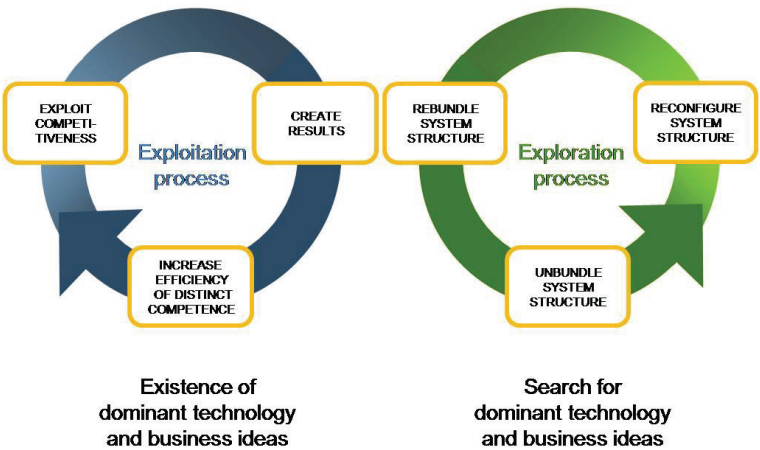
Eliasson's five characteristics are, first, a strong knowledge based information economy that underlies the environment. People are regarded as boundedly rational (Cyert & March, 1963), holds tacit knowledge (Polanyi, 1969) and act from what they believe are right. Second, the system is open and development is characterized by Schumpeter's processes of "creative destruction". Third, there are supportive competences and institutions that create competence blocks suitable for global and local demand. Fourth, there are institutions – of all sorts – that allow and stimulate new ideas and, most importantly, do not oppose that which challenges the current norms and ideas. Last, social capital (Putnam, 2000) stimulates meetings and open discussions leading to exchange of ideas and learning. A model of innovation in systems should start from these characteristics but also incorporate more specific characteristics of learning and change.

Different learning process for growth and renewal!

To further our understanding of innovation systems we will apply theories on organizational learning and change where two fundamentally different change processes have been identified. One type of change process has been described as evolution (Greiner, 1972), adaptation and correction (Normann, 2001), single-loop learning (Argyris & Schön, 1978), reinforcing feedback (van der Heijden, 2005), and exploitation (March, 1991). This change process leads to increasingly improved production and exchange within the current system by upgrading the internal efficiency. There is change and learning within this process but this learning does not challenge the fundamental assumptions, structures and values upon which the system is grounded.

The second change process has been called revolution (Greiner, 1972), frame breaking reconfiguration (Normann, 2001), double-loop learning (Argyris & Schön, 1978) and exploration (March, 1991). This change process challenges the underlying assumptions of what makes the current business system successful and, if successful, leads to a new type of business system. Fundamental system dimensions as technologies, business ideas, values, behavior, what is valued as well as roles and responsibilities of different actors may change completely. The structure of the system is unbundled, reconfigured, and rebundled into a structure capable of higher system efficiency and value creation (Normann, 2001).

Figure 3. Exploitation and exploration processes



The two models of change outlined above have previously mainly been applied to explain organizational change and learning. But we argue their systemic features also make them relevant for understanding innovation processes in systems. Exploration of new opportunities and exploitation of old certainties as well as the inherent conflict of the two was in fact also a part of Schumpeter's work (1934). Our objective is thus to better understand change dynamics in open systems with the help of these two different types of change process. The two processes are outlined in more detail below based on March.

Table 1. . Characteristics of exploration and exploitation (March 1991)

Exploitation	Exploration
Refinement	Search
Choice	Variation
Production	Experimentation
Efficiency	Play
Selection	Flexibility
Implementation	Discovery
Execution	Innovation

Complementary and dynamic interaction between exploration and exploitation

It is important to note that the two change processes, which from hereon will be called exploitation and exploration, do not substitute each other but rather complement one another. It is not a matter of either or. As stated by March (1991:71):

> *"Adaptive systems that engage in exploration to the exclusion of exploitation are likely to find that they suffer the costs of experimentation without gaining many of its benefits. They exhibit too many undeveloped new ideas and too little distinctive competence. Conversely, systems that engage in exploitation to the exclusion of exploration are likely to find themselves trapped in suboptimal stable equilibria. As a result, maintaining an appropriate balance between exploration and exploitation is a primary factor in system survival and prosperity". This quote also reveals the underlying conflict that often appears between these two processes. An organization or a system of actors may chose to concentrate their resources on one or the other of these two processes during a certain time period. Over the long run, however, efforts to stimulate both are crucial. Exploration is needed to renew the system but it is only through exploitation that the benefits of renewal are reaped.*

It is also important to note that Porter's model (1990) is built on the notion that innovation processes are created through rational decision-making processes in firms and among other economic actors (Porter 1980) while:

> *"…there seems little question that technologies of rationality are often effective instruments of exploitation"*
> (March 2006: 207).

The rational approach may consequently block exploration. We will therefore build a model of dynamic processes in innovation system built on the two different but complementary learning processes of exploitation, which potentially leads to increased efficiency and short-term growth, and exploration, which potentially leads to radical innovation, increased effectiveness and long-term renewal.

Towards a new understanding of drivers of innovation

To better understand how long-term renewal happens in regional innovation systems, the next chapter will explore the drivers behind growth and renewal respectively, and study the interplay between exploitation and exploration. We will present and discuss our studies of long-term innovation processes in three different industrial systems in Sweden. In this research process, we witnessed clear and shared patterns of how the systems tended to be dominated by growth or renewal in specific time periods, which then were followed by periods of tension and almost competition for critical resources between proponents of each of the two processes. Actors wanting growth were found to fight for resources against actors wanting renewal. Even though both these types of actors needed each other over the long run, they became fierce opponents in the short run. When doing these studies we realized that a critical factor for long-term renewal concerns how these fights are governed. The next chapters will explain why and how.

3 Stories about long-term renewal

> *'If you have the union and Rotary against you, then you know you may be on the right way.'*
>
> Interviewee in the IT and telecom case study

We use three stories or cases to illustrate and explore the inner characteristics of growth and renewal processes in large industrial systems. The cases are historic and study how the systems have evolved over time, in order to better understand processes and drivers affecting change. In dialogue with VINNOVA, we have chosen two cases which succeeded in long-term lasting renewal and one in which it is less obvious if the renewal has been truly transforming and sustainable. Specific attention is given to the social dimension; interaction between actors in these systems, and the roles of such interaction throughout growth and renewal. The historical case studies were conducted by us in 2004 and 2005.

The two cases which have had lasting and transforming renewal are both industrial fields within biomedicine in the Gothenburg region in West Sweden – cardiovascular and metabolic diseases is the first of these fields and the other is biomaterial and cell therapy. The third case is IT and telecom in the South Swedish region Blekinge.

The Gothenburg region has emerged as a breeding ground for substantial innovation within biomedicine. The journey has spanned from the middle of the 1950's and up to today. Over this long time period there has been phases dominated by those wanting to break with traditional 'rules of the game' to seek new technology and business ideas, and other times when new business paradigms have gained foot hold and have gradually evolved towards dominant business ideas with good growth potential. It is a journey with a set of actors with both strong minded and controversial individuals, as well as mobilizing companies which have had the capability to create economies of scale around unique and distinct competences. Two areas within biomedicine have been of specific importance for the sector and regional innovation system; the field of cardiovascular and metabolic diseases,

and the field biomaterial and cell therapy. These fields have many similarities in terms of how they have evolved. But there are also some important differences. Therefore they are described as two separate stories and cases.

The so called 'Telecom City' in Karlskrona in the region Blekinge has gained a lot of recognition in Sweden during the last decades. Collaboration between academia and industry succeeded in a turnaround of regional decline, into renewal and growth during the intense IT era in the 1990's. From having been a rust belt region, it established a position as an internationally leading centre within signal processing technology related to telecom. The story about Telecom City is rich and informative, both for what drives successful renewal and challenges to make renewal turn into a sustainable long-term growth.

Biomedicine in West Sweden

Sweden has a long tradition within pharmaceutics. The Gothenburg region has played a key role in that tradition, in particular for the emergence of an industry with global competitiveness and lasting value creating capability.

From national to international ambitions

The pharmaceutics company Hässle had a central role in the development of the Gothenburg region as a domicile for biomedicine. The company was sold to Astra in the 1940's. In the 1950's Hässle divested other chemical preparations and focused on pharmaceutics. In connection with this, the company moved from Hässleholm to Gothenburg to gain physical proximity to academic research.

With some few exceptions, the Swedish pharmaceutics industry was not internationally active with its own preparations at that time. Instead, Swedish companies developed products which were similar to what international companies already had in their product range. This was the case for Hässle too, which was exclusively focused on the Swedish market and had a difficult economic situation. Shortly after the move to Gothenburg, Hässle recruited Ivan Östholm who later would become its head of research. Already from the very start, Ivan had the ambition to develop unique preparations for international markets.

Through collaboration with academia in particular in Gothenburg and Stockholm, and through seeking innovative ideas in dialogue with hospitals, Ivan created some preparations which contributed to improving the economic situation for Hässle. The collaboration with academia also improved the quality control at the company, which was an organizational innovation in itself, with importance for the company.

However, in the beginning of the 1960's Hässle was facing lack of resources and competences for developing new medicines. The company felt pressure from international competition and increasingly costly development processes. Through dialogue with academia Östholm understood that the existing R&D portfolio was too weak. Something drastic had to be done.

Towards new development mechanisms

Östholm contacted Arvid Carlsson, a young and talented professor who had been recruited from the University of Lund and had been offered to head the department of pharmacology at Gothenburg University. Carlsson advised Östholm to let go of the existing development portfolio and instead focus on biological human disease mechanisms. This was in stark contrast with the development model established in the industry, which synthesized chemical substances and explored their medical effects. Carlsson thought that Hässle would not succeed in creating unique medicines if they used the same development models as its international competitors. They needed a proprietary and unique approach. To use the new science pharmacology for this purpose was controversial compared to the dominant approach and seen with great skepticism by the established industry and academia at this time. But the entrepreneurial Östholm saw that something drastic had to be done and had faith in the approach suggested by Carlsson. Furthermore, Carlsson was willing to assist as consultant to Hässle. This also helped Carlsson himself, as it enabled him to test and explore ideas which had met resistance from more traditional academics.

Hässle changed its R&D strategy under the leadership of Östholm. In collaboration with academia Hässle started to follow new biological principles when designing new projects. Other influential researchers who had significance for the development of this research practice at Hässle were the physiology professor Björn Folkow and the professor in cardiology at the Sahlgrenska University Hospital, Lars Werkö.

Östholm and his close associates also collaborated with others in academia, which enabled each of them to develop individually and to test their ideas. Östholm recruited researchers from the medical faculty at Gothenburg University and the Sahlgrenska University Hospital, to improve the quality of Hässle's own research and strengthen the capability to collaborate with academia. And several of his colleagues received their own Ph.D. degrees during their work. On the whole there was a close collaboration and interplay between a small circle of people within the company and academia. The young academics fought battles against the established schools of thought in academia and the pharmaceutics industry when developing new medicines. Östholm and his close associates also fought many internal battles, often with controversial methods to overcome obstructions from the power residing in formal hierarchies. It was a pragmatic development, guided by perceived needs in healthcare and high qualitative visions and ambitions. The central individuals also developed close personal bonds.

> *'The right individuals in the right context create sparks that lead to potential blockbusters. There are sometimes individuals who can do that on their own, but in most cases the context is of crucial importance'*
> Interviewee in the biomedicine case study

Structuring of the system

Over time the collaboration led to commercial successes, but it was also beneficial for academia. Östholm stimulated academics to publish new scientific advances which had emerged through collaboration. This motivated the young researchers in academia, and also contributed to strengthening the internal knowledge culture at Hässle. But the key benefit for Hässle was that publishing gradually built market acceptance for new preparations. And the openness around the own knowledge development implied opportunities for further learning, since Hässle became part of dialogues in wider research communities. The management teams of Hässle and its owner Astra were initially skeptical to this exposure of information critical for the business, but Östholm succeeded in keeping them at bay.

The process of transforming the college of higher learning to a full university status was supported by dialogue between Hässle, academia and the political leadership during the second half of the 1960's. This improved the prerequisites for the knowledge development that Hässle

had access to, both locally and internationally. Local and government politicians also created a complimentary hospital, which gave Hässle access to an advanced user system. Hospitals are important customers and demanding users of pharmaceutics companies' products and services, but they also have patient data bases with detailed information about patients. These patient data bases are very important for development of medicines. For Hässle, they had just as profound importance as the close contacts with Carlsson, Folkow and Werkö. Lars Werkö helped initiate data base collaboration between academia and Hässle. The collaboration included concept stages, pilot tests and full scale clinical tests. The geographic proximity facilitated the collaboration, and has continued to do so throughout the years. Terms for formal clinical tests were regulated and academia and medical care were compensated by Hässle, whereas collaboration in clinical research at basic level or conceptual stages was conducted without compensation. Relations built on confidence gradually shaped over the years. Researchers met and discussed informally in corridors without formal confidentiality agreements and also met outside work at dinners and other social gatherings. The collaboration around the patient data bases was a critical success factor for Hässle, since it could not access this data without the collaboration with the hospital.

The collaboration between academia and industry lost some momentum during the early 1970's, as the anti-commercial values of that era meant that industry collaboration was seen as unethical within academia at large. But this did not hinder the creative groups of individuals around Östholm to keep driving the development forward.

Breakthroughs

In 1967 Hässle had its first patented original product Aptin, which had effect on several heart diseases. It became somewhat of a breakthrough and the most sold medicine in Sweden. But it was never registered in the US, and could therefore not reach broader markets internationally. So far, the international markets did not have sufficient acceptance for this kind of medicine.

The follow-up medicine Seloken had a stronger breakthrough. Extensive high quality documentation of its medical value meant that it could be registered fast in Sweden in the beginning of the 1970's. Approval on the important US market was also fast, due to the extensive documentation of the preparations medical value. Seloken became one of the world's 10 most sold medicines during the 1980's and

1990's. The market successes created an increasing amount of financial and knowledge resources. This also made it easier to recruit competences to both academia and business.

When Seloken was to be further developed, a small number of strong minded individuals paved way for renewed success. In 1986 the chemist John Sjögren at Astra developed the preparation so that its effect had longer duration, which implied that the preparation could get an extended patent. This was completed in 1990. There were, at the same time, indications that the preparation was a good treatment for heart failure. But extensive and very costly clinical tests were required to prove this. The management team at Astra (now AstraZeneca) did not believe in the new application and were very skeptical to initiating clinical tests. But John Wickstrand and Åke Hjalmarsson at the Sahlgrenska University Hospital were convinced they had a correct indication. In the end they succeeded in getting a green light for clinical testing. It turned out to be a successful path. The preparation is one of the medicines that saves most lives per year today and is the most prescribed heart medicine in the world. The position on the US market is very strong and the medicine is an important source of income for AstraZeneca.

What later would become the blockbuster Losec was completed in its synthesizing by the end of the 1970's, after 20 years of development. The pioneering project contributed to a whole new class of medicines, but the development was lined with a lot of serious setbacks. At one point the governmental technology development agency NUTEK co-financed some of the development. The management team of Astra, on the other hand, tried to cancel the project at five occasions. The persistence, creativity, collaboration, entrepreneurship and good luck of the researchers – together with the development approach which had been founded since the late 1950's and early 1960's – brought the project to its success. Losec was the world's most sold medicine during several years.

Streamlining of the business system

As time went by and the financial resources accumulated, Astra Hässle could employ its own professorships of commercially interesting fields. The company conducted research on its own, but also initiated academic research within its own fields and supported research within complementary fields. Finding complementary research fields was a particular strength, which led to development of the business.

The networks gradually became more global, even if geographic proximity continued to be important.

The proximity and access to both academia and medical care was of great importance and in some sense it became part of the business idea or the business system around Astra Hässle. From the industry point of view, academia and medical care had complementary roles in the business system and contributed to making it more effective. Medical care had customer data through its patient data bases and its register. Academia provided biomedicine companies such as Astra Hässle with competence in terms of graduated specialists, but also complementary competences for joint projects or consulting. Today, companies as AstraZeneca and Siemens run units for development and evaluation within the Sahlgrenska University Hospital. These units cooperate closely with the hospital's medical care.

> *'The notion of commercialization of ideas generated by academia is a new construct. It is important not to forget that each one should do what he or she is good at, and take that as a starting point for collaborating with each other.'*
>
> Interviewee in the biomedicine case study

Another way in which academia contributed to the development of the industry, was and is profiling and legitimizing a company, strengthening the image of a company and its products and services and fostering recognition of its qualities, through commissioned research that lead to publication or presentation at research seminars. That kind of collaboration can also have negative side effects on academia, if researchers devote a too large share of their time to 'commissioned lecturing' instead of spending it on their research.

The successes enabled further streamlining of market channels and the creation of better conditions for market collaborations, for example in terms of better negotiation position for license agreements. The growth gradually generated further resources which amongst other things could fund expanding of the market capacity.

The head of research Östholm retired in the beginning of the 1980's, but there were still people within Astra Hässle who were driven by strong research interest – and who at times could neglect internal rules in order to get acceptance for their ideas and succeed in their efforts to create something new.

Stabile system, with early signs of tensions

For a number of years Astra Hässle – today AstraZeneca – was the only substantial business within this field of biomedicine in the region, due to the highly capital-intense development process. Spin-offs came later, when Astra Hässle grew and couldn't capitalize on all its ideas internally. AstraZeneca is still dominant in the region and sector, but there are also other commercial ventures as for instance companies for clinical testing that were founded by professors in networks and with a university's holding company as co-financer. Furthermore, with its extensive research activities AstraZeneca in itself is a demanding customer for new technologies and offerings developed by other companies.

But in spite of these exceptions, Biomedicine in western Sweden is a comparatively traditional industry today. There are few companies that in a profound sense challenge the currently dominant technology and business ideas, as Hässle once did when they contested the then traditional approach to medicine and market development. At the same time, there are signals that today's traditional big pharma companies – including AstraZeneca– have meager development portfolios. In addition, biotechnology advances in other regions lead the way forward toward individualized diagnostics and treatments, which implies serious challenges to the pharmaceutics industry.

> *'There is no one who shakes up the pharmaceutics industry today! It is a fairly traditional industry as it comes to business thinking; substances become medicines, which are prescribed by doctors… Sure, the generic market rattles the cage a bit. The established actors do not really know how to manage that challenge. But the industry in general is traditional.'*
>
> Interviewee in the Biomedicine case study

The leading research competence in biomedicine resides in big established companies today. Collaboration with a broad and strong research community in academia was, however, of crucial importance for a successful biomedicine business during the emergence and the most intensive years of development for Hässle. It was the basis for development of a leading niche company. Reduced governmental research funding to academia may therefore undermine the basis for future commercial successes. At the same time, the region is now mobilizing resources to re-strengthen the development capability

within this field, and continue to build on the long tradition of collaboration between academia, industry and policy makers.

Biomaterial and cell therapy in West Sweden

In recent times the Gothenburg region has developed an international position within biomaterial. The development of this field shares many features with the development of the industry and innovation system within cardiovascular diseases. But there are also some noteworthy differences, which complement our understanding of the interplay between forces stimulating change and those conserving existing business and technology ideas, i.e. between renewal and growth.

Challenging of existing practice

It is foremost one individual person who had a decisive role in the origin of the biomaterial industry in the Gothenburg region. Per-Ingvar Brånemark – a young doctor educated as a surgeon in Lund – was recruited to the department of anatomy at the University of Gothenburg. In the 1950's, he was involved in basic research on the anatomy of human blood cells. By mere accident he observed that titan and bone tissue attached well. He redirected his research to focus on bone tissue and titanium. This eventually led him to the idea of using titanium screws to attach dental implants in the jaw bones, which he thought would considerably improve dental implants. Clinical testing was initiated in the mid 1960's. Brånemark himself was not a dentist and was seen with great skepticism by dentists as he challenged the conventional dental practice.

> *'Brånemark was an outsider and a persistent entrepreneur who didn't hesitate to get into conflict with the values of others.'*
> Interviewee in the Biomaterial case study

Brånemark did not let himself be stopped by the skepticism he met. He was seen as a controversial person who didn't hesitate to follow his own route. In the beginning of the 1980's he started to elaborate on the idea of large scale commercial manufacturing of the dental implant. He explored the business and technology idea together with the industrial group Bofors. The well reputed businessman Erik Penser was decisive for the support of the project during its time within the domains of Bofors and the Nobel Industries. It received substantial funding but several directors of the board were very hesitant about the

project. The initiative would not have succeeded without the personal support from Erik Penser.

Forming the business idea

The titanium screw wasn't advanced as an innovation in pure technical terms. Instead, the difficulties were to manufacture it with sufficiently high quality and to create market acceptance among the dentists.

Brånemark worked close to the manufacturing people and was continuously very demanding on quality issues. That led to a gradual evolution of the business idea, which consisted of not only the basic idea of using titanium for dental implants but also a high quality manufacturing process. The quality of the manufacturing process was a key question to resolve in order to create success. But it would take even longer before the market dimension of the business idea was resolved.

Breakthrough

Brånemark and Bofors/Nobel Industries had worked for a long time on the development of the implant, its manufacturing process, and entry on the international market. But the real breakthrough was a long time in coming.

Brånemark had the established academia against him and his idea for a long time. First, because he was not a dentist. And then since he was collaborating with business, which was in conflict with the anti-capitalist values in academia during the 1970's and early 1980's.

But by the middle of the 1980's some tone setting academics within odontology started to mention the method in favorable terms. It received support in influential publications. Together this eventually led to acceptance by academia. Having gained that acceptance, the technology rapidly came in demand. It was the last key that enabled an exponential business growth.

The growth generated economic resources that allowed for further competence and market development. Nobel Biocare, which was the company which owned the titanium screw, had locked into a virtuous circle, where they could exploit and further strengthen the competitiveness of its business idea. By the mid 1990's they had captured two thirds of the international market for dental implants.

Specialization and diversification

The industrial field of biomaterial in Gothenburg went through a period of specialization and diversification during the 1990's. In general terms, this industry did not require as much start-up capital as the pharmaceutics industry, which enabled a multitude of companies to emerge.

Nobel Biocare decided to specialize on dental implants in the early 1990's. This was a necessity since the international competition was starting to increase. As a consequence from the specialization of Nobel Biocare, the company left its business in hip implants. The company Astra Tech took advantage of this and chose to specialize on hip implants, when the competition from Nobel Biocare disappeared. Nobel Biocare employees who did not work with the dental implants were then recruited by other companies or started their own businesses. A richer biotope of sub-suppliers and other related activities emerged as a consequence.

Eventually some dental implant specialists at Nobel Biocare left the company and went to Astra Tech, where they developed a dental implant that could compete with the products of Nobel Biocare. The implant is equivalent, but also incorporates new ideas from academia. The intense competition between these two companies spurs further development, which is even more intensified when they face increasingly fierce international competition. Nobel Biocare is still the global market leader, even if its market share has decreased since the extremely dominant position in the 1990's.

By the end of the 1990's Nobel Biocare spun off Entific, a unit which develops hearing implants that are attached to the skull bone with titan screws. The development has been user focused and has been conducted in close collaboration with academia and medical service. After some problems on the path to achieve growth and enable scale in the activities, the company achieved good profitability and growth. The spin-off from Nobel Biocare, which remained the majority owner, enabled Entific to prioritize its own development on its own terms. The company was sold to the Australian company Cochlear in spring 2005.

Profitable growth and continued diversification

Today additional companies contribute to the growth and diversity of the field of biomaterial and cell therapy in the Gothenburg region. There is a continued tradition of collaboration between business and

academia. The positive development makes it easier to attract competent professionals to academia and business, even if this remains as one of the main challenges for the current growth. The companies and academia manage to attract research competence from other regions, but there is a lack of people with middle management competence.

The right constellations of competences – what we can call competence symbioses – is a question of profound importance for the biomaterial field's research intense companies. Mölnlycke Healthcare is one of the successful companies in the region. The company entered into the biomaterial industry based on insights within textiles and plastics, in terms of basic plasters. Mölnlycke Healthcare had competence within chemistry and commercial competence within consumer products. But it lacked competence within medical biology, and sought collaboration with academia to be able to develop advanced and unique solutions for wound care. There is a parallel to the motives of Hässle, who sought complementary competence collaborations with academia to create more unique products. The industry in biomaterial has also experienced how innovation can emerge from the interaction between industry and research. Mölnlycke Healthcare found suitable people to collaborate with in academia. The company was motivated to collaborate since it was difficult for it to effectively develop its own medical knowledge. Collaboration with academics also gave access to wider international knowledge networks. Furthermore, the company does not have their own labs for the relevant purposes and prefers to support research with suitable lab environments.

> *'The triggering factor for the company's collaboration with academia was partly that people in academia contacted the company with product ideas – interactive with the body – and partly that the company needed better evaluation methods for its development work. As the product has reached world markets, the most important role academia has for the company is to educate people who can be hired by the company for further education, and to assist in methodology development.'*
>
> Interviewee in the Biomaterial case study

The Mölnlycke Healthcare collaborates with individuals or groups of people in academia who have both complementary knowledge and common ambitions, in terms of a shared ambition and vision for what to accomplish.

As for other companies mentioned here, collaboration with advanced customers has been important for Mölnlycke Healthcare, in particular for developing and commercializing its competence. One of these advanced customers is based in the region, whereas others are based elsewhere, for instance a prominent clinic for burns in the Netherlands. The company collaborates with the cliniques that are leaders in specific application fields, regardless of where they are located.

The region now has several growth companies in this field. It is foremost these companies that have been creating jobs during the 2000's. In addition to this, companies from elsewhere have started to establish themselves in the region, as for example Nobel Biotech's main competitor Straumann who has established activities to stay tuned with what is happening in the regional business environment. There are similar examples from other fields of biomedicine, as Bayer who has based its Nordic marketing and sales resources in the region. GlaxoSmithKline is another example of a pharmaceutics company who has localized considerable resources in the region.

IT and telecom in South Sweden

The region Blekinge in South Sweden gained recognition in the 1990's as a strong and dynamic business center within IT and telecom. But we need to go far back in time, to get a good understanding of how the position could emerge in more recent times. And in contrast to the previous two cases, this case illustrates more challenges for sustained growth, and by that complements those cases, in our efforts to exploring and illustrating the interplay between renewal and growth in large innovation systems.

The historical profile of the regional business

A marine base was established in Karlskrona – the large coastal town in the region – by the end of the 1500th century. The marine base laid the foundation for an industrial structure that dominated the region over the next centuries. It also provided the basis for an important factor for the development of the region – it institutionalized a strong and influential relation between the state and the local authorities (Engstrand, 2003). The shipyard and the ship industry continued to dominate the regional industrial profile till after the 2nd world war, when a new sector – electronics – started to emerge. The shipyard industry would see further decline over the coming years, in particular

caused by the end of the cold war and a naval restructuring from large naval ships to smaller vessels.

Electronics, with focus on telephony, grew in the region from practically nothing by 1945 to becoming the largest industrial sector in terms of employment by mid 1960's. It developed from having been a support industry to becoming the dominant industry in the region. The ties between the military and the shipyard industry played a role in this development, but the main cause of expansion occurred when LM Ericsson located a telephone production unit in the region in 1947. This gave Ericsson a stronghold in the region, which later led to larger commitments and contributed to laying the foundation for the rapid development during the 1990's. By the mid 2000's the electronics sector held a third of the region's employments.

Crisis in the 1980's and challenging of the old

The region went into a serious crisis in the 1980's, which led to substantial industrial restructuring in the region. The steel mill in the regional town Ronneby was shut down in 1985 and the shipyards struggled to be competitive and contribute to wealth creation in the region. This led to a sharp increase of unemployment and the region was more and more often portrayed by media as a rust belt with high dependence on state support to survive. The region also applied for state support for establishing new industries and re-localizing subsidiaries and large companies and governmental agencies to the region. Companies as Dynapac, Luma, Uddcomb, Åkermans and ABB and governmental agencies as Boverket – the Swedish agency for planning, construction and building – and The Swedish Coast Guard were established in the region in the 1960's, 1970's and 1980's. But this did not result in positive spiral effects with further development for the region. But paradoxically, the grave situation resulted in something that would become important for its progress later on: a feeling of being an outsider with everything to win and not much to lose – and a will to once again stand on its own.

Creating a new industrial structure

The building of a new industrial structure was initiated during the late 1980's and early 1990's. The software science park Soft Center was created in the town Ronneby. Blekinge Institute of Technology (BTH) – a regional college focused on IT applications - was founded in

1989,. It soon had an important role as supplier of competence to companies in the region.

A small number of key individuals with strong and clear personal ambitions moved to the region at this time. They would later strongly influence the development in the region.

Per Eriksson became head of BTH and quickly built up research capacity within his own research field, signal processing. He immediately set high targets based on his own ambitions and decided to create a distinct profile in applied IT with internationally strong researchers. Early on he succeeded in creating a research foundation with substantial capital, which allowed him to recruit leading researchers. Even if Per was born in a small town fairly close to Karlskrona, many locals still saw him as an outsider since he had been active outside the region for many years. There was also some historic tension between the part of the region where Karlskrona was located and the part where Per came from.

During the same time period the telecom company Ericsson decided to strengthen its software activities. It appointed Jan-Åke Kark as managing director for their subsidiary EP Data, which later became integrated into Ericsson. Jan-Åke initiated an ambitious and visionary effort of making EP Data into an important and successful part of the future of Ericsson. The immediate challenges for Jan-Åke concerned rationalization and profitability improvement. But at the same time, he thought that mobile telephony could become a rapid growth area and he saw the need for access to competent people in that new field. Besides attracting several Ericsson professionals from abroad, he contacted Karlskrona municipality and BTH to explore local supply of people with competence within telecommunication.

One of the most fundamental factors behind the growth in the region was Ericsson's decision to locate its production unit of mobile telephones in Karlskrona. This decision was also strongly influenced by a political will to create new jobs in a region who was suffering from the decline of the shipyards. Ericsson's early presence contributed to a foundation for the growth of the telecom sector in the region. This development gained further momentum when the telephone operator Nordic Tel/Europolitan located its head office to the region. This was again influenced by a political will to support the region (Engstrand, 2003). As during the 1500th century, the region was able to foster and benefit from a good relation to the state.

Visionary individuals in conservative systems

Another very important factor for the development was the dynamics that were created through the ambitions by leading individuals at BTH and EP Data. These ambitions contrasted with the established norms in the society at large. Per Eriksson and Jan-Åke Kark brought visions and ambitions which were new to the region, which initially created strong tensions with local politicians, traditional industries and their ambitions, and even with other people in their own organizations BTH and EP Data. For instance, politicians initially were mostly concerned and worried about the new social tensions that emerged when successful entrepreneurs rapidly built up fortunes and started to drive luxury sports-cars in the traditional working class community. Paradoxically, it seemed as if Per's as well as Jan-Åke's persistence was fuelled by others' resistance to change.

Tensions were constructive. They did not lead to paralysis but instead to increased development efforts and gradually more alignment between key actors. A factor that contributed to this was the role taken on by the municipal's office of commerce. After a while, it became a place for an open and constructively contesting discussion between companies and politicians. It was recognized as a forum for constructive conflicts, and at the same time a guarantor for long term continuity even if there would be a shift of political power in the municipal executive committee. As efforts by the key actors started to have success, the resistance was reduced and more actors in the region started to share their ambitions and support the initiatives. This led to positive tensions between the three towns in the region – Karlskrona, Ronneby and Karlshamn – and between the region itself and Stockholm's telecom district Kista and the IT environment in the city of Lund in South Sweden. A virtuous circle had been created in spite of – or rather thanks to - the initial resistance. Per Eriksson described the process as 'learning by fighting'.

> *'The two persons were of absolutely profound importance. They made it happen, in spite of the local context.'*
>
> Interviewee in the IT and telecom case study

In addition to these two key individuals, there were a small number of other people in the municipality, business firms and the university who contributed to spearheading the emergence of the new regional profile and industrial structure. It can also be noted that Kark and Eriksson did not have a shared vision of the future of the region, but

that their motives and actions complemented and reinforced each other and therefore fueled the development.

> *'Political visions can tend to be empty rhetoric. The real visions were shaped by those who really wanted to accomplish something, but each one of them had his or her own passion, in its venture. There was no uniting vision.'*
>
> Interviewee in the IT and telecom case study

In 1993 Nordic Tel/Europolitan, later part of Vodafone and Telenor, decided to locate its Swedish head office in Karlskrona. Nordic Tel had recently become the third largest mobile telephony operator in Sweden. Flemming Örneholm, Nordic Tel's CEO at the time, who also had a background at Ericsson, and Jan-Åke Kark found each other and initiated a discussion about Karlskrona as a 'telecommunication center'. After initial resistance, they managed to get the municipal politicians to back their ambition. The region started to market itself as a new growth and future-oriented area within telecom, and the efforts gained increasing recognition. The name Telecom City came out of a meeting in 1993, when a group was writing a vision for regional growth. The name became an icon in the marketing of the region and its vision.

In 1995 the regional development moved into a next stage, as local politicians decided to act with more force to enact the region's own future (Engstrand 2003, p. 258), by using the construct 'Telecom City' as the basis for a more aggressive marketing of the region. The representatives for the region marketed the region as a hot-spot for IT-related activities to attract external companies, investors and entrepreneurs, but also to build up and strengthen the image among the local citizens.

Growth in the new structure

The later part of the 1990's was characterized by strong regional growth, with a basis in the IT sector. The early collaboration between a small group of individuals had now resulted in a growing number of people who took initiatives and created success. It became a lever on existing ambitions. The region was well positioned to benefit from the global IT sector growth, in which Sweden had international strength. And the region was good at creating positive publicity. Media started to talk about the turn-around or miracle in Blekinge, which helped BTH attract more students from other parts of Sweden and interna-

tionally. The companies show good profitability and growth. During the period 1999-2001 BTH is the school in Sweden with the second largest number of students in applied IT. Only the Royal Institute of Technology in Stockholm is larger. BTH gets an important role in the development of the region, through its ability to attract, educate and later provide competent people to the region's IT and telecom companies, fueling their local and global growth.

> *'The education was like one big trial employment.'*
> Interviewee in the IT and telecom case study

The historically close collaboration – and similar ambitions to achieve something extraordinary – between Jan-Åke Kark and Per Eriksson stimulated BTH's complementary role for the companies. The wealth and the levels of education grew in the region. People with capital, ideas, ambitions and knowledge were attracted to existing companies as well as newly started, and reinforced the virtuous circle in the region. Simultaneously, a more business friendly culture emerged, as values and norms of local citizens were affected. This was fostered by the inflow of people with values and ambitions new to the region. There was also easily accessible risk capital available, in particular from Stockholm, which made it fairly easy to start and grow new businesses.

Global clients reinforce growth

Another important event in the region was the creation of UIQ Technology, later part of Symbian. The company was divested from Ericsson in 1998 and became a source of growth for companies in Ronneby. Here too Per Eriksson played a role. His contacts at Ericsson Radio System were useful and he actively participated in the search for a suitable CEO for UIQ Technology. The CEO was recruited from BTH were he was an appreciated teacher with a suitable background as a former manager for a development unit for mobile applications at Ericsson. UIQ Technology was started with a basis in existing research and software of Ericsson and then grew rapidly through extensive recruiting of graduates directly from BTH. The company became an important part of Symbian that supplied software to some of the most advanced telecom companies in the world, including Ericsson, Nokia and Motorola. It is an example of strong business relations between suppliers and their clients in the region, contributing to development and strengthening of the business activities.

Yet another important factor was the establishment of Flextronics that acquired one of Ericsson's factories. This was one of the first Ericsson factories that were outsourced to Flextronics in Sweden, and the management and workers of the factory were reacting in a comparatively optimistic and proactive way. The event was seen as inevitable which made management and workers to embrace the change and actively work for a good outcome. This would later lead to Flextronics placing its regional head office in Karlskrona.

Several supplier-client relations were of importance for the development of the region, in particular when growth picked up. The most important of these were Ericsson-Vodafone, Flextronics-Ericsson, and local entrepreneurs and suppliers to Vodafone. In addition to this, the local consumer market developed very fast, in particular mobile phone use. And as already mentioned, investors developed a healthy appetite for the region.

Karlskrona's other neighboring town Karlshamn made its own effort to establish its own unique industrial sector with the founding of companies within digital media, experience based services and intelligent logistics. As a sign of the progress and success of the region, BTH was later given the official to educate and award Ph.D. degrees.

The good results decline, quest for new visions

In the beginning of the 2000's, the region experienced a sharp setback, as the global dot-com bubble burst. Companies as Flextronics dismissed large numbers of workers. Private equity was no longer easy to access. Companies shut down. The number of applications to BTH decreased drastically. The focus of the most dominant and tone setting companies rapidly shifted from expectations on future profitability to hard immediate cost cutting. The region's phenomenal renewal and growth came to an abrupt halt.

After some years of first abrupt halt and then slow development in the early 2000s, optimism and new ideas for the future again started to emerge. The presence of Ericsson remained important in the region even though now with focus solely on software. Vodafone located its development of the wireless office to Karlskrona. A new shared development arena called WI.SE was created for the region. Education levels rose and the number of doctoral students increased. The number of companies in the region increased too, and entrepreneurs started to become more active. The region – led by the municipal government in dialogue with industry and academia – strived to coordinate activities

and competences in the three towns Karlskrona, Ronneby and Karlshamn, with closer collaborations and more focus on customer and user understanding.

But there were also signs that the kind of tensions that had been important during the renewal of the region was lost. The time when strong and executive individuals with complementary ambitions fostered the emergence of the new, in partly in tension with the surrounding society and established institutions, was over. It remains to be seen if and where the future conflicts and tensions will emerge and in what direction they will drive the region.

Stories of storms

The story of the evolution of the Telecom sector in the Blekinge region in the South Sweden was the last of our three stories about renewal and growth in large industrial innovation systems. Together with the story about biomedicine for cardiovascular and metabolic diseases, and biomaterial and cell therapy, the story shows how long-term renewal happens over time, with a particular attention to social aspects. The cases are from three different sectors, and span over at least somewhat different time periods. Yet all emerged over a long time, several decades. They did not emerge over night. And despite their differences, they have several characteristics in common, especially if we look at the social dimensions of the developments.

We believe the three stories deepen our understanding of innovation systems, and can help us free ourselves from frameworks which are less relevant and useful today, as for instance Porter's cluster model. They can help us leave such models behind. Those models were sails well suited for seas in the past, but not for conditions and realities of today's business context. As we will see in the coming chapters, the stories can help us develop a conceptual framework which is better suited to address today's innovation realities.

So, what can we learn from the three stories? In our next chapter we will compare the stories and analyze drivers of growth and renewal. After that, we will explain the descriptive conceptual framework of the interplay between growth and renewal, which we have developed based on the analysis and its conclusions. We will also show how it has been deployed in innovation policy evaluation and formation.

4 The interplay between growth and renewal

> *"(O)ur actions – all without exception – help bring forth and validate the world wherein we become what we become with others, in that process of bringing forth a world. Blind to the transparency of our actions, we confuse the image we want to project with the being we want to bring forth."*
> Maturana, H. & Varela, F. (1987: 249)

The previous chapter gave us three stories of how change and renewal sweep through industrial landscapes with broad impacts for not only industries and academia, but for customers and broader parts of society too. What can the three stories or cases tell us about drivers of growth and renewal in large industrial innovation systems? In order to facilitate an analysis of the stories, we will first describe and compare them in overview and highlight drivers that came across as important for their development. After comparing the stories, we will move to analyzing and learning from them by showing how a deeper understanding of the cases helps us to construct a conceptual framework that can explain the interplay between growth and renewal.

Comparing the stories

How did the new exploration efforts emerge? What actors – individuals or organizational entities – were involved and what roles did they play? How did they interact with each other? What were the relations to people not involved in the renewal efforts, and even societies at large? What was the role and relation to established structures in society? When did renewal succeed in transforming into growth, and which social dynamics influenced that? Were the renewal efforts successfully transformed into growth – and did it last? What were the crucial resources and social dynamics when growth was dominating? As we compare the stories, we give specific attention to social interaction and the roles actors held and what value creation they enabled, as

we argue that these aspects are important for the understanding of the mechanisms of large innovation systems.

Sector and region

Sectors were the industries or applied business areas which the innovation systems focused on. Region refers to the innovation system's geographical localization. The two cases on biomedicine in West Sweden were both concentrated mainly in the Gothenburg region. One of the cases concerned the sector biomedicine for cardiovascular and metabolic diseases. We will call this case Biomedicine. The other biomedicine case was about the sector biomaterial and cell therapy. We will call this case Biomaterial just to facilitate distinction from the other biomedicine case. The innovation system of the third case focuses on the sector IT and telecom. We call this case Telecom. It was geographically concentrated to the region Blekinge, with the towns Karlskrona and Ronneby and later also on Karlshamn. All three innovation systems also had important development nodes or contact points outside the region.

Time

The systems and their environments differ in terms of the periods when renewal and growth have dominated the systems and how long these periods have been. Telecom showed the shortest renewal and growth period, spanning from mid 1980's in its visionary stage to the beginning of the 2000's when the growth abruptly stopped in connection to the dotcom crisis. Biomedicine spans over the longest time period from its upbeat in the middle of the 1950's, the renewal intense 1960's, -70's and -80's, and the growth intense 1980's and in particular 1990's. The Biomaterial environment originated from a patent from 1952, gradually took shape during the 1960's, continued into intensified development during the 1970's and with growth dominating during the 1980's, -90's and 2000's. Developments in the three cases were studied up to the year 2005.

Renewal and growth were not accomplished in some few years in any of the sectors and regions. Instead, it took a long time and both renewal and growth gradually took shape over the years.

Table 2. Descriptions of the innovation systems I

Description	Biomedicine	Biomaterial	Telecom
Sector and region	Pharmaceutics in the region of Gothenburg	Biomaterial; dental implants, wound care, etc. in the region of Gothenburg	IT and telecom in Blekinge
Time	1950's to today	1950's to today	1980's to 2005
Opened up for new exploration	Increased international competition, in combination with weak product portfolio for leading company	Discovery in other basic research field	Crisis in existing industry
Initiated new exploration	Two individuals in academia and business initiating new approach to preparation development	One individual saw application opportunity in dental care. Succeeded in creating business model.	One individual in business + one in academia with complementary ventures
Society's view of entrepreneurship when exploration dominated	Initially positive, but during 1970's negative to academia collaborating with industry	Negative to academia collaborating with industry	Negative to new initiatives, in particular by people from outside region
Relation to existing practice	Development approach seen as controversial by both industry and academia	Dentists skeptic to inventor's background as surgeon	Seen as too narrow technology field
Drove new exploration	Small circle of collaborating individuals with vision of creating something unique	Inventor from academia in collaboration with company	Small circle of visionary pragmatics
Breakthrough trigger	Broad publication of research results lay foundation for market acceptance	Securing quality in manufacturing. Tone setters in odontology started to recommend the method	Focusing on IT and telecom coincided with the general IT-boom

Opened up for new exploration

External circumstances created the first breeding ground for the new development in two of the cases. In one of them there was crisis in the existing regional industry structure, which implied need for growth in new sectors. In the second case, international competition started to threaten the national companies. In addition the development company Hässle in Gothenburg came to the conclusion that it had a too weak development portfolio. In the third case, Biomaterial, the origin of the renewal process came from a scientific discovery in another basic research field.

Initiated new exploration

In all cases, exploration was initiated by few individuals. In Biomedicine it was the head of research at Hässle, together with the young researcher in Academia, Arvid Carlsson, who initiated a new and controversial approach to development of medical preparations. In Biomaterial it was one researcher who saw the application opportunity of something he had observed when conducting basic research in another field – that titanium and bone tissue attached well – and for which he saw an application opportunity for dental implants. In Telecom, it was the new head of the college/university who wanted to create a national and international position for his research field and the CEO for a software company within Ericsson, EP Data, who wanted the company to become an important part of Ericsson's future.

Society's view of entrepreneurship when exploration dominated

For two of the cases, the society was skeptic towards entrepreneurship as well as academia and business collaboration in general. In Biomedicine, the society was initially in favor of collaboration between academia and business, but became skeptic and negative toward commercial interests in particular during the 1970's. The situation was similar for Biomaterial. For Telecom, the society at large was skeptical towards new initiatives, in particular from people who did not originate from the region.

Relation to existing practice

In all three cases established actors showed resistance against the new initiatives. In Biomedicine the new development approach challenged the industry's and academia's traditional approach to developing new preparations. In the Biomaterial case the inventor of platinum implants

and leading person had a background which was not well received by the established dentists. In the Telecom case the new profile was seen as a far too narrow technology field.

Drove new exploration

Renewal was initially driven by a small circle of people with their own and complementary visions, who explored the path forward in a pragmatic way. In Biomedicine, key individuals in academia and business strived to accomplish something unique in their own individual work. In Biomaterial, it was an entrepreneurial researcher in academia, in collaboration with business and a lead investor. In Telecom, it was two individuals with personal professional ambitions and visions which gradually were changed and modified during the course of exploration.

Breakthrough trigger

Hässle consistently fostered scientific publications from its research in Biomedicine. This was seen as risky but it gradually laid the foundation for succeeding in market acceptance of new preparations. Two factors seemed to have been important for the breakthrough in Biomaterial. The first was the establishment of a high level quality in manufacturing processes. The other factor was that tone-setting individuals within odontology started to recommend the method, which contributed to fast market acceptance and breakthrough. In the case on Telecom, the local efforts and focusing came timely with the general IT-boom during the late 1990's.

Table 3. Descriptions of the innovation systems II

Description	Biomedicine	Biomaterial	Telecom
Client's and market's role in development	Medical care gave test market. Broad publication built market acceptance.	Close collaboration with advanced clinics in Gothenburg and abroad.	Early establishment of global development companies
Academy's role in collaboration with industry	Development collaboration and wider networks. Graduated researchers to recruit.	Complementary competences for development, consulting and methodology development. Branding.	Supply of graduated professionals that can be employed by industry for growth
Externals moving in to the region	The initiators from outside the region. Exploration attracted researchers to region. Growth attracted world leading competence and competitors.	Growth created competence inflow to region; researchers to recruit and whole companies	The initiators came from outside the region. Later in-flow of students and graduate white collars, and investment capital
Institutionalization and its role	Politicians enable advanced test market through new hospital. Industry professorships created during growth.	Tradition of collaboration between business and academy emerges during exploration and into growth.	Collaboration between politicians, college/ university and business in marketing of region in shift from renewal to growth
Critical resources for exploration and renewal	Intrapreneur in collaboration with humanitarian knowledge visions of controversial researchers	Entrepreneurial researcher humanitarian visions in collaboration with business and investor, with commercial visions	Tone-setting individuals own ambitions about positioning their fields in national and international academia or corporate context.
Critical resources for exploitation and growth	Access to global research competence, markets and economies of scale in production and marketing	Global collaboration with research competence and economies of scale in production and marketing	Graduates to recruit and presence of global leading clients
Sustainability of growth and ability for new renewal	Very strong growth but tendencies to weaken in recent years. One company dominates; low diversification	Strong growth, in later years in particular in established companies. Diversified environment.	No sustainable growth, due to IT crash. Initiation of new renewal in progress.

Client's and market's role in development

Clients and markets had a profound importance in all regions, both in renewal and growth. In Biomedicine the proximity and collaboration with regional medical care – as client and collaborator – provided an early and important test market. Also publishing efforts were critical for creating market access. In the second case – Biomaterial – collaboration with advanced clients was of profound importance, regardless if the clients were located in the region or elsewhere. The companies collaborated with clients who were international knowledge hubs in the region, in Sweden at large, and internationally. In the telecom case, a few internationally leading companies within their sector were set up in the region, which paved way for breakthrough.

Academy's role in collaboration with industry

The key role for academia for enabling long term sustainable growth was to be a collaboration partner when focus was on renewal and exploring of new business and technology ideas, and to be a competence supplier when focus was on growth around the established business and technology idea. When focus was on exploration in the Biomedicine case, the most important roles for academia was to complement research collaboration and expanding the knowledge network, and to enable the company access to additional knowledge required in the development process. When focus shifted to growth, the most important role seems to have been to supply leading companies with researchers. When focus was on exploration in the Biomaterial case, as in the hearing aid development, the most important role for academia was to contribute with complementing competence, in methodology development and as advisors. Academia also played a role in supporting positioning and branding, through publication and presentations at scientific conferences. In return, companies could finance research projects at the academic institutions. In the Biomedicine case, when exploration shifted towards growth, the most important role for academia was to supply companies with graduated IT and telecom engineers.

Outsiders moving into the region

Inflow of people from other regions was important in all cases. In two of the cases the initiators and tone-setters migrated from other regions. In the Biomedicine case the exploration and the further development attracted new and competent researchers into the region. When explo-

ration shifted towards growth, world class competences were attracted to collaborate and take on positions in the leading companies in the region. Leading global competitors set up operations in the region in order to be present when development was intense, which also happened in the Telecom case. Also there, in the Biomaterial case, companies and academia succeeded in attracting new influential research competences from other regions. However, the companies struggled to attract and recruit critical middle management competence. In the Telecom case, the inflow of students, manpower and capital was critical to enable development of the regional companies in the sector.

Institutionalization and its role

In all cases, institutionalization in terms of broader collaborations and structures for this did not occur during exploration, but in the shift towards or during the early phases of growth and exploitation. In the growth stage in the Biomedicine case, politicians organized an advanced market in terms of the medical care units and their patient data bases. Academy created professorships within industry relevant research fields in collaboration with leading companies. The institutionalization increased gradually, to support the effectiveness of the system once needs and opportunities started to become apparent. In the Biomaterial case, academy and companies developed a tradition of collaboration that provided the companies access to competence in academia. This complemented the companies' own competencies and strengthened the system's capacity for both renewal and growth. In the Telecom case institutionalization foremost took place when development had started to create results and find its shape, where politicians together with academia and business initiated an intense marketing of the region.

Critical resources for exploration and renewal

In all cases, the personal ambitions of leading professionals were the key resources when early exploration was in focus. For the first case, it were Hässle's head of research that strived for the unique preparation, which was combined with controversial researchers' quest for new knowledge and better life quality for patients through a new development approach. In the Biomaterial case, the critical resource for the early exploration of the dental implant was the entrepreneurial researcher who saw a potential in improving the quality of life for people in need of dental implants in collaboration with the company

who saw the business potential in the new and revolutionary technology idea. Also in the Telecom case, the most critical resources for exploration were the entrepreneurial ambitions of tone-setting individuals.

Critical resources for exploitation and growth

In particular the two cases in the Gothenburg region show a common pattern. In the Biomedicine case, the most important resources for growth was global access to relevant research competence, effective development of new preparations in the established new approach, effective market channels and economies of scale in production. The Biomaterial case, growth required global collaboration with research and advanced users, economies of scale in production and in marketing. Access to graduated and competent manpower was critical in order to succeed in sustainable growth around the know-how and companies – old and new – in the region.

Sustainability of growth and ability for new renewal

In the Telecom case, there was strong growth during many years. It was only in the years closer to 2005 that the growth showed a tendency of slowing down. In 2005, the sector had low diversification and was dominated by one strong company with a weakening R&D portfolio. The Biomaterial case showed an innovation system that was in strong growth up to 2005, in particular in the well established medium-size companies. The sector was diversified, with several small and medium-sized specialized companies, and had during the later years showed ability for both continued renewal as well as growth around established companies. In the Telecom case there was no sustainable growth by 2005. The big IT-crash in the beginning of the 2000's implied an abrupt halt for both renewal and growth in this regional innovation system.

After this overview of the three stories, we will now move to a cross-case analysis. We will have a closer look at the dynamics of exploration and exploitation, and the interplay between them. This will help us draw conclusions for how to foster innovation systems, with particular attention on how to stimulate renewal leading to generation of new sustainable growth platforms, proactively meeting challenges from storms ahead.

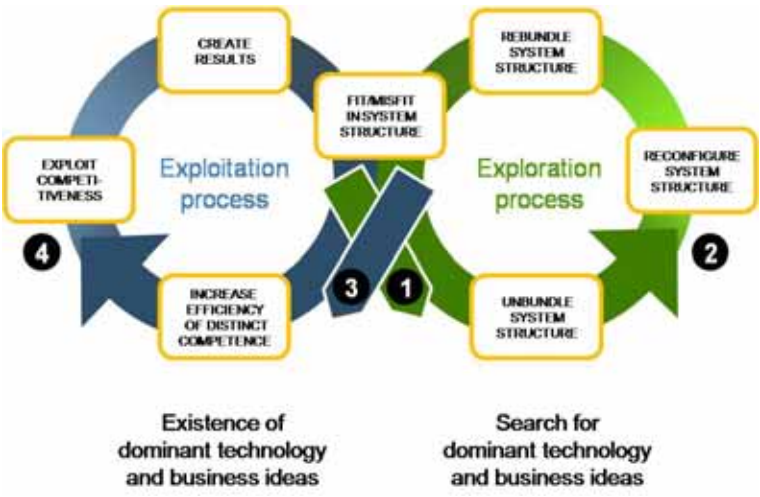
Dynamics of growth and renewal

The study of the three stories of long-term renewal in industrial innovation systems confirms the well-established insight that both exploration and exploitation should be recognized as 'change' processes. But when studying how these processes evolve and interact over time, we note that different dynamics drive and trigger these two processes in innovation systems. We also note that shifts between focus on either of the two processes constitute change dynamics in themselves. When analyzing the cases, we have identified four different key dynamics that drive renewal and growth – thus leading to sustainable long term value-creation – in innovation systems:

1. Transition from focus on exploitation to focus on exploration
2. Exploration process dominates and transforms system structure
3. Transition from focus on exploration to focus on exploitation
4. Exploitation process dominates and increases efficiency of system structure

We have illustrated the interplay between these four dynamics in the conceptual model below, which we call the *framework for the interplay between growth and renewal*.

Figure 4. Framework for the interplay between growth and renewal



We can make a number of observations on the four dynamics behind change processes in innovation systems:

1. Transition from focus on exploitation to focus on exploration

Tensions or misfits within the currently dominating business system or in relation to new alternative ideas, initiated a shift from focus on exploitation to exploration. Such tensions could be external, created by changed demand, new technologies, new development approaches or different business ideas. There could also be internal tensions, as weakening development portfolios or due to internal priorities within firms. New technologies, for instance, may break accepted cost frameworks. And – beyond the stories – changed regulation may hamper established and dominating business models. Tension can also be reflected in changed customer preferences, changed competitor behavior, internal organizational power games or visions of future conditions for value-creation and sustained excellence. In the stories, shifts from focus on exploitation to exploration were often made in conflict and opposition with existing soft (e.g. values and norms) as well as hard (e.g. business structures, patents and IPR) social institutions. These were changes that contest the dominance of the existing business or technology idea.

Furthermore, exploration was initiated and led by a few strong individuals, which collaborated directly or who indirectly complemented each other. The individuals belonged to academia or business, and collaborated with each other in visionary initiatives.

An additional observation of this dynamic is that there were early prerequisites for developing unique knowledge and competences. Already from an early stage of exploration, the two most successful cases set out to explore technology and business ideas which had potential to be internationally competitive and "changing the existing game" in business and academic contexts.

Table 4. Cross-case analysis constructs and their evidence, 1st dynamic

Description	Biomedicine	Biomaterial	Telecom
Tensions in existing system allowed search	International competition and weak R&D portfolio at leading company	No evidence. Discovery in related clinical scientific field	Regional crisis created need for alternatives and sense of urgency
Some few unique outsiders ignited exploration	Initiators came from other regions. Exploration attracted new researchers.	Competence inflow gave access to competence and researchers.	Initiators of exploration came from other regions.
Early resistance from society, business or own organization	Society negative during 70's on collaboration academia and business. Controversial in both academia and business.	Society negative to academia-business collaboration. Skeptical to non-disciplinary inventor	Society negative to new initiatives and external people. Field seen as too narrow for academia
Early prerequisites for unique knowledge and competences	Yes. Through new and pharmacologic approach via dialogue with leading research	Yes. Through new technology for dental implants, in collaboration with leading research	No international uniqueness, but critical mass in technology field that gained high profile.

2. Exploration process dominates and transforms system structure

Successful technology and business ideas which later obtained dominance in future growth periods tended to evolve slowly during exploration, and did not emerge in isolation from their historical context. In exploration, ideas gradually took shape in competition with existing business models and technology ideas. There was often early – and fierce – resistance from practice in industry and academia, and even from values residing in society at large, or in the internal organization.

Small groups of devoted individuals initiated and drove new exploration, sometimes in conflict with the interests of key players in their organizational context. Visionary and entrepreneurial exploration was led by individuals having close social links and who had complementary and evolving visions and ambitions.

Exploration evolved in dialectic iterations between changing visions and enacted realities as technology and business ideas were tested, iterated, reshaped, and guided by visions that gradually were

adjusted, reframed and developed. Leading individuals were driven by their own complementary visions, which gradually evolved as ambitions were met. Collaboration and success was built up step-by-step in a pragmatic visionary entrepreneurial process.

Vision, relations, and individual ambitions – rather than capital – were critical resources for exploration. Conflict prone and controversial individuals with visions – some complementary and others competing – in business and academia were of critical importance as were the relations between them. They were driven by entrepreneurial, humanitarian or knowledge ambitions, and with a strong urge to make a difference.

Learning in collaboration with advanced and demanding clients was central to developing technology and business ideas during exploration.

Table 5. Cross-case analysis constructs and their evidence, 2nd dynamic

Description	Biomedicine	Biomaterial	Telecom
A few strong individuals led exploration	One in academia and one in an established business, which together had vision of creating unique preparations	One inventor in academia in collaboration with small group in new company	One in global business and one in academia led own but complementary visionary initiatives
Close social bonds between key people crucial	Small group of collaborating persons, who also had private, social relations	Friendship ties between key persons in academia and business	Initially two persons and then a larger group of pragmatic entrepreneurs
Emergence via dialectic between visions and enacted reality	Collaboration and success was built step-wise, preparation by preparation	Individuals developed titanium implant, which triggered biomaterial visions and initiatives	Leading individuals driven by own visions, which gradually evolved as ambitions were met
Visions, relations and personal ambitions were critical resources	Intrapreneur in cooperation with controversial researcher with humanitarian knowledge quest had critical importance	Entrepreneurial researcher with vision of new therapy and business was decisive for developments	Development was driven by entrepreneurial ambitions of conflict prone and tone setting individuals
Cooperation with frame-breaking clients	Exploration ideas via dialogue with hospital, which provided access to demanding test market	Cooperation with world leading clinics helped companies develop leading distinct competences	R&D intense global companies established early, partnering drove development

3. Transition from focus on exploration to focus on exploitation

A key process for realizing growth around promising business and technology ideas concerns the shift from exploration to future exploitation. Innovation systems that succeeded here had early prerequisites for development of distinct and unique competences even already during exploration.

In addition, actors in these innovation systems had a capability to use distinct competences and other means to develop, seek and create acceptance for the visions of new dominant technology and business ideas. Break-through for exploitation was facilitated by building broad stakeholder acceptance – in particular with players influencing market development and behavior. The means for this could be extensive publishing of academic research results, which both built market and gatekeeper acceptance and – for preparations – speeded up test approval processes. Buyers and suppliers with complementary visions sought collaboration to gain momentum in mass market development.

Academia contributed to the shift not only by legitimizing new technology through publications and presentations, but also by continuing to give advice on methodology development and complementary research, as it had done in the industry-academia collaborations when focus was on exploration. The methodology development and complementary research broadened and deepened the knowledge field and its potential for applications and additional customer offerings.

Furthermore, institutionalization of soft (e.g. values and norms) and hard (e.g. business structures, patents and IPR) values accompanied the shift from exploration to exploitation. Whereas the initiation of exploration was characterized by individuals breaking out from and challenging existing institutions, extensive re-institutionalization staged for exploitation. The emerging technology and business ideas reached increasing acceptance in business and academia. Policy makers enabled further development of ideas that showed potential for growth, for instance by providing access to user systems as hospitals patient data or by providing additional resources for relevant academic fields.

Access to people and competences to recruit as well as capital enabled firms to realize large scale production and distribution, and were critical resources when moving from exploration to exploitation. As tension between the new technology and business idea, on the one hand, and actors and resources in the old system, on the other, de-

creased, the shift of focus from exploration to exploitation gained momentum.

The foundation for exploitation had been established when new technology and business ideas had gained acceptance from markets, primarily in terms of demanding clients and collaboration partners. This was not a turn-key change that happened overnight. And whereas advanced but not necessarily large clients were important in exploration, the shift to exploitation was facilitated by access to clients with large customer bases, and who had interest in deploying new solutions on a larger scale.

Table 6. Cross-case analysis constructs and their evidence, 3rd dynamic

Description	Biomedicine	Biomaterial	Telecom
Growth initiation by building broad acceptance for new technology	Extensive academic publishing and presentations paved way for early market acceptance of preparations	Academic tone setters approved methodology, which triggered rapid market acceptance	Indirectly; Growth enabled by good timing, as initiatives coincided with general international IT-boom
Academia's key role was to give advice and build recognition	Preparations developed and findings published in academia-business collaboration. Academia were advisors to business	Researchers helped firms develop technology and methodology, and gave advice. Science articles helped firms build brands	The technology field's regional position was led and legitimized in collaboration between academia and business
Institutionalization contributed to shift from exploration to exploitation	Politics organized advanced market through hospital with access to patient data bases. Initial success triggered establishment of industry oriented professors	Tradition of collaboration with academia developed gradually, gave companies access to complementary competences and supported specialization.	Collaboration between politics, academia and business in regional marketing when visions started to take shape. Contributed to inflow of students and capital
Large customers with large markets facilitate shift to growth	Large medical care units are important clients. Access to the large US market was vital to create strong growth.	N.A.	Large global customers moved to region in early stage. These had global market interests

4. Exploitation process dominates and increases efficiency of system structure

In exploitation, development was focused on gradually strengthening the existing technology and business ideas. Market dominance generated results in the form of increased resources, which were used for further efficiency improvements of the business and technology idea. Resource generation and efficiency improvement tended to be led by well defined and widely understood shared objectives.

We can note that institutionalization contributed to enabling growth, both regarding soft and hard institutions. Institutionalization did not occur during early exploration, which instead was driven in conflict with existing institutions. It actually seemed like the exploration phase was energized by being in conflict with the current institutions. Shaping and establishing of lasting institutions foremost took place when focus shifted from exploration to exploitation.

Another key concern was to increase and ensure efficient competence and resource utilization. Competences and resources were attained globally when required, even if local proximity continued to be important in certain competence collaboration between companies and academia. But in general terms, it was vital to keep fuelling the growth by having access to and making the most of competences and resources.

As in initiation of exploitation, demanding mass market clients continued to be crucial as they contested and ensured strength of the business and technology ideas, and guided further exploitation of those.

Table 7. Cross-case analysis constructs and their evidence, 4th dynamic

Description	Biomedicine	Biomaterial	Telecom
Access to competences and capital was critical for exploitation	Global access to research competence, market and economies of scale in production and distribution	Global collaboration with research competence and economies of scale in production and distribution.	Yes, but not sufficiently secured. Did not reach long-term sustainable development with exploitation
Academia's key role in exploitation was to supply competence	Researchers broaden companies' research network and supply researchers for employment	Diversified and specialized companies employ researchers, but also cooperate with researchers	Academia's role was to supply graduates which could be employed for growth
Masses of external competences fuelled exploitation	Exploitation attracted world-leading competence and competition	Immigrating people were important when firms grew	Exploitation supported by inflow of entrepreneurs, students, people and cash

Concluding cross-story reflections

To provide some overall reflections, we observe that the four dynamics could exist in parallel in a given innovation system, and shifts between the two main processes – exploration and exploitation – transformed industries and their value creating constellations.

We identified four different key dynamics that drive change processes of exploitation and exploration in innovation systems. These dynamics are focusing on exploitation, moving from focus on exploitation to exploration, focusing on exploration, and moving from focus on exploration to exploitation. As suggested above, one may view exploration/exploitation shifts as dynamics in themselves. These shifts are fuelled by the degree of tension – fits and misfits – such as those described above. Tension seems to act as a "motor" that drives the system to keep or shift its main focus on any of the two iterative processes of exploitation and exploration. Shifts or transitions between the two processes – or rather between emphasizing any of the two – seem to be particularly important. Identifying these shifts and their importance is a key contribution of this study.

Exploration and exploitation exist simultaneously in innovation systems. But either of them may dominate the system at any point in

time, as the system's tone setting actors will have its main focus on one of the processes. This is not the same as saying that a particular innovation system lives in one particular stage at the time, which theories of linear technology diffusion may lead us to assume (see Moore, 2002; Moore, 2004). It is on the contrary important to avoid a "linear model of technical change" since it in essence means that the innovation system is reduced to an R&D system (Lundvall 1992:13). Our standpoint on innovations systems resonates with Schumpeter (1934), Dahmén (1988), Emery & Trist (1965), March (1991) and Archibugi & Lundvall (2001:283-284).

The study confirms the importance of characteristics of experimentally organized economies as described by Eliasson (2000). But the study also takes our understanding of these characteristics further, as it enables understanding of how they relate to and support – or conflict with – the four different dynamics of innovation systems. One important conclusion is that there is no optimal context or institutional setting for innovation systems since some of the drivers behind the four dynamics stand in stark conflict to each other. The best design of the context will depend on the critical needs of the innovation system, i.e. which kind of dynamics that currently are dominating the system.

Our results are consistent with the critic of Porter's cluster model and point to the importance of networking and social interaction as success factors, instead of Porter's emphasis on market and competition (Moulaert & Sekia, 2003; Normann & Ramirez, 1993; Normann & Ramirez, 1984/1998).

These findings stand in contrast to Porter's focus on specific industry clusters and their birth, growth and decline. In Porter's cluster model (1990) the genesis and evolution of innovation systems is said to be triggered by one of three possible factors: factors of production, related and supported industries or demand conditions. In addition, Porter adds the possibility that chance may initiate the process. Thereafter it is the whole system - the factors mentioned above as well as how firms develop strategies, structures and rivalry - that determine the long-term strength of the innovation system. If the system deteriorates there is a risk that it collapses.

> *"Decline once begun, however, is hard to arrest because the mutual reinforcement of the 'diamond' works in reverse"*
> (Porter, 1990: 170).

Thus;

> *"Nations…are either moving ahead or falling behind in the upgrading of competitive advantage. Standing still is difficult"*
> (Porter, 1990: 173).

Porter's discussion of dynamics is focused on clusters manifested in particular industries as, for instance, his examples of the decline of the steel industry in the US and the fall of the ship-building cluster in Sweden indicates. The cluster model is less focused on what happens to people, skills and other resources after the decline of an industry. This is where our model makes a clear contribution since it recognizes the social dimension of change dynamics. It acknowledges resources as such and the possibility that they are deployed in alternative uses as existing, dominating technology and business ideas deteriorate. It also recognizes that the four change dynamics are fundamentally different from each other but exist in parallel. Furthermore, it does not limit the analysis to a particular industry and its surrounding cluster. Instead, it focuses on the innovation system as such which may include several industries and does not limit the analysis to the birth, growth and decline of one particular industry or cluster. This also implies that the model can be used to address system and market failures, and not only innovation problems in a particular industry.

The framework of exploration and exploitation is useful for understanding dynamics of innovation in large industrial or business systems in relation to a social context. Applying this framework to innovation systems, the study contrasts Porter's cluster model which instead is limited to analyzing the life cycle of particular industry clusters. The framework deepens our understanding of characteristics of exploitation and exploration (March, 1991) in a system perspective.

5 The innovation platform

GENERAL REGULATIONS FOR EMPLOYEES: SWITCH TENDERS

The Switch Tender reports to and receives his instructions from the Yard Master or Station Master. It is his duty to operate the switches under his charge for trains using them; to keep the switches in good condition and clear of snow or other obstruction, and promptly report defects. He must keep the switches secured for the main track, except when passing trains to or from another track, and must watch for approaching trains and give a signal to proceed if all is right. A Switch Tender to be relieved by another must not leave his post until relieved, and the one going off duty must inform the one coming on of trains due which have not passed.

RULES OF THE OPERATING DEPARTMENT OF THE ERIE RAILROAD (LINKING CHICAGO AND JERSEY CITY-NEW YORK, USA) IN 1930.

The two critical dynamics and the innovation platform

As we showed in the previous chapter, our model of dynamic processes in innovation systems builds on four different dynamics. We put specific emphasis on two of these four dynamics: the transition of main focus from growth to renewal, and the transition of main focus from renewal to growth. We argue that both these two dynamics are interlinked and also influenced by what we call *the innovation platform*, i.e. the process through which the system may shift focus from growth to renewal or from renewal to growth.

Inadequate or faulty governance structures and processes for the innovation platform may lead the system into prolonged and unsuccessful periods of growth or renewal. Both cases are equally harmful for the innovation system but in different ways. An exaggerated period of growth may lead to "races to the bottom" and high probability that the companies in a specific innovation system become outcompeted by innovations and companies from elsewhere. Shifting focus too fast from exploitation to exploration may mean that the system has not reaped full benefits and value-creation of the dominant technology and business ideas. A prolonged period of renewal, on the other hand, will lead to innovation fatigue and poor return to the capital and resources invested in innovative activities. Shifting too fast

from a focus on exploration to a focus on exploitation may kill good ideas too early – before prerequisites for growth have been established. It may be industry, academia and other institutions that are strongly rooted in the growth path that will defend the current business and technology ideas from renewal. Our studies also show the importance of entrepreneurial individuals in these processes as they are well-suited to drive the "messy" exploration phase once these have been initiated.

We therefore argue that the most critical aspect of any innovation system is the innovation platform as it influences and drives the two types of transitional phases when entrepreneurial efforts related to technological discontinuities (Utterback, 1994) meet strong opposing forces related to existing technologies (Van de Ven, 1993).

The Railroad switch

Using a metaphor from the industrial era, we see the innovation platform as a railroad intersection where the oncoming train has a possibility of continuing its journey on two different tracks – the growth track or the renewal track. The growth track is faster, more convenient and allows a greater average speed, and it makes sense to continue on this track most of the times. Even when the train continues to run on growth track, there is still a need for continuous fine-tuning of the train and its main functions. At certain times, however, the train may be in need of selecting a different track in order to reinvent itself via new experiences and technological improvements. There may of course be some passengers that do not want to switch track, some that do want to change and others that are waiting on the first stops of each alternative track. All these persons must be listened to and the discussions and tensions between them may be an important informant for which track to select. Changing track, however, is easier done if someone is managing the switch in the railroad intersection.

The role of the policy-makers may thus be to from time to time inspect the conditions of the train, listen to different types of travelers and adjust the switch to help the train find the most appropriate track. Or continue letting the old train run on the same track and instead encourage others to build a new train that can run on the alternative track. In the long run, there must definitely be trains on each of the two tracks even though one of them at times may be traveling almost empty and in a slow speed.

The innovation platform builds on the two most crucial dynamics for governance of the innovation system:

1 Transition from focus on exploitation to focus on exploration
2 Transition from focus on exploration to focus on exploitation

Figure 5. The innovation platform for balancing growth and renewal

The innovation platform is the governance of the intersection between the two main processes of exploration and exploitation in the innovation system. Are drivers in place to enable initiation of new exploration, also during ongoing exploitation of existing technology and business ideas? Does a system allow for sufficient drivers that can succeed in enabling the shift from exploration towards exploitation, once the emerging technology and business ideas show substantial potential and readiness for growth? In the next section, we will show how the framework for the interplay between growth and renewal, and the innovation platform, was used in analysis of innovation systems of European large city regions.

Innovation policies for balancing growth and renewal

In 2006 we were given the opportunity to deploy our model on a larger scale when the County of Stockholm asked us to use the innovation framework to facilitate a two-day workshop about innovation with high-level researchers and policy-makers from 13 European regions. The aim was to discuss and understand how innovation policy frameworks could be improved and how cross-national collaboration between policy-making authorities could be initiated to meet the identi-

fied needs for improvement. The background to this workshop was that EU's Lisbon Agenda had not given the results on innovation in Europe that many had hoped. Europe was – and still is – trailing behind the US and parts of Asia when it comes to innovation success. The European Commission was and is determined to close this gap and the conference aimed to help by improving the links between business and science within and across European regions.

Prior to the conference, we had developed our model of dynamics in innovation systems (discussed previously) and the workshop provided an excellent opportunity to test and develop our model. To realize valuable results via a truly collaborative workshop, we engaged representatives from universities, industry and policy-making authorities in a collaborative work process. The researchers and policy-makers represented Tallinn (Estonia), Helsinki (Finland), Munich and Stuttgart/Karlsruhe (Germany), Budapest (Hungary), Riga (Latvia), Vilnius/Klaipeda (Lithuania), Warsaw (Poland), Barcelona (Spain), Stockholm (Sweden), The Öresund region (Sweden/Denmark), North Brabant (Netherlands), and East England (UK). Before the workshop we sent a short report to all participants as well as a short survey regarding their expectations for the workshop and important innovation challenges in their regions. The ambition was to prepare and engage them in the coming workshop.

From competition to collaboration between innovation systems

This survey also identified challenges for innovation policy-makers in Europe. This was evidenced by each region's ambitions where all 13 regions wanted to excel and build a prosperous regional innovation system in life sciences as well as in ICT. All regions wanted to become an innovation system star in the two most attractive industrial fields of that time. When they realized this the atmosphere became a little bit tense. After applying our model to this discussion they realized that the situation was not as bad as they first believed. Some regions were advocating growth issues in certain fields of life sciences while other regions were stimulating renewal in other fields. It became clear that they could not use the same policies for each of these ambitions but they also realized how their regional innovation systems could complement each other. There was room for collaboration if each region could maintain or even increase its regional diversity and create a specialized innovation system that complemented other inno-

vation systems nearby. We believe that this insight became an eye-opener for the policy-makers.

The workshop included EU Commission representatives, regional representatives, researchers as well as policy-makers. After the workshop we made preliminary conclusions, sent these to all participants for comments and feedback, and then wrote a final report. The results from the workshop were strong and clear. Not only was our model tested and proven valuable if we are to better understand innovation policy frameworks, but the results also surprised many of the participants.

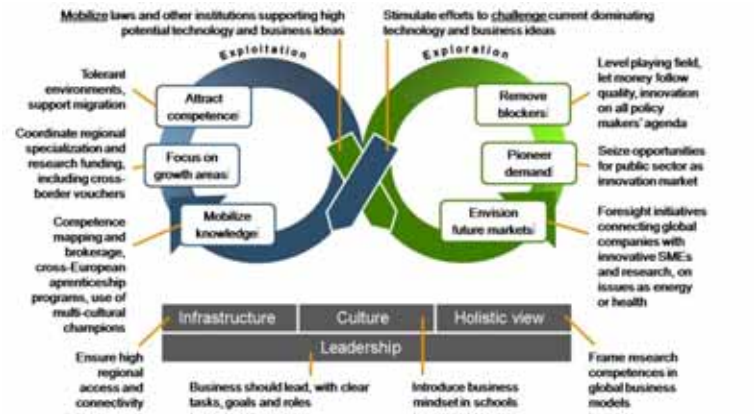
The Innovation Society Conference led to an Innovation Alliance

During the workshop it became clear that the participants – who worked with innovation policies in their regions – generally had not conceived the idea that policies may support either growth (exploitation) or renewal (exploration) in the sense we have discussed above. The policy-makers had not seen the difference between these two processes and therefore did not see innovation policies in this respect. The work process increased their understanding of what specific innovation policies actually lead to. Could you really expect entrepreneurial renewal emerging from an initiative which started by establishing large sector committees having strong vested interests in preserving the existing dominant technology and business ideas? While some policies actually do stimulate renewal and the creation of tomorrow's platforms for growth, others instead conserve the system and stimulate continued growth around currently dominating technology and business ideas. This categorization was new to them and seen as a critical and valuable result from the workshop.

The work process identified six major types of innovation policy areas that each region should stimulate. Three of these concerned growth and three of them concerned renewal. To stimulate renewal the participants concluded that work aiming to envision future markets via foresight initiatives, pioneering demand through innovation-focused public procurement and removing blockers to innovation, e.g. by creating a level playing field, were critical action areas. To stimulate growth it was concluded that work aiming to mobilize existing knowledge via competence mapping and brokering, focusing on specific growth area by coordinating regional specialization and research funding, and attracting new knowledge via increased tolerance and migra-

tion were of particular importance. In addition there were more general efforts like, for instance, introducing a business mind-set as part of national education systems and letting business initiatives lead private-public partnerships for renewal around critical systemic problems that were identified. Figure x below provides an overview of these results.

Figure 6. Conclusions by participants on the Innovation Society Conference in 2006



The final conclusion of the conference were that the greatest innovation challenges concern renewal, i.e. to stimulate exploration leading to new business and technology ideas that will create for tomorrow's growth. However, most existing activities that aim to foster business innovation actually strengthen existing business and technology ideas by stimulating growth. And, while both growth and renewal are important for long term performance, it is this misfit between challenges on one hand and the activities and efforts on the other that becomes a critical blockage to innovation. It was evident that one could not hope for renewal if the innovation policy framework fostered and rewarded growth.

The Innovation Alliance – a framework for a collaborative approach

The positive results from the Innovation Society Conference made the participating regions decide to continue their efforts to share insights and experiences on innovation policies. Stockholm and some of the other regions took the initiative to establish an Innovation Alliance - a

triple-helix based cross-regional collaboration between innovative regions and innovation networks aiming to foster better links between industry and science by deploying the innovation process model. The mission of this alliance was to:

> *"Enhance long term economic growth, sustainable development and improved quality of life, through regional and cross-regional policies and activities fostering innovation".*

To achieve this mission, the alliance formulated four governing values and principles:

- Competitiveness and prosperity
- Diversity and specialization
- System view and collaboration
- Openness and transparency

This Innovation Alliance has had annual meetings each year after its foundation and provides an example of how the work of innovation policy-makers to create a balance between growth and renewal can be structured.

Tensions or lack thereof drives the innovation platform

After the conference and additional studies, we were certain that it is the tensions between different actors in the innovation system that serves as a critical force for the innovation platform. These tensions can be seen as fuel for the "motor" that drives the system to keep or shift its main focus on any of the two iterative processes of growth and renewal. This insight is also what underlies the formulation of the governing values and principles of the Innovation Alliance. It is the shifts or transitions between the two processes – or rather between emphasizing any of the two – that are particularly important and challenging; ensuring timely renewal in an established growth-centric system or reaping benefits of renewal by again being able to shift into growth centricity.

Transition from growth to renewal

The transition from focusing on growth to focusing on renewal is initiated when tensions or misfits becomes powerful enough to initiate a shift from focus on exploitation to exploration. These tensions may rise between different forces within the currently dominating business system or between the currently dominating business system and new,

alternative ideas. Such tensions may be driven by changed demand, new technologies, new competition, different business ideas or internal priorities within firms. This means that shifts from growth to renewal often are made in conflict and opposition with existing soft as well as hard social institutions. And, the institutional framework guiding how existing business models and technology ideas are contested therefore becomes an innovation platform for future exploration processes. It is the reaction to such tensions that manifests the action pattern or values in the innovation platform. An open and renewal-friendly innovation platform must listen to and act on tensions, not ignore or counteract them.

Transition from renewal to growth

The transition from focus on renewal to focus on growth has a strong base in prerequisites for development of distinct and unique competences that may become evident already during the renewal phase. The actors and leaders of the renewal process often tend to have a capability to use these prerequisites and other means to develop, seek and create acceptance for the visions of the new dominant technology and business ideas. The resulting break-through for growth was facilitated by building broad stakeholder acceptance; in particular players influencing market development and behavior.

This meant that institutionalization of a new system framework for the future growth based on a renewed technology- and business idea was manifested in soft and hard institutions during the shift from renewal to growth. Other critical resources during this phase was access to people and competences to recruit as well as capital enabling firms to realize large scale production and distribution. As tension between the new technology and business idea, on the one hand, and actors and resources that remained operating in the old system, on the other, decreases, the shift from renewal to growth is finalized. The innovation platform must in this situation be able to help initiatives taken during renewal to move into the growth phase and enter the competitive and commercial phases of market launch.

We would say that the central discussions in innovation system research, including the discussion of “crossing the chasm” (Moore, 2002; Moore, 2004), the Swedish paradox (Andersson et al, 2002) and Porter’s cluster model, has been focused on the latter of our two critical phases in the innovation platform, i.e. how to shift from a focus on renewal to a focus on growth. Our model introduces and complements

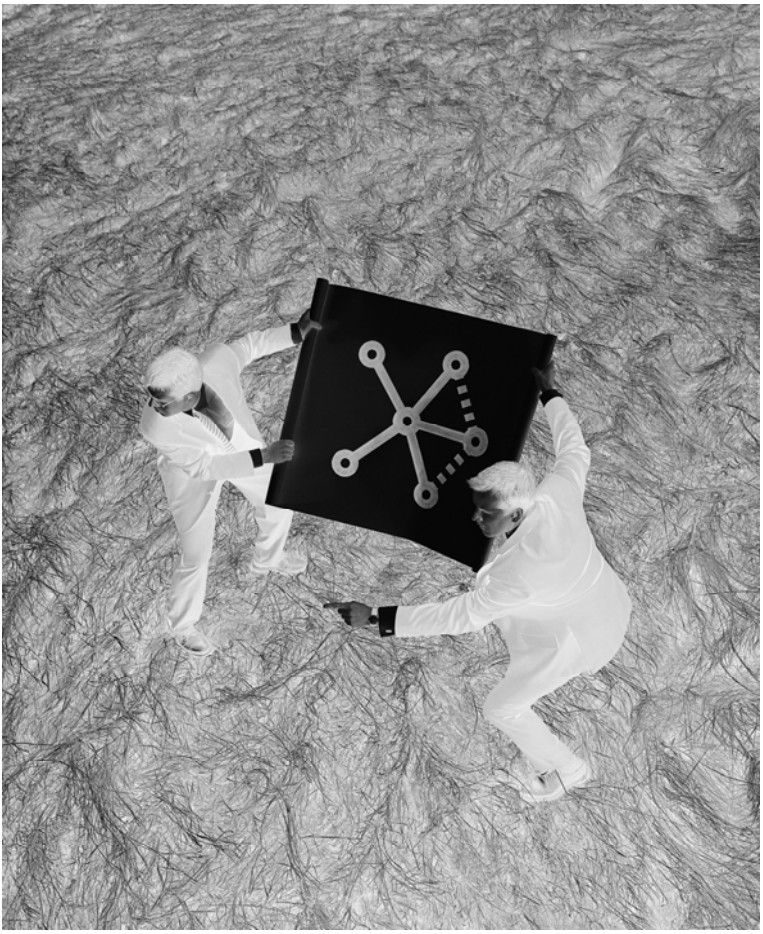
this pictures with the discussion of another and highly critical phase – how to shift from a focus on growth to a focus on renewal. And, it may even be the case that problems related to "crossing the chasm" and the Swedish paradox originate in the parts of the innovation platform that governs the shift from growth to renewal! It is in this sense our model provides a new understanding of dynamics of innovation in large industrial business systems. The framework also deepens our understanding of characteristics of exploitation and exploration (March, 1991) in a system perspective.

Conclusions on how to balance growth and renewal

We have shown that forces stimulating exploration or renewal on one hand and those stimulating exploitation or growth on the other exist simultaneously in innovation systems. Either set of forces may dominate the system at a given point of time, as the system's tone setting actors will have its main focus on either growth or renewal. This is not the same as saying that a particular innovation system lives in one particular stage at the time, which theories of linear technology diffusion may lead us to assume (see Moore, 2002; Moore, 2004). It is on the contrary important to avoid a "linear model of technical change" since it in essence means that the innovation system is reduced to an R&D system (Lundvall 1992:13). To repeat, our standpoint on innovations systems resonates with Schumpeter (1934), Dahmén (1988), Emery & Trist (1965), March (1991) and Archibugi & Lundvall (2001).

One important conclusion we draw in our study is that there is no optimal context or institutional setting for innovation systems since some of the drivers behind the four dynamics stand in stark conflict to each other. One can not apply a generic model for how to govern the innovation platform since the needs of any innovation system will vary over time. One can, however, aim to make sure the innovation platform always is open for each of the two critical transitions we have discussed above. The purpose of the innovation platform must be to stimulate transitions – either from growth to renewal or from renewal to growth – as the innovation system is in need of a transitional phase. It is the governance structure and processes of the innovation platform that determines the long-term effectiveness of the innovation system. And, one cannot hope for renewal if one stimulates growth!

We therefore believe our study and its result is a promising explorative step towards what Martin and Sunley (2003:18) call for: models of territorial innovation that addresses dynamics and evolutionary innovation processes. We think what contributes to the relevance of the model, is that it is built on a view of firms that reflect the collaborative and socially dependent economic and business realities of the 21st century.



6 An approach to foster renewal

> *"A cluster policy must have a very strong policy rationale. They must be based on a clear identification of either market failure or system failure. And they must clearly apply the principle of subsidiarity"*.
> Reinhard Büscher, Head of Innovation Development Unit, DG Enterprise and Industry, at the European Presidency Conference on Innovation and Clusters in Stockholm, January 22-23, 2008.

Previous chapters have discussed and emphasized the importance of understanding how processes for growth differs from those leading to renewal, and launched the innovation platform as the central stage for innovation policies and thus also the a critical factor for innovation system governance. We have argued that it is governance of the innovation platform that determines whether an innovation system will be enabled to shift from renewal to growth or from growth to renewal. Our advice is therefore that innovation policies and ambitions should be structured and organized in a certain way if the innovation system is to avoid being dominated by short-term growth processes to the detriment of future oriented renewal processes. Any system need both these types of processes to be successful but should not be dominated by either over too long periods. Our work with the regions in Europe has proven that regional innovation systems are generally more prone to foster growth and weak when it comes to fostering renewal. And, given that our societies also are facing periods of storm and turbulence, there is an indisputable need to improve our shared efforts to realize renewal. This chapter therefore aims to explain and articulate a work process that realizes innovation system governance for renewal.

Avoiding the innovation policy paradox

Before we move to a discussion on collaborative action for renewed innovation policies, it is important to revisit the critical challenge of innovation work - the innovation policy paradox. As we have seen above, the innovation policy paradox is the situation where policy-

makers have ambitions for renewal, but where their policy activities foster growth around existing dominant business and technology ideas. To overcome this inertia it is important to develop specific innovation policies that directly focus on ambitions for renewal, as well as others that directly focus on ambitions for growth. One policy measure will not do both! Moreover, we can not only select one or the other since it is the combination of renewal and growth that lead to long-term economic growth. There may still be situations where policies need to favor renewal over growth, or vice versa. Our ambition, however, is to outline a work model that stimulate renewal.

Why policy-makers and industry must collaborate for renewal

We believe there is a need for a new form of innovation governance if we are to realize not only growth via exploitation but also renewal via exploration. Many business landscapes today are characterized by a state of turbulence (Emery & Trist, 1965; Ramirez et al, 2008) which means that the business context has conditions that are uncertain, complex and that also may change quickly and unpredictably. The theoretical meaning of turbulence is that changes may occur not only within the business system but also within the external context in which a business system is operating and that each of these changes may affect each other (Emery & Trist, 1965). This creates a situation where the business system and the external context are simultaneously changing in rapid and unpredictable ways and where each change may ignite and strengthen new changes. In turbulence, "the ground is moving" (Emery & Trist, 1965). Interestingly and far from intuitively, policy-makers' actions and firm's competitive moves when a system is in a state of turbulence may increase the turbulence and harm the system. Even if a logical move for a firm may be to work more aggressively and competitively when facing a turbulent environment, this action may make the situation worse (Selsky et al., 2007). And, if a policy-maker stimulates exploitation and growth in situations of turbulence the effect will be the same, i.e. it may increase turbulence (Arvidsson, 2008).

As advocated by Ramirez et al (2008: 24): "In turbulent causal textures, attention must shift from understanding the competitive, often one-on-one, games in the existing transactional environment to understanding how the forces from the contextual environment may shape the transactional environment in the future". Instead of accidentally increasing turbulence via increased competition and support of exploi-

tation processes, policy-makers and firms should collaboratively try to understand the causes behind the current state of turbulence and focus on creating a new understanding of how the future business landscape may look like after the current state of turbulence (see also Bergek et al, forthcoming). By institutionalizing a new understanding and new governing values of the business landscape, the collaborative efforts may handle the turbulence and move to or reframe (Normann, 2001) a new business landscape where the future growth may shape itself (Emery & Trist, 1965; Ramirez et al, 2008).

Renewal in the health care sector

We have discussed the need to develop a new approach for fostering renewal and to illustrate how this can be done we will turn to what was done in the health care sector in the Swedish region of Skåne. This business system faced a strong "storm", i.e. a turbulent causal texture (Emery & Trist, 1965), in the end of the 1990s. It was also – as the health care industry is – strongly influenced by both political and corporate decision processes, and therefore an interesting case to learn from.

In the end of the 1990s, the Swedish health care system had problems to adapt to its changing environment as the traditionally state-financed system for a long time had been driving out organizational forces for continuous improvement and innovation. There were no incentives to be innovative around new solutions within health care organizations which had made them focus their efforts to improve the economic situation by adopting schemes for rationalization and downsizing. The organizations suffered from internal fights over resources and subdivision around classical professions as surgery or orthopedics. These silos primarily fought against each other for shares of the diminishing resources. Improvement and innovation where not seen. As a result, costs for healthcare in Sweden increased more than 5 percent per year between 1997 and 2000 and productivity had deteriorated (Jönsson et al, 2004).

This had made the politicians to intensify their rationalization projects, which, however, did not solve the problems at hand. The real problems had to do with external factors such as how health care was financed and organized, which meant that the organizational solutions that were tried did not make the situation better. Instead, they made it

worse since the employees lost energy and drive. The political governance system – aiming to create a generous welfare system with health care for all – was, at the same time, reluctant to accept change. The situation made adaptation of the health care system to a highly uncertain contextual environment impossible.

In this situation, the region of Skåne faced the risk of reaching hyper-turbulence where organizational failure increases rapidly, rendering turbulence endemic (McCann and Selsky, 1984). Hyper turbulence would be a situation in which the self-reinforcing downward spiral of rationalization, internal fights for resources, and lost hope among employees made the organization destroy itself. The process faced the risk of becoming a self-fulfilling prophecy fuelled by political, organizational and individual decisions all leading to a worsened situation. Instead of letting this happen the region took another approach.

By creating an idealized design of how the business system may reframe itself (Ackoff, 1974; Normann & Arvidsson, 2006), it was able to build a vision of a non-turbulent future state which led the actors away from the on-going negative spiral that reinforced and reinstated the current turbulence (Arvidsson, 2008). The vision allowed the region and its actors – including politicians, managers and employees at hospitals as well as the public – to regain confidence in the care system and start engaging in a way that broke the destructive process. Visions of new and changed roles and responsibilities for all the critical actors led the system in the right direction. One critical factor in this process was to start seeing people as people and not as patients by setting health as the main objective. If the system was governed by the aim to create healthy citizens instead of, for instance, making as many hip replacements as possible, it set itself in a new and rewarding direction. Other factors included openness to non-public care providers, seeing that there were many different types of care logics – emergency care, distance care, and elective care – that each needed a different organizational set-up, and that public authorities had to learn to correctly organize and stimulate an entirely new health care system.

This example illustrates an alternative and new conception of governance design of policy-making and industry collaboration aiming to more effectively address turbulent environments.

Such collaboration should be based on two critical factors (Arvidsson, 2008).First, the “storming” situation made it critical to bring a

systemic model of governance to the policy-making table, and to invite stakeholders such as industry actors to become engaged in regulatory affairs around that table. The argument is that if stakeholders are fully engaged in the early stages of governance dialogues this will lead to new policies, rules and laws that effectively address turbulence. This has to do not only with effectiveness, but also with fairness (Elahi, 2008). The setting of the governance model in this way is a necessary, but insufficient, step to address such turbulent conditions.

The second factor is that governance designs relying on a future orientation are more capable of addressing turbulence than governance designs using case-based historic experiences and current convictions. This approach sets a more inclusive than exclusive tone for attracting the multi-stakeholder format needed to enhance future effectiveness of renewal efforts. It also draws the engaged stakeholders away from simply being lobbyists active in the policy-making process.

Based on our understanding of how new platforms for future industrial growth emerge, as illustrated in the cases and our analysis of the cases, we have developed a working model of how to foster new platforms for future industrial growth. This model is based on collaborative action between individual actors who want to challenge existing dominant business and technology ideas.

Future growth platforms for Sustainability in Cities

Our work started in relation to the planning of the European Presidency Conference on Innovation and Clusters that was organized by the Swedish and the Slovenian governments and staged in Stockholm on January 22-23, 2008, under the Slovenian Presidency. The County of Stockholm asked us to organize a Round Table discussion of innovation policies under the theme of *Sustainability in cities* during this conference and we therefore developed a new model for how this should be achieved.

In our work aiming to understand innovation policies for *Sustainability in Cities*, we started from the model of renewal and growth in innovation systems that we have discussed above, and made a thorough literature study as well as pre-studies of two very different cities - Stockholm and Shanghai - to explore challenges or innovation gaps in relation to sustainability in cities. We also wanted to identify

emerging actions to foster renewal with the ambition of closing these innovation gaps.

The selection of these two very different cities - Stockholm and Shanghai – was based on the idea that by identifying similarities and differences in term of innovation challenges in these two cities, we could test and understand how our model works. Where Stockholm is a rather small city well recognized for its efforts to realize sustainability, Shanghai is one of the largest and most fast growing areas in the world where sustainability has become a key issue for the long-term well-being of the city. The selection of Stockholm as an ambitious city for sustainability was recently manifested as Stockholm was named the Green Capital 2010 by the European Commission. This award is given to a city that has a record of achieving high environmental standards, is committed to ambitious goals for further environmental improvement and sustainable development, and can act as a role model to inspire other cities and promote best practices in other European cities. Shanghai was selected not only since it is a large city and urban region with environmental challenges but also since it has adopted a strong sustainability strategy which also became the theme – "*Better City, Better Life*" – for the World Exhibition in Shanghai in 2010.

The overall conclusion from the cases on Stockholm and Shanghai are that, first, it is crucial to focus ambitions on the effectiveness of the larger system surrounding cities if we are to address sustainability – the risk of limited, suboptimal solutions is otherwise too large. Second, innovation activities must be coordinated by public authorities and other innovation system custodians. Together, the two cases illustrated system failure, innovation gaps and business opportunities which could create enhanced sustainability, and by that staged for concrete a dialogue on innovation policy formation and governance.

Round Table discussion at the EU Presidency Conference on Innovation and Clusters

Our Round Table *Innovation and Cluster Policy for Sustainability in Cities* during the European Presidency Conference on Innovation and Clusters focused on how European innovation policy can stimulate renewal for tomorrow's growth platforms. In this Round Table we argued that the industry-based cluster approach needs to be complemented by an approach for industrial renewal that recognize new growth platforms developed by actors in cross-industrial constella-

tions. We also showed cases of emerging solutions for sustainability in cities which led to identification of critical challenges for industry and policy-makers if these solutions are be realized. The sub-themes we used in the round table were energy, which was developed in collaboration with the power plant division of the global company Wärtsilä, of Finnish origin, and public transportation, which was developed in collaboration with the Transport division in the Swedish subsidiary of the French company Veolia. The energy case can be used to exemplify our approach.

We had first defined the larger system – *Sustainability in Cities* –in which we collaboratively were to engage in search for innovations leading to improvement of system effectiveness. To make this actionable, we gathered a work group consisting of industry actors, policy makers and researchers around the sub-theme energy. This approach meant that we limited our work to the energy system in cities. The work then started via literature surveys and initial interviews, which were followed by workshops and meetings. We developed an embryo to an idealized design – a new system model that would stimulate and realize the system improvements we were aiming for – by first identifying a number of critical *system characteristics* that had to change if the system were to improve its effectiveness.

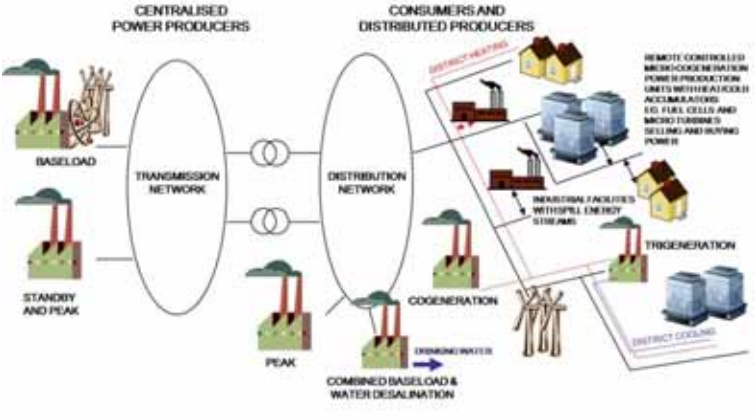
These characteristics included, for instance, that energy generation would have to become more diverse. There would still be large-scale structures and long-distance transmission for base load energy but this then had to be complemented by distributed generation for peak consumption. To realize this, it was critical to integrate and combine cooling-heating-power (CHP) whenever possible. Another critical characteristic that needed to be changed involved the role of business firms and consumers. It was critical that their role as passive power users was changed given that firms and households do not use all their power or heating generating capacity to its full extent. Their overcapacity makes them potential distributors of energy in local markets if the governance structures and technological solutions would allow it. If firms and households became buyers and sellers in local and distributed energy systems, the system effectiveness would increase substantially as it would utilize its existing power generating capacity more effectively. This would also introduce powerful incentives for both firms and households to use energy more effectively and then potentially earn money from selling its unused capacity in local mar-

kets. These were some of the critical factors in an idealized design of a future energy system.

Given the characteristics we identified above, we could understand which innovation and policy gaps that existed, which in turn helped us to formulate challenges for policy makers and future business opportunities for firms toward which they could steer their renewal and innovation efforts. Innovation gaps included, for instance, research around metering systems that were needed for local buy-sell markets to be created, research around small-scale and renewable energy systems. Challenges for policy makers included, for instance, using public procurement to develop system effectiveness via metering and system integration (CHP) solutions, setting goals for system effectiveness by acknowledging that power generation is not a one-way process from large power plants to final users, and by developing a regulatory framework that provides incentives for overall energy effectiveness at the system level.

Under the theme of *Sustainability in Cities* we showed how the creation of renewal builds on collaborative exploration by industrial actors with potentials of best practice learning from different geographic areas and innovation policy makers with a learning agenda. In this work, the policy-makers need to embrace the realities of how industrial renewal and creation of tomorrow's growth platforms is driven by industry, and what that implies for the new breed of innovation policies.

Figure 7. Illustrative model of idealized design in the energy system; Distributed energy sharing network prioritising electricity production and high total efficiency



We must learn from how renewal happens in large industrial systems as seen in the cases presented previously, and acknowledge that innovative action is lead by entrepreneurial actors. Our societies cannot wait for industries to change themselves, especially not given the established actors vested interests in existing dominant technology and business ideas, and the urgent need for renewal in critical industries as, for instance, energy and transportation.

Our main message is that it is not clusters that drive renewal of industrial systems, but instead individual companies and actors from different clusters. Existing clusters tend to be occupied by defending their territory reflected in existing and dominant business and technology ideas. There is need for collaboration in international actor constellations, with focus on not only technology innovation, but in particular on system and business innovation. Policy makers must be involved in dialogue with leading and challenging actors, to understand how policy frameworks can enable system innovation.

Four steps to realize renewal

So, given this understanding of how renewal and growth happens, and what their drivers are, how can you foster renewal that becomes tomorrow's growth platforms? The work and the dialogue with policy makers and companies in quest for renewal resulted in the following recommended model:

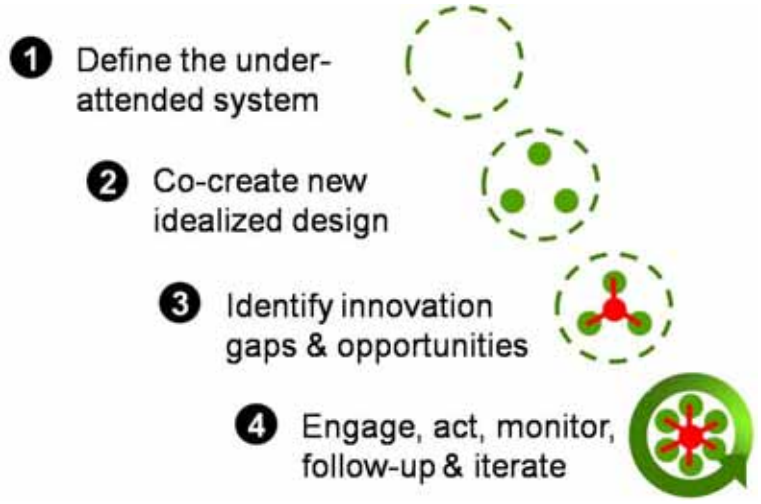
1. Define the system that the study will focus upon. This should not be a pre-defined and existing industry since this would create a lock-in effect that increase the risk that the work lead to policies for growth rather than renewal. The ideal is to define a wider system which includes many different types of stakeholders such as industrial actors, policy-makers and researchers, but that also includes many different types of industries. The definition should also stimulate action that addresses the inherent challenge. In our study we used the theme or system called Sustainability in Cities.
2. Thereafter, assemble a group of diverse actors with different backgrounds and interests (as also advocated by Bergek et al, Forthcoming) to collaboratively create visions of how the future system may look like in its idealized design (Ackoff, 1974). As discussed above, this future orientation and colla-

borative approach aims to avoid being stuck in turbulent states and at the same time deflects the risk that specific interests rules the process. This vision should not only define the larger system – in our case Sustainability in Cities – but also include more narrowly defined and demand- or customer-oriented sub-areas, which in our case were energy and public transportation. By starting from the larger system definition, e.g. Sustainability in Cities, the work avoids getting hijacked by strong lobbyists aiming to conserve status quo, and by including more narrowly defined sub-areas we at the same time makes the results actionable.

3 Given the idealized design, the next step focuses on identifying innovation gaps related to the action theme and its subtheme levels. The objective being to understand which innovation gaps that exist given what exists today and what needs to be created if we are to realize the idealized design. The aim being that these innovation gaps are reformulated as business opportunities in areas of under-attended societal concerns. Seeing these innovation gaps and opportunities for business innovation then makes it possible to discuss and define what industry must do to close the gaps and to define what policy makers must do to enable industry actors to innovate in order to close these gaps.

4 The last and final step aims to open up the process and stimulate international collaboration that involves constellations of industrial and territorial actors (regions and nations). It is important to open the process across geographic boundaries at an early stage since it not only enables us to draw on critical expertise and experience from different regions but also makes it easier to understand which parts of new technology and business ideas that may become globally useful and which that primarily may be successful in a more local setting. The approach builds a better opportunity for global offerings as renewal moves into growth. The aim is to close innovation gaps by mobilizing and engaging actors, coordinate actions, monitor and follow-up learning, and stimulate continuous adjustments.

Figure 8. An action-lead approach to innovation policy for renewal



Innovation policies for renewal must not focus on high-technology only, but instead support holistic approaches aiming at social and business innovation in broader demand areas of societal needs and concern (as for instance Sustainability in Cities). Renewal policies must also be broader than R&D policies, and systematically encompass all policy areas that may have bearing on innovative efforts in companies. Public procurement may for instance be a strong tool for renewal of growth platforms if it is used adequately. If not, public procurement may become an instrument supporting growth and cementing currently dominating technology- and business ideas to the detriment of renewal.

Policies must also recognize that it is not clusters per se that drive renewal for tomorrow's growth platforms, but instead individual challenging companies and actors from different clusters. Efforts from such individuals and companies may on the contrary threaten existing clusters, which is a good sign if our ambition is to stimulate renewal. To become demand and action oriented, innovation policies must be applied on demand sub-themes, and the role(s) of the policy-makers must be defined in dialogue and collaboration with industry actors based on future system visions.

The need for an innovation policy shift

There is a need for a fundamental shift in the European Union's innovation ambition from having had a strong focus on supply factors as R&D and education to also focus on demand factors as the overall system effectiveness including consumer behavior and demand and non-technological innovation – for instance based on customer knowledge and organizing capabilities. This is based on a strong understanding that the current economic realities with specialized companies, network-based collaboration, open source innovation and increasing customer influence have made general policies aimed toward large, diversified multinational enterprises and general cluster systems obsolete.

We believe there are important innovation policy shifts that must be taken at the EU, national and local level if the systems are to stimulate renewal. The most important ones are:

1. To acknowledge that renewal is driven by engaged actor constellations that collaboratively drive the search for new business and technology ideas through a pragmatic and emergent process driven by complementary visions.
2. That the main sources of success for firms today reside in their abilities to specialize and collaborate – not necessarily only within regional innovation systems but also across them – in order to meet societal challenges by innovation of new cross-sector technology and business ideas. And, regional innovation systems are often not regional – they are virtual!
3. That policy-makers cannot passively rely on regulation. They must act to create innovation platforms that enable and stimulate others and themselves to launch action for renewal. They must be the "switch tenders". This includes the ability to do public tenders for "that which do not yet exist" (as one participant of the EU Conference on Clusters and Innovation put it). This ability – in turn – implies that public actors must radically change their culture and action patterns, which is a transition that cannot be taken lightly. It is a demanding challenge to launch innovative public procurement and Private-Public Partnerships.

4 To listen to and stimulate the quiet voices that our society usually deem to be too vague and poor to receive due attention during social change processes.

5 Public innovation authorities must become more active in the dialogue with the business community focused on the task to overcome innovation gaps and thus getting rid of system and market failures. But the renewal process must despite this be a bottom-up process.

We believe policy-makers in Europe have a good opportunity to succeed in the work aiming to create renewal if they manage to re-organize and re-frame themselves in the direction we have pointed out in this book. The good side in this transition is that does not need a lot of resources to realize this shift. This new way of working may even demand less resources as action become better focused on renewal and also by better engaging resources residing in companies, customers and other critical actors in our societies. The major challenge – and perhaps negative side – in this transition is that it requires policy-makers to change their mind-sets concerning how innovation happens and innovation policies should be governed to realize renewal. We hope our book contributes to this much needed change in the mind-sets governing innovation policies.

7 Embracing the storm

> *"Curiosity, not money alone, drives research. Creativity, not linear development, drives innovation. We have to replace the linear model of innovation by a systemic and horizontal one".*
> Klaus Gretschmann, Council of the EU, at The Innovation Society 2006 Conference

We have aimed at a contemporary understanding of what drives long-term renewal in large innovation systems and what it means for governance of innovation systems. We would like to end with some final and concluding reflections on what we have seen through our studies and the work behind this book. Specific attention will be given to what we believe are key challenges for actors involved in influencing prerequisites for renewal. But we will also try to reflect on our own work - our own explorative journey of challenging dominating conceptual models.

The innovation platform as the center stage

The framework for balancing growth and renewal shows how the two processes interact, and in particular how the two additional processes of shifting between growth and renewal function. These two additional processes constitute the innovation platform, which we argue should be of main concern for innovation policy custodians.

We believe good companies are excellent at driving exploitation processes by themselves, as long as there is a level playing field including regulations and institutions accomplishing that. Poor companies will under circumstances inevitably fail which is an important part of the market system. We also believe capable entrepreneurs and entrepreneurial collaborators in academia and elsewhere will stubbornly be able to seek and find their way in repeated exploration processes, often in fierce competition with other visionary explorative initiatives, until they reach a point where technology and business ideas have a high potential and readiness for shifting towards a growth path. Again, many of these initiatives will inevitably fail. We believe

it is most effective if policy-makers – apart from guaranteeing level playing fields - leave theses two processes to the actors themselves. The framework conditions need to be attended, as securing regional attractiveness and level playing fields, but not more than that.

But, in order to ensure a long-term balancing of growth and renewal, we advocate that innovation policy makers put specific attention to the innovation platform. They need to ensure that there are those who explore impacts of storms before they happen, and foster unleashing of creative initiatives that result in more effective solutions to ensure better robustness against the storms. They must stimulate those who aim to enter exploration. They also need to govern prerequisites for initiation of exploitation, before existing, pre-mature and inadequate solutions are hit by storms and swept away. And they need to foster and ensure existence of adequate mechanisms for allowing high potential growth ideas to take on the dominant technology and business ideas, and thus reach the growth path of exploitation to become new growth platforms. Thus they need to govern prerequisites for shifts to exploitation.

We have given specific attention to two of these two processes, which our studies and work have shown is the most under-attended today – the initiation of exploration and the initiation of exploitation, what we in this book have called the embracing of the storm. The huge challenges, systemic failures, our societies are facing in years to come make this process specifically worthy the attention of innovation policy makers. In the three studies we showed, policy makers attended new growth opportunities only after they were established, and then institutionalized the environment to support the proven new ideas. Before that point, there was a tendency by policy makers to defend the old and existing industrial structures. Policy makers should not stop institutionalizing around well proven ideas to accelerate their growth patterns. But they also need to think about how to allow for some de-institutionalization or at least contesting of existing structures, before these structures crack in the storm. And for that, they have to have the courage to explore systemic failures, and engage in dialogues with small actor constellations, and reflect on which policy measures that could facilitate shifts by addressing systemic failures in areas such as energy, food, water, health, and transportation.

We have shown and advocated one approach for innovation system renewal in this book. There are of course others, and there need to

be. We believe a key concern for custodians of innovation systems is to ensure that exploration activities exist, but also acknowledge that they may take different shapes in different contexts. We do not believe systemic failures will be solved by silver bullets, or one-size fits all solutions. But it is important for policy makers to start exploring and develop such tools and approaches. We have suggested one approach and shown how it has emerged and how it is embedded in understanding of how long-term renewal happens – we hope that our study and work can inspire other approaches too.

In addition to what has been described up to here, we would like to suggest concluding principles for innovation policy makers.

Guiding principles for innovation policy makers

There are a few concluding principles that we believe can serve as guides for innovation policy makers who wish to better stimulate the emergence and exploration of new technology and business ideas in collaboration with actors who have the ambition and resources to realize them. These principles emerge from an unofficial high level ministerial and industry leader meeting which we were asked to help stage for based on the framework for balancing growth and renewal.

The four principles are straight forward:

1. Have a system view, not sector view, when looking at underattended societal needs where business can contribute to solutions. The system view helps focusing on the real and present systemic failures. It also helps to avoiding getting stuck in conventional thinking linked to existing technology and business ideas – and it is a tool also to explore which collaborative efforts that are needed across different policy sectors.
2. Have a long time horizon that allows for a long investment horizon for business. Short term horizons will foster short term solutions. More systemic changes may require substantial investments and the planning horizon must allow for these to pay back. And even though new solutions do not necessarily have to involve new technology, but may instead be based on new business models and new actor constellations, a longer time horizon allows for new technology development.

3 Say what you want industry actors to accomplish, but stay away from determining the details of the solutions. Expect, require and allow industry to be creative and explore new solutions which may contest the current dominant technology and business ideas. In too many cases, as in public procurement, public authorities detail the requirements to such a degree that it leaves very little freedom for business to address systemic failures.

4 Engage in genuine dialogue with actors who want to change the current structures to follow-up, learn and adjust the support policy makers may be able to provide to ensure that systemic failure is addressed via exploration of new technology and business ideas. There has to be flexibility around the vision, the idealized design, and the solution which all three gradually evolve over time. And policy makers need to be part of the learning journey.

The four principles above may sound down to earth and straightforward. But they can pose considerable challenges to an innovation policy practice which by tradition has had poor coordination between different policy areas. And political priorities may shift somewhat too often due to electoral processes to allow for a long term view. Our proposal aims to improve the political endurance around specific innovation policy actions. And as said above, public authorities often detail required solutions rather than focusing on what a service provided by industry should achieve in terms of system value. And lastly, too often policy makers may passively listen to people from business or academia rather than engage in collaborative quests for addressing of systemic failures. By engaging in collaborative quests we believe the policy makers can transform the dialogue from a traditional lobbying campaign by the industry to a collaborative learning and action process to realize renewal and treat systemic failures. We hope this will make them better “switch tenders”.

These reflections conclude what we believe innovation policy makers should learn from this book.

Lastly, we would like to make some observations of our own journey of exploring a new conceptual framework for understanding the balancing of growth and renewal in large innovation systems. We believe these observations are relevant not only for those who want to deploy the framework, but also for others who want to embark on

similar journeys aiming to explore new conceptual frameworks and thus meet tension and resistance from existing and dominant ideas and their proponents.

The exploration process behind the framework itself

The several pieces of work displayed in this book mirror an inspiring and challenging journey – from the initial study of innovation systems to the framework, the innovation platform and the approach in innovation policies for renewal. The framework has proved itself useful in various applied analyses and action recommendations, of which also include a study of the innovation system effectiveness in a global corporation – which is not mentioned here for confidentiality reasons. The process has allowed us to test, adjust and modify the framework by deployment. The progress has been enabled not only by what we argue is a sound theoretical basis and good fit with the contemporary challenges of long-term renewal in innovation systems, but also by the support it has received from influential stakeholders where it has been deployed – from high level policy makers to business leaders.

Interesting enough, just as in the stories we have described in this book, the framework has also been fiercely opposed. Custodians of the dominating concepts, which we have contested in this book, have worked hard to defend the old conceptual models and the many tools and methodologies that are linked to them, and to prevent our framework from challenging the old bastions. The framework has always found a way, in spite of such efforts, to improve itself. In itself, it is a small example of an exploration process which has challenged the dominating exploitation process.

We all need more such challenging and explorative initiatives and approaches if we are to proactively embrace the storms our societies are facing!

References

Ackoff, R. 1974. Redesigning the future. Wiley, New York, NY.

Andersson, T., Asplund, O. & Henrekson, M. 2002. Betydelsen av innovationssystem – Utmaningar för samhållet och politiken, VINNOVA FORUM, Innovationspolitik i fokus, VFI 2002:1.

Archibugi, D., Lundvall, B.A., 2001. The Globalizing Learning Economy. Oxford: Oxford University Press.

Argyris, C., Schön, D.A., 1978. Organizational learning. Reading, MA: Addison-Wesley.

Arvidsson, N. 2008. Designing More Effective Political Governance of Turbulent Fields; The Case of Health Care. In Business Planning for Turbulent Times – New Methods for Applying Scenarios Ramírez, Selsky & Heijden (Eds.), Earthscan, London, 131-146.

Bagnasco A. 1977. Tre Italia: La Problematica Territoriale Dello Sviluppo Economico Italiano. Bologna, Il Mulino.

Bell D. 1976. The Coming of Post-Industrial Society: A Venture in Social Forecasting. New York: Basic Colophon

Bergek, A., Hekkert, M. & Jacobsson, S. Forthcoming. Functions in innovation systems – a framework for analysing energy system dynamics and identifying goals for system-building activities by entrepreneurs and policy makers. In T. Foxon, J. Köhler, and C. Oughton (eds.) Innovations for a Low Carbon Economy: Economic, Institutional and Management Approaches. Edward Elgar, Cheltenham.

Bouchrara M. 1987. L'industrialisation rampante: ampleur, mécanismes et portée. Economie et Humanism. 297: 37-49.

Brusco S. 1986. Small firms and industrial districts: the experience of Italy. In New Firms and Regional Development in Europe, Keeble D, Weaver E (eds). London: Croom Helm.

Brusco S. 1992. Small firms and the provision of real services. In Industrial Districts and Local Economic Regeneration, Pyke F, Sengenberger W (eds). Geneva: International Institute for Labour Studies.

Camagni R. 1991. Innovation Networks: Spatial Perspectives. London / New York: GREMI / Belhaven Press.

Carlsson, B., Jacobsson, S., 1997. Diversity Creation and Technological Systems: A Technological Policy Perspective. In Systems of Innovation: Technologies, Institutions and Organizations, Edquist C (ed.). London and Washington: Pinter.

Cooke P. 1998. Introduction. In Regional Innovation Systems, Braczyk H-J, Cooke P, Heidenreich M (eds). London: UCL Press.

Cyert, R.M., March, J.G., 1963. Behavioral Theory of the Firm. New Jersey: Prentice-Hall Inc., Englewood Cliffs.

Czarniawska, B. (2004) On Time, Space, and Action Nets, Organization, 16(6):777-795.

Dahmén, E., 1988. Development Blocks in Industrial Economics. Scandinavian Economic History Review XXXVI (1), 3-14.

Dei Ottati G. 1994a. Trust, interlinking transactions and credit in the industrial district. Cambridge Journal of Economics. 18:529-546.

Dei Ottati G. 1994b. Cooperation and competition in the industrial district as an organization model. European Planning Studies. 2:463-483.

Drucker P. 1969. Management's new role. Harvard Business Review. Nov-Dec.:49-54.

Edquist, C., 1997. Systems of innovation. Technologies, Institutions and Organizations. London/Washington: Frances Pinter.

Elahi, S. 2008. Conceptions of Fairness and Forming the Common Ground. In Business Planning for Turbulent Times – New Methods for Applying Scenarios Ramírez, Selsky & Heijden (Eds.), Earthscan, London, 223-242.

Eliasson, G., 2000. Industrial Policy, Competence Blocs and the Role of Science in Economic Development. Journal of Evolutionary Economics 10, 217-241.

Emery, F.E,, Trist, E.L., 1965. The causal texture of organizational environments. Human Relations 18, 21-32.

Engstrand, Å.-K. 2003. The road once taken : transformation of labour markets, politics, and place promotion in two Swedish cities, Karlskrona and Uddevalla 1930-2000. Doctoral Dissertation. Stockholm, National Institute for Working Life (Sweden)

Geels, F.W., 2004. From Sectoral Systems of Innovation to Socio-Technical Systems: Insights about Dynamics and Change from Sociology and Institutional Theory. Research Policy 33, 897-920.

Greiner, L.E., 1972. Evolution and Revolution as Organizations Grow. Harvard Business Review.

Grönroos, C. 1978. A Service-Oriented Approach to Marketing of Services, European Journal of Marketing 12(8): 588–601.

Grönroos, C. 1982. An Applied Service Marketing Throry', European Journal of Marketing 16(7): 30–41.

Grönroos, C. 2006. What Can a Service Logic Offer Marketing Theory?, in R.F. Lusch and S.L. Vargo (eds) The Service-Dominant Logic of Marketing: Dialog, Debate, and Directions, pp. 354–64. Armonk, NY: M.E. Sharpe.

Jönsson, B., Arvidsson, G., Levin, L.-Å. and Rehnberg, C. (2004) Hälsa, Vård och Tillväxt – Välfärdspolitiska Rådets Rapport 2004, SNS Förlag, Stockholm, Sweden.

Katz, R.L., Kahn D., 1966. The social psychology of organizations.

Kim, C.H. & Mauborgne, R. 1999. Creating New Market Space. Harvard Business Review, January-February.

Kuhn. T.S. 1962. On Scientific Revolutions. : 5-6).

Lambkin, M. & Day, G.S. 1989. Evolutionary Processes in Competitive Markets: Beyond the Product Life Cycle. The Journal of Marketing, 53(3):4-20.

Lavén, F. 2008. Organizing Innovation, PhD thesis, School of Business, Economics and Law at Gothenburg University. BAS Publishing.

Lundvall BA. 1994. The learning economy: challenges to economic theory and policy (mimeo).

Lundvall, B.A., 1992. National Systems of Innovation - Towards a Theory of Innovation and Interactive Learning. London: Pinter Publishers.

Machlup F. 1962. The production and distribution of knowledge. Princeton: Princeton.

Mannervik, U. & Arvidsson, N. 2005. Värdeskapande Innovationsmiljöer. VINNOVA (VR 2005:15).

March JG. 2006. Rationality, foolishness, and adaptive intelligence. Strategic Management Journal. 27:201-214.

March, J.G., 1991. Exploration and Exploitation in Organizational Learning. Organization Science 2(1): Special issue: Organizational Learning: Papers in Honor of (and by) James G. March, 71-87.

Martin, R., Sunley, P., 2003. Deconstructing clusters: chaotic concept or policy panacea? Journal of Economic Geography 3, 5-35.

Maturana, H. & Varela, F. 1987. The Tree of Knowledge. Shambhala, Massachusetts.

McCann, J. & Selsky, J. 1984. Hyperturbulence and the emergence of type 5 environments. Academy of Management Review, 9(3):460-470.

Moore GA. 2002. Crossing the Chasm: Marketing and Selling Disruptive Products to Mainstream Customers. HarperCollins Publisher Inc.

Moore GA. 2004. Inside the Tornado: Strategies for Developing, Leveraging and Surviving Hypergrowth Markets. HarperCollins Publisher Inc.

Morgan K. 1997. The learning region: institutions, innovation and regional renewal. Regional Studies 31:491-503.

Moulaert, F., Sekia, F., 2003. Territorial innovation models: A critical survey. Regional Studies 37(3), 289-302.

Normann R. & Arvidsson N. 2006. People as Care Catalysts - From Being Patient to Becoming Healthy. John Wiley & Sons Inc.

Normann, R. & Ramirez, R. 1984/1998. Designing Interactive Strategy. Chichester: Wiley.

Normann, R. & Ramirez, R. 1993. Designing Interactive Strategy: From Value Chain to Value Constellation. Harvard Business Review (July-August).

Normann, R. 1975/1977. Management for Growth. Chichester: Wiley.

Normann, R. 1984/2000. Service Management, 3rd Edition. Chichester: Wiley.

Normann, R. 2001. Reframing Business: When the Map Changes the Landscape. Chichester: Wiley.

Piore M, Sabel CF. 1984. The second industrial divide; possibilities for prosperity. New York, Basic Books.

Polanyi, M., 1969. Knowing and Being. London: Routledge and Kegan Paul.

Porter ME. 1980. Competitive Strategy: Techniques for Analyzing Competitors and Industries. New York: NY, The Free Press.

Porter ME. 1985. Competitive Advantage: Creating and Sustaining Superior Performance. New York: NY, The Free Press.

Porter, M.E., 1990. The Competitive Advantage of Nations. McMillan Press Ltd. London and Basingstoke.

Putnam, R.D., 2000. Bowling alone: the collapse and revival of American community. New York: Simon & Schuster.

Ramirez, R. & Wallin, J. 2000. Prime Movers. Chichester: Wiley.

Ramírez, R., Selsky, J.W. & van der Heijden, K. 2008. Business Planning for Turbulent Times – New Methods for Applying Scenarios, Earthscan, London.

Ratti R. 1989. PME, synergies locales et cycles spatiaux d'innovation. Working Paper 135, GREMI-Barcelona

Ratti R. 1992. Innovation Technologique et Développement Régional. Méta-Editions S.A., Lausanne

Saxenian A. 1994. Regional Advantage: Culture and competition in Silicon Valley and Route 128. Harvard University Press, Cambridge, MA.

Schilling, A. & Werr, A. 2009. Managing and organizing for innovation in service firms – a literature review with annotated bibliography. Vinnova, VR 2009:06.

Schumpeter, J.A., 1934 (English Ed.). The Theory of Economic Development. Harvard Economic Studies, Vol. XLVI, Harvard University Press, Cambridge, M.A.

Selsky, J., Goes, J. & Babüroglu, O. 2007. Contrasting perspectives in strategy making: applications in 'hyper' environments. Organization Studies, 28(1):71–94.

Sölvell Ö, Zander I, Porter ME. 1999. Advantage Sweden. Stockholm: Norstedts Juridik.

Sölvell, Ö., Lindqvist, G. & Ketels, C. 2003. The Cluster Initiative Greenbook. Ivory Tower, Stockholm

Touraine A. 1971. The Post-Industrial Society. New York: Random House.

Utterback, J. 1994. Master the Dynamics of Innovation. Harvard Business School Press, Harvard.

Van de Ven, A.H. 1993. The Development of an Infrastructure for Entrepreneurship. Journal of Business Venturing, 8:211-230.

van der Heijden K. 2005 (2nd edition). Scenarios – The Art of Strategic Conversation. Chichester: Wiley.

Weick, K.E. 1979. The Social Psychology of Organizing (2nd ed.). Reading, Mass.: Addison-Wesley.

VINNOVA´s publications

October 2009

See www.VINNOVA.se for more information

VINNOVA Analysis VA 2009:

01 Svenska tekniker 1620 - 1920

02 Effekter av statligt stöd till fordonsforskning - Betydelsen av forskning och förnyelse för den svenska fordonsindustrins konkurrenskraft. *For brief version in Swedish and English see VA 2009:11 and VA 2009:12*

03 Evaluation of SIBED. Sweden - Israei test bed program for IT applications. *Finns endast som PDF*

04 Swedish possibilities within Tissue Engineering and Regenerative Medicine

05 Sverige och FP7 - Rapportering av det svenska deltagandet i EUs sjunde ramprogram för forskning och teknisk utveckling. *Only available as PDF*

06 Hetast på marknaden - Solenergi kan bli en av världens största industrier

07 Var ligger horisonten? - Stor potential men stora utmaningar för vågkraften

08 Vindkraften tar fart - En strukturell revolution?

09 Mer raffinerade produkter - Vedbaserade bioraffinaderier höjer kilovärdet på trädet

10 Förnybara energikällor - Hela elmarknaden i förändring

11 Sammanfattning - Effekter av statligt stöd till fordonsforskning. *Brief version of VA 2009:02, for brief version in English see VA 2009:12*

12 Summary - Impact of Government Support to Automotive Research. *Brief version in English of VA 2009:02, for brief version in Swedish see VA 2009:11*

13 Singapore - Aiming to create the Biopolis of Asia

14 Fight the Crisis with Research and Innovation? Additional public investment in research and innovation for sustainable recovery from the crisis.

15 Life Science Research and Development in the United States of America - An overview from the federal perspective. *Only available as PDF*

16 Two of the "new" Sciences - Nanomedicine and Systems Biology in the United States. *Only available as PDF*

17 Priority-setting in the European Research Framework Programme

18 Internationellt jämförande studie av innovationssystem inom läkemedel, bioteknik och medicinteknik

19 Investering i hälsa - Hälsoekonomiska effekter av forskning inom medicinsk teknik och innovativa livsmedel

VINNOVA Information VI 2009:

02 Forskning om chefskap. Presentation av projekten inom utlysningen Chefskap; förutsättningar, former och resultat. *For English version see VI 2009:03*

03 Research on the managerial tasks: condition, ways of working and results. *Finns endast som PDF. For Swedish version see VI 2009:02*

04 Högskolan utmaningar som motor för innovation och tillväxt - 24-25 september 2008

05 VINNOVA news

06 Årsredovisning 2008

07 Innovationer för hållbar tillväxt. *For English version see VI 2009:08*

08 Innovations for sustainable Growth. *For Swedish version see VI 2009:07*

09 Forska&Väx.

10 Ungdomar utan utbildning - Tillväxtseminarium i Stockholm 4 mars 2009

11 Cutting Edge - Swedish research for growth

VINNOVA Policy VP 2009:

01 TRANSAMS uppföljning av "Nationell strategi för transportrelaterad FUD" åren 2005 - 2007. Två uppföljningar - en för 2005 och en för 2006 - 2007. *Only available as PDF*

02 VINNOVAs internationella strategi - att främja hållbar tillväxt i Sverige genom internationellt forsknings- och innovationssamarbete

VINNOVA Report VR 2009:

01 Affärsutveckling inom träma faktur och möbler - hur skapas effektivare värdekedjor? *Only available as PDF*

02 Användarna och datorerna - en historik 1960 - 1985

03 First Evaluation of the Berzelii Centra Programme and its centres EXSELENT, UCFB, Uppsala Berzelii & SBI Berzelii

04 Evaluation of SAFER – Vehicle and Traffic Safety Centre at Chalmers - a Centre of Excellence with financing from VINNOVA. *Only available as PDF*

05 Utvärdering av forskningsprogrammet SkeWood. *Only available as PDF*

06 Managing and Organizing for Innovation in Service Firms - A literature review with annotated bibliography. *Only available as PDF*

07 Den tjänstedominanta logiken - Innebörd och implikationer för policy.

08 Tjänster och relaterade begrepp - Innebörd och implikationer för policy.

09 Underlag för VINNOVAs satsningar inom transportsäkerhetsområdet. *Only available as PDF*

10 Utmaningar och kunskapsbehov - Om innovation, ledning och organisering i nio olika tjänsteföretag. *Only available as PDF*

11 De två kulturerna på Internet - En utmaning för företag, myndigheter och organisationer. Huvudrapport

12 Uppföljning av VINN NU-företag

13 Kartläggning av svensk FoU inom området IT och miljö - med fokus på teknikens indirekta och systemmässiga effekter. *Only available as PDF*

14 Forska&Växa - Hållbar tillväxt genom forskning och utveckling i Små- och Medelstora Företag

15 Tjänsteinnovationer för tillväxt

16 Behovet av genusperspektiv - om innovation, hållbar tillväxt och jämställdhet. Utvärdering. *Only available as PDF*

17 Ekonomisk omvandling och makrologistiska kostnader. *Only available as PDF*

18 En undersökning av innovativa företags syn på strategiskt utvecklingsarbete i spåret av lågkonjunkturen. *Only available as PDF*

19 The Public Sector - one of three collaborating parties. A study of experiences from the VINNVÄXT programme.

20 Från hantverkskilt till hästföretag - Genusperspektiv på innovation och jämställdhet

21 Innovationer för hållbar vård och omsorg - Värdeskapande vård- och omsorgsprocesser utifrån patientens behov

22 Organising Work for Innovation and Growth. Experiences and efforts in ten companies

23 Mid Term Evaluation of the Institute Excellence Centres Programme

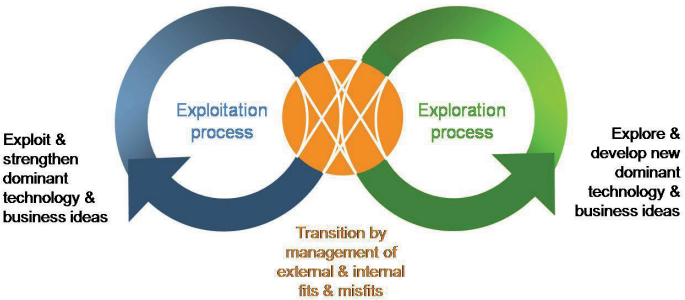
25 The Innovation Platform

Production: VINNOVA's Communication Division
Photo: Bruno Ehrs
Printed by: Arkitektkopia, Stockholm, www.arkitektkopia.se
October 2009
Sold by: Fritzes Offentliga Publikationer, www.fritzes.se

Why do not R&D efforts investments in innovation systems generate more radical innovation, new growth platforms and renewal of industrial systems? This is a question of profound importance, in particular given the socio-technological and ecological system failures we are facing in years to come. How can we meet such storms well, and proactively turn threats of system failures into opportunities for sustainable growth? This book shows why radical innovation and renewal meet resistance, and describes the tension and competition between continuous improvement and radical innovation.

To enable a better balance between growth and renewal we propose that innovation systems should be governed by an innovation platform, i.e. structures and institutions that:

1. Stimulate transition from focus on growth around existing business and technology ideas to search for renewal that can embrace approaching storms of change, and
2. Mobilize for transition from innovative renewal to sustainable and profitable business and technology ideas when these are ready to enter or create markets



The book describes a model for how to stimulate exploration and renewal, using examples from innovation policy analysis and formation in international and cross-regional settings. This book is written for innovation policy-makers and corporate innovation managers responsible for creating an innovation climate that allow for and stimulate exploration of tomorrow's business and technology ideas. It is a result from work organized and done by NormannPartners in close collaboration with VINNOVA and the County of Stockholm.

Ulf Mannervik, M.Phil., Managing Director, NormannPartners, and Associate Fellow at the Institute for Science, Innovation and Society, University of Oxford.
Niklas Arvidsson, Ph.D., Manager Innovation and Organization, NormannPartners, and researcher at the Centre for Banking and Finance at the Royal Institute of Technology.

VINNOVA

VINNOVA's mission is to promote sustainable growth
by funding needs-driven research
and developing effective innovation systems

VERKET FÖR INNOVATIONSSYSTEM – SWEDISH GOVERNMENTAL AGENCY FOR INNOVATION SYSTEMS

VINNOVA, SE-101 58 Stockholm, Sweden Besök/Office: Mäster Samuelsgatan 56
Tel: +46 (0)8 473 3000 Fax: +46 (0)8 473 3005
VINNOVA@VINNOVA.se www.VINNOVA.se