TNO innovation for life

Industry

De Rondom 1
5612 AP Eindhoven
P.O. Box 6235
5600 HE Eindhoven
The Netherlands

www.tno.nl

T +31 88 866 50 00
F +31 88 866 88 19

TNO report

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Author(s)	Dr. ir. A.F.E. van Veenstra
Authorization	A.J.A. Stokking Managing Director Industry
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Contents

1   VP ICT

1.1   Introduction

This report describes the 2016 update of TNO's 'Speurwerkprogramma 2015-2018: thema ICT'. The 2015-2018 program is based on two Demand Driven Program's, i.e. VP ICT and VP ESI. The latter contributes to the HTSM Embedded Systems Roadmap and therefore the update of VP ESI is included in the 2016 update of TNO's Speurwerkprogramma 2015-2018: thema HTSM'.

TNO also has a long track record in the Creative Industry, most notably in the media sector, and in cross-overs with other sectors. In the last years media analysis, content delivery and business innovation have been important topics of TNO research projects. From 2016 onwards TNO will not continue the Theme Creative Industry. TNO's research projects on Media Analysis and Content Delivery will be carried out within the Demand Driven Program ICT (VP706) and research activities on gaming and user interaction will be continued within other Themes within TNO.

TNO has one of the largest groups of experts working on a wide range of ICT innovations in the Netherlands. This group was boosted with the acquisition of KPN Research in 2003 – at that time the focal point was telecom networks at large, but the relevance of internet technology was growing extremely fast. The merge of telecom, internet and media gave rise to the development of data-driven innovation, internet-of-things, and cross-overs to domains where 'big data' and sensor networks could act as game changers.

1.2   Roadmap ICT

1.2.1   Vision and ambition
Networked information has become the backbone of our economy and society, and one of the main drivers for the transitions that are taking place in domains such as mobility, energy, health, and manufacturing. These transformations create great economic opportunities, and they have great impact on society: the complexity of the 'systems of systems' that emerge requires new roles and skills. Innovations driving these developments include connected systems and devices, reliable and high quality networks, big data and new services. The program's three main ambitions remain to improve these networks, ensure their reliability and collaborate with partners to realize data-driven innovation. A fourth ambition is incorporated from the Theme Creative Industry and is concerned with content delivery and cross-overs. These ambitions are formulated in four research lines.

The **Smart Networking** research line encompasses several aspects of improving networks: the emergence of the *Internet of Things* and machine to machine interaction, *Network Function Virtualization and Software Defined Networking*, and improving *Mobile and Fixed Access* by increasing the agility and quality. Considering TNO's reputation, our Dutch partners in this research line expect TNO to be *on-par* with international thought leaders, and to have concrete insight in their

business-concerns on the mid to long term; our ambition is to meet and exceed these expectations.

Reliable ICT is concerned with the security of digital devices and networks as well as with privacy protection in a hyperconnected world. The value of digital assets continues to increase and (critical) infrastructures increasingly rely on ICT, making secure connections paramount. TNO's ambition regarding *Cybersecurity* is to continuously improve threat and anomaly detection. Now online service provisioning has become the standard, personal data and digital identities need to be carefully treated. For *Privacy and e-Identity* the ambition is to treat privacy as an opportunity for services development together with our partners.

Data-Driven Innovation is shaping all sectors through the increase of (big) data-based services. TNO has the ambition to shape PPPs to develop these services, even though such efforts often take place over a long time period. While the Netherlands can be considered a launching eco-system, a clear international business potential exists. Furthermore, in these developments *Smart Sensing*, concerning the human side of these services, will be taken into account. In TNO's data-driven activities the ambition is to incorporate trends such as the quantified and social self and the quick adoption of wearables to allow for better insights into people's drivers and their behavior to be able to act on it in an effective manner.

Media Analysis and Content Delivery concern innovations in (social) media mining and content item orchestration in order to process large amounts of media data enable the media industry to provide seamless services on and across all devices. TNO's ambition is to maintain and expand its international position in the content delivery domain. On a national level, TNO will do so by involving parties from all parts of the value chain to improve the international position of the Dutch media industry. Furthermore, this program will also stimulate opportunities for the Creative Industry to offer innovative, smart solutions in cross-over domains.

1.2.2 *Interaction and collaboration*

The program portfolio should continually increase TNO's credibility on ICT research, development and innovation. This position enables our principals to act as strategic advisors for business and governmental partners, in the Netherlands, in Brussels, and in Europe. To achieve this, this program aims at Public Private Partnerships connecting business interest and assets, and public stakeholders such as municipalities, TO2 institutes and universities.

Partners in the **Smart Networking** research line are telecom and media service providers (KPN, Proximus, Eircom, TDC, Swisscom, A1, Manx Telecom, EWE, …), infrastructure vendors (Alcatel-Lucent, Ericsson, Huawei, Sckipio), and R&D partners (SURFnet, Fraunhofer, UvA, …). Furthermore, TNO is represented in many standardization fora (ETSI, 3GPP, W3C, …) and at the European level (5GPPP).

In the **Reliable ICT** research line partners are government organizations (Ministries of the Interior and Economic Affairs, NCSC), financial service providers (Rabobank, ING), and R&D partners (IvIR, PI.lab, Fox-IT). These developments will be addressed also in the context of the PI.lab, a collaboration between TNO, TILT,

Radboud University and SIDN. TNO currently holds the position of managing director of the PI.lab.

Ecosystem and PPP building are central to the **Data-Driven Innovation** research line, with a wide range of partners. Domain-agnostic technology partners include SURFsara, SIDN, and TIE Kinetix. Cross-overs require more specific partners such as technology suppliers (dikes: AGT, Siemens, ATOS Origin, IBM; health: Almende, Philips, Noldus, Sense OS; telecom: Thales, Alcatel Lucent, Telecom Italia; cattle management: Nedap, S&S Systems, Sentron), and stakeholders that clearly pose a number of challenging and visionary demands (dikes: Dutch water management authorities; health: municipality of Enschede; cattle improvement: FrieslandCampina, CRV; floriculture: Florecom; vegetable industry: Frugicom). In the field of *Smart Sensing* TNO collaborates with organizations such as Nu.nl, Unilever, Noldus, and Achmea. Regarding *Data-Driven Innovation* TNO is also active on multiple government levels. On EU level the most notable development is the creating of the Big Data Value Association (BDVA). Furthermore, TNO is also active in industry fora such as NESSI. On the national level TNO played a leading role in the composition of the COMMIT2DATA proposal, based on the KIA-ICT, and TNO will intensify cooperation with NWO. At the local level TNO participates in the Big Data Value Center (with the Economic Boards of Almere, Amsterdam, Utrecht, eScience Center).

Within the field of **Media Analysis and Content Delivery**, TNO has a strong international footprint with board positions in international fora (HbbTV, NEM), cooperation in European research projects with EU thought leaders (BBC, Fraunhofer, IRT) and contributions in relevant standardization groups (MPEG, IETF, W3C, HbbTV/OIPF). In the Netherlands, our partners and customers include the NPO, Swisscom, Sanoma, Ministry of Education, Culture and Science, Media Distillery and other SMEs in the creative industries.

The program is well-connected to national and international ecosystems, such as R&D&I programs (FP7/Horizon 2020, EIT ICT Labs, COMMIT, ICT Doorbraakprojecten) and standardization groups or industry fora (ETSI, 3GPP, W3C, HGI, …). Several part-time professors are associated with the program, connecting to relevant Dutch universities (Rijksuniversiteit Groningen, Universiteit Twente, Universiteit van Amsterdam, Technische Universiteit Delft, Radboud Universiteit). Also on board-level and advisory fora, TNO is represented (BVDA, 5GPPP, Operational Team ICT Topsector HTSM, ECP, EIT ICT Labs, PI.lab, DG CONNECT Advisory Forum).

1.2.3   *Dynamics*

In the **Smart Networking** research line we are a European centre of excellence in the area of xDSL technology and further develops *Fixed Access*. Furthermore, the program influences the 5G landscape and 5G ecosystem in the Netherlands and Europe regarding *Mobile Access*. The 5G standard is expected to encompass *Internet of Things* and M2M connectivity and thereby provide a comprehensive standard for future connectivity. TNO actively helps shaping the 5G standard through its association in the 5GPPP board. *Software Defined Networking (SDN) or Network Function Virtualization (NFV)* can provide an extremely powerful concept to increase robustness, but also increases flexibility and thus improve business case

when demand is uncertain or highly irregular. *In Home* connectivity brings challenges related to fixed and mobile access together and addresses them in a specific environment. In close cooperation with TNO's ICT cluster we are setting up a facility named Operator 3.0, which will allow us to experiment with future network technologies.

With so many vital applications across one network, **Reliable ICT** is of key importance. Regarding *Cybersecurity*, the program focuses on targeted attack and anomaly detection and on autonomous response to attacks. The Shared Research Program Cybersecurity will continue in 2016 and is expected to attract new partners. Furthermore, networked risk management aspects for cybersecurity will be further developed. In the field of *Privacy and e-Identity* privacy aspects of data-driven innovation will be investigated and together with partners privacy-friendly services will be developed. Frameworks describing identity attributes and the protocols how to authenticate them, how to assign and review rights related to the identity are of key importance when it comes to societal adoption of these new possibilities.

Data-Driven Innovation has seen many initiatives on the EU and on the national level and in many different domains such as agrifood, energy and healthcare. It can thus be seen as an enabler for solutions to societal challenges in these domains. *Social sensing*, provide insights (algorithms) about what people intent, do, feel, think, etc. by combining different sources will be taken into account in these data-driven activities. Incorporating trends such as the quantified and social self and the quick adoption of wearables allows for better insights into people's drivers and their behavior to be able to act on it in an effective manner.

Regarding **Media Analysis and Content Delivery** many and heterogeneous actuators (presentation devices) present challenges for data presentation and orchestration, for instance when immersive media is displayed on multiple screens and when it is a combination of professional and user-generated input. Media have specific requirements beyond those that apply to other types of data such as real-time sync in space and time, and efficient contribution and distribution of potentially massive amounts of data over wired and wireless networks. New developments also include the emergence of scalable, real-time delivery of virtual reality content.

Some dynamics have an impact beyond individual research lines. Firstly, the speed of ICT innovations. Especially in the *Data-Driven Innovation* and *Media Analysis and Content Delivery* research lines the development cycle does not follow the traditional TRL's (technology readiness levels). Rather, to gain market share beta versions of services and software are launched. As a result, it is expected that cross-overs will emerge, giving rise to a new economy of (start-up) companies that offer interactive services. The rise of this new economy comes with organisational and economic challenges.

Secondly, the transdisciplinary nature of ICT will mean most of the programs involve more than technology alone; e.g. big data applications it is not only about producing a model that fits the data, but also about sense making – this involves domain knowledge and expertise on user interaction. TNO is seen as an organization that is unique in having all these experts in close proximity, such as

policy research, organizational and business expertise and knowledge of user interaction.

The third aspect is the ongoing development of *ICT Standards*. TNO has a long track record in contributing to the development of these standards. The standardization efforts are increasingly presented as an integral part into the program. This includes the development of good domain standards. Furthermore, since interoperability across the chain and the service governance are important and critical success factors. TNO is one of the leading contributors to the widely supported IT-Capability Maturity Framework, that clearly describes the value of investments in IT capabilities; this framework gains attention as it serves as a powerful context to organise the governance in complex service-delivery webs.

Fourthly, the transformational nature of ICT requires domain specific knowledge. This is especially the case for the *Data-Driven Innovation* research line that concerns 'making sense' of multi-sensor data in domains such as dike-management, cattle-health improvement, and gas/water mains monitoring. As a result, the boundaries between ICT and these domains are expected to blur.

1.2.4   *Connection to the innovation contract HTSM and roadmap*
The program's four research lines will contribute to the KIA-ICT of HTSM/ICT, and have clear links with its four research lines 'ICT one can rely on', 'ICT systems for monitoring and control', 'ICT for a connected world' and 'Big Data'. Besides in the Operational Team of the Topsector HTSM/ICT, TNO played a leading role in the composition of the COMMIT2DATA proposal, based on the KIA-ICT. The proposal describes the role of Big Data in four innovative economic sectors: Life, Energy Transition, Smart Industry, and Security. The program further contributes to the Smart Industry agenda within the Topsector HTSM.

1.2.5   *Activities in the PPPs*
The 2016 program has a number of key contributors: (Dutch) PPPs such as enabled by 'TKI toeslag' and budget to stimulate cooperation between TO2 institutes, H2020, EIT ICT Labs, and COMMIT.

More concrete, the program has projects in cooperation with the aforementioned stakeholders on e.g.
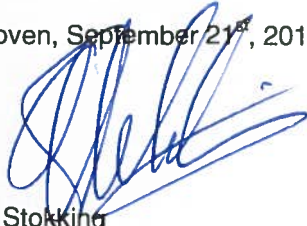- Smart Dairy Farming (in cooperation with the WUR; including TKI toeslag and TO2-budget)
- COMMIT/SWELL – detection of burn out risks for knowledge workers based on analysis of human sensor data
- SRP Cybersecurity
- 5G Pilot program Loppersum (KPN, Ericsson, Huawei)
- Amsterdam ArenA Innovation Center (media technologies)
- Amsterdam Almere Metropolitan Region, with a focus on health, data and circular economy
- Smart Industry (creating and contributing to regional field labs)

Many of the PPPs are regionally embedded, and it is also at this level that TNO's leadership is present (e.g. Groningen/Drenthe, Noordvleugel, Brabant, The Hague Security Delta).

2 Signature

Eindhoven, September 21st, 2015   TNO

A.J.A. Stokking
Managing Director Industry