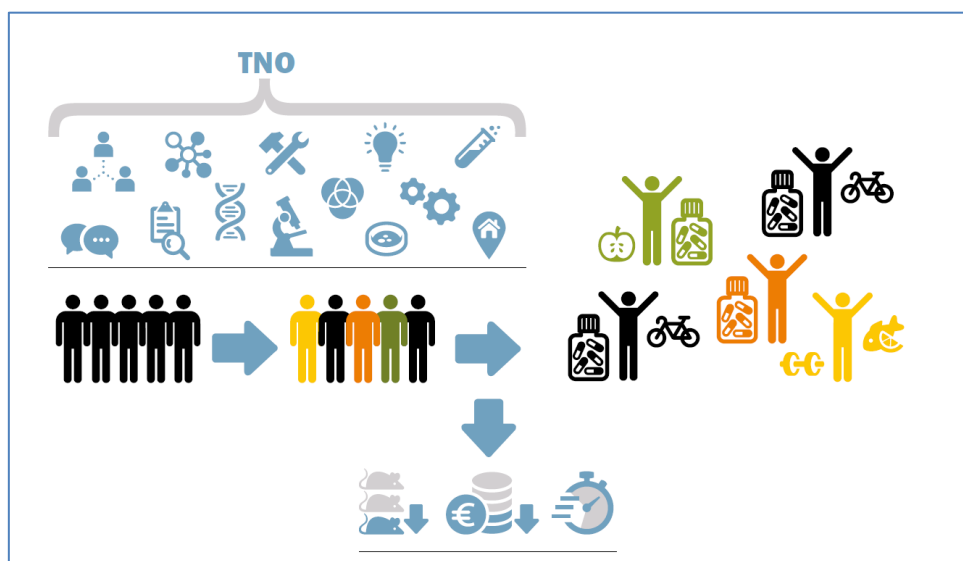


Titel	Biomedical Health (P203)
Missie/ Topsector	Topsector Life Sciences and Health
Contactpersonen TNO	Ivana Bobeldijk
Contact Extern	Nico van Meeteren (Topsector LSH)
Programma jaar 2020 - Samenvatting	
<p>BMH supports the Mission driven Innovation approach of Topsector Life Sciences & Health ('LSH') and the Dutch Ministry of Health, Wellbeing and Sports ('VWS'). – <i>the central mission aiming for Dutch citizens living 5 year longer in good health and reducing the health differences between the higher and lower social classes.</i> More specifically we will contribute to: <i>reducing health issues that are a consequence of unhealthy lifestyle or exposure to unhealthy environment (Mission I), and we will also help to prevent chronic diseases and increase the proportion of people with a chronic illness or lifelong disability who can participate in society as desired (Mission III).</i></p> <p>We aim to achieve this by developing new technologies for efficient drug development, thus enabling faster access to the right drugs for the chronically ill, and by developing knowledge on mechanisms of metabolic and immune health diseases and use those to develop and help citizens to adopt tailored lifestyle changes that will help them maintain or restore their metabolic and immune health. The new technologies and knowledge will be implemented in collaborations with academic and industrial partners as well as health professionals in field labs.</p> <p>By 2023 we want to have achieved the following:</p> <p><i>Enable lower attrition rates and more efficient development of innovative drugs and other health intervention development:</i></p> <ol style="list-style-type: none"> 1. Demonstrate in practice that current pre-clinical trajectories can be improved (reducing costs, time and animal use) when new approaches and technologies are employed (Mission III) 2. Demonstrate that smaller clinical trials for a novel therapy can be achieved by targeting the right patient population through novel tools for stratification (Mission III) 3. Demonstrate that determination of accurate dose of new drugs for young children can be determined directly in children, using advanced (safe) microtracer approaches (Mission III) 4. Demonstrate that a fairer pricing of innovative medicine is possible by applying the right technology and integrated discussions with pharmaceutical industry and public stakeholders. <p><i>Help improve metabolic and immune health:</i></p> <ol style="list-style-type: none"> 5. Demonstrate metabolic and immune health improvement by (combination of) food, lifestyle or medication therapy in stratified groups of patients; right drug and intervention for the right patient (Central Mission, Mission I and III) 6. Prove that tailored interventions contribute to vitality of the citizens as well as the quality of health care and cost management (Central Mission, Mission III) 7. Demonstrate that tailored interventions for the lower SES are more effective in improving healthy lifestyle than one size fits all interventions (Central Mission) 	



To progress towards these above goals, in 2020 we will:

- Establish position of TNO as one of the opinion leaders and facilitators of discussions on fairer pricing of innovative medicines in NL, achieved by publication of a position paper and active participation in strategic discussions with public and industrial stakeholder representatives
- Develop advanced microtracer techniques that will help to personalize drug dosing in young children.
- Develop in-silico methods that enable better and faster choices of the right targets for drug development.
- Continue the co-development of animal free tests for drug development, such as advanced in-vitro and ex-vivo techniques
- Continue the development of an immune flexibility test, based on dynamic biomarkers and host-microbe interactions, which will help companies to measure the effect of their immune health interventions in prevention and cure of chronic inflammation.
- Develop a blood test for early detection and prediction of NASH /fibrosis in humans, as an alternative for liver biopsy.
- Evaluate, together with care providers, the 360° tool for diagnosis in which various aspects of health and vitality are integrated (metabolic health, mental health, socio-economic environment, activity); the tool is designed to help define personalized approaches in prevention, cure and care for different SES groups in the society.
- Develop new strategies to detect, prevent and reverse inflammation (in infants and adults), one of the main underlying processes in chronic illness.
- Generate a first assessment of gender differences in muscle health deterioration (with age) that can serve as basis for personalized intervention development

Korte beschrijving

The global healthcare industry grapples with an unsustainable cost trajectory. Most economies face increased demand for healthcare services by an expanding population of consumer/patients and by growth in costly chronic disease management. Furthermore, high attrition rates in drug development contribute to expensive medication and to higher health care costs. Innovations in several areas may offer solid solutions for structurally improving the drug development process, for increasing the quality of care and population health while containing costs.

Our program is founded with the firm believe that through development and application of advanced tools and technologies and knowledge on models and mechanisms of disease (onset) in metabolic and immune health, we can enable more efficient development of personalized treatments for prevention of these diseases, delay or cure the onset of (chronic) diseases and thus reduce healthcare costs. In personalized treatments, we recognize that every individual is unique, not only with respect to their physiological and genetic background, but also related to their mental status and social context.

In the last years we have shown that we are an active contributor to innovation in the healthcare in collaboration other knowledge institutes, industry and government bodies. In 2020-2023, through specific regional collaborators (area of the Hague, also including citizens with a low socio-economic status) we plan to strengthen the active participation of patients and citizens in improvements of their health.

Goals for 2023

The overall goal of this program is to help professionals and industry to efficiently develop (personalized) treatments to maintain health and wellbeing and to prevent or cure diseases with main focus on metabolic and immune health. In addition we aim to help professionals to bring the developed approaches in prevention and cure directly to the citizens that need them, through field labs.

The knowledge we develop together with partners will enable earlier detection of metabolic and immune diseases, help their prevention and also improve the efficacy of their (drug) treatment. The novel tools and technologies developed by TNO and partners will also contribute to efficient drug development, lower the attrition rates and help to achieve a more efficient clinical study design and thus help to bring the right drugs to the right patient faster.

More specifically we will:

Enable lower attrition rates and more efficient development of innovative drugs and other health intervention development:

1. Development of translational and better predictive models (in-vitro, ex-vivo, in-vivo, in-silico), by development of advanced measurement methods, and by increasing the information density of early clinical trials, enable first in man studies much earlier in the development (Personalized medicine, LSH Mission III)
2. Development of advanced in-silico tools for risk and safety assessment of targets and treatments as well as assessment of biomarker efficacy (LSH Mission III)

Help improve metabolic and immune health by:

3. Better understanding of metabolic and immune health and disease mechanisms, thus enabling the development of better predictive models and improved diagnostics (Mission III)
4. Identification and validation of (novel) translational biomarkers for early detection and better stratification of the medical status, combination of blood biomarkers with multimodal parameters for a personalized analysis of metabolic and immune disease including complications (Mission III)
5. (co-)Development and (co-)implementation of tailored (lifestyle) intervention strategies for improvement and maintenance of metabolic and immune health in different communities, based on advanced biomarkers and health assessment tools including multimodal aspects of health (Central Mission, Mission I and Mission III)

Tools and models for efficient innovative drug and other intervention development

Within this research line we will *address the need for better predictive, translational models and tools for efficient drug and other intervention development*. We will focus on development of validated, highly predictive translational models (in-vitro, ex-vivo, in-vivo and in-silico) that assess the efficacy, kinetics and toxicity of various interventions (drugs, foods, lifestyle) in humans, applicable in the entire product development trajectory. We will contribute to innovations towards animal free testing (e.g. 'organs-on-a-chip', candidate selection directly in humans using microdosing and AMS). We develop tools and models that predict biological outcomes of the modulation of a biological process or protein target in-silico (risk assessment) and better mimic (personalized aspects of) physiological and disease processes in humans. The development of the tools and models is based on *better understanding of the mechanisms of onset* of inflammation, metabolic and immune health dysregulation (*including chronic complications*). Data mining tools and systems biology approaches will be developed for *identification and risk assessment of targets and identification and efficacy assessments of treatments and biomarkers*.

Improvement of metabolic and immune health through personalized interventions

Within this research line we will focus on *identification of (dynamic) biomarkers for early detection of metabolic & immune disease and corresponding (chronic) health complications, identifications of new targets for treatment of metabolic and immune disease*. Systems biology methods will be used to identify biomarkers based on genes, proteins, metabolites, specific

microbiome compositions or specific lifestyle aspects. The biomarkers can be used for *stratification of patients in clinical trials* and for development and implementation of personalized intervention strategies. A logical follow-on application for patient profiles and biomarkers is the ability to provide health care professionals with concrete advices on what preventive measures or therapeutic interventions fit best with the biological profile of their patient. We aim to have these advices laid down in standards of care for the various diseases.

We will develop personalized interventions for maintenance and improvement of metabolic & immune health and well-being. We will help to implement personalized and stratified interventions in specific target groups, children (immune and metabolic health and pediatric microdosing), (chronically ill) adults (immune and metabolic health) and (pre)obese persons, (immune and metabolic health) and elderly (metabolic decline of skeletal muscle with age), but also cancer patients which might benefit from metabolic and immune health improvement. This line is closely connected to TNO’s research program Digital Health Technologies.

Resultaten 2020

We have a strong position in bringing together parties from different industrial sectors (pharma, nutrition, diagnostics, retailers) and develop PPP projects with several industrial partners. In 2020, we will continue to expand our activities in public-private partnerships and shared research program(s) in which we will (co) develop the technologies and knowledge necessary to achieve the set program goals.

To align with the KIA missions, even more than in the past years we will focus on development of PPP projects that will test and implement the developed technologies in field labs.

selection of (planned) collaborations	2018	2019	2020	2021	2022	2023	2024	contribution to program BMH goals	main deliverable	Roadmap LSH	Mission LSH
	2018	2019	2020	2021	2022	2023	2024				
Tools, models for efficient drug development											
SRP Food allergy and immune health								2,5	immune health risk assesment tools	7	III
PPP Ex-Vivo models as an alternative for animal testing								1,3	better translational models	5	III
PPP Animal free drug development								1,3	better translational models	5	III
PPP in silico target discovery tools safety								1	animal free pre-clinical tools	5	III
PPP in silico target discovery tools efficacy								1	animal free pre-clinical tools	5	III
PPP microtracers in Antibody drug conjugates for cancer								1	advanced analytical tools	5	III
PPP microtracers in Pediatric drug dosing								1	advanced analytical tools	5	III
PPP Organ on a chip models for vaccine development									tools for intervention development,	5	I, III
PPP Anti-Clostridium								1,4	tools for intervention development	7,6	I, III
Metabolic and immune health improvement											
PPP NASH Biomarkers								3	metabolic health biomarkers, NASH	1	III
PPP Phenflex 2, phenotypic flexibility in prevention								3,5	novel biomarkers metabolic health	3,8	C, I
PPP Microbes and immune health								3,5	biomarkers and targets immune health	7	III
PPP Muscle health and gender differences								1,3,4	mechanisms and translational models	7	III
PPP 360 Diagnosis								4,5	tailored interventions metabolic health	7,8	C, I, III
PPP Personalised nutrition in cure								1,3,5	tailored interventions metabolic health	7	III
PPP Pro Liver, targets for NASH treatment								1,3,4	insight in mechanisms metabolic health	1,5	III
PPP Identification of dietary factors in inflammatory diseases								3,4,5	insight in mechanisms, immune health	1,5	C, I, III
PPP Global, Organ cross talk in metabolic health improvement								1,3,4	mechanisms and translational models	1,8	C, III

■ PPP just signed and started
■ PPP planned
■ PPP already in execution
■ PPP in preparation/submitted
■ PPP extended with RQ and/or partners

Figure 1: Selection of current and planned PPP collaborations and their contribution to the Biomedical Health research program goals and the roadmaps and missions of Topsector LSH. BMH program goals: (1) Development of translational and better predictive models and measurement methods, (2) Development of advanced in-silico tools for drug discovery, (3) Better understanding of disease mechanisms, (4) Identification and validation of (novel) translational biomarkers, (5) (co-)Development and (co-)implementation of tailored intervention strategies for improvement of metabolic and immune health. LSH roadmaps: (1) Molecular Diagnostics, (3) Homecare and self-management, (5) Pharmacotherapy, (6) One Health, (7) Specialised Nutrition, health and disease, (8) Health technology, assessment, individual functioning and quality of life. Missions: C, Central Mission, I reduction of negative effects of lifestyle and environment, III (Enabling increased participation in the society of the chronically ill).

In figure 1 several examples of existing and planned public-private collaborations that are planned to start in 2020 are shown, as well as their contribution to the program goals and the LSH mission-driven innovation. In the course of 2020, new ideas/technology needs will be identified that will be used for the setup of new collaborations. The activities within these PPP's will lead to achievement of several knowledge and technology deliverables. Each PPS contributes to one or more program goals. The table also indicates the LSH roadmaps to which the newly developed knowledge and technology will contribute.

The knowledge and technology developed within this program will also contribute to developing PPP collaborations in the area of Do-it-yourself measurements, eg. smart toothbrush, smart incubator. These PPP projects will be a collaboration between Biomedical Health, Digital Health Technologies, Child Health and Semiconductor equipment.

Program line tools and models for efficient drug and other intervention development

- Demonstrator microdosing in pediatrics with FDA (BMH goal 1).
- Improved in-vivo and in-vitro translational models for NASH/fibrosis (BMH goals 1 & 3).
- (Semi-) automated in-silico platform for drug and biomarker discovery (BMH goal 2).
- Proof of concept of ex-vivo perfused human liver model as an alternative for animal experiments for application in pharmaceutical industry (BMH goals 1 and 3).
- 3D liver-function (NASH/Fibrosis) model on a chip, validation with model drugs (BMH goals 1 & 3).
- Human intestine model on a chip combined with microbiome, collaboration with early research program Organ-function-on-a-Chip (BMH goals 1 and 3).
- Personalized iScreen: in-vitro microbiome modulation model, for healthy and diseased (IBD) microbiome (BMH goals 1 and 5).
- Blood test for circulating biomarkers for early detection of liver fibrosis in patients (BMH goals 3 and 4).
- Protocol for application of microdosing techniques for studies on Antibody drug conjugates to identify (toxic) metabolites (BMH goal 1).
- Platform for functional microbiome analysis (BMH goals 1 and 3).
- Relevant biomarker analysis methods enabling analysis of low sample volumes, applicable in child cohorts. (BMH goal 1).
- Established position of TNO as one of the opinion leaders and facilitators of discussions on fairer pricing of innovative medicines in NL, achieved by publication of a position paper and active participation in strategic discussions with public and industrial stakeholder representatives.

Program line Improvement of metabolic and immune health

- Protocol for metabolic health improvement interventions as a support to increase the efficacy of standard drug treatments for e.g. gut cancer (BMH goals 4 and 5, in collaboration with early research program Personalized Nutrition).
- First demonstrator assessment of immune health risks based on food consumption and food composition databases (BMH goal 2).

- Evaluation of the 360o tool, which integrates multimodal data (from different domains, amongst others socioeconomic status) in addition to plasma bio markers, tested in collaboration with caretakers in a (BMH goals 4 and 5).
- Automated tool to generate personalized health reports (BMH goal 5, in collaboration with VP Digital Health Technologies).
- First assessment of gender differences in (deterioration of) muscle health based on which gender specific interventions can be developed for elderly or chronically ill (BMH goal 3)
- A novel protocol for the simultaneous assessment of caloric value and metabolic fate of oligosaccharides by mass balance determination that can be used to more accurately label new products (BMH goals 1 and 5)
- Description of user requirements for optical sensors to monitor health status, stress and other triggers of (chronic) inflammation in infants (BMH goals 4 and 5)
- Method for detection of early metabolic dysfunction in young children that might lead to development of obesity at a later age, collaboration with VP Child Health (BMH goals 4 and 5)

Internal collaboration:

Several of the deliverables listed above will be realized in close collaboration with TNO early research programs and development, testing and in the future also implementation of deliverables related to empowerment of patients and citizens will be done together with research program Digital Health and those focused on young children will be developed and implemented together with research program Child Health (part of Prevention, work and Health).

In order to achieve the set goals we will develop new interventions, knowledge, tools and technology in two program lines which will be interacting with other research programs and TNO early research programs, shown in figure 2.

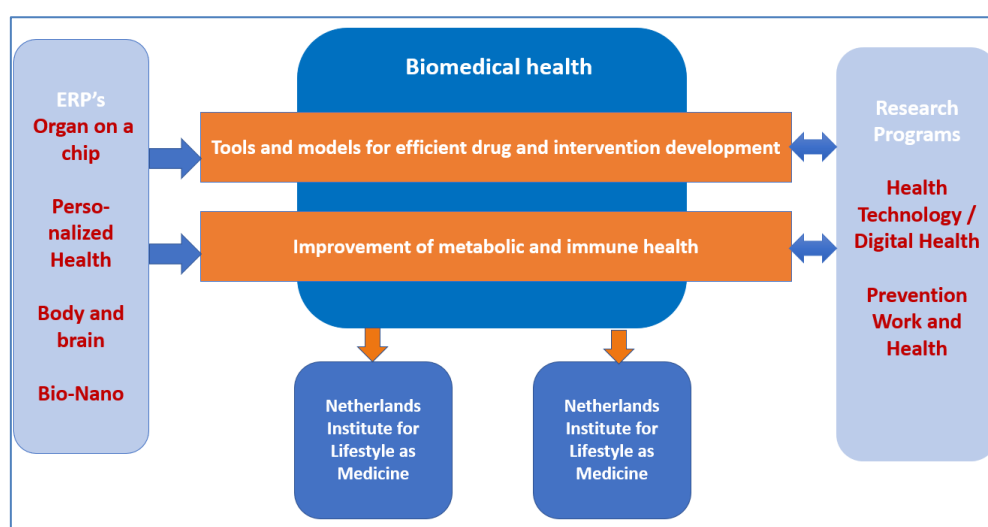


Figure 2: Program lines of research program Biomedical Health. Connection to three early research programs (Organ on a Chip, Personalized Health, Body and Brain, Bio-Nano) and strong collaboration with research program Digital Health Technologies, and Prevention, Work and Health. In 2020 Biomedical Health is supporting 2 shared research programs (the National Institute for Lifestyle as Medicine, SRP Food Allergy and Immune Health)

This program will only be successful if we succeed in realizing further (project based) collaboration with the experts also from other Units within TNO, specifically from:

Unit Industry: Optics, Holst Center, Nano-instrumentation, Materials and Solutions for Organs on chips technologies for development of novel materials that will be used in better translational in-vitro and ex-vivo models. In collaboration with these

departments, also new readouts for use in combination with in-vivo translational models are explored (ERP Bio Nano). For detection of low-grade inflammation, collaboration is needed with the Optics group to develop advanced sensors.

Unit Defense, Safety & Security: Distributed Sensor Systems, Human Behavior and Organizational, Innovations Training & Performance Innovations, Modeling, Simulation & Gaming, for knowledge and approaches in personalized interventions.

In many cases collaboration has already been realized, through collaborative projects and early research program 'Personalized Health', early research program 'Organ-function-on-a-Chip', and Seed early research program 'Body and Brain'.

External collaborations and connections.

This program is directly connected to the mission, ambition and objectives of topsector LSH (Knowledge and Innovation Agenda 2020-2023 (see section 1.3). The results of this program will directly contribute to the tackling of the societal challenge: vital citizen in a well-functioning economy.

Our PPP projects will continue their contribution to the roadmaps of Topsector LSH:

1. Molecular Diagnostics
3. Homecare and self-management
5. Pharmacotherapy
6. One Health
7. Specialized Nutrition, Health and Disease
8. Health technology assessment, individual functioning and Quality of Life

The program is linked to the following NWA routes:

- NWA route Personalized Medicine
- NWA Gezondheidszorgonderzoek, preventie en behandeling
- NWA route Kwaliteit van de omgeving
- NWA route Regenerative medicine

Examples of operational strategic PPP collaborations that are supported by LSH include:

Personalised Nutrition & Health: the ultimate goal of the consortium is to enhance the health and wellbeing of society by empowering consumers to choose and maintain an optimal personalized diet & lifestyle.

Netherlands Institute for Lifestyle as Medicine this collaboration with TNO and LUMC in the lead aims at reversing or curing lifestyle related diseases by changing lifestyle. The initial focus is on type 2 diabetes with the aim to cure this disease within 10 years..

With the technology and knowledge (to be) developed with will effectively contribute to the mission driven innovation as described in the Knowledge and Innovation agenda of LSH and supported by the *Ministry of Health, Wellbeing and Sports, Health and Care*.

This program also has a number of strategic collaborations with academia, such as University Medical Center Utrecht in the area of immune and metabolic health, Wageningen University and LUMC in the area of metabolic health and physiology, ACTA metabolic and dental health, University of Nijmegen for links between metabolic health and healthy brain development as well as pediatric research. We are setting up a collaboration with University of Maastricht in the area of liver health and advanced molecular readouts, VUMC for microtracers and PET imaging. In addition to academia we also have strategic collaboration with several companies that are often partners in PPP projects, such as BioFortis, PRA, CHDR (Human studies) and Nordic Biosciences (biomarker measurements).

We participated in several consortia applying for NWA funding in 2019 and will be participating in the projects, depending on the outcome.

Apart from being linked to the Knowledge Agendas of topsector LSH, this program also links to hDMT (a strategic PPS, national initiative in the area of organ-on-chip technologies, TNO became partner in 2016), has good connections with policy makers at ZonMw. We align with *One Health, Humane Meettechnieken (3/4V)* and Animal free innovations and are currently strengthening our links to the *European Medicine Agency (EMA)*. We will also align and participate in the PPS in development, FAsT (Affordable Future Therapies). We work together with several patient organizations and foundations, such as MLDS, Diabetes Foundation.

Dynamiek

The recent decision-making on the Dutch Food Institute has important implications for the collaborations and expertise in the roadmap Food & Nutrition. The program High Quality Products left to DFI, Food Safety (Food allergy) and Healthy Food became part Biomedical health as of 2018 and jointly defines the current focus on metabolic and immune health. TNO will continue research on health-related nutrition issues.

E-health, digital health and medical devices (collaboration with the Van 't Hoff program) have shifted from the roadmap Biomedical Health to Digital Health Technologies in 2018. The collaboration between Biomedical Health and Digital Health Technologies is very strong and the programming of the two research areas is coordinated.

We steer the knowledge development within this program based on societal needs and changes. As of 2018 we collaborate with LUMC and co-fund projects that are part of the Netherlands Innovation Center for Lifestyle as Medicine.

For efficient drug development, we believe that the use of the right innovations in the private sector and joining forces in the public & private sector, innovative medicines will become available to patients faster and the (high) development costs and prices of new medicines can be more contained. We will actively participate in the discussions with industrial and public stakeholders. In Leiden Bioscience park we are building new laboratories with advanced unique technology Accelerator Mass Spectrometer (as of 2020 two instruments available) to meet the high demand of our pharma and biotech partners.

We will further align our technology development with the needs of pharma industry by connections to HollandBio, EMA and EATRIS. In 2020 we will actively interact with VWS and other public bodies in the discussions on affordable medicines.

Titel	Digital Health Technologies (P210)
Missie/ Topsector	Topsector Life Sciences and Health
Contactpersonen TNO	Jildau Bouwman
Contact extern	Nico van Meeteren (Topsector LSH)

Programma jaar 2020 - Samenvatting

The world around is digitalizing, this also holds true for health care. People gather masses of health data using apps that record their pulse rate, daily activity, diet, etc. It is not only members of the public who are interested in this data, it is also valuable to scientists. Such Real World Evidence data together with standardized health data have the ability to create new models and improve existing models and software applications that provide health and medical advice. Based on these models personalized health advice tools can assist both patients and healthy individuals, by offering guidance about their health and lifestyle and prevent disease. This program supports the Mission driven Innovation approach of Topsector Life Sciences & Health ('LSH') and the Dutch Ministry of Health, Wellbeing and Sports ('VWS'). – *the central mission aiming for Dutch citizens living 5 year longer in good health and reducing the health differences between the higher and lower social classes*. More specifically we will contribute to: *reducing health issues that are a consequence of unhealthy lifestyle or exposure to unhealthy environment* (Mission I), and we will also *help to prevent chronic diseases and increase the proportion of people with a chronic illness or lifelong disability who can participate in society as desired* (Mission III).

The research program Digital Health Technologies (“DHT”), together with partners outside TNO (including several SMEs), takes up this approach bringing together new medical knowledge, data and information technology services and solutions as well as knowledge about lifestyle change and behavior. As the whole system is directly connected to individuals by design, citizens can also specify their needs. Health and healthcare can benefit from the secure registration of personal data from birth to death, and from its subsequent use in providing personal support or advice, as well as in predictive models. The developed systems can be used by medtech companies and by data brokers that want to use health data in a system that is private-by-design.



The goal of this 2020 program is to contribute to the implementation and operation of innovative digital health interventions and bring together three focus area's –Healthy Youth, Sustainable Employability and Metabolic Health– to maintain health over one's personal life span. The program will develop knowledge, (ICT-) solutions, facilities and services to apply in the focus area's in three program lines with the following deliverables for 2020:

SENSE: Starting the initiative around the child personal health train (together with VP Child and BMH), working towards new digital biomarkers for health (together with VP BMH) and test eHealth and mHealth applications together with partners.

REASON: Hybrid models from data science department implemented in health domain (results are relevant for VP BMH). Documentation of models is transparent throughout TNO healthy living.

ACT: Personalized nutrition advice (together with VP BMH) implemented in software of partners.

Korte beschrijving

Our society faces tremendous challenges in health care due to an aging population, an increased amount of chronic/lifestyle diseases and a rapidly rising shortage in staff . One of the most important challenges in the coming years for health care in the Netherlands is to create and maintain an effective, high quality and financially sustainable healthcare. It is crucial to improve all three components (quality, access and costs) at the same time .

An important step towards this goal is to enable and support people in making healthy choices and pursuing a healthy lifestyle. This requires first of all in-depth knowledge of biomedical and behavioral aspects of (improving) health. With this knowledge validated and reliable predictive models for health and disease can be developed, as well as personalized interventions to improve health and maintain a healthy lifestyle, at home and at work. Next, these interventions have to be delivered to people by providing personalized advice, monitoring effects and effectiveness of the changes in a person's life and lifestyle and giving feedback to support sustainable behavioral change (personalized health).

To enable the aforementioned steps we need to integrate health technologies and data science technologies with in-depth knowledge of biomedical and behavioral aspects. This raises numerous issues, from dealing with big data to secure privacy and data, from seamless monitoring to interaction design for small smartphone screens, from legal issues to viable business models for all value adding parties and much more. It requires a truly integrated and multidisciplinary approach to solve these issues and deliver effective digital tools for a healthy life and related research.

The research program Digital Health Technologies, together with partners inside and outside TNO, takes up this approach bringing together new medical knowledge, data and information technology services and solutions and knowledge about exposure, lifestyle change and behavior. New insights from youth healthcare, the sustainable employability of employees, exposure science, biomedical research are combined with health technology and big data technologies, so that data from cradle to grave come together. This program is directly connected to the mission, ambition and objectives of the topsector Life Sciences & Health (Knowledge and Innovation Agenda 2018-2021), is linked to the Knowledge Agenda of the Societal Theme 'Work and Health' and is linked to the following NWA routes:

- NWA Op weg naar een Veerkrachtige Samenleving
- NWA Waardecreatie door verantwoorde toegang tot en gebruik van big data
- NWA Jeugd in ontwikkeling
- NWA NeurolabNL

Goals for 2023

The goal of the program is to contribute to the implementation and operation of innovative digital health interventions in three focus area's -Healthy Youth, Sustainable Employability and Metabolic Health- by developing knowledge, (ICT) solutions, facilities and services and is structured in the following three program lines:

1. *Sense*: optimal and innovative ways of measuring, sensing and data collection in the health and labor domain.
Goal: seamless, (non-) invasive 3 measuring, monitoring and collecting data, compliant with privacy and security demands for knowledge application, validation and follow-up research (Mission I).
2. *Reason*: transform knowledge and research outcomes into digital models, applications and advice and process the necessary big and personal data.
Goal: transform data into knowledge and advice (Mission I and III).
3. *Act*: digital resources (tools, methods) for giving feedback, supporting behavioral change and monitoring, focused on end user empowerment and shared decision making with a professional.
Goal: empowerment of individuals by providing data-based feedback and advise (Mission I and III).

The development of these innovations takes place in close collaboration with the experts in the focus area's in order to maximize the chance of successful implementation, and also recognizing the importance of knowledge about the conditions for operational and commercial success. In this respect this program is supporting and enabling TNO programs with regard to Healthy Youth, Sustainable Employability and Metabolic Health domains. Our aim is to be the digital knowledge and information provider for JGZ (youth health care services), sustainable employability and metabolic health.

Resultaten 2020

SENSE

Research and development in this program line is aimed at innovations for measuring, sensing and data collection in the health and labour domain. Goal: seamless, (non-)invasive measuring, monitoring and collecting data, compliant with privacy, data ownership and security demands for knowledge application, validation and follow-up research.

Main research / innovation questions:

- How can digital biomarkers and real world evidence data improve health care?
- Which digital biomarkers serve as proxy for health outcomes or for health relevant processes?

- Which Real World Evidence data is relevant to improve health advice models?
- Which (existing or new) sensors provide reliable, (semi continuous) measurements relevant for health outcomes (or processes)
- How do we store these health data (? How do we connect the data stores?)
- How to implement privacy, data ownership, and security measures (privacy ownership by design)?
- How should we store health and health related data in terms of privacy, ownership and security?

Technology / knowledge required:

- Composite & digital biomarker development
- Sensors & sensing methods/ development
- Sensor/sensing search & selection
- Data platform
- Communication framework
- Ontologies
- Data safety solutions

Results 2020:

- Two PPS project proposals for gateways for exchange of data in the preventive health area and youth community (together with VP Child) in collaboration with public and private partners (including citizen centered initiatives as NLzorgtvoorelkaar and SamenBeter to build virtual Grozterdam-solutions). These projects will deliver in the fundamentals (the standardization and functional design) of the Preventive and Youth Personal Health train.
- With the DHT Hackathon 2020 we will build further on the network of biological data experts. Use cases that will be worked on will include questions like: 'How can we bring together data from the different youth health providers' and 'What is the relation between exposure to particulate matter and metabolic health (connecting the early research programs Exposense and Personalised Health)'.
- Improved data sharing and reuse of data in the food and nutrition community by active participation in Food, Nutrition and Health-RI, JPI HDHL, HealthRI and ELIXIR. We will start the Food and Nutrition community within ELIXIR.
- In 2019 a project proposal was send in on the Personal health train in the NWA call. In this project TNO will bring in its expertise on secure data sharing and preventive & personalized advice systems. Also, another NWA proposal looks at using personal health data in a care setting (NutriDutch+).
- A Health Data Cooperative (governance and facilities) where people can execute their property and management rights on their own personal and health data will be implemented and used in a human study (diabetes challenge) in the PPS project HDC. In addition, the privacy dashboard will be developed in the related PPS, this dashboard will help customers in checking the privacy level of their environment.
- Several PPS project proposals (2 or 3) were we will co-develop Do-It-Yourself (DIY) measurements based on the needs from our commercial partners and in line with the goals in the roadmap (e.g. a smart toothbrush, a smart incubator) (together with BMH and Child). These projects will deliver tools to quantify human health.

REASON

This WP aims at the processing of big (health) data and personal (health) data and to combine this with domain expert knowledge and in order to transform it into A.I. (advice) models. Goal: Combine knowledge and data and transform it into diagnostics, interventions and knowledge leading to personalized advice and behavioral change.

Main research / innovation questions:

- What are the requirements/limitations/challenges for building a decision support systems based on explainable artificial intelligence?

- Can we build a (data driven, hybrid model) that quantifies health based on non-invasive acquired data?
- How can we improve our Bayesian nutritional advice models for disease?.
- How do we create A.I. models without a central data repository (How to create responsible AI models?), e.g. using federated learning or multi-party computation
- How can we optimally integrate publicly available data to get the best insight into the safety and efficacy of new drug targets?

Technology / knowledge required:

- Data processing (encrypted data; decentral analysis; safe exchange and storage)
- Integration of sensor data with advanced data-assimilation techniques
- Interoperability and standardization
- Statistical Analysis Tools
- Visualization
- Data interpretation: generic platforms for knowledge model/algorithms and biological interpretation
- Biological interpretation: finding meaning and causality: Hybrid models (together with ERP AI)
- Simulation models
- Contextualization
- Self-learning and predictive analytics
- Client/patient profiling. Data security/privacy: governance of health data

Results 2020:

- An updated health space model with hybrid modeling techniques. Innovative modeling techniques, including distributed learning and hybrid modeling, will be implemented in several (commercial) projects. This will be done in interaction with early research programs Personalised Health and AI.
- Improved health diagnostic and advice by combination of data from the different domains, to (e.g. what is the benefit for employers if they stimulate health advice for their employees) (together with VP BMH and VP Labour).
- Improved Do-It-Yourself (DIY) measurements by improving algorithms behind (in specific PPS projects).
- An overview of health modeling in the APPL.AI initiative (a website that shows the overview of the modeling tools developed with TNO).

ACT

This WP aims at digital resources (tools, methods) for giving feedback, supporting behavioral change and monitoring, focused on end-user empowerment and shared decision making with or without a professional. Goal: empowerment of individuals and healthcare professionals by providing data-based feedback and advice and the digital tools therefor.

Main research / innovation questions:

- How can we use ICT (feedback, monitoring, information supply etc.) to support personalized life style interventions?
- How can we create a digital twin that helps reaching particular health goals?
- How to improve the Onboarding process for life style advice systems (digital persuasion)How do we keep people compliant with eHealth applications (predict risk of stopping; offer interventions to prevent people from stopping or stimulate restart)?
- What are the right incentives for which group of eHealth users?

Technology / knowledge required:

- Behavior science (including persuasive technologies)
- E-learning (including applied gaming)
- Human-machine interaction
- Personalized design
- Applications for interactions

Results 2020:

- Behavior science knowledge and ontologies developed in the early research program Personalized Health is implemented in this program.
- Extension of the TNO apps (IRIS and Howami app) with TNO's knowledge on biology, physiology and sociology, so that we can deliver wellbeing advice, this will be done together with projects in the other VPs.
- Validated nutritional intake tools to be able to support partners (together with VP BMH).
- Automated tool to generate personalized health reports (VP BMH goal, supported by this VP).

Dynamiek

The DHT program started in 2018, in which digital knowledge from the VP's Biomedical Health, Youth and Sustainable Employability were brought together. We have intensified the interactions between the programs and research groups on the digital agenda. In 2019, the second DHT hackathon was held where data scientists from different groups have worked together closely to get to know each other's expertise, to work towards new ideas and to connect data from different sources. The hackathon led to new collaborations and will be programmed in 2020 again.

Developments in the program were based on the needs of the other VPs within TNO unit Healthy Living and additional opportunities. In 2019 several public/private collaborations were initiated that will result in PPS project proposals in October 2019 and March 2020.

The Prevention agreement (preventie akkoord) was signed in 2019. This collaboration will require a technical backbone. In the PPS PH (this program) and the early research program ExpoSense (VP Sustainable Employability), technically, similar platforms will be developed. This program will actively align the work between this projects.

In 2019 a close collaboration was built with the ICT department of TNO. This broadened the port-folio of this program. It also made it possible to better align with the developments in the ICT Roadmap and the early research program Applied AI, that mainly run within the ICT department, but undertake to develop similar toolsets.

Titel	Human Health RM Nano (P511)
Missie/ Topsector	HTSM
Contactpersonen TNO	Wouter Fransman
Contact extern	Frank de Jong (FEI), Topsector HTSM

Programma jaar 2020 - Samenvatting

As one of the Key Enabling Technologies, nanotechnology has emerged in a broad area of industries and applications. By the time regulators became aware of potential omissions in guidance and guidelines addressing the nanospecific nature of chemical substances and products, products were already on the market. Scientific evidence obtained from research still had to be developed. This lack of timely alignment has formed a crucial hurdle to appropriately govern the risks of nanotechnology. The public currently also remains unsure about nanomaterials/nanotechnology and potential human health risks, while they would benefit greatly from the use of nanomaterials in innovative materials, products and applications. This VP Human Health Risks Nano therefore aims to develop reliable tools, guidance and training for proper risk assessment, risk management and

communication of these risks during and after product innovation to assist industry in their decision making during product innovation.

TNO develops knowledge to assist industries in taking into account the safety of their (nano)product during the innovation of new materials and products. TNO invests in this VP Human Health Nano in the development of innovative tools, guidance and training to support safe innovation and risk governance for innovative SME, sector organizations and industry in the absence of clear guidance and regulations. The activities of VP Human Health Nano in 2020 consist of collaborative work in various H2020 EU projects (Gov4Nano, NanoUptake, PeroCUBE, NMBP-16-2020 Safe-by-design), ZonMW EXPLAIN and will result in the development of various innovative risk assessment models into a toolbox containing: LICARA nanoSCAN, Guidenano Tool, SUN Decision Support System, caLIBRAte system-of-systems, NanoSafer, Stoffenmanager Nano, and the Future nano Needs Bayesian belief network. Further results in 2020 are the development of Safe-by-Design (SbD) and Safe Innovation principles and linkage to the regulatory process. Through the participation of TNO, also the Dutch Nanocentre (www.nanocentre.nl) will be connected in 2020 to the European EC4SafeNano initiative, as an international nanosafety platform. For future and emerging technologies such as nanotechnology, clear communication about the state of the art, knowledge, concepts about risk perception, transparency about dealing with uncertainties is of utmost importance and help to influence the risk perception of the public regarding nanomaterials, increase their market value and help companies in anticipating potentially conservative regulations. TNO's work in 2020 will result in clear conclusions and communication on nanomaterial health risks for the commercial success of nanomaterial innovative research and implementation in Europe.

Korte beschrijving

Large expectations surround the potential for manufactured nanomaterials to be key elements in the development of innovative materials, products and applications. Manufactured nanomaterials are already produced in large amounts and it is expected that in the next decades numerous new nanoproducts will enter the market every year. For companies it is important to produce sustainable products and comply with regulations. In order to overcome regulatory difficulties and negative market perception on nanomaterial human health risks, clear conclusions and communication on nanomaterial health risks are now urgent. This will support the commercial success of nanomaterial research and innovation in Europe.

VP Human Health RM Nano builds new knowledge and networks on human health risk management of manufactured nanomaterials and supports safe innovation of nanomaterials. In order to assist stakeholders (industry, investors, insurers) to overcome safety, regulatory and market perception barriers for the investment in pilot plants, and scale up / product launch facilities various milestones are defined:

1. Safe innovation and risk assessment for industry

(driver: Lack of good quality risk assessment and management tools that fit with industry needs. Make generic risk assessment tools specific to specific industries and industrial sectors)

2. Risk governance and implementation of 'soft law' and good practices in industry

(driver: Absence of legal requirement on nanomaterials and therefore unwillingness to invest in beneficial technology by industry, investors and insurers. Need for regulatory supported guidance on how to manage the risks of nanomaterials by industry and consumers)

3. Setting up a network and trusted environment for industry to share successes and problems

(driver: Lack of confidence in nanotechnology as an enabling technology due to regulatory and HSE uncertainties. Strong urge to use nanotechnology due to economical, societal and environmental benefits)

Resultaten 2020

The results of VP Human Health RM Nano in 2020 in various EU projects.

The Gov4Nano project focuses on developing and implementing a future-proof risk governance model that addresses the needs of the transdisciplinary field of nanotechnology. The overarching aim is to showcase a proof of concept of an efficient and effective risk governance process for nanotechnologies, providing state of the art methods and tools, and delivering recommendations, which will be aligned with and facilitate innovation processes in this field. TNO will support the

Implementation and operationalization of the safe-by-design nano risk governance hub. Testing of operational feasibility of scientific and technical requirements for data harmonization and data curation to strengthen the current position of TNO in exposure data harmonization in Europe. TNO will focus on the identification of findable and accessible data and work on the inter-operability of existing database, data entry and data-query (such as interoperability between the NanoReg2, caLIBRAte and NECID databases). TNO will also contribute to the development of a post-project business/operational model for the self-sustainability of the Risk Governance Council for nano (NRGC) and to the establishment of the NRGC. During the course of the project TNO will further define its strategy towards the legal entity of the NRGC and decide whether or not to take place in or what relationship is preferable towards the to be established NRGC. Finally, TNO will lead a task on the establishment of stakeholder positions and needs within risk governance. This includes the establishment of a stakeholder advisory group composed of industry, trade associations, regulatory authorities and the undertaking of a series of interviews to determine baseline industry position on risk governance and industry needs for RGC.

The NanoUptake project will work on the development of new approaches and tools to support the rapid development of safe nanomaterials, products and processes, focused, but not limited, on the following industrial sectors: Coatings, Cosmetics, Pharmaceutical industry and medicine, Structural and functional nanomaterials sector. TNO will be involved in almost all work packages and will lead WP4 'Safe by process design: exposure assessment and risk management'. The objective of this WP is to develop a newly tested and calibrated cost driven exposure model to predict the effectiveness of Risk Management Measures (RMM) to design a safe process with a data e-infrastructure with updated databases consisting of release, exposure and RMM effectiveness information that will support an exposure-driven safe-by-process-design modelling framework as key outcome. Knowledge from previous EU projects like caLIBRAte, NanoReg2, EC4safenano, Guidenano, SUN, FNN, Gov4Nano will be used as input for the NanoUptake project.

The PeroCUBE project brings together top experts and pioneers in upscaling of the OLED technology, namely partner FRAUNH and VTT, and the top groups in perovskites materials (partners UOXF and UPAT) and perovskite processing for device manufacturing (CSEM). Due to its ambitious, but feasible goals, new nanocharacterization tools will be developed (TUW and ALPES) while theoretical studies will significantly contribute to development and upscaling of the perovskite technology (CNRS). Any human health and environmental issues, along with LCA will be studied by TNO while robust commercializing channels of the PeroCUBE developments are guaranteed by the involvement of AURA, a pioneer in the lighting market, and also VBC. Finally, partners OM, EULAM and VODAF will develop and demonstrate communication applications (LiFi) of the new devices. All advancements will be demonstrated at TRL 5 for printed, large area (>10 cm²) devices for lighting, PV and LiFi applications and also wearables. The objective of WP 7 (lead by TNO) is to assess the potential human health risks and to provide a life cycle assessment to balance the risks and benefits of the application of nano-perovskites in lighting and energy harvesting applications. The LCA will enable the weighing of the benefits versus the potential risks across the life cycle of the product (from production to use to end-of-life). Tailor-designed tests will be conducted to assess the effectiveness of the encapsulation scheme for the lead containment and recycling approaches to end-of-life of the PeroCUBE devices will be suggested.

Given the interests at stake, the European Commission has set out a European Strategy for Nanotechnologies, based on a safe, integrated and responsible approach. Within this, Mandate M/461 is a mandate for standardization activities regarding nanotechnologies and nanomaterials addressed to CEN, CENELEC and ETSI by the European Commission. TNO invests in the elaboration of a programme of standards with the result to take into account the specific properties of nanotechnology and nanomaterials in the standardization process.

The results of VP Human Health RM Nano in 2020 in various knowledge investment projects

Sector specific Safe-by-Design and risk assessment tooling

There is a need for sector specific risk assessment tools addressing specific exposure scenario's and the hazards of sector specific nanomaterial and nano-enabled products. In various EU funded projects development has focused on the generation of generic Safe-by-Design and risk assessment frameworks. Examples of these are caLIBRAte, NanoReg, NanoReg2, LICARA, Future Nano Needs. One of the difficulties arising from these generic frameworks is that they are seldomly directly applicable to specific cases in practice since these require more specific tooling and frameworks. This is also shown in the NanoStream project with the result the matching of many available nano risk assessment tools against the needs of the semi-conductor industry. In 2020 we aim to develop sector specific frameworks for safe by design and / or risk assessment of nano-enabled

product and processes. We aim to find relevant partners to co-develop such frameworks and tools, with specific focus on: 1) Green ICT, 2) Nanomaterials for battery development, 3) Semi-conductor industry.

Risk Management

Risk management of nanomaterials has received considerable attention in recent years, especially in the United States (NIOSH, 2013) and as part of various European Union (EU) research projects – amongst others LIFE NanoRISK, SUN, NANoREG, Scaffold and GUIDEnano. It is apparent from these initiatives that there is limited information available regarding the efficiency of risk management measures (RMM) for nanomaterials, with a handful of open source or published reviews on the effectiveness of workplace RMM (Frijns, 2016; Oksel et al., 2016; NIOSH, 2013; OECD, 2009; Goede et al., 2018). TNO's work in 2020 will result in a new risk management approach to control exposures to nanomaterials by obtaining information on the quantitative RMM efficiency from a number of sources, e.g. the CEFIC RMM Library (CEFIC, 2016), the OECD emission scenario documents (OECD, 2016), the Exposure Control Efficacy Library (ECEL) (Fransman et al., 2008). These sources are focused on chemical substances that represent substantial variation in efficiency of RMMs and do not specifically account for nanomaterials yet. In 2020, the list of effective control measures for the workplace is linked to frequently occurring exposure scenario's as indicated by industry, resulting in a set of "best practices". In the 'soft law' initiative in 2020 TNO assesses the efficacy of a set of methods currently applied in practice, which results in the future requirements for companies to report their risk management measures with regards to nanomaterials. In 2020 collaboration with the Ministry of Social Affairs and Employment and the Labour Inspectorate will be sought resulting in a combined roadmap. This work package fits well with Milestones 1 and 2.

Quantitative risk assessment tool knowledge base

Various qualitative risk assessment models have been developed for nanomaterials, of which Stoffenmanager® Nano was developed by TNO and introduced in 2011 as a separate module to Stoffenmanager® (Van Duuren-Stuurman 2011). The risk bands were developed into a semi-quantitative risk assessment approach. In 2020 further knowledge will be developed towards quantification of the risk bands for specific exposure scenario's and collaborations for co-financing with various partners will be sought to update the knowledge base in the public domain. In future years work will focus on: 1) identification of nanomaterials in practice, 2) Quantifying the exposure bands for all source domains, 3) Link to NECID and ECEL and other databases, 4) exposure scenario libraries, 5) Hazard assessment and NRV's, 6) Effectiveness of risk management measures. Dustiness modelling has been highlighted as one of the major improvements in exposure assessment of powders. Measured dustiness data was found to be a good potential predictor for estimating the emission potential of powdered MNM, which forms the basis as a sensitive input parameter in most of the HRA tools. In 2020, TNO's work will result in a dustiness library together with the Danish National Research Center for the Work Environment (NRCWE), which will be accessible from the nano-risk governance portal and is considered to become open for further expansion by certified data contributors. TNO will work in 2020 on the sharing and collation of measured dustiness data resulting in a harmonized data library to enable better meta-analysis of these data to study the most predictive parameters of emission potential of nano-powders for improved exposure modelling purposes. This work package fits well with Milestone 1.

Dynamiek

Since 2007, the European Registration, Evaluation, Authorisation and restriction of Chemicals (REACH) regulation is in force. Already in 2008 it was concluded that REACH focuses on substances in any size, shape or physical state. Nanomaterials are already included in the REACH regulations as no distinction is made according to size. At ECHA there is a growing attention for the registration of nanomaterials under REACH and new annexes have now been added to the REACH regulations and guidance in 2019. Based on these governmental developments, there is an increasing awareness to perform a proper risk assessment for nanomaterials and to comply with the regulations. VP Human Health Nano is building new knowledge and networks on human health risk management of manufactured nanomaterials and supporting safe innovation of nanomaterials. TNO has a strong position in currently running Horizon 2020 calls in the field of nanosafety and has a leading position in the field of exposure assessment, risk assessment and modeling, tool development and risk management. Scientifically there are still many challenges to assess the risks of nanomaterials. According to the Nanosafety in Europe 2015-2025 it is concluded that the various costs related to safety to the industry can be substantially reduced by enabling the manufacturing companies to focus their investment on safe materials by encouraging safe innovation. The main achievement will be the development of integrated risk assessment and decision frameworks to enable forecasting the potential impacts of nanomaterials on human

health and the environment, and adequate risk management. Undertaking this may require the development of novel risk assessment strategies, sensors and standardized measurement methods together with companies that will replace the current ones, being equally reliable, affordable but faster. Environment, health and safety solutions mapped to the specific requirements of market driven value chains will provide industry at all stages in the innovation chain with the confidence that the materials that they are using will not present future business risks (reputation, litigation) resulting from unforeseen safety problems with their materials. This will maximize and support the uptake of these materials in the development of new processes and products.

Titel	Sociale Innovatie (P207)
Missie/ Topsector	HTSM, Logistics, LSH
Contactpersonen TNO	Sandra Eikhout (dir markt GL), Steven Dhondt (VP mgr)
Contact extern	Henk Gritter (EZK), Corine Cornelissen (EZK)

Programma jaar 2020 - Samenvatting

Smart Working, as a part of the Smart Industry initiative, focuses on what the optimal work setting is for smart operators and how to support these operators in their skill development within such settings. Technology solutions are connected to organizational solutions to secure implementation and upscaling. Two major context developments are central for Smart Working: robotization and digitization. These changes raise skill and performance demands. To maximize the adoption of this skill growth, solutions are developed together with companies. Our solutions help the operator to maneuver faster within a factory setting with robots, collaborative robots (cobots), exoskeletons, operator support systems and other digital support systems. Operators get tools to learn faster and to learn on the long term. Systems are developed to avoid harm to workers.

The Smart Working projects focus on robotics, cobotics, exoskeletons, cognitive support systems, use of digital information and communication in work settings. Key is that operators receive a maximum of autonomy to adopt these tools in their work settings to their needs and responsibilities. The projects therefore create solutions that take account of physical, cognitive and psycho-social demands on operators, but also on the organizational conditions to allow working in multi-disciplinary and autonomous working environments. This means solutions at the workplace level (exoskeletons, collaborative robots, augmented reality training and guidance for operators) and at the organizational level, cooperation between operators, colleagues and robots (Workplace Innovation, lean systems, blockchain/AI driven organizations). Smart working also involves (social/legal) conditions as required by society. In 2019, the National Science Foundation project SHAREHOUSE integrates all these elements: an innovative experimental environment within a school setting for testing the newest technologies developed by SMEs in the logistics sector. The core innovations are: giving schools access to the newest technologies without incurring the investment cost; training of thousands of students in the newest technology environment, guaranteeing to-the-point skills; helping SMEs to test their solutions in a scientific responsible way without incurring the costs of possible innovation failures; developing more insight into how human-robotic interaction works and how workplace innovation contexts need to be developed.

The solutions are always science and practice based. For the success of the program, the disciplines human factors, organizational sciences and technical sciences need to work in concert on solutions and designs. Collaboration with technical experts and information system specialists is also crucial. The program builds on Fieldlab/Living Lab environments to secure practical application of each solution.

Goals 2023

The P207 Social Innovation (Smart Working) program has two objectives: (1) First of all, the development of a concept of Operator 4.0 in Smart Industry and Logistics, a model in which new and flexible ways of cooperation between operators and technology are realized in production and logistics processes. Core ideas are performance, safety, health and sustainable employability; (2) Secondly, the development of a concept to create Smart Organizations in Smart Industry and Logistics, more flexible, inclusive and productive organizational concepts. Skill development is connected to the organizational objectives.

Core ideas are digitization (including blockchain technology), platformization of company structures and Big Data. The outcome of the program is instructive, productive and innovative work in Smart Industry and Smart Logistics. For companies, the program delivers flawless and more efficient production systems.

What has been achieved by the end of 2020?

The Operator 4.0 project line leads to new concepts about matching human tasks and robot tasks. New in 2020 are: a task scheduling concept that enhances human robot collaboration on the shop floor (i.e. a design method that monitors job quality based on allocation of tasks between human and robot) a model to better fit the design of an exoskeleton to human requirements; a concept of robot support linked to the flexible deployment of employees and employees with a distance to the labor market; a second version of a concept for adaptive cognitive operator support has been developed. The project line Smart Organizations will provide new organizational concepts for a learning environments for industrial settings and logistics in 2020. In 2020, from the roadmap on how organizations are better connected to blockchain and other digital technologies, a concept is further developed for managing learning behavior on the basis of blockchain.

Korte beschrijving

The Smart Working 2020-2023 program focuses on the development of new concepts of human-technology (Operator 4.0) and organization-technology integration (Smart Organizations) with the purpose that modern work can be connected to new forms of robotization and digitization.

Goals 2023

The outcome of the program is flawless, productive, healthier, safer, and more knowledge-intensive work in Smart Industry and Smart Logistics:

We strive for a new concept **Operator 4.0** because the Smart Industry processes have changed drastically. Robots and operators used to work independently from each other and the productivity of robot-human systems depended mainly on the correct programming of the robots. Further integration, flexibilization and acceleration of production processes force people to produce directly and together with robots. Robots will have to be able to 'communicate' with their environment differently. In this development, new cognitive operator support technology (e.g. augmented reality) is increasingly becoming an important link in flexible and error-free production. The productivity and flexibility of these people-oriented technologies depend on optimal conditions (and interaction) for the Operator 4.0 and the application of Workplace Innovation concepts. It should be clear what knowledge, skills and attitude the operator 4.0 should have and how this concept fits into the Smart Organization. The goal with this first line of research is to achieve the following objectives by 2023: (1) have adapted the general concept to specific robot technologies (cobots, exoskeletons) or sectors; (2) adapted the concept of robot support so that employees with a distance to the labor market can be deployed in industrial production environments. With this concept, new target groups such as younger, inexperienced employees, flex workers and older employees in high mix, low volume, high complexity production processes can produce flexible and error-free; and (3) an adaptive concept for cognitive operator support has been developed and validated on the shop floor.

In the further integration of production and service provision processes in the digital environment, digitalization and platformization of companies are other important trends. The internet ensures the integration of tasks and processes. Companies are trying to find out what possibilities new communication and information technologies offer. New technologies such as blockchain technology offer new perspectives on the organization of the work. To be able to respond to both developments, new concepts in Smart Working 2020-2023 are developed about the optimal conditions for **Smart Organizations**, based on the principles of Workplace Innovation. The goal is to deliver a concept of new organizational forms (Smart Organization) in Smart Industry that help industrial companies become more productive using blockchain concepts. In companies, concepts for digitization (including blockchain/AI technology) and platformization have been developed and applied. For this type of technology we want to develop a development path aimed at better use of data and organizational principles.

Which knowledge/technology is needed to get there?

First, we collect new concepts about 'operator 4.0' and 'smart organizations' through literature research, conferences, monitor data and discussions with companies.

Second, (ecosystem) partnerships in the sectors will be continued.

Third, testing in practice is necessary for testing and evaluating the various concepts:

- we already have a collaboration with Robohouse (Delft) and Fieldlab Flexible Manufacturing (Brainport Industries Campus, Eindhoven) in which we test Operator Cognitive Support Systems and a robotic solutions.
- Together with our partners, we create other learning environments at customers or at partners (including educational institutions). A test environment, SHAREHOUSE, is under development with STC Rotterdam for analysis of alternative devices in warehousing; a joint venture with the TU Dortmund and Fraunhofer IML is considered to develop lab-setting for Workplace Innovation.
- A European initiative to continue the European Workplace Innovation Network (EUWIN) has been launched. Fieldlabs help to come up with solutions with a broad set of stakeholders.

Finally, to safeguard our knowledge, we focus on ecosystems in which research institutions, education and companies work together on new solutions. Examples: Fieldlabs FlexMan (BIC), RoboHouse and SAM|XL (SMITZH), the Skillslabs in HTSM, the SHAREHOUSE in Rotterdam. Lab environments and Fieldlabs will be finalized. In the following years the concepts are further developed.

Resultaten 2020

The Smart Working program provides the following deliverables:

New concepts for human-robot interaction in manufacturing and logistics. More in particular, we deliver models based on performance, health and employability perspectives:

- to appropriately use exoskeletons in production and logistics environments;
- to deploy cobot solutions (human-robot collaboration) which function optimally: connection to a new task-model, connection with Augmented reality.

Concepts to make Operator Support Systems adaptive based on the measured quality, operator capacity and the current skill level so that operators in high-mix low volume high complexity production environments learn faster, work faster, are more flexible, are less annoyed and produce faultlessly.

- The usability and added value of AI based algorithms will be explored;
- A successful test of 'inclusive technology': learning faster with Augmented Reality in sheltered work places.

New organizational concepts and skills of operators to work with robotization and digitization:

- Guidelines for developing new digitization solutions (including Blockchain, Artificial Intelligence) embedding solutions into software to incentivize the right learning at work (rules for smart contracts; apps);
- Rules to implement information and communication technologies in such a way that employees keep control of their working environments;
- Methodologies to support the development of technical, cognitive and social skills from employees in robotized environments (exoskeletons, cobots and operator support). The principle of adaptive support is also central to these concepts. Exoskeletons can be made more adaptable by measuring human intention and operator support systems can adapt to the skill level and the current need for cognitive support.

Models for optimal conditions for Smart Organizations.

- A model to use ICT-driven behavioral incentives to create 'smart organizations'. The model relies on decentralized and bottom-up processes making use of knowledge and insights from employees and groups of employees.

A model to better evaluate future development of labour markets and skills, in the context of further robotization and digitalization of work.

In 2020 we will mainly work on the development and underpinning of the new concepts on '**Operator 4.0**' and on '**Smart Organizations**'. We conduct experimental lab research, research in practice, literature research, conferences and discussions with the companies. We continue to build on the partnerships that we have built up over the past years in P207. We develop tests and test environments for the evaluation of these concepts. This implies cooperation with national and international partners. We are working on the development of the Skills Labs Smart Industry, Flexible Manufacturing at the Brainport Industries Campus (BIC) and Fieldlab Robohouse (part of ecosystem Smart Manufacturing: Industriële toepassing in Zuid-Holland), SHAREHOUSE. For the blockchain research we are working on a proof-of-concept with several sectors (logistics, health care).

Which parties are or will be involved?

On the company and funding side:

- FME, Hightech-NL, FNV, AWWN, Agoria (BE): in the framework of the Skills Fieldlabs and Interreg FOKUS; linked to these social partners there are broad networks of HTSM companies;
- Human Capital Table Logistics and TKI Dinalog: for various skills projects in logistics. In this sector we have broad connections with companies;
- Brainport Industries: together with end users (OEMs and Tier One suppliers), robotics suppliers, system integrators, Technical University Eindhoven and the Fontys and Avans Universities of Applied Sciences in the ecosystem of Fieldlab Flexible Manufacturing.
- Werkspot: a knowledge center is being developed for the topic 'platform economy'.
- Continue collaboration within the Horse project (TNO Competence Center) in RoboHouse with partners (Robovalley, Festo, Hogeschool Den Haag, Delft University of Technology, Innovation Quarter, Thomas Regout International) in Delft, South Holland.
- Flanders Make, Sirris, KU Leuven and the Open Manufacturing Campus : Flemish research partners in the Interreg project FOKUS

The program also links up with (TNO) Early Research Programs, ERP i-Botics and ERP Artificial Intelligence. The program ensures a substantive alignment with these research programs. Different elements can be better selected in those ERPs. The application of these ideas follows in the program P207.

In the Netherlands we work together with the universities of VU Amsterdam, University of Twente, TU Eindhoven, Erasmus University and Utrecht University and several Universities of Applied Sciences:

- VU Amsterdam: Collaboration in several exoskeleton projects. Knowledge development in the field of wearable robots (among others 3 PhD students, of which 1 appointed from ERP i-Botics)
- Erasmus University: partner in TKI Dinalog, NWO-TKI project (SHAREHOUSE)
- With the University of Twente, we continue the joint innovationcenter i-Botics.
- With the University of Utrecht, we will have one PhD student, linked to the Future-of-Work program. The University of Utrecht is collaborating in the context of the NWA Smart Industry route.
- Start-up collaboration on robotics with university of Applied Sciences The Hague and Den Haag, TU Delft in RoboHouse Delft
- With the TU Eindhoven we collaborate in the Fieldlab Flexible Manufacturing, the H2020 project Horse and SHAREHOUSE.
- Collaboration with the Avans, Fontys, HAN, Saxion, Windesheim and Hogeschool Utrecht colleges. Avans and Fontys are working in the Fieldlab Flex Manufacturing, HAN and Saxion are partners in Raak Assemblage 4.0. Windesheim and Fontys work together in logistics (SHAREHOUSE).

We have several partnerships in Europe. The most important foreign cooperation:

- with KU Leuven (Belgium) with whom we have acquired the Paradigms 4.0 project on Industry 4.0 applications

- with Sirris, Flanders Make and KU Leuven in which we collaborate intensively within the framework of FOKUS.
- With the TU Dortmund and Fraunhofer IML, a collaboration is set up in Logistics 4.0.
- With 15 partners all over Europe, we develop a renewed EUWIN-network for workplace innovation.

What is the external connection with government or top sector KIAs or with NWA routes?

The results of the program, error-free and productive work - more skills-intensive work - healthier work, is relevant for different target groups. Firstly, the program closes with flawless, productive work and organizes in the first instance the interests of operational, logistical and HR managers in (industrial) companies. Secondly, the insight and overview of the applications in the companies provide information for policy makers in the sectors (social partners) and in policy. The concepts Operator 4.0 and Smart Organizations are useful for all stakeholders. The insights for skills are specifically relevant to the further development of the Roadmap Smart Industry (NWA agenda) (among others 5.8 Human Technology Interaction). Human-machine interaction is central to the HTSM program. The program is further aligned with the 'Future of Work' plan that was programmed in the SZW Multi-Annual Program. The SZW program mainly focuses on the labor market consequences (polarization, higher skill requirements, inclusiveness) of new workplace and organizational concepts. The Smart Working program allows for skills-intensive workplaces to arise. This makes the program relevant for the Technology Pact, for the partnership between the Human Capital Tables of the top sectors (Life Long Development Initiative). TNO can acquire a directing role with the whole in the national (SER) and international (OECD) skills and workplace innovation agenda's.

The Social Innovation program is mainly in line with the themes of the Top Sector Smart Industry (NWA route 20. Smart Industry) and to a certain extent of the top sectors Logistics and LSH. For the Smart Industry top sector, it is important that we contribute to the Challenge "Strengthening Key Technologies - More advanced manufacturing systems and processes". We already have data on which parts of the Smart Industry roadmap are important (e.g. 5.8 Human Technology Interaction). The program provides knowledge for the themes Robotics and Big Data.

In addition to this core focus, the program also matches other societal challenges:

- Challenge III - Health and care: KIA "Longer, Healthier life"; Theme VWS "Prevention". This concerns the NWA routes 6. Health research, prevention and treatment, and 25. Big data
- Challenge VI - Mobility and transport (Smart mobility): KIA Top Sectors Logistics and HTSM; NWA routes 11. Logistics and transport (Logistics as an enabler). NWO-themed blockchain.
- Challenge VIII - Inclusive and innovative society. NWA route "16. On the way to resilient societies".
- Challenge "Strengthening Key Technologies - ICT": KIA Top Sectors Logistics and HTSM. NWA routes 20. Smart Industry and 25. Value creation through responsible access and use of big data, themes Robotics and Big Data.

Dynamiek

Developments in relation to plan 2019

The main change in the "Operator 4.0" project line is the first integration of Artificial Intelligence solutions for the embedding of 'learning' in the models for human-robot collaboration. In the "Smart Organizations" project line, the 2020-plan is much in line with the 2019 plan. The main idea is to upscale the efforts with the launch of the Sharehouse-project. For the blockchain-initiative, further investigations will be done in the way behavior can be incentivized by digitally supported systems.

What is the impact?

In the 2020 program, the course had already been chosen to focus more on the new project lines in 2019 (digitization and robotization). These options continue to form the core of the new long-term plan. In the new long-term plan we will continue to work in the top sectors HTSM, Logistics, LSH. We remain committed to strengthening our European leading position in new European projects and initiatives to set up joint lab environments (Germany, Belgium).

Titel

Arbeid & Gezondheid (P204)

Missie/ Topsector	Life Sciences and Health
Contactpersonen TNO	Seth van den Bossche
Contact extern	Henri Géron (SZW)

Programma jaar 2020 - Samenvatting

De wereld van werk verandert snel door globalisering, demografische en technologische ontwikkelingen. Banen verdwijnen, maar er komen nieuwe voor in de plaats. Er ontstaan nieuwe gezondheids- en inzetbaarheidsrisico's, maar die zijn ongelijk verdeeld zijn over arbeidsmarktsegmenten.

Een optimaal functionerende arbeidsmarkt is een essentiële hefboom voor toekomstige economische groei. Dat vraagt een beroepsbevolking die beschikt over kennis en vaardigheden voor het werk van de 21ste eeuw en die voldoende veerkrachtig en vitaal is om zich aan te passen aan verandering en langer door te werken (zie ook World Economic Forum: Towards a Reskilling Revolution: A Future of Jobs for All, 2018). Lerende en adaptieve organisaties en netwerken zijn nodig om de beroepsbevolking ook toe te rusten deze verantwoordelijkheid op zich te nemen. De huidige krapte op de arbeidsmarkt vergroot de urgentie om innovatieve oplossingen te vinden voor zaken die een duurzame gezonde en productieve inzet van mensen in de weg staan (zie ook EZK Brief DGBI-I&K / 18148309 'Naar Missiegedreven Innovatiebeleid met Impact').

TNO werkt in het programma Arbeid en Gezondheid aan innovaties die het aanpassingsvermogen van mens én organisatie versterken, waardoor zij zich beter kunnen voorbereiden en reageren op bovengenoemde veranderingen. Het doel van het programma is het arbeidspotentieel in Nederland te versterken door een serie samenhangende instrumenten te ontwikkelen die:

- De arbeidsparticipatie vergroten van mensen met afstand tot de arbeidsmarkt
- Het aantal van-werk-naar-werk transitie vergroot
- De arbeidsproductiviteit en innovatie-adoptie vergroten
- De ziekte last door ongezond en onveilig werk verkleinen

Met dit instrumentarium stellen we (netwerken van) organisaties in staat de duurzame inzet van mensen te bevorderen en de slagvaardigheid van de arbeidsmarkt te vergroten. Het programma omvat drie hoofdlijnen, gericht op drie maatschappelijke uitdagingen:

1. *Innovations for sustainable work*: Hoe kunnen mensen, van jong tot oud, langer gezond en productief werken?
2. *Future of work*: Hoe zorgen we dat mensen en organisaties goed voorbereid zijn op de arbeidsmarkt en het werk van de toekomst?
3. *Inclusive work*: Hoe zorgen we dat meer mensen duurzaam en zinvol aan het werk komen en blijven?

De drie hoofdlijnen worden van structurele data voorzien door middel van hoogwaardige dataverzameling onder werknemers, zelfstandigen en werkgevers (zie www.monitorarbeid.nl).



Resultaten 2020

In 2020 zullen we de kennisontwikkeling, metingen/dataverzameling, fieldlabs en ecosystemen die in 2018 zijn gestart en in 2019 zijn opgeschaald op basis van de verhoging van de Rijksbijdrage, verder voortzetten.

Voor de hoofdlijn Innovations for sustainable work ligt de focus op het vergaren van sensor-data en het analyseren van die data in verschillende pilot-studies en de start van een grootschalig H2020 exposoom-project. Voor de hoofdlijn Future of work ligt de focus op de verdere ontwikkeling van een integrale skills-aanpak en technology impact assessment. Voor de hoofdlijn Inclusive work ligt de focus op inclusieve technologie en inclusief werkgeverschap.

De hoofdlijnen van het programma zijn in nauwe samenspraak met regievoerder SZW tot stand gekomen, mede op basis van raadpleging diverse externe strategische agenda's (oa SZW, NWA, KIA topsector LSH, Skills Strategy NL, EU H2020 challenges & VN Sustainable Development Goals). Vanuit SZW is tevens matching voorzien in de vorm een Additionele Rijksbijdrage.

De kennisontwikkeling vindt plaats in publiek private samenwerking, met andere kennisinstellingen, bedrijven, intermediairs en lokale overheden, onder meer in de vorm van proeftuinen/living labs.

Korte beschrijving

Het doel van het meerjarenprogramma is om in 2022 een substantiële bijdrage geleverd te hebben aan de vergroting van de duurzame inzet van mensen op de arbeidsmarkt. Dat doen we door gerichte kennis- en instrumentontwikkeling waarmee we (netwerken van) organisaties in staat stellen:

- De arbeidsparticipatie vergroten van mensen met afstand tot de arbeidsmarkt
- Het aantal van-werk-naar-werk transitie vergroot
- De arbeidsproductiviteit en innovatie-adoptie vergroten
- De ziektelast door ongezond en onveilig werk verkleinen

Het programma omvat drie hoofdlijnen, gericht op drie maatschappelijke uitdagingen:

1. *Innovations for sustainable work:*

Hoe kunnen mensen, van jong tot oud, langer gezond en productief werken?

2. *Future of work:*

Hoe zorgen we dat mensen en organisaties goed voorbereid zijn op de arbeidsmarkt en het werk van de toekomst?

3. *Inclusive work:*

Hoe zorgen we dat meer mensen duurzaam en zinvol aan het werk komen en blijven?

Innovations for Sustainable Work

Een werknemer staat tijdens zijn werkzame leven (in meer of mindere mate) bloot aan verschillende arbeidsrisico's die de gezondheid (en daarmee de inzetbaarheid) bedreigen. Deze risico's versterken elkaar in veel werksituaties. In recente kennisprogramma's zijn we de diverse arbeidsrisico's daarom steeds meer in samenhang gaan bekijken. Binnen de programmaliijn *Innovations for Sustainable Work* werken we de komende jaren toe naar een real-time riskmanagement beheersstrategie voor arbeidsrisico's op het gebied van gevaarlijke stoffen, veiligheid en mentale gezondheid, waarbij we aandacht hebben voor de bedrijfskundige en sociale consequenties van real time risk assessment. Het is namelijk steeds beter mogelijk om risico's te meten op het moment dat zij zich voordoen. Ook zijn we steeds beter in staat om verschillende data die iets zeggen over blootstelling aan en effecten van risico's (zoals omgevingsdata, fysiologische data en contextuele data) aan elkaar te koppelen om zo inzicht te krijgen in de blootstelling aan risico's en de relatie met gezondheid (exposoom onderzoek). Dit maakt het mogelijk werknemers 'real time' gepersonaliseerd advies te geven hoe zij hun duurzame inzetbaarheid kunnen vergroten en organisaties 'real time' advies te geven hoe een veilige en gezonde werksituatie te faciliteren.

De programmaliijn *Innovations for Sustainable Work* heeft de volgende lange termijn doelen:

- Selecteren of ontwikkelen van tools die real time risk assessment faciliteren voor verschillende arbeidsrisico's ('METEN').
- Ontwikkelen van een real time risk management methodiek voor verschillende arbeidsrisico's, met in achtname van de privacywet- en regelgeving, in te zetten binnen organisaties ('WETEN').
- In samenwerking met partners inzicht ontwikkelen in de belemmerende en bevorderende factoren zijn voor het implementeren van een real time risk management methodiek, met aandacht voor kwetsbare groepen ('TOEPASSEN').
- Inzicht ontwikkelen in de risico's van nieuwe technologieën (bijv. robotisering) en de wijze waarop nieuwe technologieën zo ingezet kunnen worden dat risico's beperkt blijven.

De benodigde kennis en technologieën voor deze kennislijn omvatten onder meer: omics technieken, systeem-biologie, PBTK (physiology-based toxicokinetic) modellering en behavioural change kennis.

Future of Work

Het doel van de programmalijn Future of Work is tweeledig:

- Inzicht geven in de impact van technologische ontwikkelingen (kansen en bedreigingen). In het eerste jaar ontwikkelen we een methodiek voor sectorale en regionale technology impact assessments en passen we deze toe op een testcase. In de volgende jaren zal de methodiek vervolgens in diverse sectoren en regio's worden toegepast in samenwerking met externe partners. In het eerste jaar brengen we tevens de impact van digitale platforms op de kwaliteit van arbeid in kaart aan de hand van een casestudy;
- Handelingsopties, methoden en instrumenten aanreiken aan stakeholders om adequaat op de technologische ontwikkelingen en hun impact te kunnen reageren. Daarbij besteden we zowel aandacht aan het belang van werkgevers, werknemers en maatschappij als geheel. De handelingsopties, methoden en instrumenten zijn bedoeld voor organisaties en individuen in regionale ecosystemen. Om bij te dragen aan innovatieve, lerende en flexibele organisaties en werkenden wordt eerder ontwikkelde kennis op het gebied van duurzame inzetbaarheid, workplace innovation en flexibel organiseren gecombineerd.

De benodigde kennis en technologieën voor deze kennislijn omvatten onder meer: impact modellering/technology impact assessment en kennis over ecosystemen, organisatiekunde, sociale innovatie, arbeidsmarktdynamiek en behavioural change.

Inclusive Work

Het doel van de programmalijn Inclusive Work is om een bijdrage te leveren aan de ontwikkeling van een inclusieve arbeidsmarkt waarop werkzoekenden en werkenden van de doelgroep volwaardig kunnen participeren en zich kunnen ontwikkelen. De doelgroep omvat alle personen uit de (potentiële) beroepsbevolking die kunnen werken, maar daarbij ondersteuning nodig hebben. TNO ondersteunt de ontwikkeling van een inclusieve arbeidsmarkt door kennis en innovaties te ontwikkelen voor:

- Het versterken van de werkzoekenden;
- De transformatie van het gemeentelijk sociaal domein in een lerende organisatie waarbinnen de dienstverlening aan de doelgroep voortdurend wordt verbeterd doordat professionals methodisch te werk gaan en gebruik maken van de best beschikbare kennis over wat werkt;
- Het stimuleren van inclusief werkgeversgedrag.

De benodigde kennis en technologieën voor deze kennislijn omvatten onder meer: statistical/predictive modellering/big data en kennis over evidence based interventies, ecosystemen, behavioural change, inclusive technology/robotics.

Externe aansluiting

De programmering sluit zeer goed aan bij onderstaande maatschappelijke uitdagingen en kennisagenda's:

VN Sustainable Development Goals

- #3. Good health & wellbeing
- #8. Decent work & economic growth
- #9. Industry, innovation and infrastructure
- #10. Reduced inequalities

EU/H2020 societal challenges/maatschappelijke uitdagingen

- Health, demographic change and wellbeing
- Europe in a changing world - inclusive, innovative and reflective societies

Nationale kennis- en innovatieagenda's:

Kennisagenda ministerie van SZW

KIA topsector Life Science & Health

Nationale Wetenschapsagenda (routes: Gezondheidszorgonderzoek, preventie en behandeling; Kwaliteit van de omgeving; Op weg naar veerkrachtige samenlevingen; Smart Industry)

Roadmap “Human Capital Topsectoren 2016 – 2020”

Skills Strategy NL

Verder is er een *link met de volgende sleuteltechnologieën*:

Life sciences technologies (Biochips/biosensing)

Digital technologies (AI, Big data & data-analytics)

Engineering and fabrication technologies (Robotics, Sensors and actuators)

Interne aansluiting

Het programma Arbeid & Gezondheid hangt samen met de volgende kennisprogramma's binnen TNO:

Vraaggestuurd Programma	Early Research Programma
P102 Veilige Maatschappij	I-Botics
P201 Digital Health Technologies	Hybrid AI
P207 Sociale Innovatie	ExpoSense
P209 Innovations for development	Personalised Health
P510 Milieu en Duurzaamheid	Personalised Health
P511 Human Health RM Nano	Body Brain Interactions
P706 ICT	

Resultaten 2020

In 2020 zullen we de kennisontwikkeling, metingen/dataverzameling, fieldlabs en ecosystemen die in 2018 zijn gestart en in 2019 zijn opgeschaald op basis van de verhoging van de Rijksbijdrage, verder voortzetten.

De beoogde resultaten voor 2020 per programmalijn zijn:

Innovations for Sustainable Work

Met de resultaten van 2018 en 2019 werken we in 2020, met diverse partners, aan het realiseren van het einddoel: real time risk management interventies die medewerkers ondersteunen bij het nemen van eigen regie en bedrijven ondersteunen bij het creëren van een faciliterende omgeving om de aan arbeid gerelateerde risico's zoveel mogelijk te beperken. Het betreft risico's op het gebied van werken met (chemische) stoffen, veiligheid en mentale belasting. De resultaten van 2020 liggen op alle vier de subdoelen van de programmalijn (meten, weten, toepassen en impact/kansen van nieuwe technologie voor gezondheid en veiligheid op de werkvloer). De focus zal liggen op de start van een grootschalige H2020 exposoom project (EPHOR), het ontwikkelen en testen van een werkstress-interventie in het onderwijs, uitbreiding van de onderzoeksactiviteiten op het vlak van digitalisering/robotisering in relatie tot safety en het vergaren en analyseren van sensor-data in verschillende pilot-studies.

Samenwerkingspartners: hoogrisico-branches (oa bouw, houtverwerking, chemie, metaal, onderwijs, zorg), Arbodienstverleners, softwareontwikkelaars en leveranciers van ERP en HSE management systemen, HSE, NIOSH, RIVM, Hogeschool Utrecht, TU-Delft, TAQA, TOBII, Tata Steel, Stoof, Ministerie SZW, Inspectie SZW, ISense it, 17 partners uit het EPHOR-project (waaronder Aarhus Universiteit, Utrecht Universiteit, Katholieke Universiteit Leuven, Bergen Universiteit, University of Manchester, FIOH en het Karolinska Instituut).

Future of Work

Impact van technologie in kaart brengen

- Technologie impact assessment: De vier toepassingen van de TIM (technologie impact methode) uit 2019 worden in 2020 geëvalueerd. Op basis daarvan ontwikkelen we de methode door. Daarnaast zullen we de methode overdraagbaar maken (do-it-yourself instrument voor bedrijven, A&O fondsen en/of onderwijsinstellingen) en onze positie versterken en impact vergroten door 'thought leadership' met een publicatie en congrespresentaties.
- Impact van platform-technologie op kwaliteit van werk: Reguliere methoden van dataverzameling onder platformwerkers blijken ontoereikend. Het is een vluchtige moeilijk te bereiken doelgroep. In 2020 ontwikkelen en experimenteren we met innovatieve en interactieve dataverzamelmethode om platformwerkers te bereiken en informatie te ontsluiten. De lessen hieruit worden ook benut in het monitorprogramma. Mogelijk wordt er ook een phd-traject opgezet met de Universiteit Twente om platformwerkers te empoweren zich staande te houden in de platformwereld.

Handelingsperspectief bieden om om te gaan met de impact van technologie...

...in Skills ecosystemen (regionaal/sectoraal niveau)

- House of Skills: De lessen van het project House of Skills in de metropoolregio Amsterdam worden in 2020 opgeleverd. TNO heeft een bijdrage geleverd aan de monitoring. De lessen m.b.t. succesfactoren en randvoorwaarden worden gepubliceerd en benut voor het opzetten van andere regionale ecosystemen voor up-skilling en re-skilling (start Friesland).
- De ontwikkeling en toepassing van de Paskamer (die intersectorale mobiliteit stimuleert via matching op basis van skills) wordt geëvalueerd en de lessen worden gepubliceerd en meegenomen voor nieuwe toepassingen van de Paskamer. Om meer inzicht te krijgen in de werking van ecosystemen start een promotieonderzoek in samenwerking met de Universiteit Utrecht naar zes internationale skills ecosystemen.

...met Lerende en innovatieve organisaties (organisatieniveau)

- Wendbaar Vakmanschap in Lerende Organisaties: Het programma Wendbaar Vakmanschap in Lerende Organisaties (Wvlo) gaat het tweede jaar in. TNO zal aan de hand van het ontwikkelde organisatiemodel samen met MBO en bedrijfsleven interventies ontwikkelen en testen. Daarvoor wordt onder meer de recent ontwikkelde diagnostool ingezet. Daarnaast streven we er naar om enkele tools te ontwikkelen voor 'eigen regie' in Leven Lang Ontwikkelen (met Hogeschool Arnhem Nijmegen en 'samenwerkende O&O fondsen') en samenwerking met de Actie-agenda LLO van de SER.
- Intrapreneurship: de door TNO Intrapreneurial Behaviour Measure (IBM) wordt samen met een partner toegepast in de praktijk. Daarnaast wordt een stappenplan op het gebied van intrapreneurship ontwikkeld en getest in samenwerking met externe partners.

Samenwerkingspartners: nationaal: A&O fondsen, brancheorganisaties, VNO-NCW, FNV, SER, CBS, SBB, UWV, sectorale en regionale samenwerkingsverbanden, individuele bedrijven, universiteiten (UU, Erasmus, UT en hogescholen (Windesheim, HvA, HAN, Saxion), nationale overheid als werkgever (BZK) en beleidsmakers (SZW, OC&W, EZ) en regionale overheden. Internationaal: Cedefop, Eurofound, DG Employment, DG Grow, en de (voormalig) partners van EUWIN.

Inclusive Work

Het kennisinvesteringsprogramma Inclusive Work rust op drie pijlers: 1. versterken van werkzoekenden, 2. stimuleren vakmanschap van re-integratieprofessionals en 3. bevorderen van inclusief ondernemen. Op het snijvlak van pijler 1 en 2 continueren we het onderzoek naar componenten van 'samen beslissen' (shared decision making, beproefd concept afkomstig uit de gezondheidszorg) die leiden tot een betere samenwerking tussen re-integratieprofessional en werkzoekende en meer evidence based werken. In co-creatie met klantmanagers en werkzoekenden ontwikkelen we tools die die componenten versterken. T.b.v. de tweede pijler hebben we laatste jaren kennis ontwikkeld over de 'leidende principes' voor het handelen van re-integratieprofessionals. In 2020 zetten we samen met 10-15 gemeenten, Divosa, Beroepsvereniging voor Klantmanagers, universiteiten en hogescholen een Community of Practice (CoP) op. De CoP beoogt een intensieve samenwerking tussen praktijk, wetenschap én het onderwijs en beoogt antwoorden te vinden op vraagstukken die de professional ondersteunen in zijn of haar keuzes t.a.v. individuele gevallen en t.a.v. de ondersteuning van werkgevers die inclusief (willen) ondernemen.

We werken toe naar een gedeelde body of knowledge, op basis waarvan de gehele sociale dienst - van hoog tot laag werkt - volgens de 'leidende principes'. Op de derde pijler continueren we in de eerste plaats het longitudinale onderzoek naar inclusief ondernemen waarmee we zicht krijgen op het willen, kunnen en volhouden van inclusief ondernemen. De inzichten die we opdoen maken we toegankelijk voor HR-professionals, adviseurs inclusief ondernemen en werkgeversservicepunten van gemeenten met behulp van digitaal leer- en instructiemateriaal. In de tweede plaats onderzoeken we in het kader van de derde pijler de effecten van de inzet op de arbeidsmarktpositie van mensen met een afstand tot de arbeidsmarkt. Ook wordt het aantal pilots rond inclusieve technologie uitgebreid. Nieuwe elementen in het programma voor 2020 - op het snijvlak van de drie pijlers - is ten eerste een verkenning op de mogelijkheden van de 'Gemeente 3.0' waarin in een 'living lab' geëxperimenteerd wordt met nieuwe vormen van ondersteuning aan werkzoekenden. We onderzoeken hoe werkzoekenden met de inzet van technologie ondersteund kunnen worden bij het zoeken en vinden van werk (Bv. via Virtual Reality kennis maken met werksoorten, werktaken oefenen, self assessments, in een virtuele omgeving sollicitatiegesprekken kunnen oefenen waarbij feedback wordt gegeven). Met een tweede nieuw thema leggen we de link met het SZW-kennisprogramma Werkgeversinterventies Arbeidsmarktintegratie (KWA); onderzocht wordt de betekenis van interculturele verschillen voor de samenwerking tussen professional en werkzoekende en voor het inclusiviteitsbeleid van bedrijven.

Samenwerkingspartners: koplopergemeenten landelijk Innovatie Centrum Sociaal domein, Windesheim, Startfoundation, AAVN, SBCM/Cedris, Extend/Universiteit Twente, CBS, PSO Nederland, uitzendorganisaties, sociale ondernemingen (Amfors, DSB, Ergon, Senzer en WVS) en reguliere technologie bedrijven (Dorel, Hapro, Secrit en VDL).

Dynamiek

In 2020 zal zullen de huidige kennislijnen worden voortgezet. Binnen de kennislijn sustainable work is groei voorzien op het domein van exposoom, middels matching van een grootschalig internationaal H2020-project EPHOR. Ook is groei voorzien op het vlak van digitalisering/robotisering in relatie tot safety. Binnen de kennislijn inclusive work zal meer nadruk komen te liggen op het onderdeel inclusive organisaties. Binnen het onderdeel gemeentelijke uitvoering verschuift de focus van professionalisering van de uitvoering meer naar het perspectief van werkzoekenden en innovatie van de gemeentelijke dienstverlening. Ook zullen middelen beschikbaar komen ten behoeve van de aansluiting bij het SZW-kennisprogramma Werkgeversinterventies Arbeidsmarktintegratie. Tot slot zal vanuit het VP Arbeid aansluiting gezocht worden bij het Early Research Programme Hybrid AI, waarbinnen een use-case Arbeid start.

Titel	Jeugd: Gezond, Veilig en Kansrijk opgroeien (P211)
Missie/ Topsector	Gezondheid en Zorg
Contactpersonen TNO	<i>Symone Detmar</i>
Contact extern	

Programma jaar 2020 - Samenvatting

Het programma Jeugd: Gezond, Veilig en Kansrijk opgroeien richt zich op kinderen en jongeren vanaf preconceptieperiode tot jong volwassene met als doel dat ieder kind zo goed mogelijk kan participeren in de maatschappij. Specifieke aandacht gaat uit naar het bereiken van kwetsbare gezinnen, in lijn met de missie van VWS, zoals verwoord in de kamerbrief van 27 april 2019 over het missiegedreven topsectoren- en innovatiebeleid: *"In 2040 leven alle Nederlanders tenminste vijf jaar langer in goede gezondheid, en zijn de gezondheidsverschillen tussen de laagste en hoogste sociaal-economische groepen met 30% afgenomen"* De grote diversiteit aan achtergronden, opgroeiomstandigheden en kenmerken van jeugdigen en hun ouders gaat namelijk nog te vaak samen met ongelijkheid in uitgangspunten, kansen en effectiviteit van preventie en interventies. Onze aanpak richt zich derhalve op het op maat ondersteunen van ouders in de opvoeding en het begeleiden van kinderen en jongeren waar nodig en het bieden van een systematische en integrale aanpak met richtlijnen, signaleringsmethodieken en "evidence" based vroege interventies in het hele netwerk van preventie en zorg voor jeugd.

TNO richt zich op een drietal hoofdlijnen. Deze hoofdlijnen zijn in nauwe samenspraak met diverse stakeholders (o.a. ministerie van VWS, ZonMw, NCJ, NJI) tot stand gekomen, mede op basis van raadpleging van diverse externe strategische agenda's (o.a. VWS, NWA, topsector LSH, H2020, VN Sustainable Development Goals).

Het betreft de volgende hoofdlijnen:

Integrale aanpak eerste 1000 dagen: De eerste 1000 dagen, van preconceptie tot minimaal 2 jaar, zijn cruciaal voor de ontwikkeling van het kind. Hier wordt de basis gelegd voor de fysieke, emotionele, intellectuele en sociale ontwikkeling en daarmee voor een gezonde en kansrijke toekomst. Wij richten ons op het ondersteunen van (aanstaande) ouders, met een focus op ouders met lage gezondheidsvaardigheden door doorontwikkeling van preventie en zorgmodellen waarbij zelfmanagement, interactie en peer support centraal staan. (centeringpregnancy en centeringparenting). De doorontwikkeling richt zich op het integreren van deze modellen tot een ketenaanpak, waarbij de groep centraal staat en de zorgverleners de groep volgen. *In 2020 zal een eerste pilot plaatsvinden van deze ketenaanpak in de Veenkoloniën.* Tevens richten we ons op de doorontwikkeling van de D-score (een maat om ontwikkeling van kinderen te kunnen monitoren). *In 2020 willen we de D-score als internationale standaard op de kaart zetten.*

Preventie en Jeugdhulp op maat: Hier richten we ons op het ondersteunen en versterken van kinderen en ouders en professionals in de (preventieve) zorg voor jeugd. We richten ons specifiek op hoe om te gaan met uitdagingen en ingrijpende levensgebeurtenissen en op de persoon toegesneden instrumenten en interventies tbv een gezonde leefstijl en mentale weerbaarheid. Hierbij gaat het om het stimuleren van gezondheidsbevorderende gedragingen (bijv. gezonde voeding), voorkomen van risicogedrag, stimuleren van keuzes en opvolging van gezondheidsadvies en gezondheidsbeschermende maatregelen (bijv. rondom vaccinatie). *In 2020 zal op maat advisering rond vaccinaties doorontwikkeld en (voor HPV) geïmplementeerd worden. Tevens zullen in 2020 diverse interventies op het gebied van vergroten weerbaarheid en ondersteunen bij ingrijpende levensgebeurtenissen worden doorontwikkeld en een eerste proof of concept van "slimme" richtlijnen binnen de JGZ geïmplementeerd worden.*

Samenwerking en implementatie: Met kennis van samenwerkings- en implementatievraagstukken richten we ons op het ondersteunen van organisaties om de transitie en transformatie van het jeugdstelsel goed vorm te geven. Onze focus ligt op het opzetten van duurzame leernetwerken en ontwikkelen van sturingsinformatie voor gemeenten. *In 2020 zullen we dit met name uitvoeren en door ontwikkelen door het opzetten van leernetwerken.*

Korte beschrijving

TNO richt zich in het meerjarenprogramma Jeugd 2018-2021 op een drietal hoofdlijnen. Deze hoofdlijnen zijn in nauwe samenspraak met diverse stakeholders (o.a. ministerie van VWS, ZonMw, NCJ, NJI) tot stand gekomen, mede op basis van raadpleging van diverse externe strategische agenda's (o.a. VWS, NWA, topsector LSH, H2020, VN Sustainable Development Goals). In het bijzonder wordt ingezet op en afgestemd met het Programma Kansrijke Start van het ministerie van VWS en de daaruit voortkomende kennis en innovatieprogramma's van ZonMw en NWO/NWA.

Integrale aanpak eerste 1000 dagen

Wij richten ons op onderzoek naar goede aansluiting binnen de gehele keten van zorg voor het kind en welbevinden van de (toekomstige) ouder, startend voor de zwangerschap en doorgaand in de kraamzorg en verder naar de Jeugdgezondheidszorg. We richten ons met name op interventies die ook kwetsbare doelgroepen bereiken. Voorbeelden zijn het bereiken van kwetsbare doelgroepen met preconceptieadvies door inbedding van een lesprogramma in het MBO, en het aanbieden van een integraal zorgmodel door doorontwikkeling van CenteringPregnancy en Centering Parenting naar een doorgaande lijn, waarin ketenbrede zorg wordt verleend.

Daarnaast wordt aangesloten bij innovatieve ontwikkelingen op het gebied van

E-Health, statistical modelling en big data. Zo zijn wij leidend in onderzoek naar een internationale maat om ontwikkeling te kunnen meten (de zogenaamde D-score). Deze maat wordt een belangrijke uitkomstparameter (naast groei), waarmee interventies kunnen worden geëvalueerd. In 2020 zetten wij in op verdere validatie van deze maat door participatie in een grootschalige internationale studie, geleid door de WHO. Tevens zal de D-score inzicht kunnen bieden op het volgen van de ontwikkeling van individuele kinderen, zodat vroegtijdig ontwikkelingsachterstanden gesignaleerd kunnen worden. Daarnaast

wordt nagegaan hoe een dergelijk instrument geïmplementeerd kan worden in de praktijk, zowel in de (jeugd)gezondheidszorg als in de dagelijkse praktijk, door ouders zelf. Kennis wordt met name doorontwikkeld op (statistische) modellen voor ontwikkeling, ketenaanpak en implementatie in de praktijk.

Dit doen we samen met partners zoals de Bill and Melinda Gates Foundation en de Bernard van Leer Foundation.

Preventie en jeugdhulp op maat

Hierbij richten we ons op het ondersteunen en versterken van kinderen en ouders en professionals in de (preventieve) zorg voor jeugd. We richten ons specifiek op hoe om te gaan met uitdagingen en ingrijpende levensgebeurtenissen. Pesten, kindermishandeling en (v)echtscheiding zijn dergelijke uitdagingen in het leven van kinderen: ingrijpende omstandigheden die het veilig opgroeien van een kind bedreigen. Het onderzoek vindt plaats in de settings thuis, de school en de buurt, in afstemming met JGZ, jeugdhulp en met de arbeidssector. In projecten op het gebied van sociaal emotioneel leren (SEL) en weerbaarheid op scholen wordt de verbinding gemaakt met het voorbereiden van jongeren op de arbeidsmarkt. Naast ondersteuning voor ouders en kinderen zelf, richten wij ons ook op betrouwbaar signaleren en screenen, effectieve methoden voor preventieve ondersteuning en zorg, en wetenschappelijk onderbouwde handelingsrichtlijnen voor professionals. Ook in deze ontwikkelingslijn maken wij gebruik van digitale hulpmiddelen om advisering en coaching op maat te kunnen geven. Zo richten we ons bijvoorbeeld op slimme richtlijnmodules voor de Jeugdgezondheidszorg en op advies op maat rond vaccinaties. In 2020 zullen de eerste resultaten hiervan beschikbaar zijn voor de praktijk. Specifiek werken we aan I-JGZ: een breed gedragen ICT-oplossing, gebaseerd op integratie en personalisatie van digitale innovaties in de Jeugdgezondheidszorg. Kennisontwikkeling vindt met name plaats op onderbouwing/validatie van effectieve gedragsveranderingen en – communicatie methodieken en op e-health.

Samenwerking en implementatie

Met de transitie en transformatie van het jeugdstelsel wil de overheid de grote druk op de gespecialiseerde zorg terugdringen. Vraagstukken op het gebied van onderwijs, zorg en participatie vragen tevens om een integrale benadering. In de praktijk blijkt het echter nog zeer lastig te zijn om dit goed vorm te geven. Met kennis van samenwerkings- en implementatievraagstukken richten we ons op het ondersteunen van organisaties om dit goed vorm te geven. Onderzoek wordt bijvoorbeeld gedaan naar: monitoring van zorgvraag en –aanbod ter onderbouwing van vraaggestuurde zorg; onderbouwing van modellen voor integrale zorg, zowel in de community, dichtbij het gezin thuis, als in de zorg en evaluatie van de werkzaamheid van innovaties. Er is binnen deze lijn specifiek aandacht voor lage SES-groepen en multi-probleemgezinnen.

Ook is hierbij aandacht voor het versterken van het ‘evidence-based’ handelen in de praktijk en het beleid. Dit geschiedt in de vorm van het gezamenlijk met de praktijk, het beleid en universiteit uitvoeren van onderzoek, continue feedback van onderzoeksresultaten en het ontwikkelen van scholings- of implementatieprogramma’s.

Dit doen we bijvoorbeeld binnen de Academische Werkplaats SAMEN (samenwerkingsverband van 20 organisaties op terrein van onderzoek, praktijk, onderwijs en beleid in regio Midden-Holland) en binnen I-JGZ. Kennisontwikkeling vindt met name plaats op (statistische) sturingsmodellen en implementatie strategieën.

Externe aansluiting:

Het meerjarenprogramma Jeugd sluit aan op de agenda van het ministerie van VWS en bij de Maatschappelijke Uitdaging Gezondheid en Zorg en daarmee de topsector Life Sciences and Health (Preventie coalitie) en op het Missiegedreven Innovatiebeleid op het terrein van gezondheid, specifiek m.b.t. vroege preventie, (meer kinderen een gezonde, veilige en kansrijke start), waarvoor VWS in 2019 het programma Kansrijke Start gelanceerd heeft.

In de KIA LSH zijn kennisvragen rondom preventie en participatie in de samenleving en de ontwikkeling van jeugdigen opgenomen. Een deel van het programma heeft raakvlakken met de Maatschappelijke Uitdaging Inclusieve en Innovatieve Samenleving.

Daarnaast is er samenhang met de volgende routes uit de Nationale Wetenschapsagenda:

- Jeugd in ontwikkeling, opvoeding en onderwijs.
- Gezondheidszorgonderzoek, preventie en behandeling.

- Op weg naar veerkrachtige samenlevingen.
- Neurolab.

Binnen de routes 'Jeugd in ontwikkeling, opvoeding en onderwijs', 'Op weg naar veerkrachtige samenlevingen' en 'Neurolab' zijn gefinancierde projecten waaraan wij deelnemen met expertise die opgebouwd is vanuit het kennisprogramma Jeugd. Momenteel is tevens een onderzoeksvorstel rond Early Life Stress ingediend in de lopende NWA call.

Ook sluit het programma aan op de EU H2020 challenge Health, demographic change and wellbeing. Ons voorstel voor implementatie-onderzoek van Centeringpregnancy and parenting voor verbeteren gezondheid 1e 1000 dagen voor de H2020 (RIA) call : Implementation research for maternal and child health is gehonoreerd en zal in 2020 starten. Dit zal ook basis bieden voor verdere internationalisering,

Daarnaast is er aansluiting bij het Innovation for Development programma van TNO, met name op het gebied van het ontwikkelen van strategieën voor verbeteren moeder en kindzorg. Er lopen projecten in Suriname, Ghana en Togo,

Interne aansluiting

Binnen TNO bestaat samenhang tussen het programma Jeugd: Gezond, Veilig en Kansrijk opgroeien en investeringen in onderliggende kennisontwikkeling (Early Research Programs): Personalised health, Exposoom, AI. Ook met het i.o kiem ERP: Body brain.

Samenhang en samenwerking met het VP Arbeid is er op het snijvlak van Jeugd en werk, en zal geïntensiveerd worden op de terreinen: 1. scheiding & werk, 2. ouderschap & werk en 3. scholing/alle kansen voor alle kinderen.

Samenhang met het VP Predictive Health Technology is er op het terrein van het gebruik data/ e-health. In 2020 zal gezamenlijk een PPS opgezet worden ten behoeve van het gebruik van digitale innovaties voor de Jeugd met het consortium I-JGZ.

Met het VP Metabolic Health wordt verder ingezet op het integreren van kennis van biomedische en gezondheidsdomein. In 2020 zal dit met name ingezet worden op vroege signalering en interventieontwikkeling van overgewicht.

Voor uitvoering van het programma zal naast kennis van de expertisegroep Child Health samenwerking aangegaan en uitgebreid worden met de Researchgroepen WHT, SPE, MSB, Rapid, Data sciences, Perceptual and Cognitive Systems.

Resultaten 2020

In 2020 zal TNO zich blijven richten op het ontwikkelen, implementeren en evalueren van evidence-based innovaties voor ouders/jongeren en het (preventieve) veld. We willen deze positie borgen en versterken door nog mee in te zetten op multidisciplinaire kennisontwikkeling en consortiumopbouw waarbij we ons met name richten op inzichten en handelingsopties voor het bereik van kwetsbare groepen. Daarnaast zal ingezet worden op het versterken van kennis rond gedragsbeïnvloeding om strategieën te ontwikkelen om ouders/jeudigen en professionals duurzaam te kunnen ondersteunen. Door meer in te zetten op het ontwikkelen van slimme statistische technologieën (inclusief big data analyses) zal er gericht en efficiënter ondersteuning geboden kunnen worden. Uiteraard is het borgen en verstevigen van domeinkennis onontbeerlijk om kennis daadwerkelijk voor en met het veld te ontwikkelen.

We werken binnen grotere consortia aan onze kennislijnen.

Voor de lijn 1e 1000 dagen is dat met NJI, NCJ, MinVWS, Bernard van Leer foundation, gemeenten, zorgverzekeraars. VWS heeft in september 2019 het Actie Programma Kansrijke Start gelanceerd, gericht op versterken kwetsbare (aanstaande) ouders waarin vanuit het rijk 32 miljoen beschikbaar is gesteld voor de komende drie jaar. Wij zijn volop betrokken bij dit programma en gebruiken onze kennis in aansluiting op dit programma en de bijbehorende kennisvragen uitgezet bij ZonMw en NWA/NWO. We zetten tevens in op deelname aan de WHO validatiestudie internationale ontwikkelingsmaat van kinderen. *In 2020 zal een eerste pilot plaatsvinden van een geïntegreerde ketenaanpak van groepszorg in de Veenkoloniën en zal de D-score als internationale standaard gevalideerd worden.*

Voor de lijn preventie en jeugdhulp op maat is dat met NCJ, JGZ organisaties, ACTIZ, GGD-GHOR, ICT kinddossier bedrijven, ouderorganisatiesVWS, Health Holland. In samenwerking met VWS en Health Holland hebben we in 2019 een zogenaamde "health deal" ondertekend ten behoeve van gepersonaliseerde preventieve zorg voor jeugd. In 2020 willen we hiervoor een PPS afsluiten in afstemming met het VP: Predictive Health Technology, gericht op het benutten en integreren van de data van de JGZ via de FAIR principes. In 2020 zal op maat advisering voor ouders en meisjes over deelname aan hpv vaccinatie met behulp van getailorde informatie landelijk ingevoerd worden en beogen we voor andere vaccinatieprogramma's tailorde communicatie te ontwikkelen. Tevens zullen in 2020 diverse interventies op het gebied van vergroten weerbaarheid en ondersteunen bij ingrijpende levensgebeurtenissen worden doorontwikkeld en een eerste proof-of-concept van "slimme" richtlijnen zal binnen de preventieve zorg voor jeugd geïmplementeerd worden.

Voor de lijn samenwerking en implementatie werken we met vele organisaties samen in de Academische werkplaats SAMEN. *In 2020 willen we deze samenwerking versterken door gezamenlijk een aanvraag te doen bij ZonMw: versterken Academische werkplaatsen Jeugd waar we onze kennis van lerende organisaties gebruiken voor het opzetten van Leernetwerken.* Ook big data analyses zullen hierbij ingezet worden om sneller en beter in kaart te krijgen wat de verwachte zorgvraag zal zijn.

Dynamiek

Gezien de toenemende (inter)nationale aandacht voor vroege preventie zijn er volop kansen voor het Programma Jeugd. Het programma is goed aangesloten op de belangrijke dossiers en kennisvragen van de (centrale) overheid. Dit uit zich in veel passende programma's van ZonMw en grotere fondsen. Aandacht voor Preventie, eerste 1000 dagen, transformatie van het jeugdstelsel en implementatievraagstukken zijn zeer actueel en groeiende. De honorering van bv het EU voorstel: implementatie-onderzoek van Centeringpregnancy and Parenting voor verbeteren gezondheid 1e 1000 dagen en het sluiten van de health deal I-JGZ geeft aan dat onze kennisontwikkeling goed aansluit op deze maatschappelijke vragen.

De huidige vragen van VWS richten zich voornamelijk op preventie, kwetsbaren van de samenleving en de eerste levensfase. Gezien de grootte en breedte van het veld, waardoor continue kennisontwikkeling en borging noodzakelijk is om hierop goed te kunnen aansluiten, alsmede vanwege de benodigde matching van Eu calls, NWO/NWA calls en Raak subsidies, zullen de middelen van het programma Jeugd hier op gericht zijn. Samenwerking en afstemming met (middelen van) andere Vraaggestuurde Programma's binnen de Unit Healthy Living van TNO, P's, in het bijzonder het VP Predictive Health Technology, zal noodzakelijk zijn, om ook de gewenste samenwerking met private partners in het preventie domein vorm te geven.