



INNOVATIVE ENTREPRENEURSHIP THE NIKOS STORY

PROF. DR. A.J. GROEN

TEN YEARS
OF ENGAGED
SCHOLARSHIP IN
ENTREPRENEURSHIP
AT THE UNIVERSITY
OF TWENTE



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Foreword

The University of Twente is more enterprising now than ever before, which automatically implies that it keeps on innovating. The fact that the new house style introduced last year no longer includes the pay-off 'the entrepreneurial university' as standard in no way means that we have changed course. The UT is and will continue to be entrepreneurial, a value that has become a matter-of-course for us. And the outside world recognises this fact, as evidenced by Prime Minister Marc Rutte's visit this spring. He wanted to see with his own eyes how we combine academic excellence and an enterprising spirit.

We continue to build on the success of this concept of the entrepreneurial university, and continue to consistently create new businesses. That is our underlying strength. At the same time, as already mentioned, an entrepreneurial university is innovative by definition, which means it keeps questioning the organisation of its academic entrepreneurship. In the early years, the entrepreneurial UT mainly operated in isolation and aimed primarily to convert knowledge into new activity.

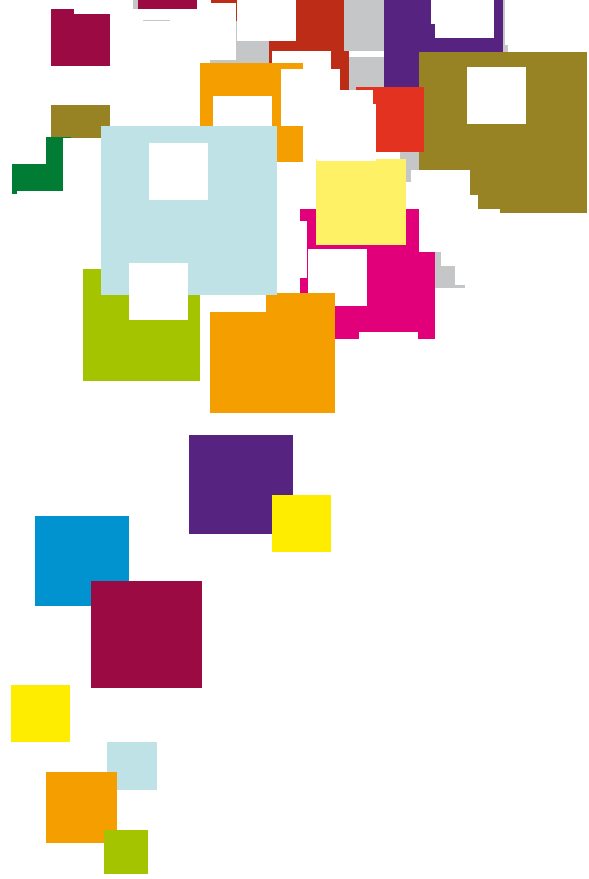
We have now reached the next stage, where we demand more of the way in which our academic entrepreneurship is organised, which is now mainly about valorisation. For instance, in the context of *Kennispark Twente* our emphasis has shifted to working together with relevant partners, such as municipal, regional and provincial authorities, as well as businesses, our own NIKOS institute and other knowledge institutes, like Saxion University of Applied Sciences. This is what people call the triple helix or golden triangle and the organisation has become markedly more professional as a result.

Furthermore, our focus now is on growth acceleration, in view of the fact that many of our university spin-offs only grew to a modest size. With its VentureLab Twente, NIKOS significantly boosts growth acceleration and related knowledge development, making it a fine example of a highly entrepreneurial scientific group that can also serve as a part of the *Kennispark* concept.

There is, of course, a field of tension between maintaining academic identity and being successful in the market, but NIKOS goes a long way in combining these two aspects. This is also an inherent part of its discipline and field of study: entrepreneurship in networks and the success of innovation models in practice. In that sense, NIKOS is an academic showpiece and a test bed for the entrepreneurial university.

I would like to congratulate NIKOS on its tenth anniversary and its contributions to the University of Twente and *Kennispark*. I would also like to impress on it that it should not hold back on continuously innovating the valorisation model it shares with its partners. That will make the next ten years even better than the last.

Prof. Dr. H. Brinksma, Rector of the University of Twente



Preface

The Netherlands Institute for Knowledge Intensive Entrepreneurship (NIKOS) was established at the turn of the century. The first steps taken in 1999 included setting up an academic minor in Entrepreneurship. Then in 2001, the Executive Board of the University of Twente agreed to combine part of its knowledge & technology transfer unit (especially the part that worked on encouraging entrepreneurship, led by Dr Peter van der Sijde) with the Chair in Innovative Entrepreneurship (Prof. Wim During) and the Chair in Marketing, then represented by senior lecturer Dr Aard Groen, the first NIKOS director.

NIKOS's objective was to combine scientific development and practical regional economic development for knowledge intensive entrepreneurship. This resulted in the Netherlands' first academic centre for entrepreneurship, incorporating research, education, entrepreneurial support (business development) and consultancy/training. The centre's research started with a handful of PhD students. Having started with a team of about seven, NIKOS rapidly grew to some thirty people working in the field of entrepreneurship and marketing. In 2004, the International Management group (Prof. Erik Joost de Bruijn) joined the centre, followed by the Strategic Management group (Prof. Hans Roosendaal).

The institute's tenth anniversary in 2011 is an excellent opportunity to once again outline the scientific questions concerning knowledge intensive entrepreneurship on which NIKOS is based, and to indicate how NIKOS works and will continue to work on answering those questions using Andrew Van der Ven's maxim of 'engaged scholarship'. Moreover, this fits perfectly with the current socio-economic situation. After all, the central theme of all of our activities is entrepreneurship and innovation. The national Innovation Platform and regional *Innovatieplatform Twente* have placed this theme high up on the political agenda and the current cabinet has recently given a new impetus to this by identifying nine top economic sectors.

The central question is how (scientific) knowledge can be made to serve economic and social purposes at an accelerated rate, and how the gap between interesting academic knowledge and (technical) applications can be bridged. That's exactly what all of our activities are about. This is most visible to the outside world in projects like VentureLab Twente and *Kansrijk Eigen Baas*, but we are also active on an international level, working with such bodies as the ICT Labs of the European Institute of Technology. Ultimately, our aim is to make our (existing and new) business community more entrepreneurial, innovative, flexible and customer-oriented to be able to survive global competition.

I would like to use this publication to provide a concise scientific foundation to answer these questions, as well as a practical example with the VentureLab Twente case study. Finally, I would like to take this chance to thank the University of Twente for the opportunity it has given us to tackle these challenging subjects and to build a knowledge centre dedicated to this.

Aard Groen
Enschede, November 2011

Innovative entrepreneurship

As is the case in every higher education institution, and certainly within NIKOS as part of the entrepreneurial University of Twente (UT), academic development in the field of innovative entrepreneurship takes place across three interrelated tasks:

1. In research, into phenomena of innovative entrepreneurship.
2. In education, for students who wish to learn about innovative entrepreneurship and/or learn in that environment.
3. In services to the community, specifically aimed at knowledge valorisation and encouraging entrepreneurship in the surrounding areas.

These three tasks form the core activities of a university in accordance with the current policy. The NIKOS Chair in Innovative Entrepreneurship as well as the entire NIKOS department work in each of these three areas and actively seek opportunities to coordinate these three types of activities with one another. The services to the community in NIKOS, business development as well as training & consultancy, specifically aim to contribute towards capitalising on the knowledge developed at the UT. See also the scheme presenting an overview of activities in NIKOS.

ACTIVITIES IN NIKOS

BUSINESS DEVELOPMENT

- TOP (25 years, until 2011, n=450 entrepreneurs)
- NENSI (incubator network)
- KEB (7 years, >300 firms supported)
- VentureLab Twente (since May 2009)
- Bepart (Baltic network)
- Mephi (Moscow University)
- GlobalStart
- International business development

RESEARCH (SRO INNOVATION AND ENTREPRENEURSHIP, IN IGS)

- Entrepreneurship in networks/entrepreneurial heuristics
- Entrepreneurial university-industry interaction
- Market oriented business development
- Entrepreneurship & business development in international perspective
- Bio-medical entrepreneurship
- Organizing for innovation
- High Tech Small Firms Conference



TRAINING & CONSULTANCY

- Market orientation HTSF
- KVGGO/VNO-NCW
- Manufacturing Industry Networks
- Rabo
- International consultancy

TEACHING

- Minor Innovation & Entrepreneurship, Minor International Management
- Entrepreneurship in Technology programmes (AT, Ind. Design, Nano, etc.)
- Technology Venturing and Innovation at VentureLab Twente
- Msc Business Administration:
 - Innovation & Entrepreneurship
 - International Management
- Master Innovation & Entrepreneurship ECIU with TU Berlin
- Twente Graduate School: teaching entrepreneurship research for PhD students

By supporting innovative start-ups and existing businesses with knowledge generated at the UT, NIKOS is also creating a 'test bed' for new methods and techniques in business development and entrepreneurship support. That is why this set of duties includes a fourth one in the form of consultancy, in so far as this contributes towards creating opportunities to carry out research, to teach and to provide entrepreneurship support. The overview of NIKOS activities in the scheme clearly demonstrates the synergy between the four types. When combined they help to increase knowledge of entrepreneurship as well as accelerate business. Examples of the four NIKOS tasks will be presented below.

Key questions

Three questions arise from these three activities.

Firstly, what is innovative entrepreneurship exactly? To what extent is this an academically relevant subject? How can research be conducted in this field and how do we conduct our research into it? For example, how can we explain variations in success in innovative entrepreneurship?

The second question concerns education: How do you learn entrepreneurship? Is it something that can be learnt? What are the suitable methods used here at the UT? Is it of particular use to the entrepreneurial university?

Finally, the third question can only be: How are we as NIKOS of service to the community? Is it a precondition for our work or does it affect academic freedom? If the UT is "High Tech, Human Touch" as an entrepreneurial university, how can we make a contribution to it from this field?

Definitions of entrepreneurship

Imagine three people:

- Jan Timmer, former CEO of Philips NV, employer of over 120,000 people.
- Roel Pieper, former CEO of Tandem Computers, VP Compaq, VP Philips, creator of the Twinning IT entrepreneurship centres, investor in an aircraft plant and coal gasification in Russia, and also in various knowledge intensive start-ups, to name a few, and senior lecturer at the NIKOS department.
- Henny van der Most, scrap-iron dealer, entrepreneur in the recreation sector from the Slagharen area, well-known, amongst other things, for the sports and events centre *De Bonte Wever*, the theme park *Kernwasser Wunderland* and hotel and events centre *De Koperen Hoogte*.

These three gentlemen were guest speakers at the UT a few years ago to give a lecture on entrepreneurship. Van der Most told a hall full of students that as far as he was concerned only one of these three individuals was an entrepreneur, namely himself. He regarded Timmer as a manager, one of a large company, but nevertheless not an entrepreneur who took his own risks. Pieper, who was at the time first and foremost well-known for the Twinning centres, could perhaps be an entrepreneur, according to Van der Most, but as a former manager of various large companies he would still have to prove that...

Van der Most's view is one that we also encounter in the literature. A great many definitions of entrepreneurship can be found in the literature from the economical, sociological, psychological and, of course, business disciplines.

The simplest definition describes entrepreneurship as creating a new business at one's own risk and expense (for example Gartner, 1985; Low & MacMillan, 1988). This broad definition therefore focuses specifically on the aggregation level of the company, but the creation of a new company is usually attributed to the entrepreneur as a person. Aldrich & Zimmer (1986) focus their attention on the network aspect: an entrepreneur is a networker. Timmons et al. (1987) place the emphasis on the recognition and seizing of opportunities.

Entrepreneurship within an existing company is beyond the scope of this definition. However, other definitions of the term not only consider entrepreneurship in new companies but also distinguish entrepreneurship in existing companies. For example, an early definition from the famous sociologist Max Weber (1889) reads:

'Entrepreneurship means the taking over and organisation of some part of an economy, in which people's needs are satisfied through exchange, for the sake of making a profit and at one's own economic risk.' (in: Swedberg, 2000)

According to this definition, the element of economy can be organised both within an existing company and by means of a new company. In both cases, however, it clearly involves an entrepreneur who takes the initiative, runs a risk and seeks profit by creating a new supply of something and a demand side, the needs of which are satisfied and which is willing to give something in exchange for this. This defines the principle of market-oriented enterprise and is further elaborated in the marketing discipline (which is also in the NIKOS department). This area was introduced into research at the UT by Erik van Raaij (2001) and the value creation process is placed at the centre of this concept. It also features in the general definition of the concept of entrepreneurship used in research in NIKOS.

The entrepreneurship process

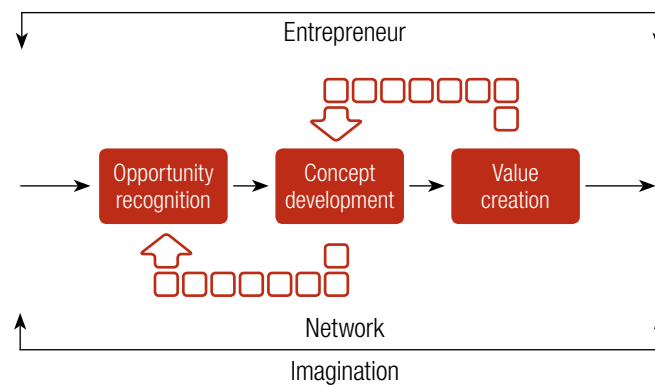
Entrepreneurship is defined as a 3-step process of:

1. Recognising or creating an opportunity for value creation;
2. Converting this opportunity into a workable concept;
3. Capitalising on the concept in a (growing) organisation.

NIKOS works primarily according to this type of definition, following Davidsson (2004), Shane & Venkataraman (2000) and others. All of this is perfectly summarised by the former NIKOS doctoral students Marijke van der Veen and Ingrid Wakkee ((2004, in Watkins). Internationally, and primarily in the USA, the matter of which discipline entrepreneurship falls into is under discussion on the basis of this definition.

Since around ten years ago, more attention has been paid to the nature of entrepreneurship as a process (see also the scheme). In keeping with this approach, the processes in which the creation of new activities in an organisational context forms the focus are therefore the subject of research at NIKOS. That means a great deal of attention is paid to start-ups, but also to existing companies who are regenerating their value creation process (see also the box on value creation). After all, this involves recognising or creating an opportunity in the market, building a concept and starting it up.

THE ENTREPRENEURSHIP PROCESS



Value creation

Researchers from the UT departments NIKOS and OOHR (Operations, Organisation and Human Resources) work in the RNCI (Regional Competency Network for Innovation) in collaboration with a group of companies from the manufacturing industry in order to improve their capacity to innovate – within existing companies – in line with market developments. Facing competition from industry in low-wage countries, these companies cannot compete in terms of cost-savings and that is why they will need to improve by creating value for their customers. This is possible by operating in a flexible, innovative, customer-oriented and cost-conscious way.

Similar issues are being addressed in conjunction with partners from the Manufacturing and Innovation Network (MAIN), who are specifically working on continuously improving the Eastern Netherlands' manufacturing industry's ability to compete in the market via the *STODT Toekomsttechniek* knowledge centre. The areas being covered include the manufacture of goods that more closely meet the needs of the market, collaboration to achieve innovation and lean manufacturing (24/7).

These projects illustrate the relevance of the consultancy branch of activities within NIKOS.

Innovation and entrepreneurship

Innovation and entrepreneurship often go hand in hand, and as such this combination is the core of the research and teaching programmes of NIKOS. One of the most well-known definitions of entrepreneurship is that of Joseph Schumpeter (1934):

'Entrepreneurship is making new combinations of products, processes, organisation and markets.'

Schumpeter bases entrepreneurship on innovation and new combinations and in this regard both incremental innovation and more radical innovation can give rise to entrepreneurship. Creating a new combination of existing products, processes, organisations or markets is regarded as incremental, which chiefly means, in fact, that no significant changes are necessary in existing situations in which the new combination can be used.

In the case of radical innovation, the new combination has genuinely new elements at its centre. Steven Walsh (2004) makes a distinction between disruptive and sustaining innovations, where in disruptive innovations the knowledge base changes radically, while in the case of sustaining innovations a relatively small change occurs in the knowledge base. In Walsh's terms, radical and incremental innovation are related to change in user behaviour. 'Radical' means a completely different behaviour in relation to a product, for example using computer technology to write a publication instead of using pen and paper. An example of incremental innovation would be the change from an XP to a Vista operating system on the PC, where the differences in usage are quite small. However, from the perspective of the generations of Windows PC systems, Vista is a significant change in terms of the knowledge base.

Technology as a driving force

In this regard, Schumpeter puts forward technology as one of the driving forces of entrepreneurship. In his view, radical and/or disruptive innovation will often give rise to 'structural readjustments': old structures disappear from the market and are replaced by new parties with new technology that can be used to create significantly more value. In his doctoral thesis, which he defended at the UT, Jan-Willem Stoelhorst (1997) demonstrated that many large companies are unable to make such leaps in technology. One example, which he discussed extensively and which was one of many, was the rise of the transistor-based industry for electronic signal processing and amplification that grew at the expense of vacuum tube technology, which had been dominant until then. In that case, it turned out that Philips was in fact one of the few large companies in the vacuum tube technology industry that managed to make the transition to transistor technology. In the Schumpeterian view, then, a CEO of Philips may very well be regarded as an entrepreneur.

These kinds of innovation processes also take place today. Philips is often featured in the newspapers in relation to the transition from the light bulb via energy-saving bulbs to the now increasingly commonplace LED lighting. The technological change that is taking place here is characterised as disruptive, as it is also the case here that large parts of companies are becoming superfluous and new parties are able to enter the market. In this situation, Philips capitalises on being a large company: it is able to work on new technologies while phasing out the old technology. New companies are also being established on the basis of new LED technology and the existing industry is also investing in some of these companies.

This phenomenon was cited by Bart Nooteboom in his thesis on dynamic complementarity (1987) in which the advantages of small businesses (flexibility, innovation, risk-taking) are linked to the complementary elements of investment capital and the associated ability of large companies to hold out longer. This is a phenomenon to which academics such as Chesbrough, Vanhaverbeke & West have drawn attention in their work on 'open innovation' (2006).

Research

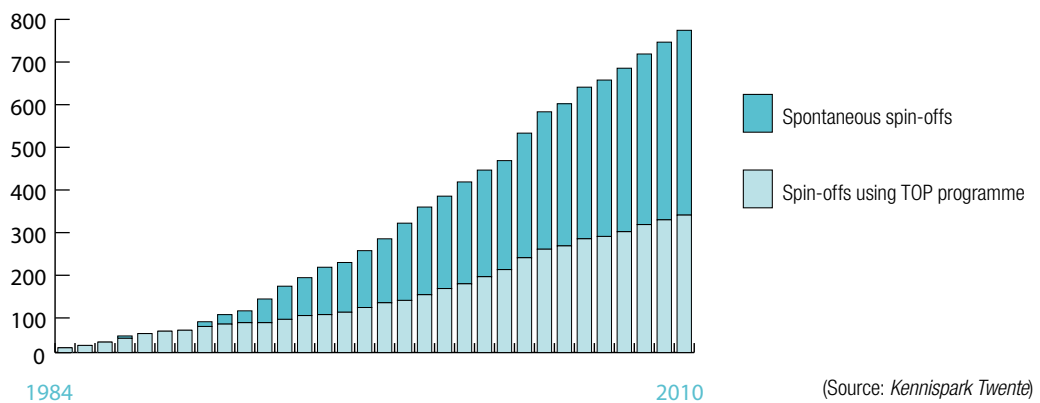
The central aim in research in NIKOS is formulated as follows:

'To describe, explain and predict differences in entrepreneurship processes and to design tools in order to improve those processes.'

Most of the research of NIKOS concerns innovative entrepreneurship, in the sense that new high-value knowledge forms the basis for enterprise processes. At a university of technology such as the UT, it would seem obvious that this is connected with technology, and traditionally the UT devotes a great deal of its work to problem- or theme-oriented research using an engineering approach. Health, for example, is a subject area in which many technologies developed at the UT are pooled. We call this converging technologies, which has already given rise to a number of rapidly developing spin-offs in that field (Micronit, Xsens, Medimate, Medspray, and so forth).

However, in addition to the technological background, the UT also carries out its research in entrepreneurship based on new insights from the domains of psychology, educational studies, business studies and public administration. One of the largest spin-off companies from this university is PNO Consultants, which has been in existence since 1984 and is based on the study of subsidy systems by three former public administration students. More recently, we have also seen some interesting spin-offs from the business studies programme that is still running (SEM ventures, B&M business development). Since 1984, around 700 companies have originated from the UT (see the diagram).

CUMULATIVE NUMBER OP SPIN-OFFS UNIVERSITY OF TWENTE



Characterising entrepreneurship processes

NIKOS approaches the subject of entrepreneurship on the basis of the aforementioned process model. A variety of parties play a role in the entrepreneurship process and in view of the complexity of enterprise, they carry out many different types of activities that each have their own significance. The main questions in research are characterised

by attempting to typify the process. In research into entrepreneurship, this also involves aspects such as the long-standing discussion regarding rational/plan-based working (Popper) versus so-called 'muddling through' (Lindblom). This opposition is encountered in many sub-disciplines of management or management theory and the term 'bricolage' (Baker et al., 2003, 2005, 2007) also crops up in entrepreneurship literature as a way of characterising the process that entrepreneurs go through. In this case, bricolage primarily refers to creating something from very few resources, with the help of improvisation and creative processes. The basic assumption is that starters often have few means at their disposal and therefore have to call on their powers of creativity to make effective use of them. A recently developed approach of which this idea can form part, but that is also more comprehensive than that, is the approach of Sarasvathy (2001), in which causation is compared with effectuation (see the table).

PROCESS: CAUSATION VS. EFFECTUATION

How do causation and effectuation approaches to entrepreneurship appear in practice and can differences in approaches explain firm survival and growth (Kraaijenbrink, Spender & Groen, 2010)?

Dimension	Causation model	Effectuation model
Starting point	Ends are given	Means are given
Assumptions on future	Predictability means controllability	Controllability reduces need to predict
Predisposition to risk	Expected return	Affordable loss
Domain	Existing products and markets	New products and markets
Attitude toward outside firms	Competition	Cooperation
Type of model	Linear	Cyclical

The main feature of causation is that planned actions are considered typical of entrepreneurship and perhaps the most noticeable manifestation of this approach is the business plan. In this regard, it is assumed that the development of the company is planned out in advance and that the course of action that is designed in this way will also actually be taken. By contrast, effectuation describes a process in which the entrepreneur adjusts their goals depending on who and what they encounter and in which the direction of the company is based more on opportunities that arise rather than on a plan. In this approach, the means available to the entrepreneur also determine how resources are used. The entrepreneur establishes what they consider to be an 'affordable loss', in other words, the maximum amount that they would be able or willing to lose if the company failed to be successful, and with that in mind the entrepreneur will have to map out the plan of action. Sarasvathy claims that the most successful entrepreneurs often take this approach. She also states, however, that after the initial stages of development, when the more or less definitive direction of the company has been determined, the successful company often makes the transition to a causation approach. Where exactly this turning point occurs, though, is a topic for further research.

Social system theory

NIKOS research was inspired by earlier work on social system theory, notably of UT staff member Peter Geurts, who still is involved with research development at NIKOS. He applied this theory to explaining differences in the outcomes of processes in which citizens try to influence the government. For his student Aard Groen this created in 1988 an

opportunity to become familiar with a multi-dimensional approach towards action processes. It suited the intuitive notion that multi-dimensional analysis is necessary to ensure that the relevance of the analysis of the actual situation is not excessively reduced. As Bart Nooteboom demonstrated in his inaugural lecture (1988): If you want to make definitive statements at a macro level about processes that take place at the micro level, it may be possible to apply firm simplifying assumptions, such as those used in classical economic theory when analysing the situation that exists at the micro level. However, if you want to make a definitive statement at a micro level regarding the resolution of specific points, over-simplification is not productive.

The original work by Parsons et al. (1937, 1951, 1977), in which Parsons criticised the classical economic, psychological and biological theories, underlined that idea. In response to those theories, he proposed the action theory, which had a significant influence on the development of sociology in the 20th century. It forms the basis for the notion of structural functionalism, although Parsons (1977) expressly rejected the development of that idea and even the term 'structural functionalism' that is attributed to him. An idea very similar to Parsons' original criticism can be found in the work of Granovetter (1992), who proposes the 'embeddedness' approach as a solution to the problem in classical economic theory that the actor is too often regarded as entirely autonomous. He also adds that the assumption of complete environmental determinism on the part of the actor is not sufficiently realistic to be able to develop a theory that is relevant in practice. The key idea in action theory is that actors always carry out their actions in a context on which they are at least partly dependent. Similar developments are also found in the literature concerning entrepreneurship.

Popular descriptions of the entrepreneur often depict him (rarely a 'her') as a type of 'lone hero' who creates a business all by himself. Consider, for example, the biographies of famous entrepreneurs such as Henry Ford, Lee Iacocca or the Dutch shipbuilder Cornelis Verolme. In reality, however, the entrepreneur works in collaboration with others in order to build a business. Entrepreneurs are of course a special type of 'actor' when involved in the process of establishing a business. They take the initiative to create a value-generating organisation on the basis of an opportunity they have identified. They assume a management role, bear the risk of entrepreneurship and take the first steps in developing their idea. Nevertheless, in this process the entrepreneur will interact with other actors, such as potential clients, team members, regulators, suppliers, competitors and knowledge developers.

Overview of Twente research

A core issue in both pre- and post-NIKOS research therefore looks at how the actors organise their interaction, and how they influence each other's performance in doing so. The first PhD research project supervised by Groen (still in the pre-NIKOS days) and his predecessor Wim During was that of Rosalinde Klein Woolthuis. This actually represented the beginnings of the 'Entrepreneurship in Networks' research programme of what was to become NIKOS. Her dissertation titled 'Sleeping with the Enemy' (1999) described the role of trust versus the role of contracts. It is an interesting study, due in part to the combination of qualitative and quantitative methods used.

Methodologically speaking, this combination features in much of the NIKOS research. Marijke van der Veen (2004), Ingrid Wakkee (2005), Paul Kirwan (2009) and Joris Heuven (2009), among others, have all combined qualitative

approaches with quantitative analyses. Qualitative research involves in-depth study of individual cases, getting to the bottom of complex processes. Quantitative analyses can range from a single case (e.g. analysing six months' worth of email, as Ingrid Wakkee did) to surveys/questionnaires among several hundreds of companies (such as Marijke van der Veen's study on the adoption of e-commerce). The benefits of this method include not only depth of explanation, but also mean that an estimate can be made regarding the generalisability of the results. This avoids the 'Clean models versus dirty hands' dilemma presented by Mitchel et al. (in Marsden & Lin, 1982).

From a methodological standpoint, the research repertoire of NIKOS is now being expanded in two directions. Firstly, research should better reflect the process nature of entrepreneurship both by focusing theory more on this aspect, and by applying research methods in a more process-oriented fashion. The sociological study as it has been conducted for years in the Business Administration faculty at the UT (e.g. the aforementioned work by Geurts) serves as inspiration. This also presents some attractive crossovers with business administration; Andrew Van der Ven's book on 'Engaged scholarship' (2007) is a very interesting example, and has prompted closer collaboration with the Carlson Business School in Minnesota, where Van der Ven works, as well as Shaker Zahra, who has already been working with NIKOS for quite some time, and also has a position at NIKOS as the 3TU professor of International Entrepreneurship.

Secondly, the NIKOS research repertoire is being expanded to include large-scale databases. Ariane von Raesfeld is already working on a database for co-patents. In association with Zahra, database research is being carried out that focuses on the development of high-tech companies in international entrepreneurship. In our research on entrepreneurial processes databases are being developed in conjunction with concrete entrepreneurship support – schemes such as TOP (*Tijdelijke Ondernemers Plaatsen*) [Temporary Entrepreneurial Positions] and KEB (*Kansrijk Eigen Baas*) [Successfully Your Own Boss] – with the ability to create relatively large longitudinal databases (see also later in the section on VentureLab Twente). The growth of the Innovative Entrepreneurship chair, and its partnership with the other NIKOS chairs and the Innovation and Entrepreneurship research programme at the UT Institute for Innovation and Governance Studies (IGS) creates a capacity that can actually cope with managing such a broad repertoire of methods and techniques.

In current research into entrepreneurial processes, we also explain differences in success in the entrepreneurial process using the social system approach. The origin of Parsons' social system theory has given rise to the development of a four-dimensional framework that can be used to describe and explain actions of entrepreneurs during the three phases of the entrepreneurship process (Groen, 2005), as well as to predict and design interventions in these processes. NIKOS researchers who have contributed to this development include Peter van der Sijde (in particular his work on university-industry interaction and spin-off research), Paul Kirwan (research into developmental processes and networking of global start-ups) and Joris Heuven (on the role of third parties in obtaining access to investment capital, and the investor's subsequent decision-making process on whether to invest or not).

Thijs Habets is working on the development of instruments geared towards a better understanding of collaboration within 'complementor relationships', as they are called. He does this using research into the success factors for innovation at

Dutch and German printing companies. Wouter Alberts was and Natalie den Engelse is conducting research into the virtual networking opportunities within social media and other channels, which also fits in well with the work of Pieper and Constantinides on e-business/e-commerce practices, and that of Basil and Paula Englis concerning the 'voice of the consumer' from a marketing and entrepreneurship perspective.

Within the department close collaborative ties are maintained between the various chairs (in particular Innovative Entrepreneurship, International Management and Strategic Management) within a research programme looking at business development in international networks. 3TU professor of International Entrepreneurship Shaker Zahra also contributes to the programme, and work has been done on this since 2000 in conjunction with researchers at the OOH department – primarily concerning innovation management at existing (often major) companies. The work with Petra de Weerd-Nederhof, Inge Kerssens-van Drongelen and others (Groen et al., 2002) mostly concerns R&D management in networks and assessment of the value of R&D viewed from the necessity of both operationally effective organisation in the short term, and strategic flexibility in the long term. Looking back, this was actually open-innovation research before the term existed.

The current 'Innovation and Entrepreneurship' research programme unites these aspects. The research of Annemien Pullen (2010), supervised by Fisscher, De Weerd-Nederhof and Groen, focused on the organisation of biomedical start-ups from a network perspective and is quite possibly the finest example of interdepartmental collaboration. Granted, the collaboration in question was also clearly pointed out in the dissertation and joint publications of Rick Middel (2008) and Fisscher and Groen (2007) on the management of innovation within a network made up of several companies. Now, Raymond Loohuis is continuing this line of work in his PhD project on the analysis of processes of alliance management in an international business development context. His work started also with a 4S analysis (see below) of a longitudinal case in which he actually himself had been the manager (so participative observation data), and he is now developing an elaboration into the role of time and triggers of change in such processes (Loohuis, 2009, 2011). Another form of collaboration is studied by Kasia Zalewska-Kurek, who is looking into the development of a strategic model for improving the transfer of knowledge from academia to industry (Zalewska-Kurek, 2008).

The dissertation by Jeroen Kraaijenbrink (2006) also drew links with social system research: in close collaboration with Wijnhoven, Groen and his supervisor Stegwee, he identified Parsons' social system ideas in his data on knowledge management, and knowledge integration in particular (the acquisition and subsequent application of knowledge from outside the organisation). This line of research now finds its succession in the work of Sandor Löwik on 'absorptive capacity'. Since his appointment as university lecturer at NIKOS, we have been working with each other (and with J.-C. Spender) on the in-depth development of new 'theory of the firm' perspectives, using our insights such as those garnered from social system theory (Kraaijenbrink et al., 2010). Our partnership with Steven Walsh, appointed at NIKOS as part-time professor of Industrial Renewal, resulted in a special issue of *Technological Forecasting and Social Change* on technology and business dynamics in such new technological areas as nanotechnology (Eijkel, Groen & Walsh, 2007). To conclude this non-exhaustive list, Tiago Ratinho (2011) conducted research on the impact of business support services, and of business incubators in particular.

The 4S model

The central theme of much of this current research is the 'entrepreneurship in networks' model (also known as the 4S model within NIKOS), which was inspired by the social system theory. The focus of this work is the question of how it can be explained that a social system becomes sustainable, in other words, how it can continue to exist. The definition of 'social system' comprises four mechanisms that must function effectively in conjunction with one another in order to achieve that sustainability, and those mechanisms manifest themselves in every action of an actor (individual, group, organisation, country, etc.) in a specific way. These four mechanisms are:

1. Setting and pursuing goals (goal attainment);
2. Creating and maintaining an effective pattern of behaviours (pattern maintenance);
3. Aiming to achieve greater efficiency in carrying out actions (adaptation);
4. Sharing/interacting with other actors, so as to ensure that the other three dimensions are coordinated (integration).

This is applied to entrepreneurship within NIKOS. One definition of entrepreneurship that is consistent with this theory and the three stages of entrepreneurship reads as follows:

Entrepreneurship is the setting and pursuit of a new goal (based on an identified opportunity in the market) by an actor (entrepreneur), who creates and maintains a pattern of effective behaviour (a business concept, organisation, culture, learning) in interaction with others (team, customer, supplier, competitor and others), in which greater efficiency (scale effects) contributes towards achieving financial results (growth).

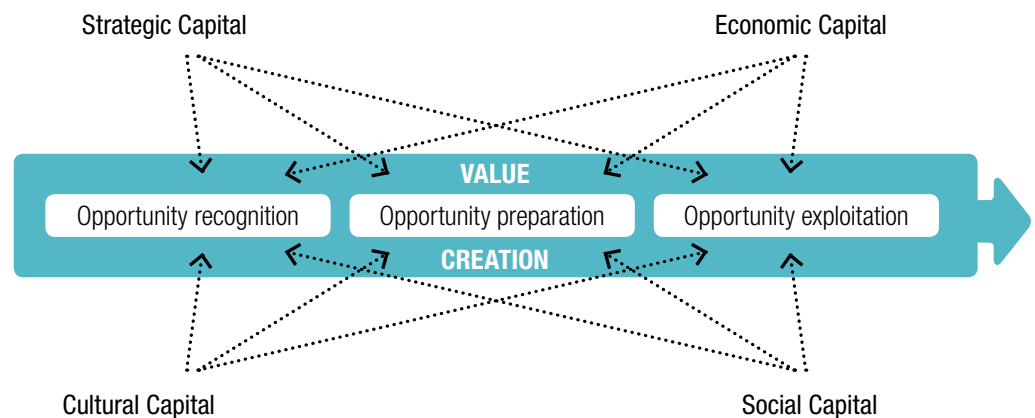
In this approach, four types of capital can be used in the targeted behaviours (or actions) of actors, respectively in relation to:

1. Setting and pursuing goals: strategic capital
2. Creating and maintaining a pattern of effective behaviour: cultural capital
3. Efficiency: economic capital
4. Interacting with others: social capital.

This means that in every type of relationship four types of capital are exchanged, or shared (see the scheme of the 4S model). This involves, for example, strategic collaboration, exchange of knowledge in the cultural dimension, loans or sales in the economic dimension and acting as a broker to other networks via the social dimension. An important part of enterprise focuses on finding out how the types of capital from one source can be linked to those of another source, for example in customer-supplier relationships.

The nature of system theory is that the mechanisms are assumed to generally work at different levels of aggregation, from an individual actor to a society. The four types of capital are produced and consumed at every level of aggregation that we can define. An analogy might be a Russian matryoshka doll or, somewhat closer to home, the *Droste* effect.

THE 4S MODEL



As far as the analysis is concerned, this means that a relationship is possible, by means of aggregation of actions at the one level into the significance of this at the next (or previous) level. From an analytical perspective, it is also possible to specialise in the actuation of one of the functions, for example the setting and pursuit of goals, into which strategic capital is invested, the specialist role of the strategist of an organisation. However, we encounter the other functions again in specialist behaviours, now only serving that one function, in this case the strategic one.

Towards application

We have been dealing with some quite abstract concepts. In order to make this more tangible, one of the central projects of NIKOS is explained further on in more detail, and this will be used to relate to the education and the valorisation role performed by NIKOS. This example forms part of a series of projects in which research is being conducted into ways of supporting entrepreneurship. This is preceded by the question as to whether entrepreneurship can actually be supported or learnt, or whether it is more a case of a talent that people do or do not possess.

Let us return to the example of Henny van der Most. He is proud of the fact that he managed to build up a large company despite having little more than primary education. He has every right to be proud, but his generalisation that entrepreneurship cannot be learnt is not correct. Jeffrey Timmons (1987) devoted considerable attention to that aspect in his work. In his view, it turns out that there is a great deal to learn about entrepreneurship. Take musicians as another example: it is only by working hard (playing for hours every day and sustaining that for many years) and gaining a wealth of professional knowledge (staying as long as possible at a college of music, taking master classes, coaching) that they manage to make a successful career for themselves in that field. Talent alone is not a sufficient condition for success, but a basic level is necessary.

The same applies to entrepreneurs. A basic degree of talent is necessary but not sufficient. Entrepreneurship is a profession in itself and innovative entrepreneurship based on new technology requires knowledge of the typical

processes of innovative enterprise. That is why teaching in NIKOS devotes a great deal of attention to entrepreneurship as a competency possessed by its graduates. This is, of course, the case in business studies but it now increasingly forms part of STEM (science, technology, engineering and mathematics) education (at the UT in Advanced Technology, Industrial Design, Nanotechnology (Master), etc.).

The question still remains whether entrepreneurship should be supported. There are, in fact, three viewpoints on this issue:

- Laissez-faire: no support is provided, as the market automatically selects the 'fittest'. The provision of support can result in the survival of companies that basically do not match market requirements. '*The invisible hand*' guides development.
- Planned economy: the government dictates which companies may be developed and which ones may not, according to collectively determined needs. The '*one hand of government*' directs development.
- Network management: taking into account the shortcomings of a free market and a planned economy, frameworks are created that provide scope for enterprise. Entrepreneurs are supported where this is deemed effective and interaction between actors promotes a situation in which networks of entrepreneurs can be created. '*Many visible hands*' coordinate development (Rip & Groen, 2002).

NIKOS is an advocate of the 'many visible hands' principle. While the traditional market approach assumes that information regarding supply and demand is transparent, and also the 'one hand' perspective assumes that government has information enough to decide on the allocation of economic resources, the 'many visible hands' approach assumes that information is distributed asymmetrically and – on top of that – often is created in the process in an unforeseeable way. For this information problem alone, the 'invisible hand' and the 'one hand' are effective nor efficient for optimal economic development. Other factors are important.

Enterprise using a new technology

In the memorandum entitled '*Innovatie Vernieuwd*' [Innovation Innovated] (2008), the researchers from the *Wetenschappelijke Raad voor het Regeringsbeleid (WRR)* [Scientific Council for Government Policy], led by Bart Nooteboom, demonstrated that in the Netherlands knowledge intensive enterprise in particular was trailing behind developments in neighbouring countries. At the same time, Bosma, Stam & Schutjens (2008) demonstrated that in fact the average Dutch citizen identifies many opportunities to start up a venture and that on average they do not lack the knowledge and skills in the field of entrepreneurship. In contrast to what is often claimed, the average Dutch citizen does not allow themselves to be impeded by over-perception of risks (Stam, 2008).

However, according to the WRR, an issue still exists in the area of innovative entrepreneurship. There may be ample knowledge and technology available for enterprise, but the risks do play a role in this regard and ambition at an entrepreneurial level appears to be limited. In particular, the WRR associates the risks with the obscurity of the (new) market. This in itself is correct, but even so this cannot explain the differences between the Netherlands and other countries, as the (new) markets in those countries are just as obscure. That leaves the relatively small ambitions of technology-based entrepreneurs. Perhaps a macro level-oriented study will demonstrate this, but it seems that a

methodological problem is involved here. On average, the ambition of entrepreneurs measured at a given time will actually not be all that great, but this is not to say that that level of ambition has never been great, or could have been greater. This situation will most likely be easier to understand if we have a greater insight into the processes at micro level.

The regional scale: Twente

When switching our focus from the national scale to the regional scale, we find the reason for the project that may help to explain in greater detail the research, teaching and support activities of the Chair in Knowledge Intensive Entrepreneurship in NIKOS.

Innovation paradox

Five years ago, Anne Flierman, the Chair of the Executive Board of the UT, in his capacity as board member of the *Innovatieplatform Twente* [Innovation Platform Twente, IPT], commissioned an analysis of the growth of spin-offs from the UT. The analysis primarily concerned insufficient growth. The number of spin-offs from this university has been high for many years and with around 30 businesses being created every year over a period of some 25 years, various studies have shown that the UT is leading the way in the number of spin-off companies in the Netherlands (Van Tilburg, 2003; Schretlen et al./PwC, 2007). However, the average size of these companies is approximately 10 full-time equivalents and this is considered to be small. Research (such as Van der Sijde et al., 2004; Enter, 2006) has shown that while K.U.Leuven University (Belgium), for example, produced far fewer spin-offs in the same period (even though Leuven is a much larger university), the average size of these companies is approximately 50 FTE. In Cambridge (UK), the number of spin-offs has risen sharply since the end of the 1990s under the influence of a government incentive programme, and the average size of relatively new companies here is already 30 FTE, not to mention the developments we have seen in Silicon Valley (Microsoft, Google, Yahoo, LinkedIn, and so forth). In short, it is possible to create larger companies based on relatively new technologies.

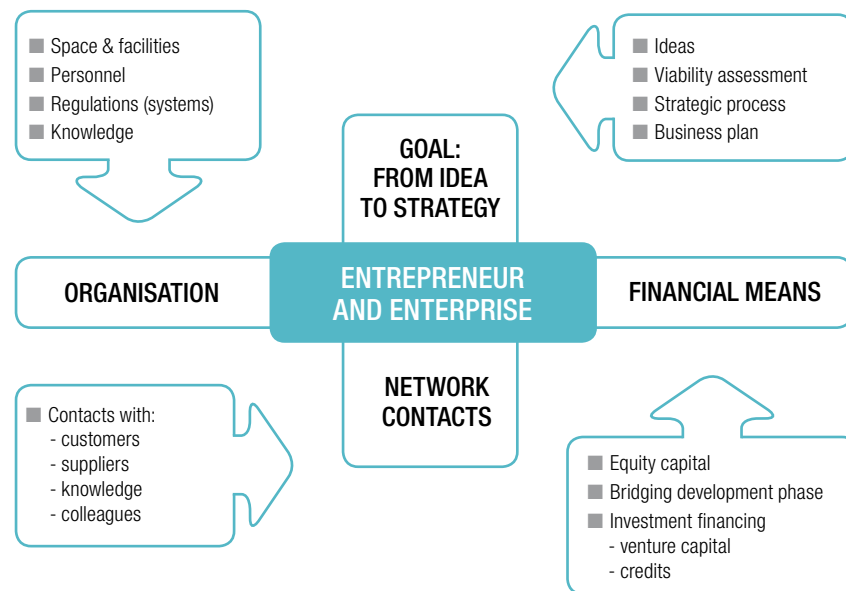
Analysis

NIKOS seeks to identify the factors that can be manipulated at micro and meso level, that is, the level of the entrepreneur/company itself and in the immediate market environment. Papers on the needs of high-tech start-ups were produced by Groen in collaboration with Ineke Jenniskens and Peter van der Sijde (Groen et al., 2005) and later with Paul Kirwan and Peter van der Sijde (Kirwan et al., 2006). These studies included an analysis of the elements of development in a high-tech start-up, based on the 'entrepreneurship in networks' model and in keeping with the dimensions of the 4S model:

- Scope, for the strategic process from idea to business.
- Skills, for organisational aspects, knowledge, regulations and facilities.
- Social networking, for contact with other actors such as customers, suppliers, experts, colleagues and supporting parties.
- Scale, for the economic dimension, which concerns input and consumption of funds.

With regard to each of these dimensions, there are reasons that explain whether or not a company grows. A number of these have already been mentioned above, but the systematic study of these using this model provides an interesting overview of and coherence within the explanation.

WHAT DOES THE ENTREPRENEUR REQUIRE?



Bearing in mind what an entrepreneur requires (see the scheme), we begin by examining the strategy of relevant companies. Then it is striking that developing a market-oriented strategy is in fact not easy, when a relatively new technology forms the basis of the venture. Even so, in view of the aims of spin-offs, they often have an idea of where they could develop the market. Certainly in the initial stages, it is rarely the case that a company does not have a goal in mind. However, the question is whether that goal is based on a reasonable analysis of the market (in accordance with the causation principle) or informed (via the effectuation principle) by opportunities that arise interacting about it with a lead customer (Von Hippel, 1986) or with other involved actors having a need that fits the development capacity of the firm. An approach to "Open Innovation" that was also proposed by Henry Chesbrough (2003).

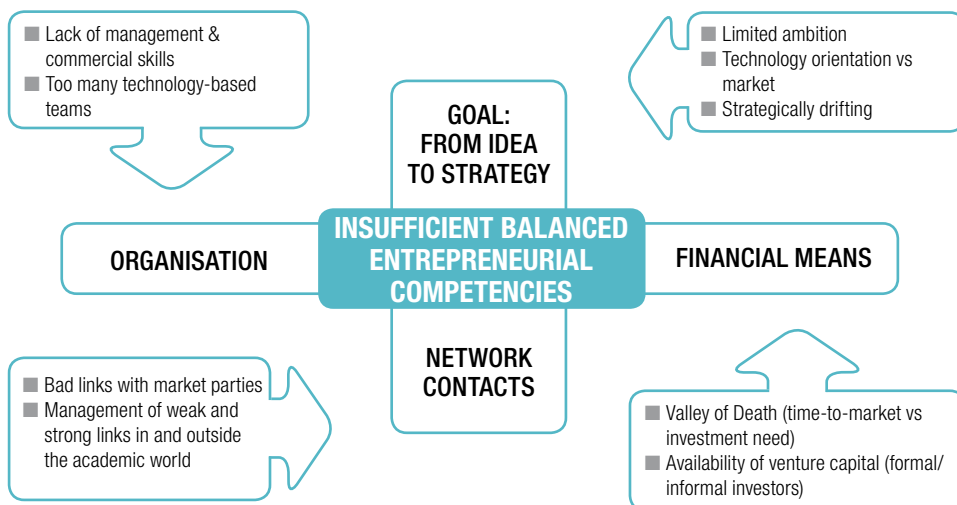
In order to analyse the spin-offs' capacity for action in the opportunity identification stage, we will examine the other three dimensions, starting with the cultural capital. In our view, the strategic capacity is limited by the fact that expertise of entrepreneurial teams is relatively often biased towards one field. They usually consist of technically trained individuals, who are only rarely specifically competent in business management. That by itself is not an insurmountable problem, if one can rely on assistance in undertaking strategic processes, such as via coaching or an advisory council. The same applies, of course, if the team is expanded with experienced managers with an affinity for the technical field. According to our model, companies often have minimal strategic capital (vague goals, ineffective in achieving goals) due to a staff background biased towards the technological field, as well as minimal previous entrepreneurial experience (or prior knowledge; see also Shane, 2000).

The network of entrepreneurs in the technology industry is first of all closely interlinked with the knowledge source. In Twente this is usually the UT, but it may also be existing companies in the case of what are known as corporate spin-offs. If the networks are heavily geared towards technology development, it is difficult to also develop in a market-oriented way. Previous research by Van der Sijde & Van Tilburg (2000) demonstrated that slow-growing companies still had close ties with the UT even after eight years, while the more rapidly-growing companies had since built their network more in the market.

Moving on to the economic dimension, we know with regard to the required investment capital that the interim stage of investment, approximately between 100,000 and 500,000 euros, is difficult to acquire in the Netherlands. This situation, for which Markham (2002) coined the term 'Valley of Death', arises due to the 'time-to-market' and the associated high levels of investment for which an investor only begins to see a return after several years. This makes it difficult to continue the development of technologies that are still far from the point of reaching the market. Radically different ones such as nanotechnology and technologies involving a lengthy testing process on the way to sale on the market, such as pharmaceutical and many biomedical innovations, are difficult to market that way. Or as Lute Broens, co-founder of the spin-off X-Flow, which now forms a mainstay of Norit Membrane Technology, once put it: 'Enterprise is a question of courage and perseverance, as the amount of negative cash flow requires courage and the time it takes to gain a return on investment requires a great deal of perseverance.'

Without now discussing every dimension separately, the scheme shows a summary of our analysis of the reasons for low levels of growth in high-tech companies.

**REASONS FOR LOW GROWTH:
MUCH KNOWLEDGE, LITTLE (BUSINESS) KNOW-HOW, LITTLE CASH**



The growth problem

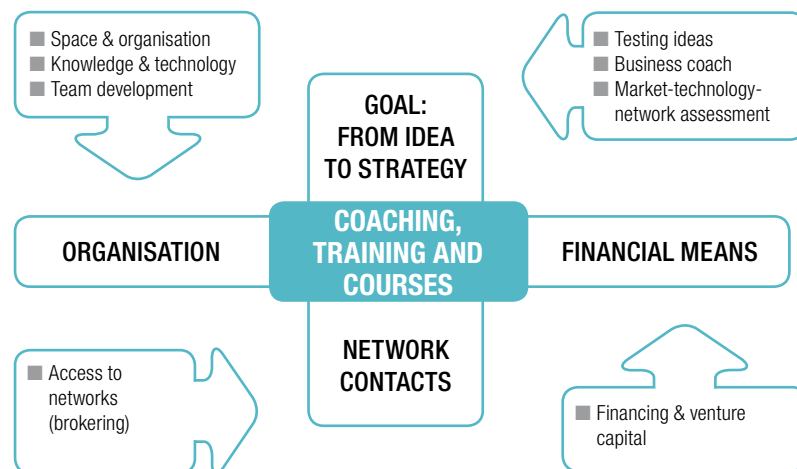
Something that has frequently occurred in Twente as a result of this phenomenon, is the abandonment of the product/production strategy in the early stages of a company in favour of a more service-oriented nature, such as an engineering agency. That type of company can manage successfully with a staff of five to fifteen. Most companies of this size that have been working at this level for several years are often satisfied with their position and the issue in the region of organising more high-value employment does not immediately concern them. However, efforts are being made to resolve this as part of the regional (IPT) and national innovation policies, for example by transforming no-growth companies into rapid-growth companies. Still, the majority of the slow-growth companies will remain in their comfort zone, and this is probably best for them.

In short, the growth problem associated with techno-starters boils down to the fact that the four capital types grow unevenly and consequently these companies miss out on any growth opportunities that there may have been – already at an early stage of development.

Towards the solution?

In order to prevent good opportunities for growth being missed, the analysis suggests, on the basis of the 3-stage model of entrepreneurship, that we need to act on this at the earliest stage. That means that companies need to be created that are focused on high-tech high-potential business from the outset, and in such a way that they are also willing and able to maintain this approach.

NIKOS SUPPORT MODEL



The scheme shows the appropriate support model that has been developed on the basis of the four-dimensional model of the needs of entrepreneurs (see Groen et al., 2004, amongst others). In short, competencies of entrepreneurship

need to be developed at the company level. The resources for development will need to be available or accessible in the company's local area. The table below shows for each dimension of the model what the company needs to put in place and what is available in the local area to assist in this regard.

SOCIAL SYSTEM FEATURES OF A HIGH-TECH COMPANY AND ITS SUPPORTIVE ENVIRONMENT		
Social system	Company	Environment
Strategic capital	Ambition, focus, direction, power of persuasion	Coaches, partners, role models
Skills/cultural capital	Facilities, organisation, knowledge of the market, technology (IP) and organisation, experience, enterprising orientation	Facilities, training, organisation/legal/economic/technological advice
Scale/economic capital	Equity capital, effective production, efficiency	Investment capital (informal/formal)
Social capital	Relationships and positions in the market, technology and organisation. <ul style="list-style-type: none"> • Relationships: Balancing weak and strong ties • Positions: structural holes versus clustering in cliques 	Brokerage (international)

Practically all incentive measures are deployed in one form or another in order to improve elements of this environment for start-ups, but the basic principle (Groen, 2005) is that the company is only able to develop if all four forms of capital exceed a certain minimum level. With regard to the support structure, this means that support must be available for all four dimensions, in a form that is appropriate to the entrepreneurship process, that is, a dynamic and multi-faceted support structure. The support programmes designed by NIKOS are therefore based on this idea and these develop support measures for each dimension and for each stage of the process.

This can be found in the oldest programme at the UT, the TOP scheme (*Tijdelijke Ondernemers Plaatsen*) [Temporary Entrepreneurial Positions]. This scheme provides business and scientific coaching, an interest-free loan (now €25,000), access to training programmes and courses, business and contact networks via the coaches, the NIKOS TOP project team, *Kennispark, Technologie Kring Twente* [Twente Technology Circle] and facilities in the faculties/institutes or in the BTC incubator. This in itself low-cost programme has proved very successful, following its creation in 1984 by Rector Harry van den Kroonenberg as part of the 'entrepreneurial university'. In particular, the number of spin-offs and the company survival rate (more than 80% after five years) is high. However, as mentioned before, the growth of the companies is limited. Another good example is the *Kansrijk Eigen Baas* (KEB) [Successfully Your Own Boss] programme, as described in the box.

SUCCESSFULLY YOUR OWN BOSS

The programme was developed in 2001/2002 by NIKOS at the request of the Rabobank branches in the Achterhoek region. The concept comprises two parts, the first of which is similar to the TOP scheme and is intended for prospective entrepreneurs who already have a clear business idea. This scheme assists them in developing the business concept further. The second part is aimed at individuals who are considering starting a venture but do not necessarily have a specific idea as such and who have several months of their time available to devote to a group-led programme. Two aspects make this scheme special, namely the early stage of development and its group-oriented nature. This combination is very rarely offered in support programmes and a total of six group-led programmes have been run in the Achterhoek and the province of Overijssel. More than half of the 360 participants have created a company, now employing on average one person. The survival rate after three years is more than 90% and this is relatively high compared with average survival rates, which vary between 40% and 60%, depending on the type of company. It is interesting to note that more than 60% of participants were unemployed (often for a long period) and a relatively high number of 'older' people (over 45 years of age) took part in the programme. Entrepreneurship has certainly lent a helping hand in improving modest opportunities in the employment market.

Returning to the issue of the IPT, are we able to do something about the relatively low level of growth in high-tech companies? The answer is yes: a previous analysis has shown that entrepreneurial competencies are an issue and that the facilities and resources available in the local area do not always suit the financial and market-related developments in the high-tech industry, causing ambitions to ultimately fade away. In order to resolve this, a re-designed programme has been launched, inspired by the success of *Kansrijk Eigen Baas*, with the aim of adapting that KEB project to a high-tech context.

VentureLab

VentureLab Twente (VLT) aims to provide facilities to support high-tech, high-potential types of business. The basis of VLT in terms of process lies in the *Kansrijk Eigen Baas* [Successfully Your Own Boss] groups.

Participants

The target audience of VLT includes both national and international individuals or existing businesses with an affinity for technology-based business development. The disciplinary background of participants ranges from engineers and technological PhDs to business administrators with a background in marketing or finance. Individually registered participants are selected based on their ambitious, entrepreneurial attitude and an affinity for technology. Participants must be mostly unencumbered with other responsibilities in order to take part. Companies may also send one or several representatives to work at VLT on the business-development function of their company; these may also be people who will eventually leave their company via VLT to start a new business themselves.

Technology-market combinations

The technologies used to build new companies are often born of research from the University of Twente and the Saxion University of Applied Sciences, or from existing companies who have a form of technology 'sitting on the shelf'. Because of its profile, at the UT these are usually nano-, information or biomedical technologies, or those from the domain of high-

tech materials and systems. Possible applications include the health care, water, energy and manufacturing sectors. Ideas are partly contributed based on knowledge development at the UT (e.g. via the business accelerators of the various institutes), at Saxion University of Applied Sciences or within companies that seems viable for commercial application. A technology-market-organisation assessment procedure is implemented for this purpose, where necessary involving external experts (e.g. primarily from the national and international NIKOS/SKIO network, but also from TOP, the Oost NV development agency, the financial world and accountancy).

Entrepreneurship process

As mentioned previously, the growth process of a knowledge intensive company (based on relatively new knowledge and/or technology) is difficult to control, for the following reasons:

- the time-to-market is often long;
- the necessary investments are relatively high; and
- the return-on-investment yields are difficult to estimate due to uncertainty regarding the functioning of the technology and market acceptance.

In such situations, it is necessary to make strategic choices. Creating a focus strategy, forging an effective and efficient team and building up relevant networks are matters that demand competent entrepreneurship and a good balance between knowledge and experience. Based on the entrepreneurship process model developed as part of NIKOS research, a method has been designed and tested that addresses the following aspects:

- the team's entrepreneurial competencies;
- access to investment capital: national and international venture capital funds;
- improving access to the market;
- involving more coaches from companies with high-tech and growth experience; and
- creating and maintaining facilities.

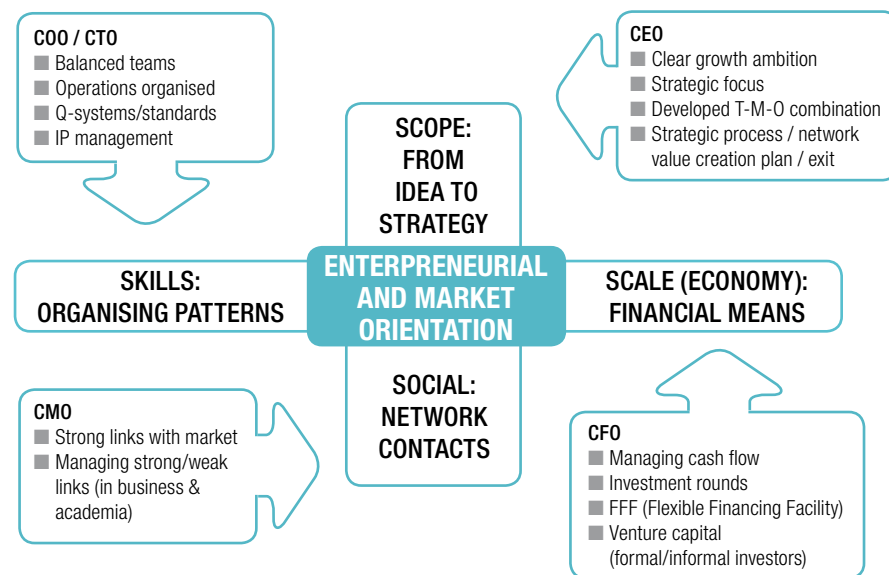
The aim of this method is to contribute to teams with high ambitions who will work on the development of new, technology-based companies. To this end, the programme incorporates intensive coaching and training. Participants are taught, trained, placed into networks and strategically coached over a period of twelve months.

The training/course content is specifically designed based on the idea that within (starting) companies multidisciplinary teams assume roles according to the aspects of the 4S-model (see also the scheme):

- **Strategy:** CEO, Chief Executive Officer, or general manager. The CEO ensures strategy development, leads the strategic process, and often acts as spokesman to stakeholders.
- **Economics:** CFO, Chief Financial Officer, or financial manager. The CFO takes care of financial matters, cash-flow management, financing and reporting.
- **Organisation:** COO (Chief Operations Officer) and CTO (Chief Technology Officer). The COO is the business manager and the CTO is the manager responsible for the technological development of the products and processes.
- **Networking:** CMO, or Chief Marketing Officer. The CMO maintains relationships with customers, partners, suppliers and other stakeholders.

There are generally few people who can effectively fulfil all of these roles individually, which is why facilitating team creation is an important aspect of VentureLab Twente.

CHARACTERISTICS OF HIGH-TECH, HIGH-AMBITION START-UPS



Practice

Participants can be recruited from among students of technology, technology management and business administration at Saxion and the UT (e.g. from the Entrepreneurship minor or the Master's (tracks) in Innovative Entrepreneurship & Business Development), enterprising researchers (final-stage trainee research assistants, as well as experienced researchers), from people with relevant work experience who are considering a career change in this direction, and (actually the majority) from existing companies that want to accelerate their growth.

VLT offers a one-year flexible programme. It comprises forty hours of personal coaching, weekly training, easy access to experts, labs, technologies, a variety of networks which in turn offer access to potential clients or finance, and free use of office space and equipment. During the first few weeks/months the process is mainly aimed at assessing the competencies of the participants, recognising business opportunities and providing instruction and training. The participants train their capabilities in recognising opportunities and constructing business concepts, and their entrepreneurial skills are being developed and put to the test. In due course, starting from the four-month point, it will become clear which participants possess strong entrepreneurial competencies. Based on this long-term selection process, participants will be working on their concrete business ideas, possibly spin-off ideas from knowledge institutes or their own ideas that are further developed during VLT.

This method is implemented with groups of approximately 25 participants/companies per completed programme (lasting 12 months), most of which are 'normal' companies with an original idea. Only a few will turn out to be 'high-growth' companies, as genuine top-class talent in the field of knowledge intensive entrepreneurship is scarce and difficult to predict beforehand. The first eight groups (as at mid-2011) have produced around 165 entrepreneurs, which will be expected to generate employment amounting to 2,000 FTEs by 2016. The initial results, in any case, match this forecast, but obviously factors like the general economic development may influence the outcome either positively or negatively.

Kennispark/network

The facilities and networks generated within the VLT programme are related to various elements of the regional entrepreneurship infrastructure, in particular at *Kennispark Twente*. The sharp increase in activities and the generation of high-potential concepts has attracted the interest of national and international investors. Naturally, VLT draws upon the developments at *Kennispark Twente*, such as the formation of new investment capital funds (including the Twente Technology Fund), the new facilities for nanotechnology-based production (High Tech Factory) and of course all kinds of network activities. As soon as it becomes possible, the VLT facility itself will be given a home in a business school at the UT campus or in the new 'Gallery' building, and other businesses that emerge from it will also be offered accommodation in *Kennispark* facilities. The large number of outgoing entrepreneurs means that there will be more demand for incubation facilities such as those in the BTC, which has been the incubator of Twente spin-offs for more than 25 years.

Inviting speakers and coaches from successful companies encourages a productive form of network formation resembling the successful VLAB model at Stanford and MIT. VLT is also affiliated with various education programmes at Saxion and the UT.

Feedback to research and international practice

VentureLab processes are being monitored closely along the lines of the research model described above. In this way we can continuously improve VLT, as well as our knowledge on high-tech entrepreneurship processes. Several researchers have based their PhD research on the development of this data in VLT.

Furthermore, the VLT model will be brought to other regions. For example, NIKOS is involved with the EIT ICT Labs Entrepreneurship Support System. EIT ICT Labs is one of the first three Knowledge and Innovation Communities (KICs) selected by the European Institute of Innovation & Technology (EIT) to accelerate innovation in Europe. Its Entrepreneurship Support System supports and nurtures SMEs and academic entrepreneurs to grow on the European level. Using its VLT experience, NIKOS is involved in developing and leading this support system.

Also, there are several contacts in Russia for exploring development of VentureLabs in for example St Petersburg with our partner, National Research University ITMO, and in Moscow with the Higher School of Economics, Bauman University and Mephi, all Russian top research universities. First steps for collaboration with the Skolkovo Foundation and Skolkovo Open University have been taken.

Education

Furthering entrepreneurial education has been a key cornerstone at NIKOS since the very beginning of its development – here, a brief overview is given. We have worked to create the academic minor in Entrepreneurship and Innovation right from the very start. The idea behind this minor is that all students, except those that already have a background in business, are introduced to the field of entrepreneurship in relation to innovation in a practical and relevant manner. A basic starting point of our teaching programme is to teach students academically-based knowledge and skills and to develop an entrepreneurial attitude. Nowadays, this is often described as competency-based learning. It is perfectly in line with the combination of research, teaching and practical experimentation that we practise in the VentureLab and in many small to large existing firms.

One element of competency-based learning is to allow students to fine-tune their learning process based on previously acquired competencies. This means that students can go more deeply into the issue than the minimum required level, based on effort or previously acquired experience, knowledge or attitudes. This works within modules, but we also differentiate our minor. The Entrepreneurship minor programme offers a variety of courses with a mix of teaching methods, theory and practice. Courses on high-tech, market-oriented entrepreneurship and on innovation management are complemented with courses on the financial management of innovative enterprises, legal aspects and the governance of innovation from a societal perspective. Those who do already have a background in business, like Industrial Engineering & Management, Business Administration, Industrial Design and Advanced Technology students, can take the extra deepening electives.

It is possible to do a 20, 25 or 30 EC (European Credits study points) variant of this minor. The minor assignment is the concluding course for the programme and offers a choice of Becoming an Entrepreneur (develop your own business plan), Managing an SME (work with an established entrepreneur), Organising Innovation (in larger existing firms), and Technology Dynamics (strategic analysis of innovation processes related to a specific technological development). In its most comprehensive form, it offers a possibility for international students to study at the UT for six months, which they can use to qualify for admittance to the Business Administration Master's. The minor is offered exclusively in English, as business students nowadays should be fluent in English.

Moreover, our expertise is integrated into the Business Administration curriculum, with distinctive elements being innovation, entrepreneurship and international management. Students can graduate in subjects related to innovative entrepreneurship both at a Bachelor's and a Master's level. Examples of such subjects include the selection of partners in the West for Russian high-tech companies, cooperating on innovation in the regional manufacturing industry, innovation in road construction and business development opportunities for Siemens Medical Systems in Dutch hospitals.

Students can now also study at and graduate from VentureLab Twente. The unique thing about this VLT field lab is the fact that we can track entrepreneurs in their first opportunity identifying stage. The business development processes can also be of interest for our students to study. They can learn on the job as a team adviser or as a (future) team

member. What is more, a double degree Master's in Innovation Management and Entrepreneurship has been developed in an international partnership with the Technische Universität Berlin. Students who successfully complete this two-year Master's course receive an MSc in Business Administration from the UT and an MSc in Innovation Management and Entrepreneurship from the TU Berlin.

NIKOS also takes things to the next level and offers an established PhD track in Innovation and Entrepreneurship within the Twente Graduate School, based on the IGS research programme of which NIKOS research constitutes an important part. The main purpose of the programme is to enhance theoretical and practical understanding of the organisation and management of innovation, entrepreneurial and business development processes and strategies at different levels (i.e. a network and a company level).

This year, the Higher School of Economics, Moscow, Russia, and NIKOS organised their first joint summer school on entrepreneurship, in Twente and in Moscow. The two-week programme for Bachelor's, Master's and PhD students covered areas such as university entrepreneurial support systems, venture capital, establishing new businesses after a crisis, and the data and reality of business climates.

For executive education and entrepreneurs trained on the job, Nikos offers a series of certificate programmes via VentureLab Twente. By following at least five modules on topics such as strategy, marketing, IP management, finance and technology management, practitioners achieve a level of professionalism necessary to work effectively in a high-tech business development situation in a start-up or existing company. These certificate programmes will be developed further into MSc BA (MBA) and possibly a PDeng or DBA, both of which are more practice-oriented research trajectories incorporating a great deal of high-level education.

New developments in science and engineering programmes can be expected. For example, NIKOS was recently also involved in the development of new innovation & entrepreneurship programmes for ICT Master's degrees in the context of the European Institute of Technology ICT Labs.

Future developments

The above demonstrates that NIKOS handles the university's three general tasks – research, education and valorisation – as a cohesive whole. The theme of entrepreneurship in a technological context has only gained ground since NIKOS was first established. NIKOS will continue to develop its position as a specialised knowledge centre focusing on technology-based entrepreneurship and business development in (international) networks, which fits in perfectly with the University of Twente's 'High Tech, Human Touch' strategy, as discussed in the Route'14 document. NIKOS is intensifying its collaborations with technological institutes and faculties.

Route'14 has also prompted a strategic plan to be drafted for the University of Twente Business School for technology venturing and technology management, which focuses on teaching, researching and developing technology venturing and management at a world-class level. The underlying idea is that building a new, separate business school is a good step towards consolidating and extending the UT's position as a flagship of knowledge intensive entrepreneurship and innovation in an international context. The discussion concerning this subject is currently ongoing. NIKOS will be a part of this school and we will further develop the executive education we have on offer within the context of a business school. Although we are currently focusing on VentureLab Twente certificate programmes, in future we expect to offer a specialised MBA in Entrepreneurship & Innovation for technology-based business development as well. Furthermore, we are currently working on ideas regarding the option to earn a doctorate through a DBA (Doctorate Business Administration), where a design-oriented research project would form the basis of the degree.

In line with these future developments, we will continue to do research on the current themes based on the four dimensions of the social system model:

■ Strategy

- Methods of technology-market-organisation assessment.
- Analysis of the target-based processes of entrepreneurship: causation, effectuation, especially during the opportunity identification and development stages.

■ Organisation/pattern management

- Coordinating internal and external sources for innovation.
- Knowledge management and knowledge protection in networks.
- Entrepreneurial learning processes (of employees, entrepreneurs, students).

■ Efficiency/Economic and financial aspects

- Entrepreneurial funding processes.
- Assessment of uncertain high-tech concepts.

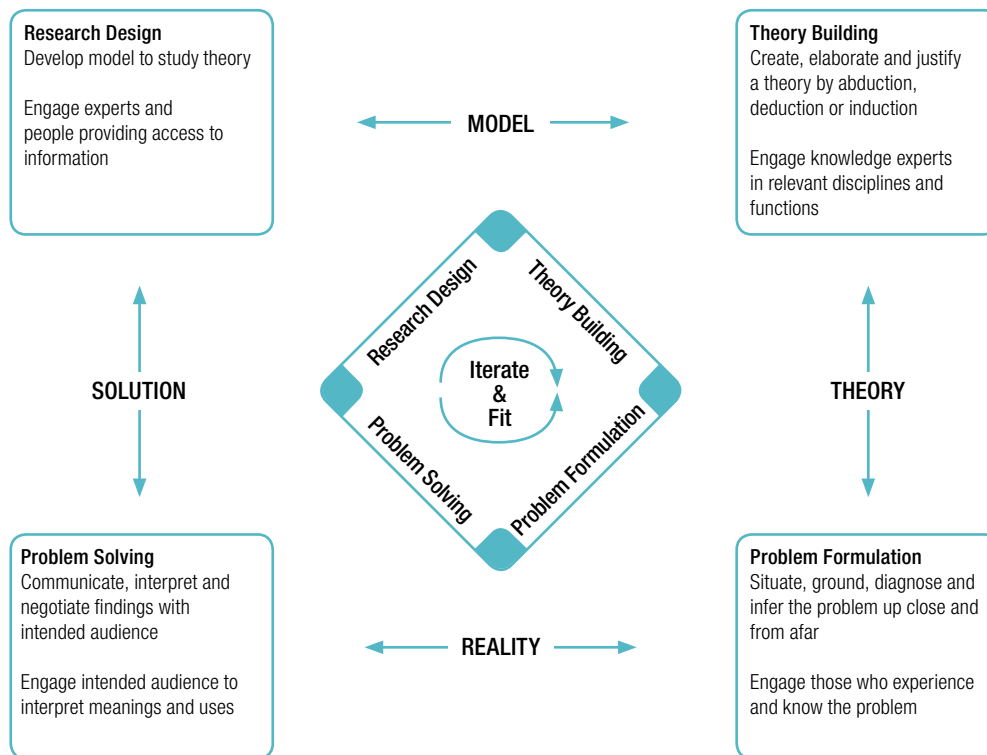
■ Networks

- The role of intermediary actors in entrepreneurial processes.
- The use of new technology for network/account management, including the role of social media.
- The role of strong and weak ties in entrepreneurial processes.

Each of these dimensions has a set of action mechanisms. However, these mechanisms are used on several levels of aggregation. The systemic character of the theory presents options for connecting micro-level research to macro-level policy.

Using the systemic nature of the theory turns this research into a multi-level and multi-dimensional analysis, conducted – as mentioned before – using multiple methods and techniques. NIKOS thus tries to shape the continued development of a productive scientific programme that also delivers relevant practical results. To quote Andrew Van der Ven (2007, p. 9), this means that we, at NIKOS, demonstrate 'engaged scholarship':

'I propose a method of engaged scholarship for expanding the capabilities of scholars to study complex problems and create the kind of knowledge that advances both science and practice. Engaged scholarship is defined as a participative form of research for obtaining the different perspectives of key stakeholders (researchers, users, clients, sponsors, and practitioners) in studying complex problems. By involving others and leveraging their different kinds of knowledge, engaged scholarship can produce knowledge that is more penetrating and insightful than when scholars or practitioners work on the problems alone.'



(Source: Van der Ven, 2007)

This approach (see also the scheme) is the intellectual basis to further develop research, teaching, training and support activities at NIKOS. By working this way we expect to further raise the level of external appreciation for our research (now labelled in research assessment as nationally leading and internationally recognised) and teaching by becoming accredited in all main business studies programmes (e.g. EPAS, AACSB). We also want to further develop our field lab for enterprise development (VentureLab) by developing specialised programmes, e.g. biomedical business, energy business and international business with MIRA@UT, UMCG, Radboud UMC, Energy Delta Institute, EIT ICT Labs, TUBerlin, Higher School of Economics, Moscow, ITB Bandung and Binus Jakarta.

Also over the next ten years, NIKOS will be a driving force behind business school development, building a house of education, research and field labs for studying innovation & entrepreneurship.

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NIKOS

University of Twente

PO Box 217

7500 AE Enschede

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NIKOS is ten years old, which is good reason to use this anniversary publication to once again pose the relevant questions on entrepreneurship and innovation and show how NIKOS continues to work on answering those questions.

This booklet also fits in perfectly with current socio-economic issues. With the Dutch cabinet having recently identified nine top economic sectors, the key questions have again been posed on how to accelerate (scientific) knowledge so that it can have an economic and social effect and how the gap between interesting academic knowledge and (technical) application can be closed. This is exactly what all NIKOS activities are about. To answer these prevailing questions, this publication will provide a - brief - scientific foundation as well as a practical elaboration using the VentureLab Twente case.

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NIKOS (Netherlands Institute for Knowledge Intensive Entrepreneurship), the University of Twente's expertise centre for technology-based entrepreneurship, is committed to research, teaching, consultancy & training and business development support. It consolidates the UT's expertise and experience from the chairs of Innovative Entrepreneurship, Marketing, Strategic Management and International Management. The University of Twente's mission to develop "high-tech with a human touch" is what drives our activities. NIKOS is an expertise centre in IGS, Institute for Innovation and Governance Studies. NIKOS is part of the School of Management and Governance (SMG)

Phone +31 (0)53 489 53 55

E-mail nikos@mb.utwente.nl

Internet www.utwente.nl/mb/nikos

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