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TNO report

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Multi-Annual Programme for 2011-2014

Enabling Technology Programme, Behaviour and Innovation; Adjustment 2014

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1 Introduction

TNO liaises with the relevant ministries and stakeholders to produce a Strategic Plan every four years, in accordance with the TNO Act. The TNO Strategic Plan for 2011 – 2014 sets out TNO's current demand-driven innovation objectives.

The plan also covers the Enabling Technology Programmes (ETPs), which are designed for performing exploratory research aimed at renewing the internal knowledge base. The current ETPs are devoted to six focused multidisciplinary programmes: Models, Sensor Networks, Materials Science, System Biology, Behaviour & Innovation, and Strategy & Change.

The choices in the Enabling Technology Programme are based on an analysis from the perspective of the TNO themes: which breakthroughs will be needed for various themes in order to achieve the theme objectives; and an analysis from the perspective of the development of science and technology: to identify the opportunities that will arise in this area that could be tackled by TNO and developed into new concepts.

The Enabling Technology Programmes that emerge from this process must:

- be oriented to technological breakthroughs with the potential to accelerate multiple themes towards the innovation objectives;
- lead in the medium-term to a recognized knowledge position (mass and focus), while being distinct from and complementary to knowledge partners (uniqueness);
- derive their strength from the combining of disciplines and areas of expertise in order to achieve genuine breakthroughs (TNO's multidisciplinary strength);
- have a relatively long time horizon (>3 years), normally building knowledge to a Technology Readiness Level up to and including 5 ('concept validation').

The ETP Behaviour and Innovation started in 2011 with a term of four years. This document sets out the proposed research lines and the constituent projects, and the adjustments for 2014 relative to the multiyear ETP programme plan for 2011-2014[1].

Where necessary, new emerging fundamental knowledge issues will be evaluated by the ETP steering group for relevance for the TNO themes, and eventually adopted in the ETP programme 2014.

[1] In accordance with DGBI-I&K/13110401.

2 Environmental perspective

Europe and the Netherlands are facing enormous social and economic challenges. These complex and interrelated problems are putting pressure on European and Dutch prosperity and wellbeing[2].

The most important global system trends and their significance for knowledge and innovation in the Netherlands are[3]:

- that social issues demand an innovative approach that is oriented, among other things, to enhancing sustainability. The government has an active role in this aspect;
- that an ageing population means that gains in labour productivity become more important as a guarantee of continued prosperity;
- that worldwide competition surrounding knowledge-intensive products and services is intensifying. The Netherlands and other EU countries lack the necessary economies of scale for innovation;
- that globalization notwithstanding, Europe is still our most important trading partner. Further political integration alongside economic divergence must also be taken into account;
- that there is a trend towards a more extensive government role in innovation. In general greater entanglement of (international) politics and economics is visible.

In support of solutions for the above major social and economic challenges, Europe has adapted many aspects of the new research framework programme for 2014-2020 relative to previous programmes, and has also increased the budget.

National and international social, financial and economic challenges demand a national policy that offers ample scope to our innovative strength and entrepreneurship. With a view to strengthening industrial policy, the Dutch national government designated nine top sectors in 2011 in the memorandum ‘Naar de top (To the top)’. Science, industry and government will invest directly in these issues to enhance their innovative strength. This collaboration will continue to be reflected in the details of the various top sector research agendas in 2014, on the assumption that the government will not assert control through rules and subsidies, but will allow Dutch industry the freedom to do business, invest, innovate and export. From this viewpoint, it is entrepreneurs, not the government, that exploit these economic opportunities, thereby creating economic growth, employment and prosperity[4].

[2] Meer werken aan duurzame groei (More effort on sustainable growth), Social and Economic Council recommendation, 2010.
[3] De Staat van Nederland Innovatieland, TNO publication, 2012
[4] http://www.top-sectoren.nl/

2.1 Europe

When the seventh framework programme ends at the end of 2013, it will be succeeded by the Horizon 2020 programme and other new supporting instruments.

In the concluding seventh framework programme (FP7), the content of the ETP Behaviour and Innovation aligns mainly with the issues in four programmes:

- Health;
- Information and Communication Technologies;
- Socio-Economic Sciences and Humanities;
- Transport;

and on components (Security, Environment) with other FP7 programmes (see Table 1).

Table 1 Match between the ETP Behaviour and Innovation projects with the FP7 programmes.

EU FP 7 programmes	Smart Coaches	Gezondheidsgedrag en -bevordering	Sociale Media en gedrag	Mobiliteitsgedrag	Organisatiegedrag	Resilience wijken	Complexe systemen
Health							
Food, Agriculture &fisheries, and Biotechnology							
Information- and Communication Technologies							
Nanosciences, Materials, and New Production technologies							
Energy							
Environment							
Transport							
Socio-Economic Sciences and Humanties							
Space							
Security							
	<- Micro			Meso			Macro->

The focus on a number of programmes, but with potential spin-offs to other programmes, is clearly visible.

The long-term technical programming of the ETP means that the EU Horizon 2020 programming for 2014 and beyond is also of great importance. In the new 2020 strategy, Europe aims to achieve success as a union with a smart, sustainable and inclusive economy and high employment, productivity and social cohesion. *Europe 2020. A strategy for smart, sustainable and inclusive growth*[5] sets out the vision for the European social market economy of the 21st century. This is the successor to KP7, and will be more extensive than ever, with a budget proposed by the European Commission of approximately 80 billion euros. Horizon 2020 has three components:

- excellent science;
- industrial leadership;
- six major societal challenges to be tackled.

[5] http://eur-lex.europe.eu/LexUriServ/LexUriServ.do?uri=COM:2010:2020:FIN:NL:PDF

The three priorities from the new European research perspective is outlined in the adopted framework decision Horizon 2014-2020[6]. Of most relevance to the ETP Behaviour and Innovation, and with compatible content, is the third part of the Horizon programme, the six '*Societal challenges'* with the following issues:

1 improving lifelong health and wellbeing;
2 promoting an inclusive, innovative and secure European society;
3 achieving efficient, environmentally friendly and safe transport;
4 a resource-efficient and climate-resilient economy;
5 safe, sustainable and high-quality food;
6 transition to reliable, sustainable and clean energy.

> Solutions to our biggest challenges such as climate change, food and energy security and an ageing population will only come from groundbreaking research and innovation which brings together the best minds from across Europe.
>
> Máire Geoghegan-Quinn European Commissioner for Research, Innovation and Science. Opening address to the Research, Innovation and Digitalisation session at the Europe 2020 conference. June 2012./ Bratislava.

The ETP Behaviour and Innovation, with its focus on behaviour and innovation issues, will align on content with the first three societal challenges. Thereby contributing to Dutch participation in the European programmes and projects.[7]

2.2 Top sectors

Innovation is an important resource for prosperity growth in the Dutch economy. Innovation raises the productivity of Dutch industry, benefits the Dutch competitive position and contributes to resolving societal issues. Research & Development expenditure is an important input factor for innovation. The Netherlands set a target in the 2011 National Reform Programme for 2.5% of gross domestic product to be invested in Research & Development in 2020. This is a deliberately ambitious objective, which takes account of the Dutch sector structure[8].

Current industrial policy is concerned with strengthening competitiveness and the innovative power of the Dutch economy. The top sectors, knowledge-intensive and export-oriented sectors that are able to contribute strongly to societal issues, are important pillars of the policy.

The government, together with industry and knowledge institutes, is setting course for the top. The letter from the Dutch business community *Naar de Top (To the Top)* identifies three firm ambitions:

1 for the Netherlands to be among the top five knowledge economies in the world (2020);
2 a rise in Dutch R&D activity to 2.5% of gross domestic product (2020);
3 the participation of public and private parties in 2015 for over 500 million
4 euros in Top Consortiums for Knowledge and Innovation (TKIs).

[6] http://ec.europa.eu/research/horizon2020/pdf/proposals/communication_from_the_commission_-_horizon_2020_-_the_framework_programme_for_research_and_innovation.pdf
[7] Blik op Brussel, Health Council (GR) recommendation, 2012
[8] Annual report and final Act amending the budget of the Ministry of Economic Affairs 2012.

The aims with Dutch industrial policy are an increase in private research and development intensity and greater innovative strength of the Netherlands. Through public-private partnership, the government is maximizing the likelihood of publicly financed knowledge development being used by industry. Knowledge use by industry is an essential link in the knowledge-skills-profit chain. Public knowledge development will accordingly come to be oriented more strongly on the seven top sectors. Innovation is up to companies, which have to take the financial and other risks that are involved. Companies' inability to assume control of all the additional societal benefit entails the risk that they will innovate below the socially desirable level. The Ministry of Economic Affairs is accordingly supporting private R&D and innovation with financial instruments in the national industrial policy.[9]

Through mediation of the various TNO innovation areas, the fundamental knowledge to be built up in the knowledge projects in the ETP Behaviour and Innovation will be used in projects within many top sectors and social sectors[10] [11] [12] (Table 2).

Table 2 Substantive relevance of the knowledge products of the ETP Behaviour and Innovation for the various top sectors and social sectors.

ETP projects / Top sectors and Social sectors	Applied neurosciences	Smart coaches	Health behaviours and promotion	Social media and behaviour	Mobility behaviour	Organizational behaviour	Resilient communities	Complex systems
High-tech systems & materials								
Chemicals								
Energy								
Creative industry								
Life science and health								
Logistics								
Horticulture								
Water								
Agri-food								
Head offices								
ICT								
Social safety								
Defence								
Sustainable living environment								
Employment and health								

It is generally assumed that the scale of R&D investment is an important factor for the development of new knowledge and innovation. However, it would appear that 25% of the *success* of innovation is determined by the technological innovations themselves, while 75% is attributable to factors on the human, organizational and societal levels[13].

[9] Adoption of the budget for the Ministry of Economic Affairs, Agriculture and Innovation (XIII).
[10] Ministry of Social Affairs and Employment Strategic Knowledge Agenda 2012.
[11] Ministry of Health, Welfare and Sport Strategic Knowledge Agenda 2020.
[12] Ministry Economic Affairs, Agriculture and Innovation Strategic Knowledge Agenda 2012.
[13] Volberda, H., Final report Erasmus; Concurrentie en Innovatie Monitor 2010-2011.

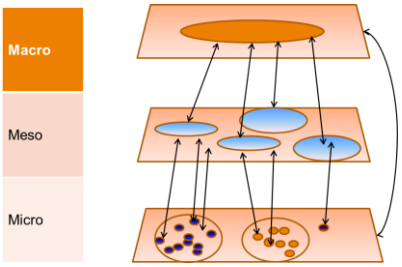
Research has shown that organizational structure and culture, leadership, collaboration between companies and the networks in which employees operate determine a company's innovative strength. These aspects are within the 'social innovation' theme. Social innovation has been designated by the government as a top-sector-transcending theme, and is defined in the Human Capital and Social Innovation TNO/NWO roadmap[14]. The purpose of this roadmap is the development of knowledge and instruments to integrate innovations and investment in human capital and social innovation in specific innovation programmes (technological innovation): 'natural science-social science integration'. The specific aim of the 'human capital and social innovation' roadmap is to link the Innovation Contracts and the Top Consortiums for Knowledge and Innovation (TKIs) on the one hand, and the Human Capital Agendas of the various top sectors on the other. The knowledge questions from the social innovation roadmap were already included specifically in the ETP Behaviour and Innovation in 2013, and will be intensified in 2014.[15]

> Economic growth will be possible only if there is a firm social foundation in the Netherlands. Research in the top sectors is impossible without the contribution from social sciences and the humanities.
>
> From: NWO press release 2012 Social Infrastructure Agenda.

[14] Roadmap 'Versterken menselijk kapitaal en sociale innovatie (Reinforcing human capital and social innovation).' A joint initiative of NWO, TNO and Syntens, 2012.
[15] In accordance with Ministry of Economic Affairs minute Programme 2014 and perspective 2015 (DGBI-I&K/13110401).

3 Objective of the ETP Behaviour and Innovation

The underlying assumption in the ETP Behaviour and Innovation is that the behaviour of individuals (micro), organizations (meso) and public authorities / business clusters (macro) determine the ultimate success of technological and social innovations[16].



The programme has two objectives. The first is for the programme to supply tools and methods based on an innovation management approach in order to bring innovations to practical application faster and more effectively. We know that this is necessary, because it is all too common for innovations to become stranded in the chain that has to be traversed to reach the end-user (90% of innovation investment does not achieve the desired result). Insufficient understanding of the chain and methods of influencing progress through it have an important role, as does underinvestment (financing is oriented mainly to achieving and demonstrating the innovation). The second is for the programme to develop generic instruments for use in influencing and modelling behaviour, and to investigate the rules of behaviour that govern the interaction between systems and individuals. The need for this is that human behaviour underlies several major social problems that confront our society, and moreover behaviour is a crucial factor in the introduction of innovative technology.

The Enabling Technology Program (ETP) Behaviour and Innovation will build fundamental knowledge concerned with explaining and changing human behaviour in relation to system innovation. Models, methods and toolboxes will be developed using a multidisciplinary and multilevel approach for effective behavioural influence, (community) interventions, system innovation and social change. These generic results will then be tested on an issue within a specific TNO innovation domain.

[16] OECD Industry, Innovation, and Entrepreneurship committee report, New Nature of Innovation, 2009.

4 Substantive relationship with government policy and TNO themes

4.1 Governance

The 2014 programme for ETP Behaviour and Innovation was produced in coordination with the steering group. The representatives of the relevant themes in the steering group are: Prof. E. Fledderus (Information society), Prof. P. Bongers (Healthy Living), Dr. B. Don (Safe Society), Dr. M. Jak (Mobility), Dr. M. Kuipers (Built Environment) and. S. Kooten (Energy) under the chairmanship of Dr. A. Sanderman (Managing Director TNO BSS).

The steering group held several formal meetings, which were minuted. The relationship with demand-driven TNO programmes is defined through the input from the steering group representatives of the various TNO themes.

The ETP is subject to a mild form of demand control by the government, on which basis there are two liaison sessions a year with representatives of various ministries led by the Ministry of Economic Affairs. The ETPs are important for the societal themes and top sectors, but there is no one-to-one allocation.

4.2 Relationship with TNO themes and top sectors

Knowledge of behaviour and innovation has a direct link with the innovation objectives of many TNO themes. The table below shows the links between the ETP Behaviour and Innovation and issues within the various TNO themes (Table 3).

Table 3 Substantive relevance for the TNO themes from the three research levels of the ETP Behaviour and Innovation.

TNO THEME	Behaviour of people (micro)	Behaviour of organizations and networks (meso)	Behaviour of social systems (macro)
1 - Defence, Safety and Security	Citizen self-reliance and civic participation;	Civil-military collaboration;	Cultural conflicts; crisis management;
2 - Healthy Living	Prevention and lifestyle programmes	Labour saving in healthcare; productivity strategies	Living longer at home; intersectoral health policy
3 - Energy	Consumption behaviour	Optimization of chains	Energy transition: implementation of sustainable energy technology,
4 - Transport and Mobility	Traffic behaviour;	The New World of Work	Mobility transition: traffic economy;
5 - Built Environment	Behaviour-reinforcing environmental interventions	Energy-neutral built environment; reduction of the construction industry's ecological footprint; The New World of Work	Livability of urban environments

6 - Industrial Innovation	Intuitive man-machine interaction	Partnering, open innovation, cooperation in coalitions and networks	Interaction characteristics innovation system and innovative capacity
7 - Information Society	User acceptance behaviour; behavioural influence through social media;	E-business strategies; Information-driven work	Socio-economic implications of Internet
Generic knowledge areas	Cognitive models; assessment and decision behaviour; learning models; human-system communication	Community interventions; self-organization; emergence; intersectoral cooperation	Social innovation; transition paths; monitoring instruments; new behaviour-influencing instruments knowledge transfer between research, policy and practice

The substantive relationship with the top sectors and social sectors is shown in Table 4 below.

Table 4 Substantive relationship of ETP Behaviour and Innovation with the knowledge issues in the various top sectors and social sectors

Top sector / theme	Output of the ETP Behaviour and Innovation
High Tech	Model for accelerated innovation in complex cooperation; Adaptive models for human-machine communication Development strategies interactive intelligent systems Behavioural influence for sustainable mobility Success and failure factors in upscaling
Chemicals	-
Energy	System models, smart grids Chain innovations and business models Intervention instruments for system transitions
Creative industry	Tools and models for e-coaches Behaviour-influencing models
Life Sciences & Health	Lifestyle programmes Guidelines for intersectoral cooperation Intervention development
Logistics	-
Horticulture and propagating stock	-
Water	-
Head offices	-
Agri-food	Health promotion and behavioural influence Relationship between food and brain health, and behaviour

ICT	Models for social influence, use of ICT in new learning
Sustainable living environment	System analysis, innovation strategies
Social Safety	Model for self-reliance; Interventions for citizen self-reliance
Defence	Methods and tool development for effective training and learning
Employment and health	Social innovation (sustainable organization forms, flexible labour market, models for cooperation) Diagnostic instruments for assessing organization capacities Interventions based on co-creation and empowerment methods

4.3 Relationship with academic institutions and institutes in the TO2 federation

The ETP Behaviour and Innovation has an active policy for establishing and maintaining relationships with academic institutions concerning the research issues. This policy is carried out through part-time professors and joint PhD students, and is the basis for obtaining a high-value fundamental knowledge interaction (Table 5). Approximately 15% of the budget is reserved for this academic network.

Table 5. Academic relationships of the ETP Behaviour and Innovation.

(Part-time) professors	PhD students
Prof. S. Dhondt (KU Leuven)	2 University of Twente
Prof. J.M. Schraagen (University of Twente)	1 trainee research assistant University of Groningen
Prof. J. Kerstholt (University of Twente)	1 VU University Amsterdam
2* professor application (University of Twente)	1 Maastricht University
	2 Utrecht University

The ETP Behaviour and Innovation will uphold the contacts with the National Institute of Public Health and Environmental Protection (RIVM), the Energy Research Centre of the Netherlands (ECN) and Wageningen UR in order to identify any interfaces between the programmes[17]. The methodology and findings of healthcare system modelling will be exchanged with RIVM. The feasibility of combining our behavioural models and ECN knowledge and data about the energy consumption of households is currently being studied with ECN. The various knowledge projects will maintain contact with national (e.g. the Netherlands Organization for Health Research and Development (ZonMw), Utrecht University, Erasmus University Rotterdam and Maastricht University), and international (MIT, KU Leuven) organizations, and will participate in competitive calls for knowledge.

4.4 Collaboration with other ETPs

A joint research case on system change in diabetes care is being handled together with the ETP System Biology. The ETP Behaviour and Innovation will contribute the application of transition knowledge and methods for behavioural change to this issue. There is collaboration with the ETP Models on applying theoretical knowledge about agent-based modelling in simulating human behaviour.

[17] As included in *Vision on applied research*, Ministry of Economic Affairs, 5 July 2013

5 Objectives of the ETP Behaviour and Innovation

The ETP Behaviour and Innovation is structured along three different levels of research – micro, meso and macro – each with various specific knowledge objectives. There is an emphasis, with specific budget allocation, on disseminating, enhancing and implementing the knowledge that is developed, through publications and membership of knowledge networks, and through participation in competitive national and international knowledge programmes. The knowledge and tools developed in the ETP will also be shared with various target groups in workshops and symposiums.

5.1 Micro-level knowledge objectives

The knowledge objectives in the behavioural research field are:

- *interventions of proven effectiveness for changing individual and group behaviour*: developed to be 'configurable' for various application domains. Some examples of domains are mobility, aggressive behaviour, overweight, infectious disease control, sustainability, informal care, and behaviour during incidents. In all these cases the (decentralized) government has great difficulty in inducing the desired public behaviour through existing methods (regulations, design of facilities, provision of information). The importance of behavioural models lies in enabling the evaluation of interventions – which may be difficult or impossible in practice – in a laboratory setting, and in providing explanations for failing to achieve the envisaged effect. New media in particular can be employed in the development of a communication method tailored to the profile of the individual citizen, as an alternative to the, hitherto dominant, universal communication. Tools and instruments with long-term commercial potential can be derived from the models;
- *optimizing natural human-system interaction*: a set of rules of behaviour is being drawn up with which natural (convincing) interaction between actors and people should conform. To demonstrate these rules of behaviour, a 4th generation personified human-system interface is being built for various sectors, including education (intelligent play room and classroom), and healthcare ('virtual companionship for elderly people', and 'virtual coach', which assists and gives feedback to professionals).

5.2 Meso-level knowledge objectives

The meso-level knowledge objectives are:

- *an optimized development model for innovative capacity*: the current models are insufficiently defined on an organizational level. The model to be developed will help improve the innovative capacity of organizations and networks of organizations. For instance, organizations will be aware of the conditions to be safeguarded when implementing innovative change, as well as the process they have to go through to ensure that innovations take root. A set of tools that is linked to the model will be provided for the effective organization of

innovation processes within an organization or network of organizations, including:
- diagnostic tools for innovative capacity;
- tools for interventions for the effective organization of innovative processes, taking account of the complexity and the dynamics of innovative processes;
- tools to monitor and learn lessons from innovative processes;
- tools for upscaling an innovation, in order to create more impact than a successful pilot.

5.3 Macro-level knowledge objectives

The macro-level knowledge objectives within innovation management are to make an *innovation model available on societal level, which is compatible with a complexity and emergence approach*. This model will be supported by well-founded and effective methods and methodologies (i.e. a toolbox). The toolbox will consist of the following:

- An 'innovation diagnostic' tool for identifying basic patterns in implementation processes: what opportunities and obstacles are to be expected?
- A design tool for an innovation strategy. Based on the diagnosis and taking account of the complexity and dynamics of innovative processes.
- Tools for monitoring and evaluating an innovative process while learning. This will address one of the most important problems in the research: the actual ability to quantify the implementation or use of innovation. The 'learning' structure, with the participation of the most relevant involved parties, also creates an opportunity for continuous intervention in connection with complexity and emergence.
- Tools for intervention. These are mainly intended for influencing acceptance and use of product and service innovations on a micro level (end-users). Other interventions, such as 'living labs', or niche experiments, are appropriate as small-scale learning experiments in preparation for the upscaling and diffusion of innovations.

5.4 Portfolio of the ETP Behaviour and Innovation

The long-term projects will be continued in 2014 within the ETP, with updated content of the research questions. The content will be adjusted on the basis of the 'transfer' of the knowledge output to the TNO demand-driven programmes. Indicators for monitoring the ETP portfolio include each project's current level of technological development, and the substantive achievement of the knowledge objectives.

The level of technological development is assessed in terms of Technology Readiness Levels (TRL), where TRL 1 means that basic principles have been observed and reported, while TRL 9 means that the knowledge product has been fully developed and is ready for application. Research subjects that have achieved a level higher than TRL 6 are normally transferred to a TNO demand-driven programme for further development into specific customer applications.

The classification in early 2013 of all projects according to level of technological development and achievement of the knowledge objectives indicated that the progress on the issues of three project lines justified their transfer to the demand-driven programmes (Figure 2013). This provided space in 2013 for a substantive renewal of these three projects.

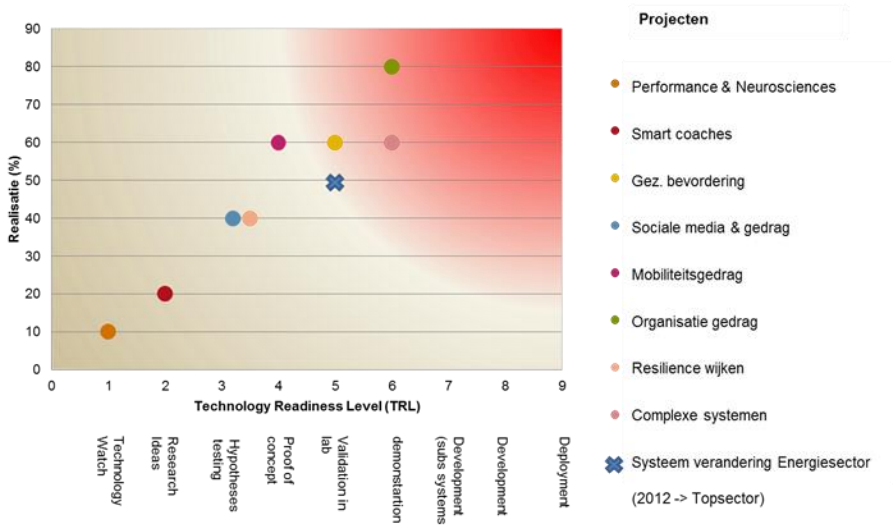


Figure 1 Classification of the ETP projects according to TRL and degree of achievement of the knowledge objectives (Q1 2013).

The portfolio assessment and the input from the steering group led to a redefinition of the content of the projects in 2013:

- innovations in health promotion;
- organizational behaviour;
- and complex systems;

and the start of a new exploratory research project into applications of neurocognitive sciences in accelerating and improving learning and performance. These adjustments will be continued in 2014. The overall budget reduction of the 2014 government subsidy to TNO will also lead to an adjustment of the content or timescale of the ongoing projects[18].

[18] In accordance with Ministry of Economic Affairs minute Programme 2014 and perspective 2015 (DGBI-I&K/13110401).

6 Projects in 2014

The following eight projects will be developed within the ETP in 2014, five of which with a specific substantive knowledge structure and three that have a methodologically integrating effect on each research level.

A small portion of the budget will be expended on KIEM projects, which have the purpose of exploring the potential of new research directions.

6.1 Innovations in health promotion

The government observes three health promotion themes that are set out in the memorandum 'Vertrouwen in gezondheidsbescherming, zorg en sport dichtbij in de buurt & zelf beslissen over leefstijl (Trust in health protection, care and sport in the immediate neighbourhood & self-determination of lifestyle)'. With a view to the economy measures that also affect public health, the need in the extremely short term for efficient and effective health-promoting interventions is evident. This demands knowledge development on het micro, meso and macro levels.

The important influence of the immediate environment on people's healthy behaviour is becoming increasingly clear. As such it is important to find out how context influences behaviour, to identify measures that can be taken to reduce any adverse effects of the immediate environment on behaviour, and to take advantage of any health-promoting effects. This demands more complex interventions that provide support tailored to the people concerned, in situations and at times where it is hard to uphold behaviour, leading where possible to beneficial changes in the environment with respect to desired behaviour. Achieving interventions of this kind generally requires the involvement of a variety of parties. This calls for a clear understanding of the factors and methodologies that enhance the effectiveness of the teamwork between these parties to the maximum.

This project is concerned with the development of generic knowledge and tools to provide tailored information for individual children and their parents, parenting support oriented to preventing 'inappropriate' behaviour of children, virtual coaching of mediating professionals who are responsible for preventive interventions, the validation of an implementation diagnostic instrument, and the modelling of intersectoral forms of cooperation.

In 2014 the personalized behaviour coaching concepts that were developed earlier as a serious game will be tested and validated with secondary vocational education students. The mEMA app that was developed jointly with Maastricht University will be employed on a large scale to monitor people's behaviour and experience in everyday life. The knowledge and tools from this project will be transferred in 2014 to the PPP project SWELL (COMMIT programme) and the new Netherlands Organization for Health Research and Development project 'MBO en schoolgezondheid (secondary vocational education and school health)'.

6.2 Social networks and media

Social networks have an important role in people's behaviour. ICT developments (social media) have further simplified the creation of networks of this kind. An example of the substantial impact of social media is how public opinion about an issue such as vaccination can be influenced. Government authority and public confidence in the government and science are being replaced, apparently effortlessly, by a collection of public utterances. We also refer to the increased impact of individual opinions as the empowerment of the individual. Because of the above, the idea that people's behaviour is simple to influence through one-way communication has become outdated. Collective emergent behaviour arises through the complexity of networks of people and organizations that form relationships, and their mutual social influence.

Social media greatly accelerate and magnify the pace and scale of development of these networks, shortening the time available to observe, analyse, explain and respond to collective emergent behaviour, while increasing the potential impact of policy and management measures, for example. We may conclude that there is no cause for alarm with the development of actual IT applications (social media) and the related opportunity for online social influencing, but that the impact on areas such as legislation (e.g. cyber crime), policy forming (e.g. cervical cancer vaccination), image management (e.g. 'Nestlé's Social Media Meltdown'), revenue models (e.g. peer-to-peer), and innovative capacity, is potentially disruptive. The ambition with this project is to generate an explanatory model for the impact of social media on people's behaviour and to provide handles for intervention.

In 2014 the generic predictive model that has been developed, with psychological, network and message attributes, will be parameterized with new cases from industry and public authorities. We will forecast the potential effectiveness of influencing strategies that use social media.

6.3 Mobility behaviour

The scope within mobility issues is set to shift in the coming period, prompted, among other things, by the Beter Benutten (Better Utilization) programme of the Ministry of Infrastructure and the Environment, from pure dynamic traffic management measures to a combination of these and mobility management behaviour measures.

For both of these fields, knowledge of behavioural motives and the opportunities for influencing them are essential. There is still insufficient knowledge of the behavioural determinants on micro, meso and macro levels to ensure the success of innovations in the world of traffic, transport and mobility. Too often an innovation will be introduced quickly (or tested on a small scale), only for the envisaged effect not to materialize on a national level (upscaling problem). In this project we are combining the knowledge and output from earlier processes from the world of traffic and transport with a view to converting success and failure factors into a mobility behaviour model. We are

engaged in this project on the development of a behavioural model that we have called FOUNTAIN, in which we are incorporating the underlying knowledge and data collected from our own and other studies in the world of traffic and transport. The central objective is to define, interlink and unravel the behavioural determinants of 'Smart Work Smart Travel', with a view to identifying the new innovations or measures that will succeed and their achievable effects, and the context in which certain measures are, or are not, worthwhile.

The focus in 2014 will be on improving the usefulness and validity of the FOUNTAIN model, whereby we will model the population-level impact on individual passengers' choices of modes of travel (bicycle, public transport, or car). The output of the FOUNTAIN model will be augmented with a visualization module to allow end-users to compute and explore 'what if' scenarios. The knowledge and tools from these projects are relevant for the Ministry of Infrastructure and the Environment (Individualization and Behaviour knowledge development line within the Strategic Knowledge Agenda (SKIA)).

6.4 Self-reliance and civic participation

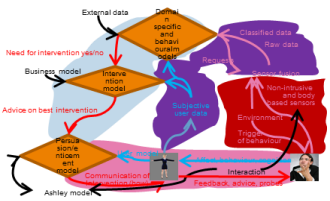
The government attaches great value to self-reliant citizens, based on the conviction that the government is unable to solve every problem that faces members of the public, and that people also have to assume their own responsibility and take action accordingly. As citizens become less dependent on the government, increasing wellbeing may also lead to more affordable social care. An example from the safety domain is the conclusion that, despite the high standard of professional emergency services, the government will not be capable of helping all victims in a timely and direct manner in the event of a crisis or disaster. At some point, citizens must rely on themselves, and take initial action before the emergency services arrive to reduce the impact of the disaster or crisis. In other domains too, such as healthcare, the government attaches great importance to self-reliance, with much attention being given to people's self-management, empowerment, freedom of choice and autonomy, so that they are able to take more responsibility for their own wellbeing (Ministry of Health, Welfare and Sport memorandum 'Gezondheid Nabij', 2011). A central basic question is how to activate citizens to actually take this responsibility (for themselves and each other) and how to support them in doing so.

The scaling down of government involvement is giving rise to a different relationship and a correspondingly different communication pattern between the government and the public: from 'top-down' control to networked cooperation. To ensure the success of this new form of interaction and cooperation, it is important to have an understanding of objectives, interests, information requirements and the convictions of citizens in order to shape the cooperation to the greatest effect. The objective of this project is to develop an influence model that describes the relationships between determinants and behaviour with respect to self-reliance. This model will be used to assess the feasibility of interventions for improving citizen self-reliance. For the interventions we will be strongly oriented on 'perception' by means of serious gaming and virtual reality.

Indicators and measurement methods for the community resilience model that was developed earlier will be created in 2014. The model will be related to a taxonomy of initiatives in order to estimate the weighting of underlying mechanisms.
The model will be incorporated in a multistep plan for the selection of effective interventions. An initial model for active citizenship (on the micro level), will be delivered with points of reference for interventions that promote active citizenship effectively. This model will be introduced into the DRIVER EU project that is due to start in 2014, with the main aim of establishing an EU platform, such as an EU-wide crisis management test-bed.

6.5 Smart coaches

Providing tailored information and assistance with behavioural change are strategic matters in many issues of the TNO themes. TNO focuses on ICT tools that help users bring about behavioural change, support task execution and set up individualized preventive healthcare. These ICT tools only work if they are compatible with users and the setting, are highly interactive and are able to present information convincingly in a coaching style. The development of constituent technologies that are needed for ICT tools of this kind is in full swing, but there is a lack of: a.) evidence-based methods for arriving at the right choices in the development process; b.) scientific insight into why certain applications are effective, and others less so;, c) scientific knowledge about how new means of interaction can best be used, and d) directing and providing opportunities for open innovation.



This project is concerned with the development and implementation of smart coaches (virtual agents) for behavioural interventions, based on multiple behavioural change models. The prototypes of interventions will be delivered through the other ETP projects that target behaviour on a micro level, but each within their own application (user case).

In 2014 the knowledge and development tools that were developed earlier will be introduced into two new ARTEMIS projects and an EU FP7 project, enabling us to use them on issues in several new research phases. There will be fundamental knowledge development on the physical interactions (e.g. ‘sensible feedback’), of a virtual social agent that will operate in specific situations in communication and conveying emotions (trainee research assistant from the University of Twente).
The knowledge developed is consistent with the roadmaps of the Life Sciences & Health, Agri&Food, and High Tech Systems and Materials/Healthcare top sectors, and is part of the collaboration in CCTR, Vita Valley, and Medical Delta.

6.6 Organizational behaviour

Improving the performance of organizations currently has to take place in a context of greater uncertainty (e.g. uncertain contracts, more market volatility). Organizations are constantly obliged to seek newer and better ways of organizing. We have learned from Statistics Netherlands' intangible investments study that organizing is an important ‘investment item’. The national growth accounts show that half of economic growth coincides with these intangible investments. Other intangible investments that are open to organizations include IPR, HR practices and

training. The development of these organizational competencies is said to influence 10% of economic growth in an economy. The ‘organization behaviour’ project integrates and adds depth to knowledge in the area of improving individuals’ and organizations’ performance and learning. Among the relevant issues are integration of learning and working, co-creation, and organization and productivity of organizations and individuals.

The objective is to integrate all these separate building blocks into a single Workplace Innovation Platform, which will provide companies with specific and cohesive measures for improving their innovative capacity and performance. The measures are oriented to both the ‘inside’ and the ‘outside’ of the organization. The project focuses on substantiating the various organizational measures with (evidence-based) behavioural knowledge. Effort in 2013 was mainly on continuing the scientific substantiation of the various organization skills that management must develop in order to enhance innovative capacity, in addition to which specific skills that workers must develop were also defined. A separate study is concerned with the collaboration skills that organizations must possess in order to work in accordance with the platform requirements.

These components will be completed in 2014 with a basic handbook for the different skills. In addition the instruments will also be brought into line with the agendas of the Logistics, High Tech Systems and Materials, Chemicals, and Life Sciences & Health top sectors. Specific versions of the platform will be developed for these top sectors. A link will also be made between High Tech Systems and Materials and the European Commission’s Factories of the Future (Advanced Manufacturing) agenda. We will investigate how our programme can answer the various questions from this programme (skills, training, organization) while we align ourselves for the calls in Horizon 2020.

6.7 Complex social systems: assessment and governance

Insight into social transitions is receiving increasing attention, and the Netherlands (together with Sweden and the UK) is a leader in transition issues and innovation diffusion. While the theoretical insight from these approaches is valuable, substantiation of the theories remains fairly weak, because the complexity of the transitions they describe hampers the identification of clear causal connections in a complex of relationships. This project will therefore use a combination of complex systems theory and innovation transition research to work towards a better quantification and modelling of complex processes of social innovation adoption.

The focus that was changed in 2013 to the modelling of innovation paths (from connections based on hypotheses to observed events) will be pursued further to link together the macro level (legislation and market operation), meso level (the private, public-private, and consumer-NGO-industry partnerships) and micro level (actions of professionals and companies, such as knowledge development, dissemination, and innovation).

The cross-case analysis of historical innovation cases in multiple European countries with respect to:

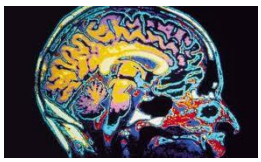
- electrical vehicles in GB, NL and DE;
- the transition from the filament lamp to 'energy-efficient lighting' in GB, NL and DE;
- diffusion of solar panels in GB, NL, PT and DE;

will lead to a database for determining the main mechanisms behind the transition to new technologies and systems. What, for example, is the role of 'bottom-up' citizen initiatives, and what is the role of lobbying by large companies? Is the market able to create a market by itself, or is government involvement needed?

The first conceptual innovation diffusion model, and a policy game based upon it, will be delivered in 2014. This will then offer unique opportunities by providing insight into the interaction between multiple actors in the field (consumers, government, industry), and by calculating the expectations of the effect of these actors' interventions and actions. We will incorporate this knowledge in the EmInInn EU project, which has the aim of integrating European policy instruments and scientific knowledge on the diffusion of innovations.

6.8 Applied neurosciences

Much has been invested in recent decades worldwide, and certainly also in the Netherlands, concerning the development of fundamental neuroscientific knowledge, and its relationship with psychological functions and behaviour. There are therefore also expectations for the future that this will rapidly translate into many concrete applications, but effort on applying current knowledge and skills must be expedited.



The brain is the basis of psychological processes, such as attention and memory, emotion and motivation, and it controls processes that interact with the brain throughout the body. Neuroscientific knowledge is therefore extremely relevant for cognitive, mental and physical aspects of optimum human functioning and performance. Applied neurosciences may have a major role to play in development in the themes of Defence, Safety and Security (selection, resilience, stress, lifelong learning, medical rehabilitation), Mobility (driver fatigue, high workload of traffic controllers), Healthy Living (later retirement, staying fit into old age, rehabilitation, stress-related attrition, people with chronic illnesses, food choices, brain foods), and Information Society (empowered living and working, serious gaming).

Much relevant advanced neuroscientific knowledge is available in all these areas in the academic world (including in the Netherlands) and applications are possible in which this knowledge can be used for improving existing and developing new products and services.

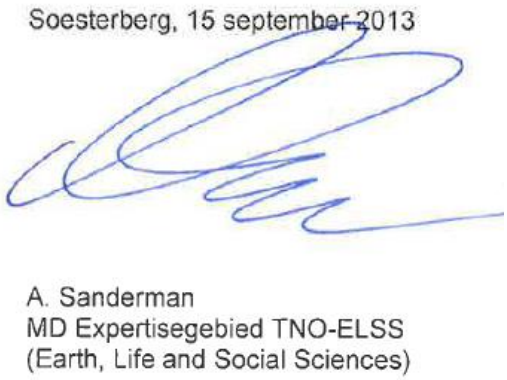
This is about:

- the use of knowledge and technologies for developing and optimizing interventions, interfaces, products, and working methods, oriented in particular to healthy users;
- the development of products and services based on the use of central and peripheral measures and oriented, for example, to increased resilience, more efficient learning, desirable behaviour, combating cognitive obsolescence, evaluating interfaces or services, or improving the quality of life;
- products and services that influence brain functioning directly (pharmacological, electrical, or magnetic) or indirectly (through self-modification, or neurofeedback), and oriented to faster rehabilitation, adaptability and flexibility, return to a balanced situation after a stressful event, faster learning, and the treatment of brain-related diagnoses, such as mild forms of stress, burn-out, and ADHD;
- the scientific validation of applications (which often arise through customer pull) where a certain effectiveness or generic applicability is assumed, for example in the area of neurofeedback.

The feasibility analysis that was started in 2013 into the neurophysiological indicators of learning and food appreciation will be continued in controlled laboratory experiments in 2014. There will be national collaboration on knowledge questions within this project in the Brain and Cognition National Initiative, the i3B Foundation and the ICT Innovation Platform for Brain and Cognition. There are international explorations with an American partner for the joint placement of a trainee research assistant within the US Defense Advanced Research Projects Agency (DARPA).

7 Signature

Soesterberg, 15 September, 2013



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