# How to make innovation happen

Katzy, Bernhard R.

# How To Make Innovation Happen?

Rede uitgesproken door

**Prof. Dr. Bernhard R. Katzy**

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*Mijnheer de Rector Magnificus,*
*En voorts gij allen die door uw aanwezigheid blijk geeft van uw belangstelling.*

***Why do we need to make innovation happen?***

"Companies face global competition with reducing margins and competitors from lower cost countries. This brings about challenges for marketing, innovation, and business development." – Stop, Professor! This are platitudes, we all know that! Indeed, it is not the content which is interesting but the context from where it is cited and which is very unexpected: The statements introduce an innovation initiative for which a regional Chinese government invited us some days ago, because it is concerned about the impact of even cheaper labour in countries like Vietnam or India. And what if we helped them? Would we become the undertakers of the European industry? Honestly, after having seen and discussed with the Chinese government officials and the ambitious Chinese entrepreneurs I have little doubt that they will do "it" - with or without us. Throughout my academic career I have repeatedly been exposed to innovation situations and have each time been fascinated by the different approaches that have been adopted to address them. Let me today therefore blend autobiographic experiences with insights from innovation research in the continued search for what this "it" stands for.

We see that today innovation is voiced as general salvage, when some companies and entire economies can no longer compete on cheaper cost. In that regard the general economic German situation in the 1980ies, where and when I studied, and Europe's Lisbon declaration of the year 2000 are no different than the cited Chinese policy change. As it was for the Japan of the 1980ies, it is only a natural step for China to increase its R&D budgets from 0 in 1999, to 1% of the GDP in 2004, to 1.35% GDP in 2005, with a long term target of 5% as announced by Science and Technology Minister Xu Gunahua (Fu 2005) to maintain growth. China only follows well established OECD policy knowledge, which categorizes the world economies in three stages from a critical basis in natural resources (which is before industrial), to cheap labour in mass production (which is industrial), and finally to reach the innovation based stage. Europe, the US and all other leading economies are on this innovation level. It therefore does not surprise that China is heading for this next stage. Why is innovation such a generally accepted strategy amongst national policy makers around the world?

The traditional reason is that innovation is generally seen as the dynamo (Stokes, 1997) of economic growth and employment, which I want to freely translate into the 18th century term welfare or "wealth of the nation" that Adam Smith (1776) used in his observation of a pin factory that introduced new production organization based on the division of labour, which increased factory productivity and the pin output. Generally speaking, the more innovations are developed, the more increases the production of goods and the wealth of the nation. Adam Smith studied the England of his time as one nation that was barely affected by foreign trade. In today's global

economy innovation, however, is as well seen as competitive weapon amongst regions and nations, because welfare can move into other countries. This increases the pressure on Europe: We can forfeit our high economic welfare standard. It is not my intention here to enter the discussion on the definition of measurable units of welfare, but I want to reflect on three fundamental aspects on which the innovation question touches.

The first aspect is that innovation is not about the neo-classic equilibrium of supply and demand in economic exchange, but about innovators changing the productive system. In the European policy language this means being "dynamic" in an economy where innovators undertake joint effort to increase wealth. The main challenge here is to introduce innovation thinking into Europe and its member states, where the application of neo-classic economic exchange models is dominant. The Wijffels (2004, p.6) commission, for example, departs from the guiding thought ("de leidende gedachte") to further and strengthen the direct link between knowledge supply and knowledge demand ("Het bevorderen en versterken van directe verbindingen tussen kennisvraag en kennisaanbod") to conclude that TNO and the GTI's should fulfil a bridge or brokerage function ("brugfunctie"). I see that it is difficult to get much closer to describing what an innovator is in neo-classic economic terms. Efficient markets are balanced, stable and if innovators are change agents, the metaphor of brokering transactions is misleading institutions and decision makers in understanding what they need to do to make innovation happen.

The second aspect stems from Adam Smith for whom welfare results from higher productivity, which again is the ratio of output to input. Productivity can be increased through the introduction of new ways of working or organizing work processes. Scientific and technological inventions can be instrumental, but in themselves do not equal higher productivity. Innovation, its application for enhancing processes or products is the necessary complementary step. Autobiographically, I experienced this difference in my first profession as a car mechanic, where I actually have mostly worked in the "office" to introduce the first computers to improve planning and thus increase productivity. It was a long and winding road, for which we of course blamed technology, at that time insufficient computer maturity. Consequently, I studied engineering to build better computers. In an industrial internship I again was confronted with the human and organizational change challenges in introducing technological inventions and took up business studies in the hope to identify non-technical concepts for enabling successful innovation that Schumpeter (1943) describes as "new combinations" with higher productivity.

The third aspect is that innovation is not about knowledge in form of papers or patents or in form of basic inventions, but about their application in society. The knowledge why sailors died from scurvy, for example, was available since the 17th century. But it took three more centuries and the navies of World War I, to bring innovations, i.e. to ship provisioning and take vitamins aboard. When I talk about innovation, I therefore do not deal with what happens in isolated laboratories and ivory

towers but about the social change phenomenon, which Schumpeter (1943, p.83) calls the process of creating new combinations and destroying old ones.

In his prologue Schumpeter answers the self-posed question "Can capitalism survive?" with a simple "No." (1943, p.61). The challenge of his time was not (post communist) China but the communist ambition that threatened the prevailing mass production orientation and the bureaucratic tendency to stabilize and resist change or evolution of institutions. His thesis is that an incessant change process of "creative destruction" is the engine of capitalism and that a slow-down or complete stop of the innovation engine would cause the entire capitalist system to break under its own weight. I was reminded of this 60 year old prediction while reading Wim Kok's (Baily and Kirkegaard, 2004) mid-term assessment of Europe's 2000-2010 Lisbon process, aimed at becoming the most dynamic economy of the world. He concludes that this process has not delivered any progress but instead, that Europe is losing momentum and has actually been falling behind the achievements of the year 2000. There is an apparent public confusion about how to make innovation happen and the political debate today seems in a similar pessimistic state as Schumpeter's conclusions. So, is there hope for Europe?

I want to take the opportunity of this lecture to explore what has been tried in the history of innovation research and what could be done in the future. In the following I want to introduce some lines of thought, which form a part of the rapidly growing and increasingly diverse field of innovation research. I choose a historical rather than disciplinary perspective on the seven main issues and developments (similar to van den Ven, 1988). I will then sketch lines of the dynamic conceptual framework that I use for my own innovation research agenda. As practical test and conclusion, I will propose seven action items, as controversial examples how a process to make innovation happen could be kicked off.

Let us now first have a look at what has been tried earlier to make innovation happen:

### *How does innovation happen? The logic of innovation revisited*

*Innovation through independent entrepreneurs: Schumpeter I*

Innovation theory is generally attributed to have started with the early works of Joseph Schumpeter, although some elements are certainly older. In his "Theory of economic development" (1912) he introduced the entrepreneur as the driving force of the economy, causing change and being at the root of economic cycles. He describes how individuals like Thomas Edison, Henry Ford, Graf Zeppelin, Claude Dornier, and Anthony Fokker, the Philips brothers Gerard and Anton, or Lodewijk van der Grinten were at the origin of innovation driven firms. Schumpeter initially draws the picture of an entrepreneur who indeed is an independent individual acting alone. Until today this picture imprinted a strong belief into the public opinion and remains an important foundation of entrepreneurship as one field related to innova-

tion research. The well-established annual "Global Entrepreneurship Monitor Survey" shows a clear relationship between entrepreneurship and growth. From here, it is only a small step to praise the more individualistic American culture as being more encouraging for entrepreneurship than the communitarian European culture – and for Holland of course "het poldermodel". To make innovation happen, we would need more entrepreneurs, and to get entrepreneurs we need to stronger support them.

*Innovation through R&D departments: Schumpeter II*

In the first half of the 20th centuries firms quickly grew in size and the former entrepreneurial firms created large R&D laboratories with significant technical and scientific potential (Philips since about 1914, NASA in 1915, NLR in 1919, Bayer before the Second World War, the Bell Labs in 1925, and so forth). Electric power generators, the first nuclear power station, the development of jet airplanes, and the first man on the moon would not have been possible without such large dedicated R&D organizations. In 1942, Schumpeter is impressed with the abundance of resources that large firms can focus on inventions. It is no longer the ambitious entrepreneur, but the efficiency of paid managers in stable, large firms that create the inventions which then drive the innovation process in what becomes a bureaucratic exercise.

To make innovation happen, thus, innovation departments are required, i.e. with more resources (including public subsidies) and more disciplined processes (Abernathy and Clark, 1988). This of course calls for a very different breed of people than the anarchistic (Sundbo, 1998) entrepreneur. Between his early and late work Schumpeter posed a question that until today sparks debate among innovation researchers: Is it the ambition and creativity of a genius entrepreneur, or rather the strength of sufficient resources that propels innovation?

*Innovation as diffusion over time*

During the twenty five years of reconstruction after the Second World War "exceptional prosperity and worldwide economic growth" (Rothwell and Zegveld, 1981, p.3) created a period of "happy engineering" for scientific and R&D staff. In the supply-driven market of that time nearly all products were adopted by users and it was only a question of time for any scientific or technical development to be adopted by markets or society. With little to worry about during that period, innovation research focused on "techno-economic" research and mainstream interest turned away from the former entrepreneur-driven research (Sundbo, 1998). One of the few exceptions to mainstream innovation research is Edith Penrose (1959) who points to entrepreneurial capabilities as the critical growth factor of the firm. Her work remained marginal in academic discussion until very recently, as we will see later. Techno-economic thinking translated into innovation as a deterministic sequence of stages from basic research to applied research, to product development and production, to the adoption by pioneers and the majority. The concept of this process is

cited back to Sir Francis Bacon (Brockhoff, 2003). In his landmark publication on the "diffusion of innovation" Rogers in 1962 (the year that I was born) introduced a mathematical model for this diffusion process based on a normal (Gaussian) distribution curve of the adoption behavior of the individuals of a market or society over time. Until today, this curve is the conceptual basis for many marketing tools (e.g. the BCG Matrix or the "S"- Curve). Similarly, Kondratjew's economic cycles (Kondratjew, 1926) attracted renewed interest and Kuhn introduced the historical analysis of the growth of science (Kuhn, 1962). All these models work well in describing past innovations but give no indications what it takes to make innovation happen.

My first contact with innovation as a young engineering researcher is associated with the advent of computers for business use since the late 1970ies and more so during the 1980ies. Early possibilities in automation spurred research to understand engineering processes and operative management methods, e.g. for cost accounting and the administration of drawings and other documents throughout the product development process. Computers are mathematical instruments and offered – I should say still offer – fascinating perspectives. It therefore cannot surprise that most innovation research followed decision sciences and business administration research in the assumption that rational behavior (see for an overview Wöhe 1996) would allow one best – and fully computerized – process from the initial design idea of a new product to its physical manufacture (Eversheim, Müller and Katzy, 1994). And indeed innovation today could hardly be undertaken without the suite of today's computer applications that firms and their R&D departments use.

To make innovation happen, therefore, more ideas need be channelled into this innovation process and be efficiently processed.

Unfortunately, a lot of well engineered ideas never made it to a successful product. Take for example Philips' often cited video 2000 system, which was praised for its technical superiority. Still, it lost the innovation competition to the Japanese VHS system. Under conditions of uncertainty or risk deterministic innovation process models lack predictive power and do not provide help for avoiding failure in the implementation of innovation.

*Innovation as a strategic means to differentiate in mature markets*

Since the oil crisis in the 1970ies and throughout the 1980s policy makers and firms were confronted with the new experience of saturated markets and economic stagnation. The best internal processes are no longer of use, if the resulting increased number of products cannot be sold. How to prevail in competition is of general concern and especially Dosi et. al. (1988), Nelson and Winter (1982), and Rothwell and Zegveld (1981) explore the relationship of innovation and economic growth, which they, from the beginning, combine with concrete policy recommendations.

Rather than suggesting what it takes to make innovation happen, their achievement certainly is to make industrial innovation economics so popular amongst policy makers that innovation today is generally associated with economic growth. Global

institutions like OECD in that period start regular reports on world-wide comparison of national and regional innovation. Initial technology and innovation policy efforts were launched with an orientation towards large-scale pre-competitive and usually collaborative research in technological development programs (Bush, 1948) which often aimed at defending existing industries that were losing innovation dynamics (AWT Advies, 2003). Innovation policies of that time followed the linear innovation process and its major phases were institutionalized through specialized organizations.

To make innovation happen in this model means facilitating "technology transfer", channelling more inventions through the process from basic to applied research and into production in firms. While basic research remained with universities, universities of applied science were created and technology transfer increased through a rapidly growing number of TNO Institutes in the Netherlands, VTT Institutes in Finland or Fraunhofer Institutes in Germany. Institutions like SenterNovem and dedicated programs from most economic ministries especially supported small and medium sized enterprises in how to adopt innovations. Most of these technology transfer institutions are still in place, but currently their strategic (re-) orientation is discussed due to their high cost associated with limited success in coping with market change through public innovation subsidies.

*Innovation through strategic cooperation in innovation systems*

Over time innovation policies turned towards breakthrough innovation through strategic pooling of available resources. The conceptual idea underlying this strategy is that within innovation systems all relevant institutions should be brought together in a concerted action to further the exchange of ideas and concurrent advances for all innovation activities from basic research to development of products and solutions, and their commercialization. Like policy levels, innovation systems have been studied on the European (European Commission, 2001), national, and regional level (European Commission, 2002) and are increasingly used as competitive instruments (Harkansson, 1989). I personally experienced this development as a young researcher in the late 1980ies in the then emerging European Strategic Program on Information Technology, ESPRIT, which was launched in the 1980ies with the clear objective to create a European IT industry and compete with America and – during the 1990ies – with Japan. Innovation systems have created success stories: the GSM phone, the business IT industry (generating firms like Baan and SAP) and Airbus are European success stories of such jointly led innovation competition. Rather than defending losing industries, such programs are meant to "back the winners" (AWT Advies, 2003).

To make innovation happen in that model entails creating the critical mass of players and interactions for a strategic field from which a chain reaction of successful innovation emerges. It requires a good strategy, and the many unsuccessful projects point at the difficult question: Which is the breakthrough innovation coming up? My perception is, that to a large part industry contributions to the current Dutch innovation discussion are based on the argument that industrial leaders are the better strate-

gists, and if only were given decision power (on the public money), could tell universities (and anybody else) what and how to innovate, how successful innovations can be generated. But why do they then not invest on their own?

*Innovation through open innovation processes*

Open innovation systems are collaborative settings that are not derived from one strategy. They instead allow multiple innovations to emerge (Moss-Kanter, 1988). The success of the innovation system in Silicon Valley (Saxenian, 1991) in creating the IT and Internet industries' growth through the 1990ies was not based on one strategy, or on the types of institutions that support a linear innovation model. Instead, a new breed of institutions, such as incubators, networking events, serial entrepreneurs, business angels, and venture capitalists emerged as players in a veritable innovation industry, which collaborate and share responsibilities and risks that go beyond the often purely financial association of the terms.

To make innovation happen in this form entails creating a self-sustaining innovation industry of well profiled and co-specialized players. The process of global adoption of this open innovation industry is currently ongoing (Hämmig, 2002). I myself got involved in a regional collaboration network of manufacturing firms, called "Virtuelle Fabrik" in the 1990ies. I need to say that we departed from a neo-classic economic position and initially wanted to use the Internet and new communication means to reduce transaction cost for inter-firm cooperation and cheaper mass production. But despite all effort, we were not able to achieve a productivity level that was any similar to traditional hierarchical firms. Instead, I was intrigued by the spontaneous success of some new product development projects, which pointed me to the innovation potential of such networks.

Research on innovation systems is challenged by neo-classic macro economics, because of theoretical difficulties of incorporating innovation networks into an economic transaction theory. And there is a lack of theoretical tools, first for analysis on a network level (Sydow, 1992), and second for the analysis of the dynamics of innovation over time. Mohr (1982), for organizational theory, and Nelson and Winter (1982), for economic theory, are amongst the first to introduce evolutionary approaches of innovation analysis including mathematical models, complexity theory being another approach, with which we experimented in the first research project "Business Architect" of the newly founded CeTIM, but which was discouraging due to the high level of abstraction.

*Innovation through organizational routines*

Nelson and Winter (1982) had already identified that firms take distinct roles similar to those we observed in the "Virtuelle Fabrik", and attributed economic evolution and firm behaviour to organizational routines, which act like "genes". Rather than computer based communication we found that management roles (Katzy and Schuh, 1998) were critical for the success of the "Virtuelle Fabrik". Some of the firms

were good in marketing and identifying new business opportunities, while others were good in project management and so forth. It was Teece, Pisano and Shuen, (1997) who in their programmatic paper called for more business policy and strategy research in such routines which they called "dynamic capabilities". Again, innovation research did face methodological difficulties and scepticism, whether such phenomenon is at all researchable (Eisenhard and Martin, 2000). It had earlier been recognized in the resource based view (Wernerfeld, 1984) that complex webs of organizational routines take a long time to build and therefore can be the source of competitive advantage – or disadvantages and rigidities (Leonard-Barton, 1995) when the market changes. Dynamic capabilities are conceptualized as those routines that (re-) align existing resources to changing market needs through an innovation process. In a changing competitive environment dynamic capabilities are needed to maintain competitive advantage and sustained growth. In contrast to economic innovation research, which has a focus on institutional networks, this strategic research brings innovation back into the single firm and relates innovation to firm success under conditions of changing markets.

This seventh approach to make innovation happen, thus, entails nurturing the organizational capabilities for the execution of innovation. Dynamic capabilities today are conceptualized as patterns of recurring collective activities that should explain how an organization systematically changes, generates and modifies its operating routines in pursuit of improved effectiveness. Let me draw once more on my automation background, where I have studied the strategic change of firms with the introduction of information systems and the (re-) design of business processes with the use of systematic methods. In the here cited perspective, change management can be interpreted as such dynamic capability (Eisenhardt and Martin, 2001) that describes the organization's ability to achieve new and innovative process forms (Schuh, Katzy and Dresse, 1995, Dissel 2003). More recently, we adopted this perspective to study the merger of three European nutrition firms (Katzy et. al, 2001) and the launch of new product development projects and the transfer of knowledge from one project to the next, which would lead to development paths (Leonard-Barton, 1995). And indeed we were able to observe similar patterns for internet telephony innovation at Siemens as for the aluminum body innovation of Audi cars (Blum, 2004). Dynamic capability research is focused on the single enterprise and its strategy.

The concept of dynamic capabilities is interesting for innovation research because it opens a conceptual avenue to understand entrepreneurial capabilities on a collective rather than on an individual level. This possibility finally as well attracted academic interest in Edith Penrose's (1959) work about the impact of managerial capabilities on the growth of the firm and triggered a new edition of her book after 40 years. Because dynamic capabilities are not necessarily linked to the institutional setting of a single firm, they as well open a way to integrate with the network analysis stream, such as the work of Stockholm School of Economics on industrial networks (Easton, 1992). In the METIS project (coordinated by Telematica Institute), we cur-

rently explore stable patterns of knowledge exchange and organizational learning (van de Ven and Polley, 1992, Nonaka and Takeuchi, 1995, Leonard-Barton 1995) that create innovation in networks.

### *A dynamic framework for innovation research*

Technology and innovation management research is a comparably young field in research – and education - that spans a broad variety of academic disciplines from economics to engineering, from organizational psychology to business strategy. Institutionally, it is now supported by the more social sciences oriented technology and innovation management (TIM) division of the academy of management, which was founded in 1987, and the more engineering based international association for management of technology IAMOT, which was founded in 1988. In Europe, we are still in a starting mode with an encouraging number of not yet fully coordinated initiatives like the European Institute for Technology and Innovation management EITIM or the more engineering oriented European Society for Concurrent Enterprising ESoCeNet (Yanez, 2005). As is the case for other young disciplines, the rapid development has resulted in a great richness and heterogeneity of concepts. I thank TU Delft for the invitation to contribute to a European text book on management of technology that will be published in fall 2005, and will hopefully bring us closer to a consistent curriculum.
Let me at this point introduce my own research agenda, focussed through a number of deliberate choices with which I try to avoid eclecticism and hope to limit complexity of research design. I am intrigued to better understand how the innovation process as a process of creating new productive combinations that increase welfare can be made to happen.

*The first choice concerns the level of analysis:*

To capture change towards new combinations I focus on the network or cluster level where the new configurations happen. It goes without saying that these terms describe a broad set of social systems ranging from industry sectors like the bio-tech industry (Liebeskind et al., 1994), ambidextrous organizations as networks of independent business units inside the large firm (Tushman and Nadler, 1986), and regional networks (Saxenian, 1991), that function as innovation systems. What is important, is the theoretical "meso" level analysis bridge to overcome the lack of a clear, explicit, developed discussion of the relationships among the macro and micro level (Sundbo, 2001, p. 2). Besides this conceptual argument I have already referred to the increased practical importance of collaboration for innovation, or at least an increased awareness for collaborative settings, over the past two decades (Saxenian 1991, Katzy and Schuh, 1998, Hagedoorn, 2002, Easton, G., 1992).

Especially interesting to me are procedural phenomena on the network level, for example, to understand the mentioned dynamic capabilities (Teece et al, 1997) as dis-

tinct managerial competences and their interdependency with routines of the hosting firms or institutions. Can this concept help to understand what the difference between a network and the sum of its member institutions is? Are such routines the foundation for synergies (Baltes 2001)? I especially choose theoretical approaches that allow for a nuanced balance of the two extreme dimensions of flexibility, which have characterized the history of innovation research: the independent entrepreneur and efficient disciplined organizational routines. Anthony Giddens (1976) provides a balanced framework for the modelling of dynamic interdependences of social structure on the one side and the innovator or entrepreneur on the other side.

*The second choice concerns the nature of innovation:*

I address it as being a social phenomenon that cannot be reduced to only science and engineering or to an economic phenomenon of a rational exchange transaction for profit maximization. I do not ignore that innovation often involves investments in R&D that yield a new product or patent, which can then be exchanged in markets. Many studies have indeed examined the antecedents to or consequences of innovation. I am interested in the processes of how to make innovation happen, why innovations emerge, how they develop, grow, or terminate over time.

"To say that R&D investment causes organizational innovativeness is to make important assumptions about the order and sequence in which R&D investment and innovation events unfold in an organization. Thus, one way to significantly improve the robustness of answers […] is to explicitly examine the process theory that is assumed to explain why an independent (input) variable causes a dependent (output) variable. To do so requires opening the proverbial "black box" between inputs and outcomes, and to take the process seriously by examining the temporal sequences of events" (van de Ven & Huber, 1990, p. 214)

I believe this to be of relevance for basic innovation research as well as of use to innovation mangers who need "road maps" or patterns that indicate likely sequences of events, how and why the innovation journey unfolds, and what paths are likely to lead to success or failure (e.g. Schumpeter, 1943, Abbott, 1990, van de Ven & Poole, 1990). If preferable outcomes can be associated with particular sequences of activities, there are obvious application possibilities to make innovation happen.

*The third choice concerns dynamic theory:*

As a complement and contrast to static approaches, dynamic theories accommodate the impact of time on the innovation phenomenon; the sequence of events and their durations. Once again, I perceive innovation as change and it therefore violates the neo-classic equilibrium assumption of supply and demand. Innovation will remain exogenous to static theories, which is at most able to model the effect but not its characteristics as a change process. The challenge for innovation research and practice is equally high in academia and firms because equilibrium models are deeply routed in the dominant thinking that consistently translates into companies' practices

and regulations, for example to document their success or failure in annual "balance" sheets. This figurative term is derived from the Italian word "bilancia", the stability point of a lever.

Dynamic explanations are powerful, but not always intuitive. Sailors, for example, until about 1920, did fabric their sails to sail down wind. Only when the aerodynamics principle was discovered to build airplanes, they as well turned their sails into wings to increase speed and the range of reachable directions. In electrical engineering, my domain of engineering studies, Maxwell's equations mark a breakthrough based on dynamic theories. Thermodynamics equations marked the breakthrough for thermo-engines. With the exception of the evolutionary approach (Nelson and Winter, 1982) economic and business theory is still on the level of 19th century Newtonian static theory that is based on the equilibrium of force and counterforce but does not include dynamic explanation. Dynamic theories advance the theoretical basis of a field to a new dimension. The challenge is to develop the necessary set of research methodologies. It may be time to acknowledge the achievements of the sailing boats of the "Gouden Eeuw" but pass on to the aerodynamic wing shape on which the windmills turn.

*The fourth choice is uncertainty as innovation characteristic:*

Because innovation does not deterministically develop, uncertainty or chance is an essential characteristic of all innovation theory (Dissel, 2003). Therefore, I choose descriptions of patterns of what "would" happen but not what "will" happen. The object of analysis therefore is not the individual case of innovation, but alternative ways or paths that take the distinct form of a process theory (Mohr, 1982) and accommodate freedom of the innovator's choice and creativity while maintaining predictive potential through statistical and stochastic methods. Mohr describes as a process theory an explanation of how outcomes of interest develop through a sequence of events, with the outcomes being only partially predictable from the knowledge of the process. He gives the example of catching malaria. "The necessary conditions are the malarial parasite, persons already harbouring the parasite, and *Anopheles mosquitoes*". It is the combination of these elements that may lead to another infection, not the value of any single factor. For example, an increase in the number of mosquitoes ("more of X") will not increase the number of persons getting malaria ("more of Y") in the absence of malarial parasites. The order of the events is also clearly important: a mosquito must bite an infected person before biting an uninfected person, not the other way around. Finally, the outcome is not inevitable, but can instead be a matter of chance. Being bitten by an infected mosquito does not inevitably lead to malaria. Still, Mohr equally notes, that laws of chance are still laws, and that process theories describe regularity in a probabilistic sense. For example, a known percentage of mosquito bites may lead to infection.

*My research agenda on innovation*

I have taken you around some of the theoretical issues that influence our innovation behaviour: Our accepted theories are based on equilibrium and we wonder why change and innovation is painful. Our accepted theories are deterministic and we wonder why Europeans are risk averse and have little regard for entrepreneurs. Our accepted theories are quiet about how the innovation process unfolds and we wonder why decision makers and policy makers do not act and that citizens and employees are afraid and hesitant if confronted with innovation. Let me introduce three research activities that I plan for the near future to develop alternatives for thinking about how to make innovation happen.

*Process innovation: productivity and information technology*

The first research line concerns process innovation that should lead to productivity from new ways of computer supported working. The driving source of innovation here is (information) technology, which is now assembled in a new version of the Virtual Enterprise Lab that spans a network from Leiden to Munich and Switzerland, and beyond. Research will focus on applications for networked instant collaboration at our institute and with use of the Wireless Leiden network infrastructure – not only for those who today follow this inaugural lecture via Internet. We work in this environment and have (almost) abandoned paper to burn all bridges behind us and make innovation happen in this "Living Laboratory". The intention is to bring technology developers and users together on this open innovation platform for use-inspired basic research (Stokes, 1997).

*Pattern of innovation and growth processes*

The second research line focuses on identifying patterns of innovation and growth on the network level. To this end, we build on existing work from a variety of backgrounds, like project management, product development, process management, or management control systems to explore patterns and develop process theories that ultimately can empirically be validated. While Baltes (2001), Blum (2003) and Dissel (2004) succeeded in re-constructing patterns of dynamic capabilities from cases, Florian Strehle is about to finish a study with empirical testing of a process theory on how top management teams can contribute to the fast growth of VC backed firms through implementing management control systems. Similarly, Ma describes patterns of process innovation during the implementation of organization wide information systems (ERP or PDM) and how top management can further the success of the implementation program by communicating the significance of the undertaking at the right moment to the right stake holder group. Fuelled by the success of these ongoing studies, I want to return to the study of innovation processes in clusters and extend earlier case based experiences of actor roles in the cluster of the Virtuelle Fabrik.

*Research methodologies for innovation research*

The third research line will remain for the time being the epistemological positioning of innovation theories and the honing of a practical innovation research methodology. With the two studies by Florian Strehle and Xiaofeng Ma we will hopefully get examples on how to adopt recent stochastic mathematical approaches (survival analysis) for the empirical study of innovation process theories. In both cases we were able to distinguish successful and less successful patterns of change and to explain – based on facts – which managerial activities increase the chance for successful growth or change.

***Seven actions to make innovation happen***

Socially relevant theories are dangerous, because once they are accepted, they set processes into motion, that tend to ensure they become self-fulfilling (Pfeffer, 2005). I think I have sufficiently stated my point that stability as policy Leitmotiv works against dynamics. This month's cut of European growth forecast to only 1.6% for the year 2005 and two percent for the next years with stable unemployment of 8.5% and 9% (Atkins, 2005) is just another indication for this tendency. But during the preparation of this lecture I had the opportunity to discover numerous initiatives and activities, which in my eyes can easily be leveraged towards a more dynamic economy and new "bedrijvigheid" in the Netherlands.

I want to use this excellent opportunity of such distinguished audience today and the fact that the rector magnificus is member of the Dutch innovatie}platform, to conclude with seven practical action items from the here presented dynamic innovation framework. In all respect and as a reply to Wim Kok's report that all has been written down in reports but nothing happens, I present some examples for some very concrete and short-term actions:

1. **Lead** with an innovation **vision** and provide conceptual leadership! I have not found a working definition, and actually I am uncertain about the shared understanding of what innovation for the innovatie}platform is. Use the high-level political support for vision creation and avoid the pitfalls of mini-reforms and endless discussions amongst pressure groups.
   - Create one or two small think tanks of not more than a handful of experts to develop a coherent innovation vision!
   - Decide on an innovation vision and focus on a limited number of ambitious objectives and priorities!
   - Communicate and create awareness!
2. Develop **meso-level mechanisms** to align macro level policy and micro level business activity at the cluster and regional innovation network level!
   - Profile and prepare institutions for the innovation industry. Strengthen relationships and create regional cluster structures for which Leiden, Delft and Noordwijk can be a prototype!
   - Profile the clusters in their full breadth and position them in a global context!

Leiden, for example as well has considerable aerospace competences.
- encourage cooperation and provide networking events, especially of researchers with non academic and business entities!

3. Clarify the third "maatschappelijke doel" **university objective** as the delivery of regional innovation capabilities!
   - Position Leiden University (as a pilot) as a network player with a clear role in and for the innovation clusters!
   - Complement the emerging innovation policy of Leiden University, which now mainly focuses on research funding with a genuine innovation policy!
   - Complement the planned Leiden Research Service Office with a separate Leiden Innovation Service Office!
4. Develop advanced **innovation process competence**! Especially public interventions and subsidies are still entirely based on the linear innovation process model!
   - Recognize and acknowledge open innovation processes that exist at "Wireless Leiden", which is a living laboratory of open ICT, or LUMC for the care domain!
   - Cross fertilize learning amongst existing open innovation processes and improve their institutional support in the region!
   - Appoint (open) innovation representatives into the national innovatie}platform!
5. Create an **innovation industry** in its own right with professional service providers! Such new division of labour will allow for highly productive innovation specialists (N.N., 2005) and a Europe based industry that already creates a similar large part of the new jobs as in the US.
   - Develop innovation out-sourcing capabilities with large firms as well as innovation in-sourcing capabilities with their suppliers and universities!
   - Reduce direct public intervention and subsidies for technology commercialization to create a level playing field for private service providers!
   - Raise awareness amongst policy makers and corporate decision makers on the specifics of the innovation process and its critical requirements, e.g. the current gap for innovation financing after the start-up phase.
6. Strengthen **market orientation** and communication! Inventions are made in laboratories. The so called European gap is that too many of them are never communicated to outside markets or society. Marketing, even simple communication skills are underdeveloped and small improvements will quickly increase innovation output.
   - use the established profile of the clusters and their competences to promote them on global level (Flower auction, Wireless IT, Astronomy & Space, Life-science)
   - Tune incentive systems towards markets and returns from markets and remove barriers to market orientation, especially for technology transfer organizations!
   - Train professors, researchers and scientists in marketing!

7. **Teach innovation** on broad societal level for all secondary education. Address the issue that knowledge about innovation is scarce at all levels of society and that this fact not only works against effective innovation action, but even creates uncertainty and fear amongst policy makers, decision makers and individuals alike!
   - Make technopreneurship education compulsory, start with Leiden University, e.g. as part of the studium generale!
   - Marshall partners for innovation capability development on cluster level, e.g. for start-up coaching, project management, technopreneur development courses, use the earmarked innovation budget of Leiden University to kick-start such initiatives!
   - Orchestrate institutions and activities like the science based business program, bio-science park, ESI, New Venture, Gemeente Leiden, University, serial entrepreneurs, and KvK through a cluster coordinator!

*Words of thank*

Ladies en gentlemen, it is my pleasure to conclude this inaugural lecture with some words of thanks.

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Dr. Claudia Bücker, Dr. Vera Kazei, Dr. Herman Löh, Kai Peters, Olivier Rerolle and the researcher team at CeTIM. We can celebrate the fifth anniversary of CeTIM as a research institute these days. I well remember the brainstorming sessions only little more than five years ago with the crazy idea of creating an internationally oriented, European research institute. It is an innovation that we made happen, but if I had then imagined the effort and pain, I am not sure whether I had ventured it. I thank you for the hard work, and the many frustrations that you tolerated in creating CeTIM with what looks from the outside as an exciting start. I am looking forward to enjoying the future opportunities.

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Dear parents, Claudia, Rebecca, and Jonathan, I am happy to share this day with you. Beyond the personal encouragement, I thank you for the very hands on practical contribution to the work, without which I would certainly not be standing here.

Innovation hurts a little when undertaken the first time. So, just do it more often, to enjoy the fun to make innovation happen.
Ik heb gezegd.

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