

Telematica Instituut and Open Innovation – new perspectives for engagement of SMEs in knowledge production and dissemination

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Innovation, in particular ICT-enabled innovation, often failed as a result of a mismatch between technology developers and end users in the market and industry. Therefore the Dutch government established public private partnerships, so called Leading Technological Institutes, to bridge the gap between science and market. In this paper we focus on one of these institutes, Telematica Instituut which addresses ICT-enabled innovation.

The institute's innovation model combines virtues of the Open Innovation model advocated by Chesbrough and the Mode 2 innovation model proposed by Nowotny and colleagues. Increasingly the institute engages SMEs in its research projects as innovation agents. The Integrated Log Family initiative serves as an interesting example. This open source project engages SMEs in the healthcare and sports into content management solutions. This application domain normally suffers from a "technology push" image and collaboration and co-development around open source help to break down those walls.

Leading Technology Institutes, and other public private innovation initiatives alike, must shift focus from centralised toward networked system integration, involving SMEs as innovation agents. Open source projects can be an effective instrument to attract SMEs and to realise impact through open innovation.

I. Introduction

Innovation, in particular ICT-enabled innovation in the past often lacked an effective introduction. Too often, there was a mismatch between technology development and actual demands and preferences of suppliers and/or end users. ICT-enabled innovation however remains an important factor for many technological developments, crucial for a viable high level (service) economic, relevant for social welfare and a challenging research field academics in natural sciences, technology and social sciences.

Dutch government, alike foreign governments, therefore stimulates companies and scientific institutes to enhance cooperation with respect to ICT; to involve business in scientifically grounded approaches and have academics triggered by business' and societal problems.

A lot has been achieved in terms of new networks and dedicated research programmes. However, in ICT-enabled innovation it has shown difficult to create results beyond a proof of concept. In our opinion, this is yet another example of the so-called 'innovation paradox': although many promising research expertises have been developed and made accessible for the Dutch market, innovation results are disappointing.

In this paper we present the approach that Telematica Instituut (TI) has been developing since 1997 in order to solve the innovation paradox. Also, we present a vision aiming at new roles for high tech SMEs in materialising new ways of knowledge production and dissemination. The crux of our vision is, as we will discuss in this paper, that HT SMEs are perfect societal actors that could speed up the innovation cycle between knowledge institutions and society, business in particular.

Furthermore, we present the Telematica Instituut consortium as a good practice example of the Dutch way towards Open Innovation. We argue that TI fits well in Chesbrough's Open Innovation concept combined with the Mode-2 concept of Nowotny and colleagues. Both concepts will be described briefly and their relevance for Dutch innovation will be discussed, referring to opinions that are circulating in the present Dutch Open Innovation debate fuelled by the AWT (the Advisory Council for Science and Technology Policy).

Finally, the 'Integrated Log' platform will be discussed as a good practice of open source application that engages public organisations, SMEs and knowledge institutes as well. The Integrated Log Family is a set of open source CMS solutions developed for, and in collaboration with, stakeholders in the domain of care, cure, sports, and culture. We suggest that government-financed research should aim at impact, and open source software seems to deliver just that.

As 'high tech SMEs' (HT SMEs) are the focal point of this paper, we need to clarify that we use a rather broad definition, in contrast to the mainstream understanding of HT SMEs. We do agree that HT SME are dealing with high tech or high level expertise processes, products and/or services in an open market, organised in small or medium-sized entities of professionals; but we also include f.i. physiotherapists or financial

advisors. As players organised in small and medium-sized organisations and businesses, these professionals represent a work field that ICT aims to improve and innovate. Innovation research aiming at for instance ICT-enabled healthcare, trade, or education, should actually address the workers in these fields.

This paper is structured as follows:

In Section 2 the Leading Technological Institutes initiative in the Netherlands is described. These Public Private Partnerships were established to bridge the gap between science and technology through collaborative projects. Telematica Instituut, which focuses on ICT-enabled innovation, is taken as an example.

In section 3 the innovation model of Telematica Instituut is compared to the open innovation model advocated by Chesbrough and the Mode 2 innovation model proposed by Nowotny and colleagues.

In section 4 we describe the Integrated Log Family, an open source infrastructure where Telematica Instituut researchers collaborate with professionals in the healthcare and sports domain to create multimedia management solutions that fit their ways of working.

In section 5 we discuss the roles that HT SMEs can play as innovation agents. By involving SMEs as co-developers, research projects can deliver results beyond the proof of concept level. Open source software guarantees freedom for partners to come and go.

In section 6 we draw conclusions about the changing role of Leading Technology Institutes. As innovators they shift from centralised to networked system integration involving communities and SMEs as advocates of end user parties. In open source projects they can reach out to these small and medium-sized organisations lending them a role as co-developer of readily usable innovations.

2. Leading Technological Institutes: Public Private Partnerships to stimulate innovation

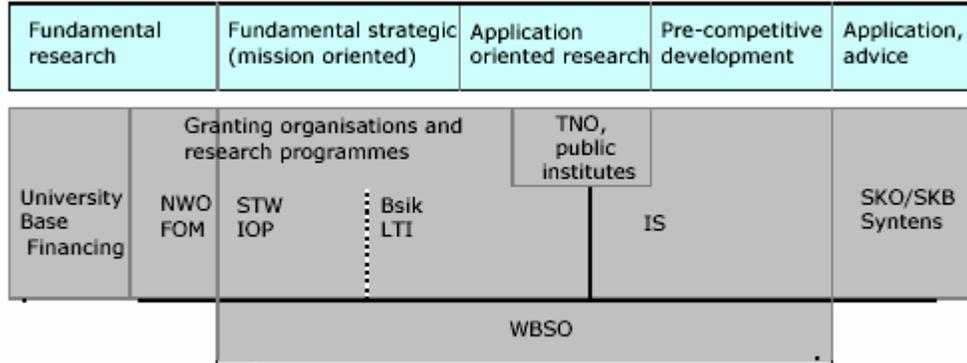
Active partnering between actors in the Dutch public and private sector has been going on for a long time, primarily fuelled by private sector partners or societal entities. Creation of bottom up coalitions is a feature of Dutch society.

Dutch industry has been actively involved in policy formation on Dutch research & innovation policy, has been outsourcing and even dissolving its research capacity, and has embarked on consortial endeavours with universities and other companies.

In some innovation areas Dutch Government has expressed a strategic interest and commitment.

As a result of policy formation, in the mid nineteen nineties four 'Leading Technological Institutes' (Top Technologische Instituten) or LTIs were established in the framework of the policy 'Kennis in Beweging' announced by the Ministers of Education and Economic Affairs jointly. This initiative was launched in 1996 in order to 'strengthen the innovation potential and competitive position of Dutch Industry'. In other words, LTIs should help in bridging the gap between the research in the (public) knowledge infrastructure and the knowledge needs of industry. See Figure 1.

Figure 1 Position of the LTIs in the Dutch innovation policy landscape (source Ministry of Economic Affairs¹)



2.1 The TRC and Telematica Instituut as an early example of Open Innovation

One of the strategic areas as elected by government is telematics: accelerating innovative ICT applications to boost Dutch business and raise social wellbeing.

In the early nineties, a unique experiment had been launched by a coalition of the Dutch Government (represented by the Departments of Education and Economic Affairs), Dutch KPN, Philips and IBM. In close co-operation with the Dutch universities, the University of Twente in particular, the Telematics Research Centre (TRC) was founded as a foundation under Dutch law. The main impetus of TRC was to establish pre-competitive research programmes, joint ventures of industrial and public sector partners. In 1997 TRC entered a new lifecycle as one out of four LTIs, government wishing to establish pre-competitive public-private research institutes, the so-called ‘Leading Technological Institutes’. TRC was invited to submit a proposal for the new LTI scheme: Telematica Instituut was launched.

TRC was in fact an early example of the Dutch way to Open Innovation: a pre-competitive business club joining forces with academia. Telematica Instituut has been extending this model towards a wider set of project consortia, covering some 40 partners from public and private sector.

In practice, the position of Telematica Instituut covers a wider range of the spectrum then depicted above, as TI focuses at research on applications and deals in a lot of projects with project partners that are directly involved in development and exploitation. Furthermore, TI operates in a private sector context that is not being dominated by major ICT research partners, as most of private sector ICT R&D capacity has left The Netherlands.

2.2 Telematica Instituut’s organisation

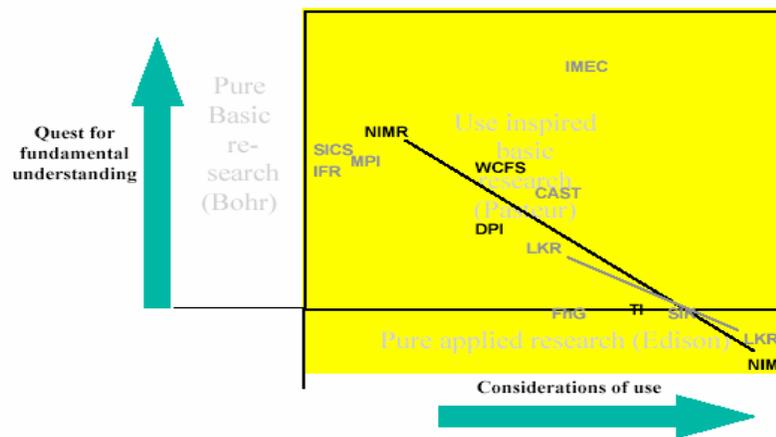
2.2.1 Operating in a public and private context

The Telematica Instituut operates in a very complex setting. TI plays an active role in the governmental innovation policy framework, ranging from the management of national programmes on mobile communication, ICT in Health up to creation of project consortia in collaboration with governmental departments or provincial/local public authorities. The role of governmental bodies varies from subsidy allocation to launching customer for new products and services.

In the public domain TI has strong and growing links with knowledge partners, ranging from universities, public domain research institutes to universities of professional education (Polytechnics, Hogescholen).

The co-operation with private sector partners is twofold. Main players in ICT, telecom and ICT application are member of the TI-consortium, in 2006 some 15 companies. They play a dominant role in project formation and execution. An increasing amount of companies – among them SMEs – partakes in project consortia. Telematica Instituut manages about 60 projects annually, engaging some 60 private sector partners. As we will discuss in chapter IV, the extending co-operation with the ‘Stichting Innovatie Alliantie’ (Innovation Alliance Foundation) and establishment of ‘knowledge and business fora’ such as the Archimate Forum (a consortium for the advancement of software architecture) create new opportunities for SMEs to engage.

Figure 2 Comparing the four Dutch LTIs (source Technopolis)



As Figure 2 depicts, TI positions, compared to other similar research institutions, on the edge of research on applications and innovation. Where as TI started of in the early nineteen nineties as a research institute on ICT with a primarily technological focus, it has broadened its scope to research on applications, including and engaging partners that use and exploit ICT services in its project consortia.

2.2.2 Governance, scale, scope and orientation

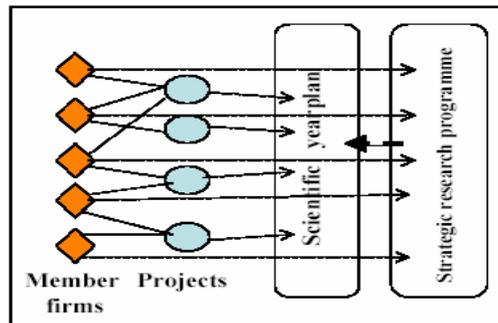
Telematica Instituut is a foundation under Dutch law. In its governance structure, three elements are crucial:

- Daily operations and priority setting is the exclusive responsibility of the general and scientific directors, and the (20) project managers that report to them. This construction guarantees a maximum flexibility towards the market. The directors are accountable to a Board of Trustees who are being appointed by the consortium members.
- Mid term and annual priority setting is being approved by the consortium members via advisory bodies called Programmaraad (Programme Council) and Raad van Deelnemers (Council of Participants). In order to avoid that this year planning cycle

results in a sitting duck event, as of the year 2004 TI organises alongside its ‘expertise groups’ the ‘expertise communities’ comprising professors, R&D directors and senior staff of universities and companies within the consortium. These communities are being regularly consulted.

- The main programming instrument is the project consortium. All research is organised in programmes and projects. Companies and ‘clients’ from the public sector are the main drivers of project formation. TI’s account managers and business developers are in daily contact with potential clients - among them consortium members are in a preferred position – in order to assist pro-actively in bundling and articulation of business opportunities and related technological innovations.

Figure 3 The strategic research programme implemented through an annual scientific yearplan. Project consortia are formed in line with such annual plans (source Technopolis) ⁱⁱ



The result of these deliberations is depicted in Figure 3.

We feel that this configuration is crucial in order to adapt to the highly dynamic and short life cycle innovation environment that TI has to deal with. Different from the branches and working context of the other LTIs Telematica Instituut deals with research & innovation projects that have an average life cycle of 1,5 years in stead of 4 to 5 years. Also, TI is engaged in variety of branches as wide as healthcare, banking and finance up to chemical process industry, in stead of focussing on one branch.

The trade off for those consortium partners, in particular universities who are used to governance structures that resulting multi-annual research programmes, is that a broad spectrum of short life cycle projects boils down. This necessitates TI to invest heavily in proper communication and trust creation among consortium partners. As well on programme and project level as on the consortium level.

The orientation, scope and resulting scale of Telematica Instituut is another crucial feature as we see it. Different from the other LTIs Telematica Instituut deploys an extensive ‘central’ research and project organisation. This specific approach causes critical reflections from time to time, as some observers expect that a LTI is primarily a ‘virtual organisation’, a smart brokerage that mediates between universities and companies, but does not engage itself in research nor in innovation project execution.

Telematica Instituut has deliberately and based on extensive consideration taken this position as an innovation accelerator, including a substantial research and project organisation core staff. Telematica Instituut aims at delivering generic and integral solutions for industry and societal institutions. This approach results in a couple of

organisational requirements that are being described briefly before we deal with the concept of Open Innovation and possible roles for SMEs in more detail. As we will argue later on, TI's position and configuration is a vital asset for effective engagement of SMEs.

The research and development capacity has to be solution oriented, multi-disciplinary, flexible and substantial. Odd as it may be in view of the pervasive impact of ICT at the Dutch society, no research lab in the private sector nor in a university can meet these requirements. This has stimulated Telematica Instituut to bridge this gap, be it cautiously. TI does not head for a research staff of about three to four hundred researchers, including 200 PhDs as a university would do. Nor do we employ hundred fifty software engineers, as a software house would do. On the contrary. TI's scientific staffing to date comprising 68 fte reflects a careful and lean and mean personnel approach. Almost all TI-researchers hold a PhD, TI itself employs only 7 PhD students and partially supports some 30 PhD students based at universities via its projects. All of them are recruited and being coached as multi-disciplinary team workers who want to build a career as innovation oriented researchers. As per 2006, some 70% of our staff has a degree in science and technology, some 30% in humanities and social sciences. Software engineers are vital in order to be able to swiftly develop mock ups, demos and test settings; it is crucial that these experts can work shoulder to shoulder with the researchers involved and that they are keen to apply generic applications in a variety of contexts. The amount and expertise of software engineers employed by TI is being carefully balanced with the amount and orientation of researchers. This capacity of 68 fte is a third of the total power of the TI-consortium: 197 fte including the researchers and developers from universities and companies engaged in projects.

Private sector partners are to be taken on board, right from scratch, fuelling project conception up to execution and evaluation. Knowledge institutes tend to operate knowledge driven: first they define their multi annual research programmes, then they consult companies in order to see if a match could be made between the ongoing research projects in a department and the research or business interest of a company. This limits the scope, span of control and most importantly the orientation of university research programmes in their effectiveness for innovation programmes. Companies are struggling with other limitations. The other way around, companies, in particular those that do not run an R&D lab, do not know how to deal with research departments and are not able to articulate their 'problems' in terms of 'scientific challenges'. This is one of the causes of the so-called 'knowledge paradox' or better said 'innovation paradox': more or even higher quality research does not automatically result in innovative solutions. Telematica Instituut solves this paradox to a certain extent. Some 8 fte senior academics with an extensive marketing experience are sitting from day to day in companies, in order to define projects and create project consortia. In most cases, these seniors also supervise project execution, chairing a supervisory team, balancing the interests of companies and knowledge institutions involved. We strongly believe that this high level marketing and project development cum supervisory effort is crucial in order to organise innovation projects that meet the – more often dynamic and shifting – demands of companies and societal institutions. Section 3.3 deals with these TI project consortia in more detail.

The operational organisation has to be project based, quick, transparent and accountable. All TI researchers are fully engaged in projects; this is being carefully monitored and managed by the so-called Resource Manager. The same goes for the TI support and management staff: 24 fte high level experts covering fields varying from project admin, project management, dissemination of project results up to literature and other electronic search support. The people work in direct contact with the project managers devoting about 60% of their time directly to projects. The main decisive result for the client is that TI is able to resource and start a project within a timeframe of 3 months. More over, projects are governed in a transparent way, stakeholders and project partners being fully involved in monitoring and governance. In doing so, TI has achieved a strong reputation among public and private partners as a reliable and productive partner.

This brief analytic description illustrates why Telematica Instituut has chosen for a rather unique configuration. A final observation concerns the overall size and scope. As ambitious and challenging as this approach may be, the bottom line is that TI operates in a smart way, not duplicating research as conducted in universities and not competing with companies that exploit results of our innovation projects. This is a vital feature for TI's role as an accelerator in Open Innovation consortia.

In its 2005 evaluation of the LTIs, Technopolisⁱⁱ concluded that LTIs have had a positive impact on companies' collaboration attitudes and increased openness in sharing R&D intentions with other firms. "Trust building has taken each of the firm's time to develop. In the modern economy depending on open innovation this is an important learning effect. The existence of the instrument in itself offers firms a platform for business-to-business collaboration, which would be very difficult to achieve without such a mechanism. The sustainability of the networking effect is therefore very dependent on the LTI instrument: without the instrument collaborations would most likely become more focused on bilateral relations."

3. Telematica Instituut's innovation model seen from two perspectives

In the Introduction to this paper we introduced ourselves as critical observers of the Open Innovation concept. In this chapter we will reflect on this concept, making best use of our experience with Telematica Instituut as a good practice example of Open Innovation. Furthermore, we will refer to some of the essays that were published by the Dutch AWT (the Advisory Council for Science and Technology Policy) from angles such as science research, ICT development, economics and political philosophy.

3.1 Open innovation

Open Innovation is becoming a new buzz word in The Netherlands. It took a while before Harvard's professor Chesbrough's concept touched base in the Lowlands. And even now, in May 2006, this wind of change has not fully reached all corners of academia nor boardrooms of companies or public sector institutes. Nevertheless, Dutch internationals such as Shell and Philips are embarking on new coalitions and have been telling the new story to policy makers and academics for some time.

Critical observers to whom the authors gladly count themselves may argue: what's new? Especially seen from the perspective of the Dutch standpoint: Holland, the country known for its international role as raider, peacemaker, coalition creator, smart player in international consortia. On a national level reflected in our once famous Poldermodel. It is helpful and inspiring that the Dutch AWT has launched an essay competition in winter 2005. The wide variety of essays nicely reflects the different viewpoints from the public and private sector, as well as from a range of scientific disciplines.

The concept of Open Innovation has inspired the authors to write this paper, telling the story of a fairly unique Dutch innovation entity, Telematica Instituut (TI). TI happens to be one of the oldest examples of the Dutch way towards Open Innovation. Based on its strong track record in this field, the new top management team that came into force in 2005 is launching new policies that include an enhanced role in Open Innovation and the inclusion of SMEs in its operations.

In using the term "Open" and 'inspiration' the reader should be warned: we are not naïve. In our opinion, 'Open Innovation' is a new power struggle, a rather disruptive and unpredictable dynamic context for big and small companies, governments and academia alike. As democratic, or even rosy and romantic the term 'open' might seem to refer to: it is a struggle, a new playing field posing new challenges that we have to live up with.

3.1.1 Chesbrough's concept of Open Innovation

Chesbrough (*Harvard*) defined in 2003 under the banner 'Open Innovation' his concept, based on reflections on the way that major American companies deal with intelligence and resource sharing. The following table enlightens the key-features of Open Innovation as Chesbrough defines it.

Table 1. Contrasting principles of closed and open innovationⁱⁱⁱ

Closed innovation principles	Open innovation principles
The smart people in our field work for us.	Not all the smart people work for us. We need to work with smart people inside and outside our company.
To profit from the R&D, we must discover it, develop it, and ship it ourselves.	External R&D can create significant value; internal R&D is needed to claim some portion of that value.
If we discover it ourselves, we will get it to market first.	We don't have to originate the research to profit from it.
The company that gets an innovation to market will win.	Building a better business model is better than getting to market first.
If we create the most and the best ideas in industry, we will win.	If we make the best use of internal and external ideas, we will win.
We should control our IP, so that our competitors don't profit from our ideas.	We should profit from others' use of our IP, and we should buy others' IP whenever it advances our own business model.

3.1.2 Reflections on the concept of Open Innovation from a Dutch perspective

As triggering as it may be, the concept of 'open innovation' as presented by Chesbrough is mainly being studied from the perspective of and consequences for major private sector firms.

In the Dutch context, Chesbrough's vision may apply for the private sector. Major companies have embarked on Open Innovation. LTIs and TNO are busy in creating coalitions, but the most visible examples are Dutch internationals such as Shell, ASML, and Philips. Van de Schootbrugge (TNO 2005)^{iv} registers from TNO's cooperative experience with Shell the following motives from this Dutch multinational for engaging in coalitions:

- establishing and maintaining contacts with excellent researchers outside own company
- improve own overall knowledge
- results of the projects (only third place!)
- sharing knowledge even with competitors is counterbalanced by these advantages
- there are more brains outside than inside

We will discuss perspectives for SMEs in more detail in the next chapter.

Different from the private sector, we expect that Chesbrough's vision does not cover the challenges that lay ahead for Dutch universities and other knowledge institutions.

He focuses on an appeal to universities and government. As companies can no longer invest in central R&D labs, R&D becoming increasingly distributed in nature, universities should expand their fundamental research, and governments should fund this. Moreover, governments should stimulate knowledge transfer from universities to industry, and universities should allow academic staff to engage in entrepreneurial activities. This limited attention for the repercussions on universities may be true for American universities, however in our opinion consequences for Dutch universities and other knowledge institutions such as the LTIs will be substantial. Countering Open Innovation challenges issued by private sector parties is an extra trigger for university departments to transform into an innovative (cluster of) department(s) and to organise new interfaces and organisational set ups with industry.

3.1.3 Dutch opinions on open innovation

After this brief reflection on Chesbrough's vision with regard to major Dutch companies and research institutes, let us now zoom in at specific aspects of the Open Innovation concept, making grateful use of some of the essays that were published by the AWT in 2006^v.

First, Patrick van der Duin, Dap Hartmann and Roland Ortt (TUD, Sectie Technologie, Strategie en Entrepreneurship state in their essay "Innoveren in nieuwe tijden" that Chesbrough's model of linear innovation (from knowledge to market) is anachronistic. They suggest to use a model of cyclical innovation (cf. professor Guus Berkhout) and describe innovation in terms of system dynamics, resulting in a learning system of interrelated innovation clusters. Furthermore, they criticise his focus on companies as sole drivers of open innovation: it is too narrow. Referring to Von Hippel they pose that consumers and societal organisations are important sources of innovation. In addition to Chesbrough's vision that major companies are drivers of Open Innovation consortia, they suggest to have "innovation initiators" organised, f.i. to give the LTIs a broader task as "Innovation Institutes" that relate to as well science, technology, companies as the market.

Interestingly, Telematica Instituut has been developing a profile as ‘innovation institute’ for some time now, focusing at establishment of ‘innovation fora’.

Second, André van Hoorn (RU Nijmegen School of Management) relates Open Innovation consortia to former ‘collective innovation’ coalitions that already existed in the 19th century. Open Innovation coalitions are in his view a logical result of enhanced international competition and scale of operations. He argues that once companies are able to organise innovation via Open Innovation coalitions, role of government changes. In his opinion government should primarily stimulate open access to research and innovation results, and should promote diffusion of results. The recently introduced ‘Innovatievouchers’ (innovation vouchers) for SMEs are in his opinion a proper instrument for knowledge diffusion, particularly when these vouchers are being allocated in the framework of coalitions between companies.

Based on our experiences, we agree with Van Hoorn that the role of government should change: more autonomy could be given to public private consortia where by government should keep the LTIs accountable for open access to project consortia and active dissemination of results. SMEs could benefit from participation in these consortia or from access to results. Telematica Instituut is well equipped to organise open access for SMEs.

Third, Ferdinand Jaspers (EUR Institute of Management) presents in his paper ‘Open innovatie: contingenties, systeemintegratie en beleid’ a thorough analysis of organisational mechanisms in the wider framework of technological innovation. Also, he tries to differentiate between kinds of innovation and organisational frameworks. After a critical reflection on four kinds of innovation as defined by Chesbrough & Teece (Incremental versus radical innovation, modular versus architectural innovation) he poses his own definition of Open Innovation (our interpretation and translation):

“Open Innovation can be seen as a set of mechanisms that covers the best of both worlds. It offers access to technologies on the market (modular innovation, incremental innovation) and enables systems integrators to coordinate networks of companies based on their knowledge of overarching architectures and improve their architecture based on architectural feedback out of this network (dynamic system integration). These system integrators, most often major players, are necessary able to enforce radical innovations within their own company (conglomerate)”. Central in Jaspers’ paper is the role of the systems integrator: the company that is able, based on architectural expertise and R&D capacity, to coordinate networks of companies.

In the Dutch context, LTIs such as Telematica Instituut are playing the role of system integrator, in doing so stimulating learning by doing fora that are open to other users, beyond the major companies.

3.2 Mode 2 science and the role of knowledge institutions in Open Innovation

The concept of 'Mode 2 science' has been defined in the early nineteen nineties by Nowotny, Scott and Gibbons^{vi} (ETH, Kingston University, Association of Commonwealth Universities), later on elaborated towards the 'Mode 2 society' and the 'Mode 2 University'.

In order to understand the possible repercussions of Open Innovation for knowledge institutions we would like to refer to the concept of 'Mode 2 Science'. Mode 2 Science, in short, refers to multi disciplinary approaches, in contrast to the traditional disciplinary order of academic disciplines.

Dutch universities show good practices of Mode-2 science^{vii}: major efforts to create 'strategic science' clusters of multi-disciplinary research and learning networks, as well within as in between universities. All Dutch universities by now established interfaculty research institutes and interuniversity research schools, some of them allocating 80% of their research capacity in these 'programme institutes'. Industry is linked or even involved in these institutes in various ways, by partaking in advisory councils up to co-making research programmes.

The concept of Mode 2 science has inspired many academics to reflect on, it has been a controversial concept for years now. In their latest book, 'Re-Thinking science; knowledge and the public in an age of uncertainty'^{viii}, four concepts are key in their analysis:

- The nature of the Mode-2 society;
- The contextualisation of knowledge in a new public space, called the agora;
- The development of conditions for the production of socially robust knowledge;
- The emergence of socially distributed expertise.

Their conclusion is that "closer interaction of science and society signals the emergence of a new kind of science: contextualised, or context-sensitive, science." (p 4).

Another interesting part of their thinking concerns the concept of the "Mode 2 University". They state that university managers nowadays have to deal with extremely complex challenges, among them the 'de-institutionalisation' of university systems. As controversial as this may seem, a strengthening of the strategic management of an innovative university does not imply that demarcation lines within or around a university system have to be frozen, on the contrary: decentralisation, flexible arrangements between teaching and research programmes and networked (international) alliances with external research institutes seem to be the modern pathways for a university system in transformation. We do recognise their observations from our own experience: the strategic necessity to combine a stronger and even more focused research profile with a broader and more diversified profile in application research, business development and dissemination.

This concept relates in our opinion to the concept of 'ambidexterity' (Harvard's professor Tushman a.o.)^{ix}. Knowledge organisations need to be efficient as well as innovative. If we project this vision on coalitions of public and private partners, Open Innovation

consortia, a specific requirement for SMEs would be that these coalitions are as well innovative (risk taking, risk sharing, intelligence sharing) as efficient. Efficient not only in terms of the ROI, but merely in terms of alignment with markets and operations of the SMEs concerned.

3.3 The innovation process at work in Telematica Instituut

In addition to the description given in par. 2.2 of the Telematica consortium as a good practice example of Open Innovation, in this paragraph we briefly describe the way that TI creates and facilitates public-private project consortia.

The Leading Technology Institutes are unique in terms of their organisation and approach. The LTIs are characterised by:

- *partnership*. Companies work with universities and public research organisations in the leading institutes to create and implement programmes of research and innovation. This enables the combination of market-led demand with the scientific knowledge supply in a continuous iterative process, a process that determines the direction research should be taking. The partners also contribute financially. Companies and knowledge institutions provide the leading institute with support, either in kind or in terms of finance, and the government then matches the participants' contributions.
- *a primarily virtual organisation*. Researchers working for the institute are joined in an LTI by researchers from businesses and knowledge institutions. They work closely together for various lengths of time on programmes and projects. Once their work is complete, the external researchers return to the company or institution from which they came or they may be hired by an LTI. This gives the LTIs a degree of flexibility and enables them to adapt their research programmes to match developments in the market, society and science. This structure also facilitates the linking of knowledge demand with supply.
- *pre-competitive research programmes*. Together and with their knowledge partners, companies in the LTI carry out multidisciplinary research in the initial phase of innovation. Research is organised in a programme, focuses on the mid and long term and tends to be pre-competitive. That is also of interest to knowledge institutions; the research that companies generally outsource to them tends to be developmental. An LTI orchestrates research and innovation in a particular key area.
- *networks and knowledge transfer*. A unique characteristic is that participants from the entire industry chain (suppliers, competitors and buyers) meet one another in the LTIs, a platform whose approach is replicated nowhere else. As well as industry participants, the network also includes knowledge institutions and the government. The LTIs aim to initiate the exchange and transfer of knowledge between the partners, preferably in the form of applications and tangible innovations.

These leading principles result in a specific approach for Telematica Instituut that can be summarised as follows:

- In its projects, TI creates public-private innovation communities. TI facilitates and stimulates knowledge sharing and circulation within these communities. In order to enforce this, among others practical measures, TI adopts during the project life cycle the role of representative for the assembled stakeholders. Actually, TI appoints a senior supervisor chairing a project steering group who ‘governs’ the project and takes care of stakeholder management.
- In terms of technology development and innovation, TI stimulates and facilitates that:
 - Competing companies co-operate in the development of future standards;
 - Suppliers of complementary products and services coordinate their strategies and products/services, in order to create effective business models;
 - Suppliers and users in a vertical chain optimise their operations in order to raise the overall efficiency and to develop and exploit new market opportunities;
 - Technology suppliers and users meet in order to raise the mutual awareness of user demands and technological constraints and opportunities, in doing so creating opportunities for new products and services;
- Finally, TI assists and stimulates SMEs to join forces among themselves and with major companies, in order to be able to engage in joint innovative R&D.

Telematica Instituut performs this role based on reputation and trust that has been achieved since its launch in the mid nineteen nineties. A range of projects has been conducted, culminating in a variety of current projects, for instance:

- The Archimate Forum – a consortium of software houses including SMEs and science partners for the advancement of software architecture.
- The Integrated Log Initiative – an open source infrastructure, initiated by the national research programme, MultimediaN aiming at co-development of content management solutions together with SMEs in the healthcare, sports, and culture domain.
- ISI – a collaborative effort with Dutch insurance companies to help their sales entrepreneurs (middlemen) develop an ICT strategy in their everyday business.
- The Innovation Alliance Foundation – for collaboration between professional education (hogescholen, polytechnics) and SMEs aiming specifically at organising innovation communities around technology topics such as ICT, environment, healthcare, etc.

4. Example: Integrated Log Family as open source project

The Integrated Health Log project (Brussee et al, 2005^x) which is part of the Dutch national MultimediaN research initiative (www.multimedian.nl), is a collaboration project from IBM, Roessingh Research and Development and Telematica Instituut.

In the Integrated Health Log project the team developed an open source infrastructure to manage, share and use multi data. Inspiration for this initiative came from earlier projects, and discussions with representatives from home care, healthcare, culture and sports who demanded solutions enabling them to collaborate while sharing various multimedia in a secure environment.

In the care case the focus lay on home care applications where district nurses kept a patient log of wound care and could consult a colleague or a dermatologist for advice. In the cure case developers chose a focus on rehabilitation medicine. Here specialists and therapists wanted to combine the data of a patient collected over different treatment sessions and discuss these data with peers. In the sports case developers focussed on the communication between trainer and pupil. Their aim was to have training data be uploaded so that trainer and pupil could discuss and compare these data afterward, even over distance. In the culture case, the focus was on the autonomy of artists and culture institutions. They wanted to open specific parts of their portfolio to specific groups but would be reluctant to put everything on the web for free, to prevent digital copying of their work.

The users in the designated cases needed a content management system (CMS) like solution but they had bad experiences with CMSs that made them hold on to grass roots initiatives such as websites set up with no larger organisation in mind.

Inspired by the steady growth in network connectivity, bandwidth and memory space, the integrated log family was built in an open source manner, based on the popular Plone/Zope open source system (<http://plone.org>) that were made fit for logging a wide variety of multimedia and giving the users the ultimate autonomy to decide what to share with whom. Out of this endeavour grew the Integrated Log Family.

To test the viability of the integrated log family, the team IHL team organised expert meetings with stakeholders from rehabilitation medicine and from the sports domain. On the one hand the software served as a rapid prototype to evoke user feedback and enable iterative improvement. On the other hand, the CMS worked properly, even in this prototype phase, because of the solid Plone basis underneath and the Apache access infrastructure that had been included. The system included a basic infrastructure with several multimedia management functions.

Figure 4: SportersLog prototype: role based access to rich multimedia



In the rehabilitation case, Roessingh R&D decided upon using the system for patient intake as internal multimedia patient record and for child physiotherapists to share cases in peer review meetings for learning and quality management.

For the sports umbrella NOC*NSF (Netherlands Olympic Committee and Sports Federation) a similar small scale growth path was foreseen. First the system is being tested at two federations, the swimming federation and the cycling union with a further roll out foreseen in case of a positive pilot outcome. Figure 4 shows a prototype.

Currently these pilots are running. That is, the IHL-team has put doctors, therapists, trainers, and sportsmen at the helm. In a rapid evolution new functions are being demanded, small problems are being addressed. And the end users start to give the Physiolog and Sporterslog a place in their everyday routine. Earlier studies in home care, “Woundlog”, showed that this appreciation for the technology is essential.

The Plone open source portal software and the Apache open source security infrastructure have been the team’s starting point. This open source approach allows a basic structure consisting mostly of ready-made fabric, but tailored in a few details that are relevant for the business. This makes solutions affordable and manageable. The general architecture encompasses the business needs that are generally felt, such as security, data management, communication, and access. Moreover, it allows easy adaptations. The Plone and Apache development communities guarantee state of art and flexible solutions. The stakeholder community of SportersLog consists of coaches, technicians, researchers, advisors, and medics. Many parties are involved. Three quarter of these stakeholders are semi independent autonomously working SME parties. Some independent organisations, but also federations themselves have a scale, budget, and focussed scope similar to SME. For them ICT is only valid if it brings a solution. Upfront strategic investments are undoable there.

5 Including HT SMEs as a condition for ICT-enabled innovation

Before entering into conclusions and issues for further research and discussion, as we will do in the next section (chapter 6), we would like to elaborate on the importance of including HT SMEs in innovation processes, in order to get innovation results that are effective for the end user, scalable and sustainable. As the focus of this paper lies on ICT-enabled innovation, we will extend lessons learned from the Integrated Log case onto open source communities.

First, an important aspect of open source software is that allows community partners of different size and nature to create a dynamic community. There is no need for a major player that coordinates the overall architecture. Likewise, exchange of intelligence is possible in an early stage, SMEs can be early engaged, they do not have to wait and see till a major player feels it to be proper to allow them to engage in dissemination. It is ideal during prototyping because it’s modifiable.

Second, a dynamic community combines the necessary autonomy with a partial sharing of roles. If we want the system to stay alive and evolving, it must be adaptable in the

future as well. Therefore we'd best lift the barrier between prototype and end product and strive at far reaching co-design with the users in these fields in an iterative manner – now and in the future. This is a combination of freedom and a willingness of stakeholders to adhere to a common (open) standard.

Thirdly, open and dynamic innovation communities require a substantial amount and variety of participants, with an independent and robust accelerator and facilitator such as an LTI. The SportersLog example is interesting because a lot of stakeholders may actually be involved. This becomes clear, e.g., when we focus on the future of this open source infrastructure. Continuation needs to be organised and the open source community has blue prints for that. To involve this large community of interest - as is necessary - any sensible initiative in this direction should be maximally open. This gives a social basis for the effort to continue.

The term 'social' refers to the democratic aspect of Open Innovation, also to our previous conclusion that SMEs could play the role of 'societal actor' par excellence. Here we think lies the fundamental advantage of open innovation compared to closed innovation. Leaving out some of these stakeholders, e.g. because of their size or (lacking) financial power, would only make a product like SportersLog less relevant. This is because the bulk of the activities and responsibilities in the sports domain are organised through small and medium-sized organisations and businesses.

In order for this open source infrastructure initiative to continue after Telematica Instituut finalises its Integrated Log activities, the institute proposes one or several not-for-profit foundations to guard the character of the software being built. These foundations are governed by a representation of the stakeholder groups. The more organisations adhere to this foundation, the more relevant a related open source product can grow. The GNU Public Licence (www.fsf.org) serves as blue print for the corresponding open source licences for SportersLog and other members of the Integrated Log Family. The bottom line here is that access to the software is guaranteed and maintenance of the software can be organised. These conditions lower the risks for SMEs (and all other enterprises) when they invest their time and money in an open source products.

6. Conclusions: changing innovation, changing roles

Open Innovation as academics from The States tend to define it, is driven by companies, where in knowledge institutes serve the purpose of accelerating or optimising innovation processes. In addition, inspired by European scholars who develop the Mode-2 science concept, we would prefer to include societal actors and knowledge institutes as essential drivers of innovation.

In this paper we described the Dutch Leading Technology Institutes initiative and the particular example of Telematica Instituut. By showing its governance, its project organisation, and a typical collaborative project in the domain of open source, we demonstrated that Leading Technology Institutes can play a prominent role as innovators.

As we see in the example of the Integrated Log Family, sections 4 and 5, SMEs need to be welcomed and involved to accelerate innovation and translate it to effective end user applications. So SMEs can be as important innovation accelerators as larger companies. Therefore the innovation role of knowledge institutes needs to broaden in the future to connect with both large and small businesses, large and small organisations.

For such community- or ecosystem-oriented innovation to work, roles must be decentralised. The “industry age” centralised system integrators must gradually give room to more “knowledge age” networked ecosystems approaches. Open source initiatives may very well guide our way. They show that size plays a lesser role in this knowledge paradigm, but social basis does.

We expect therefore that SMEs in the future will see their role in research projects broadening. Currently they are mostly involved as pilot partners in project activities targeting end user groups. Collaborative efforts like the Integrated Log applications show that SMEs can be co-developers and partners in R&D as well.

For Telematica Instituut, as a consortium and as a multi client programme management entity, the role is changing as well. The institute may become a pivot and good practice example of Open Innovation in itself. Being an efficient and reputed organiser of innovation programmes and projects, it may extend its future role as a productive docking system for HT SMEs.

In ICT-enabled innovation, dynamic open innovation communities, comprising as well SMEs as public institutes, supported and stimulated by an independent body such as Telematica Instituut, could be crucial for accelerated and sustainable innovation. Government should sponsor bodies such as the Leading Technology Institutes in their role to guarantee open access to these innovation communities and pro-active dissemination of their results.

Notes

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