Roadmap TU/e Research 'Human Vitality and Technology'

Milestones

Small-scale research in controlled environments
Use of limited size and short-term experiments in controlled environments to gain understanding of vitality at individual level

Limited-scale 'real' experience research in Living Labs
High quality (user-friendly and reliable) prototypes are co-created with industrial partners to enable larger-size experiments in the field (Living Labs)

Large-scale, longitudinal research in-situ
Intelligent and adaptive systems allow large-scale research into the real context of users, enabling research on longitudinal effects of interventions in vitality

Research Design

Human-centred research
Self-tracking and 'quantified self' approach to collect data on people's vitality, preferences and behaviour profiles – using technology as an enabler

Controlled environments
Use of (lab)prototypes in small-scale interventions to learn (research through design)

Systems approach
Systems approach to complex problem-solving: understanding, modelling and engineering of solutions

Involving stakeholders
Applying a network view to vitality to gain understanding of how it works from community perspective (> individual) — involvement of all stakeholders in the chain to be able to combine strengths and knowledge

Living Labs
Understanding 'research in context' more deeply to enable scaling-up to more users and involvement of more stakeholders in the process — including public and private sectors to enable market transformation

Integrated approach
Integrated approach to research with holistic, disruptive solutions and interdisciplinary collaboration — enabled by a large project with a higher aim that drives collaboration

In situ
Making use of adaptive systems to scale-up and accelerate iterative processes in the real user context — enabled by the grown up digital natives that form a significant part of the user group

Research Conditions

System integrator role
Applying and integrating different technologies to create prototypes of complex adaptive systems to explore new products and services in context

Design methodology
Connecting abstract challenges (vitality) to the human scale and designing solutions by integrating different disciplines

Designing desirable solutions
Combining a human-centric research approach with design to create aesthetically and convenient solutions, and marketing to create solutions people love to use

Research enabling technologies
Drive the development of new technologies (e.g. sensors) to enable further research — research questions define data collection methods in Living Labs

Professional prototyping
Creating attractive, high-quality products (production-quality prototypes) with sensors, actuators and software to enable large-scale research in the real user context (addressing individual differences)

Longitudinal research
Longitudinal evidence-based research on the effects of interventions and scaling-up of experiments in real life through integration of modelling and simulation (e.g. multi-agent simulations)

Technology

Data acquisition on/in people
Design (small, efficient) sensors and their use (electronic, optical or combination) and devices (e.g. smart watches, biofeedback and genomics) to collect data by measurements in and on people

Data acquisition in the environment
Design of sensors and 'Internet of Things' applications to measure context of people (e.g. connected lighting) — what they do, where they do it, and what motives are

Data analytics
Processing sensor data to detect patterns and changes for diagnosis (e.g. retina analysis to detect diabetes) and give feedback to users

Data representation for analysis
Visualisation of data as interactive analysis instrument

Uncertainty quantification
Dealing with uncertainty in data sets (e.g. fluctuations, measurement inaccuracies) to understand the certainty of diagnosis and make better predictions

Data security
Development of new methods for real-time mathematics and data analysis, and to increase security of personal information and stay ahead (e.g. discrete mathematics)

Combining data sources
Mash-up of data from personal sensors, smart buildings, smart cities and open data to gain understanding of the impact of individual patterns and choices on vitality (bottom-up and top-down approaches)

Improved data acquisition
Cheaper, smaller, integrated and self-sustaining sensor technologies — development of non-invasive sensors and data collectors — development of smart devices and apps as measuring instrument

Data representation for intervention
Monitoring the effect of interventions with the help of data (behavioural psychology and personal lifestyles) — towards fast learning cycles to increase effectiveness

Prediction models
Processing of sensor data to develop better models to predict vitality and health — modelling of complex adaptive systems — monitoring and measurement to gain understanding of behaviour and choices

Simulation methodology
Development of new simulation methods to integrate multidisciplinary perspectives on vitality — in collaboration with experts on measurement technology and behavioural interventions

Combining tools and techniques
Combination of tools and techniques to integrate historical and current situations for data analysis and representation in real-time applications

Human behaviour

'To measure is to know'
Knowledge of collecting and analysing data to gain understanding on different aspects of vitality

Individual behaviour
Knowledge of influencing momentary behaviour at a personal level

Impact of individual choices
Understanding the effects of choices in the environment (e.g. sound, light and ventilation) and behaviour (e.g. sleeping, eating, use of media) on vitality

Influencing behaviour
Gaining understanding ofthe differences in lifestyles, behaviour patterns and motives of people to adopt healthy behaviour with the assistance of persuasive technologies (e.g. physical activity).

Social approach
Understanding the complexity of differences in target groups and the influence of the social environments on vitality — and design to encourage people to be active (e.g. community apps like GameBus)

Defining an overall vitality index for positive health
Defining a unified index to establish the holistic impact of interventions and lifestyles — together with measurements (what and how to measure)

Personalised technology
Knowledge of data acquisition, analysis and representation for personalised interventions

Behaviour in social context
Knowledge of influencing momentary behaviour in a social context (group level)

Impact of the social context
Understanding the effect of the social context of people on their behaviour (e.g. physical activity) and how this relates to individual information (lifestyle, quality of life)

Changing behaviour
Application of smart devices and apps as intervention instrument — monitoring and measuring to make people smarter and motivate them to change their behaviour

Social interventions
Creating social movements by using people's sense of community and addressing people with similar profiles to create socially accepted behaviour change

Monitoring the overall vitality index to gain understanding
Combining data from all relevant sources to build a holistic data set on vitality and positive health to gain understanding of the different target groups

Real-time technology
Knowledge of data acquisition, analysis and representation to support real-time interventions.

Smart strategies
Keeping people healthy to the max with minimal effort — Integrating knowledge from 'smart machine maintenance' and vitality in 'smart body maintenance'

Real-time methodologies
Computational science and engineering to develop methodologies for calculations and analysis of large data sets in real time

Interventions with impact on the overall vitality index
Personalised intervention strategies based on understanding of barriers for different social groups to create social impact (economic, social, health & well-being)

Societal change
Knowledge of personalised interventions for lasting behaviour change, while people keep autonomy

Lasting behaviour change
Provide people with individual control by timely and sufficiently certain interventions, and smart algorithms that provide accurate advice to suit individual preferences and the current social context

Social inclusiveness
Extending the scope of interventions now that the digitally excluded members of society also become 'linked-in'

Environment

Healthy environments
Knowledge of the impact of the outdoor and indoor living environment on the vitality and health

Impact of the outdoor environment
Analysis of the living environment (wind, urban green, air quality) and its impact on vitality

Impact of the indoor environment
Analysis of the environment (lighting, ventilation, position of e.g. stairs) and impact of physical infrastructures on vitality to create healthy living/working environments

Design of the living environment
Research into design constraints for the correlation between vitality, behaviour and the physical context at all levels (interior, building, environment)

Design for resilience
Designing for resilience of people by taking the social context into account

Changing outdoor environment
Combining the physical and virtual environments for people to become healthy and vital

Design of the social context
Realising new systems in the social context — between individual and collective solutions — to create socially inclusive designs that promote active and healthy lifestyles

Holistic design approach
Design approach to integrate people, their behaviour and their social & physical environment

Holistic design approach
Integrated design of systems, buildings and public spaces around people, their behaviour and their social environment with the goal of creating healthy and pleasant living environments

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2016 2020 2030

2030

TU/e strategic ambition

'Human Vitality and Technology'

Increasing people's vitality is considered as a very important goal to achieve a high quality of life. It is one of the most important considerations for people, and good health also brings many other benefits such as enhanced access to education and the job market, increased productivity and wealth, reduced health care needs and costs, good social relations, and of course longer lifetime. Lifestyles and living environments are important determinants of health and vitality. Technology is an important enabler in the promotion and adoption of healthy lifestyles, with physical activity and healthy food and sleep patterns. TU/e can make a difference through technology with a human focus. Three related core ambitions of TU/e are defined:

2 The vital person
We approach vitality in a broad sense: physical, mental and emotional — and the impact of physical activity, food and sleep patterns. We research solutions that make preventive, personalised and proactive contributions to healthy lifestyles.

1 Technology for healthy lifestyles
The human body is the focus of our research. We make a difference through our research by the integrative power of analysis (sensor technologies and data science) and synthesis (engineering solutions for personalised interventions).

3 In context and with partners
We conduct research in the real context of people and with partners. We play a key role in the collaboration in the area of human vitality and technology.

The roadmap shows the different research activities on the short, mid and longer term to realise the strategic ambition. Th roadmap combines the strengths of TU/e in sensor technology, data science, design of products and living environments and behavioural psychology to address vitality and contribute to national and international programs in the area of health and well-being, and sports and excercise.

The roadmap focuses on TU/e research activities, but is intended for discussion with ecosystem partners in the Brainport region, and national and international partners to promote collaborative research and innovation in the area of human vitality and technology.