

Stories from the Future 2030

Volume 3 of results from the search phase of
BMBF Foresight Cycle II



Axel Zweck, Dirk Holtmannspötter, Matthias Braun,
Lorenz Erdmann, Michael Hirt, Simone Kimpeler

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1 OVERVIEW OF THE FORESIGHT PROCESS

Foresight is an instrument that provides a long-term perspective so that orientational knowledge for strategic decisions can be generated at an early stage. Since 2007, the German Federal Ministry of Education and Research (BMBF) has adopted a cyclical method for its Foresight processes. The last completed BMBF Foresight process (Cycle I, 2007-2009) centred on a technology-oriented approach. For Cycle II (2012-2014), the emphasis is on future social trends and challenges. With the completion of the search phase of the second cycle of the BMBF Foresight process, exciting results concerning future social and technological developments with a time horizon of 2030 are now available. The process addresses possible upheavals in the fields of health, research and innovation, education, business, politics and work. This Foresight process was conducted on a subcontractor basis by VDI Technologiezentrum GmbH in conjunction with the Fraunhofer Institute for Systems and Innovation Research (ISI), as the *Foresight Office* (Büro Foresight).

Cycle II: social challenges in focus

Time horizon 2030

Foresight provides BMBF with orientational knowledge concerning possible future social and technological trends, so that emerging challenges can be identified at an early stage and, if necessary, addressed via research and/or innovation policy measures. From the point of view of the *Foresight Office*, it is not claimed that the identified trends and challenges are entirely new to BMBF. Instead the intention is to provide the ministry with a full and complete basis for discussion, and to highlight implications for research and innovation policy.

Orientalional knowledge for BMBF

Meanwhile, the findings of the Foresight process are of interest not only for research and innovation activities, as businesses can also use the findings to identify challenges and prospects for the future in their business areas.

Orientalional knowledge for businesses

A method consisting of three work stages was chosen for the Foresight process (see figure 1). As the first stage (A), social trends and challenges with a time horizon of 2030 were identified. The key results from the first work stage have been compiled in volume 103 as sixty trend profiles on social developments, and seven topic areas involving social challenges.

Work stage A:
60 trend profiles and
7 topic areas with
challenges for society

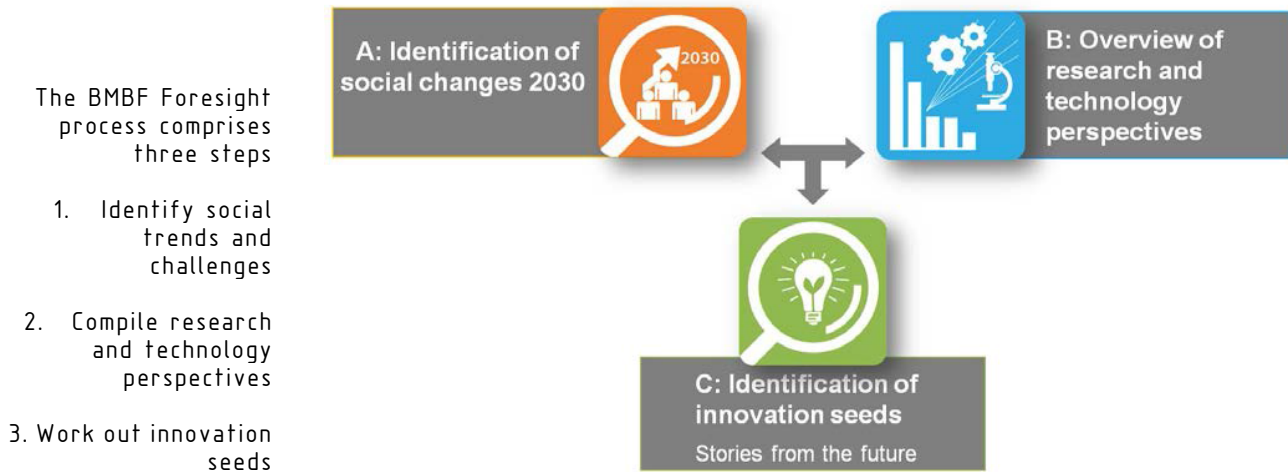


Figure 1: Three work stages for the search phase of BMBF Foresight Cycle II

Work stage B: 11 fields with research and technology perspectives (vol. 101)

In the second work stage (B), research and technology perspectives with particular application potential were identified. The most important results from eleven research and technology fields have been compiled in volume 101 (only available in German).

Work stage C: Stories from the future about 9 innovation seeds (vol. 104):

The task in the third work stage (C) was to identify new challenges at the interfaces between society and technology, in the form of innovation seeds. Innovation seeds form a basis for new potential missions in research and innovation policy. To identify the innovation seeds, the social challenges that were identified (A) were linked with the research and technology perspectives (B). To illustrate the future significance of the final nine innovation seeds, example visions of the future (Stories from the future, this volume) were formulated for the innovation seeds, and central challenges and opportunities outlined.

The following sections describe the method and the results from the first work stage, “Identification of innovation seeds”.

2 IDENTIFICATION OF INNOVATION SEEDS

The goal of the third work stage was to identify new challenges at the interfaces between society and technology, in the form of innovation seeds. Innovation seeds represent a starting point for new potential missions in research and innovation policy. To identify the innovation seeds, the social challenges that were identified were linked with the research and technology perspectives.

Innovation seeds are a starting point for new potential missions in research and innovation policy



Figure 2: Identification of innovation seeds by linking social challenges with research and technology perspectives.

To illustrate the potential future significance of the final nine innovation seeds, example visions of the future (stories from the future) were formulated for the innovation seeds, and central challenges and opportunities outlined.

Stories from the future illustrate innovation seeds

This work stage was carried out in two steps: linking, and formulation of stories from the future

Linking

As part of a creative workshop, social trends were linked to the research and technology perspectives

The linking was carried out as part of a workshop with external experts, and in a systematic linking process performed by the Foresight Office.

During a two-day BMBF creative workshop, the various different social and technological trends were exploratively brought into relation with one another via interdisciplinary dialogues. The workshop, which was held on 17/18 February 2014 in the Neue Mälzerei in Berlin, allowed 70 researchers, artists, entrepreneurs and committed citizens to familiarise themselves with all of the social themes and technology fields, firstly with regard to the drivers and possible development paths to 2030. They were then able to consider the opportunities and risks, and, in small interdisciplinary groups, develop ideas for innovations, present these to the group as a whole, and then further develop these ideas together. As the product of the workshop, ideas for links were written up by the participants.

Systematic linking by the Foresight Office

In a parallel thread of linking, possible relationships and solution approaches for all research and technology perspectives were sought for all of the identified social challenges in the systematic linking process. To this end, the Foresight Office systematically considered, in pairs, all combinations of challenges and research and technology perspectives with regard to possible relationships.

The links were compiled to produce nine innovation seeds

The results of the linking workshop and the systematic linking process were compiled by the Foresight Office, in an internal workshop, to produce nine final innovation seeds. Seeds with similar content, or with identical drivers, were merged during this work step. The key criteria here were high potential and high relevance in respect of BMBF's objectives.

The outcome of the linking process was nine innovation seeds:

- Do-it-yourself in Germany
- Citizen science in the area of health
- Automation and robotics
- Digital and virtual educational offerings
- Global innovation landscape
- Innovations support governance
- Infrastructures for socio-technical innovations
- Collaborative forms of value creation
- Privacy in transformation

Nine innovation seeds were identified

Formulation of stories from the future

To illustrate the significance of the nine final innovation seeds, example visions of the future were drafted, based in the year 2030. For each seed, a number of short stories from the future were composed, which illustrate the crux of the respective challenges. For each innovation seed, in addition to these stories, challenges and opportunities that may arise in the future were outlined.

For the innovation seeds, example visions of the future were formulated as "stories from the future"

The stories do not claim to explore the corresponding topic in full, they should not be interpreted as being desired scenarios, and nor do they represent priorities from the point of view of BMBF. They link possible developments in society with future developments in research and technology, in the form of fictional stories. They make the potential developments readily understandable, and illustrate challenges for research and innovation policy. The results may serve as a point of departure for further discussions and dialogue processes concerning the future.

Fictional stories that illustrate challenges for research and innovation policy

3 STORIES FROM THE FUTURE

Short stories from the future are presented below for each of the nine identified innovation seeds. In addition to the stories, the key opportunities and challenges for research and innovation policy are outlined for each innovation seed:

This volume contains the "stories from the future" for the innovation seeds

- Do-it-yourself in Germany
- Self-observation and well-being skills
- Work colleague computer
- Education for everyone (and everything)
- Act locally – cooperate globally
- Data-intensive governance
- Experiment together for solutions for the future
- Collaborative economy
- Privacy in transformation

3.1 Do-it-yourself in Germany

Increasing numbers of citizens are inventing, fabricating, programming, modifying and repairing things for themselves and others, instead of buying them new. By 2030, it is conceivable that freelance do-it-yourself will be an important component of economic activity. In such a knowledge and skills economy, traditional practical skills such as dressmaking, shoemaking, pottery and welding could become highly significant again, and combine with new technical skills such as computer programming and 3D printing. This may enhance the degree of personalisation and the sustainability of products, as well as improving self-fulfilment, education, and social cohesion, and therefore contribute to the development of a sustainable and competitive economy. However, it is also possible that problems will arise with regard to product quality assurance, product safety, occupational health and safety, and efficiency. Suitable infrastructures and skills are needed if this trend is to develop successfully. Today's established businesses have the challenge of positioning themselves in a potential "do-it-yourself economy", with its fluid boundary between producers and consumers.

Increasing numbers of citizens invent, make and repair objects themselves

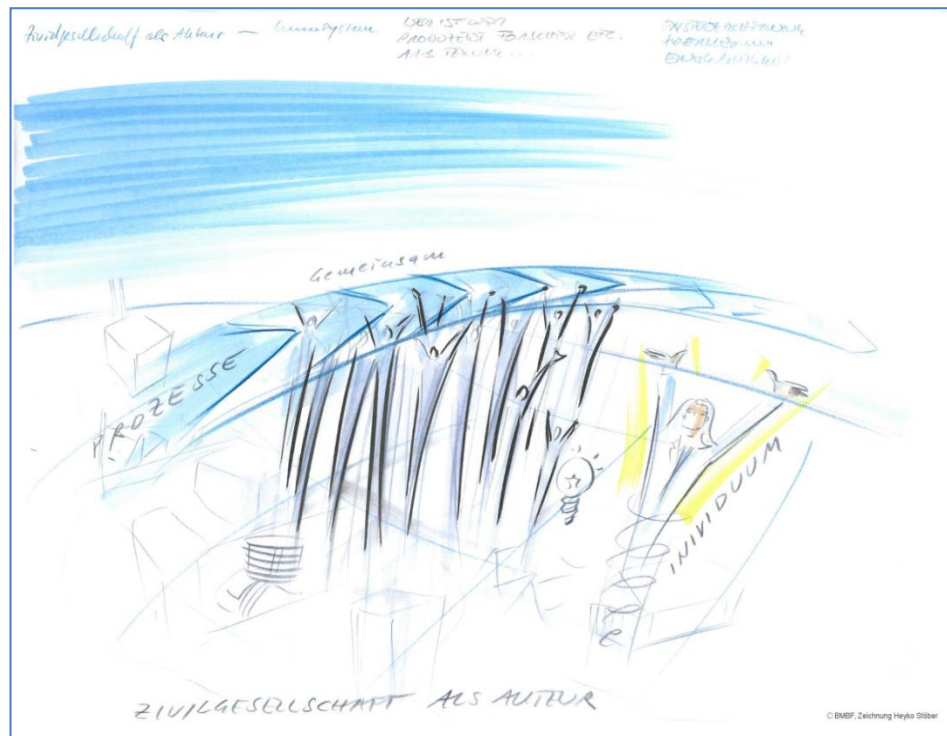


Figure 3: Civil society as an actor in the innovation system. Illustration by Heyko Stöber at the linking workshop on 17 and 18 February 2014 in Berlin. © BMBF.

Do-it-yourself in Germany: CraftSpaces 2030

As always, Tinka opens up the CraftSpace at around 9.30 a.m. Immediately, a bubbling and whistling sound springs from the mini-kitchen, accompanied by colourful flashing lights. She grins. It looks like the CoffeeBot is finally working, after the four girls from the school next door spent a week fixing it – something to do with the optical sensor, as suspected. “Wow!” On closer observation, she notices that the bot is making an extra-large amount of coffee. So the smart girls actually managed to connect the bot to the CraftSpace calendar – and now it knows that a big group is coming in this morning. She speaks into the calendar: “Remind me to put the blueprint for the CoffeeBot online today.” “Sure thing,” it pipes back. Tinka is impressed. “They’ve reprogrammed the calendar’s communication interface as well! Amazing, especially when you think how unenthusiastic these same four girls were to begin with, when they had their handicraft lessons here,” she thinks.

Tinka switches the sewing machines on. Today there should finally be enough machine capacity, as she repaired two broken-down machines only yesterday. Both machines had just two small cogs missing. She used her 3D laser printer and quickly made up replacements from a template in the CraftSpace’s virtual library. Fortunately, use of this database is now well regulated.

Until a few years ago, there were constant hassles because of alleged property rights infringements. As the operator of a certified CraftSpace, Tinka now has free-of-charge access, and her customers can earn a little money from downloads of their designs. A number of DIY-ers are even able to earn a living from their own creations, and from producing spare parts. It's a good thing, too, that only last week she ordered the newly developed TitaniumXpowder for printing the cog, as otherwise she wouldn't have been able to make the two cogs strong enough.

Her neighbour, Ralf, an environmental activist, waves to her through the door and steps inside: "Can I leave you my toaster to repair? This morning it chucked my toast three meters across the room!" "Sure, no problem," says Tinka, and thinks: "It's because of my 'Green CraftSpace' certification that he has become a regular customer of mine. I installed sound insulation, and because of the CraftSpace, the district has been able to significantly reduce its ecological footprint. Who would have thought that I would already be so established by 2030," she reflects. "Only five years ago, me and my technology-crazy friends were tinkering around with circuit boards. We saw ourselves as a small, exclusive tech community. We would have been kind of surprised at our many neighbours, of all ages, who knit, sew and build cuckoo clocks, environmental activists, and programming seniors. Now they all come and go here, and learn from each other."

Now Axel arrives, who coordinates the CraftSpace's tailoring group. The two have known each other for many years, and they have a high opinion of each other, but in the beginning it wasn't easy to get along. Axel remembers well how out-of-place he felt back then in Tinka's "tech world". As a social education worker, he was looking for a meeting place for young and old on behalf of the local church congregation, and vaguely hoped to be able to do something related to his hobby, tailoring. He never dreamed that the senior group and the cool girls from the neighbourhood would now be here trying to outdo each other at dressmaking. Tinka is pleased to see him, but soon retreats to her photonics lab - with the best will in the world, it will need to be 2040 at least before she starts to sew.

Do-it-yourself in Germany: Promoting innovation in 2030

Torsti is department head at an agency for innovation promotion in Finland. For weeks, he and his team have been working on a concept for a support programme for the do-it-yourself economy, with the working title "smart bricolage". The minister in charge of the agency initiated the project after a transnational study in 2028 showed that the do-it-yourself movement had made a significant contribution to Germany's positive socio-economic development in recent years. He reads the conclusions of the study one more time:

“... Germany’s development into a knowledge and skills society can be attributed to the high density of CraftSpaces and widespread enthusiasm among various groups in the population for their use. This trend is a clear economic location advantage for Germany. It has been shown that increasing numbers of businesses have expanded research, development and production in Germany so that they can benefit from the diversity of ideas in the do-it-yourself movement. As a result, several of these businesses, with a variety of original high-tech / self-built combinations such as have become typical in Germany since the 2020s, have succeeded in developing and establishing global markets and brands. One particular factor in Germany’s favour has been the ability to appeal to user groups worldwide that have completely different requirements and backgrounds. Between now and 2040, a further significant increase in value creation is expected in this sector of the economy.

Secondly, this study confirms the positive influence of the do-it-yourself economy on skills development in Germany. While interest in technology, science and innovation has increased among all age groups, soft skills such as self-organisation and communication have also been strengthened. Finally, the social science analysis shows that the spread of do-it-yourself in Germany has contributed to growing satisfaction and improvements in social cohesion.”

Torsti sighs. It all sounds great, but unfortunately the study doesn’t say much about how this development occurred in Germany, and what role innovation policy played in it. For this reason, Torsti sent one of his staff to Germany to interview experienced colleagues in German research and innovation policy. A number of measures emerged from this, which they want to discuss today at the team meeting: “Green CraftSpace” certification, “leading-edge maker clusters”, “CraftSpace starter kits”, and the African partnership strategy called “Sustainable Do-It-Yourself” – from which Germany gained new perspectives for do-it-yourself innovations. Torsti is keen to discover what his colleague has been able to find out, and whether they will be able to implement something similar in Finland.

Do-it-yourself in Germany: Business perspective in 2030

Carla is a designer in a furniture business. Today is her tenth anniversary of joining the firm. “Ten years already!” she thinks. “It’s incredible how time passes. And when you think how everything has developed so differently than expected.” Back in 2020, she only got a temporary contract to oversee an experimental pilot product line with an interface to Fab Labs. Everyone thought that it would soon shut down once the do-it-yourself hype subsided. Now she heads an eight-strong developer team that is fully devoted to developing products and services for the do-it-yourself movement. Together with other colleagues in accounting,

development, management and sales, her team has also developed new business models that include do-it-yourself. Today, the company supplies assembly instructions, construction kits and raw materials as well as equipment for CraftSpaces. Several employees are responsible for course management and advice in CraftSpace projects. Products and services from Carla's team have become hugely popular in Germany and other countries. Interestingly, the biggest successes have been recorded in completely different segments. The first success is high-end furniture, as increasing numbers of customers worldwide want to help design their own furniture, with professional assistance, and they are willing to pay for this service. The second big success is the "EinFach" product line, consisting of low-cost but robust and flexible furniture kits, that can be developed very easily in any CraftSpace. The brilliant design concept was devised by a partner in Eritrea. Carla knows of many other industries which have developed in a similar way. With clothing, for example, it started off with small accessories. Self-made buttons and shoelaces had been popular for some time before people increasingly began to make whole items of clothing in CraftSpaces.

Carla cuts up the cake that she brought to celebrate her anniversary. Then her boss comes around the corner: "Did you make that yourself too?" Carla groans – even ten years ago, she couldn't stand to hear that phrase!

Do-it-yourself in Germany: Cities and regions in 2030

Ernesto is the mayor of a small town in northern Germany. Today is getting off to a good start, with the opening of the new machine factory, creating more than 100 jobs, in the old industrial area. He quickly checks the programme again. Immediately after him, a historian of innovation will speak about the foundation of the firm almost exactly 150 years ago, and trace the history of the relocation and return of the manufacturing facility. Ernesto has already skimmed through the study. It is clear that the town's development into a "CraftSpace hub" was the key factor in deciding to relocate back to the town. If the firm had not been close to the CraftSpaces, they would never have scored their international sales hit with a 3rd generation fabrication robot. "And to think that setting up the CraftSpaces on the disused factory site was really a kind of emergency measure to give the laid-off workers at least some prospect of employment and prevent the decline of the area," Ernesto thinks. However, things have not always developed so positively. Ernesto himself remembers at least three businesses that had to close because they had underestimated the do-it-yourself movement. "And how will the opening event today continue?" he asks himself. After the historian, Axel from Tinka's CraftSpace is speaking. "I would like to hear his talk too," he thinks. "What have I got on my schedule for today? That's right, the opening of the Institute for Sustainable Prosumption. I can easily make that, after all they're also located in the CraftSpace hub."

Do-it-yourself in Germany: Science in 2030

Tatjana is an internationally renowned professor of material sciences, and deputy director of an applied research institute. At least she was until today – tomorrow she is starting a new job: director of IfSP, the Institute for Sustainable Prosumption. For five years, at her old institute, she and a steadily growing team worked on the concept, procured contracts, and talked with politicians and scientists as well as with do-it-yourself actors. Ultimately it was probably the impressive increase in research contracts from around the world, which were received via the crowdfunding platform, that tipped the balance so that the spin-off was finally approved. The journey from the first creative workshop that Tatjana set up in her garage in 2015, together with a few students and help from her friend Tinka, has therefore reached a new high-point. The institute will comprise six working groups: materials, sustainability, design concepts, machines, cultures, and business models for do-it-yourself. One of the town's CraftSpaces is being incorporated into the institute so that questions and suggestions from DIY-ers who are active there can flow directly into the research agenda.

Three modern fabrication robots have already been set up. They were a gift from the nearby manufacturer for the institute's founding. The institute will work in close partnership with various engineering, economics and social science departments at universities. And there is one thing that Tatjana is particularly pleased about: she saw to it that employees can do skilled craft work alongside their research activities, as she feels sure that this will help foster an innovative creative research culture.

Opportunities

The new skills of do-it-yourself actors (the “maker scene”) may increase the attractiveness of Germany as a location for research, development and production. As a result, new jobs should be created despite a simultaneous trend for highly automated mass production. There is also an opportunity for German companies to access new markets in countries where different circumstances apply, with new business models based around doing-it-yourself. Products and services that interface with do-it-yourself may both meet the increasing demand for personalised offerings for affluent customers, and attract groups with limited financial means.

It is conceivable that do-it-yourself will become another element of sustainable forms of business, and therefore promote the development of the green economy.

Do-it-yourself actors may help to increase Germany's attractiveness as a location for research, development and production

The do-it-yourself movement could mobilise creative potential for the German innovation system, revive enthusiasm for technology and innovation, strengthen the start-up culture, and encourage education in STEM subjects. Soft skills and community spirit can also be strengthened by do-it-yourself activities. The spread of do-it-yourself can be expected to be a positive force for social cohesion, inclusion, quality of life and health. In particular, it is possible that intergenerational bonds will be strengthened, and that older generations' experience-based knowledge will be mobilised.

Do-it-yourself brings opportunities for regional development, shaping neighbourhoods, and urban development. A widespread ability to do-it-yourself, especially in partnership with other people, could reinforce faith in the capacity for collective action, and so increase a society's resilience to crisis situations.

Challenges

Established businesses face the challenge of reviewing their business models with regard to more active participation by their customers, as is already happening in some cases in the context of Industry 4.0. If established products and services do not meet customers' requirements for involvement, they may easily switch to strategies of the do-it-yourself economy.

Businesses need to review their business models with regard to the new capabilities of the do-it-yourself economy

Designing regulatory frameworks for the do-it-yourself economy constitutes a major challenge, and encompasses various fields such as patent law, certification, financing, environmental law, industrial law, taxation, misuse and social security. One particularly critical point is the possible threat to public safety posed by "high-tech products in citizens' hands", as is already seen e.g. in the ready availability of drones. Product safety and liability for any damages caused by self-made products also represent challenges.

Numerous conditions still need to be clarified

Do-it-yourself could be a luxury for a few less-creative people, or equally it could serve as a survival strategy for marginalised groups. It will be a challenge to deal with tensions and counteract new exclusions. New social conflicts are conceivable as do-it-yourself spreads, e.g. because of noise disturbance in residential areas and living spaces. Moreover, a loss of efficiency and higher emission levels are feared as a result of "decentralised" manufacturing. These would need to be prevented.

As the do-it-yourself economy develops – as is similarly the case for social innovation in general – it is possible that we could see the phenomenon whereby social value is created and needs are addressed without this being reflected in conventional economic data. It will therefore be a challenge to adequately represent this sector of the economy via a suitable set of indicators.

Citizens can gain greater awareness of their bodies and improve their well-being skills

3.2 Self-observation and well-being skills

Citizens' growing interest in more consciously observing their own bodies opens up avenues for promoting and establishing a new set of "well-being" skills. Well-being skills refer to the knowledge and personal sense of what is good for you and what isn't. In the future, personal intuition will converge to a greater degree with technologically assisted self-observation of the body. Data on physiological functions will be continuously collected and processed by sensors in clothing or mobile devices.

Both the quality and quantity of data will rise continuously because of new technological developments, with the result that it will be possible to measure not only simple physiological data such as the heart rate, but also more complex data such as the hormone balance, skin impedance and blood pressure. Even medically complex cause-effect relationships between lifestyle and health will therefore become easier for many citizens to identify and understand.

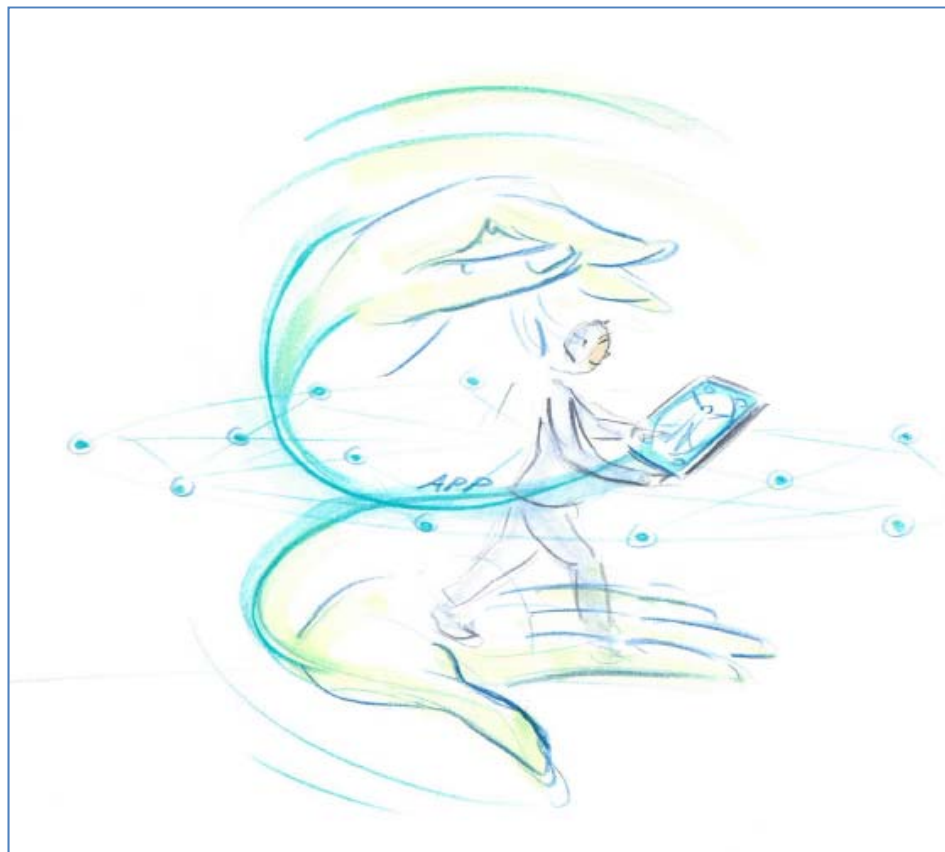


Figure 4: Linking technologies with health. Illustration by Heyko Stöber at the linking workshop on 17 and 18 February 2014 in Berlin. © BMBF

Self-observation and well-being skills: School in 2030

Lisa is in a hurry. She doesn't want to be late for her first class of the day. Firstly, she doesn't want to get in trouble with her teacher, Mr Schmidt, and secondly "Well-Being and Quality of Life" is one of her favourite subjects. This mandatory class covers the relationships between lifestyle and well-being, as well as topics such as life skills, self-perception, a positive attitude, and personal development. For today's class, she had to write a short essay on what "leading a happy life" means. This apparently simple task turned out to be a real challenge for Lisa. She had never really thought about what happiness means to her.

A look through her digital life book, which automatically records Lisa's daily routine together with her physiological data, didn't provide any conclusive answers. She did see that her happiness hormones go up when she is allowed to choose a new sweater or pair of shoes, and she thought that happiness perhaps depends on owning nice things. But then she discovered that her happiness hormones also shot up when she gave a present to her best friend. She wrote down these findings in her essay, and now hopes that the class discussion might shed light on what happiness means. She found that her previous essay, "What does you good?", was much easier to write. Lisa had taken an interest in health while she was at her old school, before she moved to the new city. Since then, she has taken an interest in her family's physical well-being too. She collects information on her parents' diet, sports activities and various vital and physiological parameters, such as their stress levels. Initially, her father found it a bit strange that his daughter would regularly comment on his lifestyle. But he thinks it's good that children today learn much more in school about how to live healthily. Since he has been listening to his daughter's recommendations, he generally has a greater sense of well-being, and takes much more interest in his own body. He has lost most of his excess kilos, knows now what foods don't agree with him, and thanks to relaxation exercises and autogenous training, he is now calmer and better able to recuperate from work stress. Finally he feels healthy again, both physically and mentally, and can keep up with most of his friends when it comes to exercise. It used to bother him that they would poke fun at him for being unfit when they went on walks together.

When Lisa opens the front door, holds her face in the warm sun, and takes a deep breath of the fresh morning air, she knows that her blood pressure is falling, her pulse is slowing, and endorphins are being released. Not because the sensors say so. She just feels it.

Self-observation and well-being skills: A better understanding of the body in 2030

Julia has just got back from visiting "Gesund 2030" – a health exhibition – and she tells her husband about her impressions. She tried out an

intelligent shirt that had micro and nano-sensors built into it, although the wearer can't tell they're there, that record and evaluate numerous vital parameters in real-time. The shirt can be controlled via data glasses or other mobile devices. "Have a look at this," says Julia, and shows her husband Jan a video presentation of the shirt. "It says here that nearly all vital functions can be monitored. The basic model records heart rate, body temperature, breathing and now blood pressure as well. The comfort model has additional sensors for measuring the electrolyte balance, blood sugar, acid-base balance and stress levels.

The luxury model can also monitor individual hormones, evaluate your immune status, and detect ozone and pollen levels in the environment." A year ago, Jan suddenly had a dizzy spell at work. The doctor diagnosed a stress-related disorder and advised Jan that he should listen to what his body was telling him, and that it was about time he started taking things easier. "Listen to my body? What is that supposed to mean?" Jan complained at home. He is part of the generation that never learned to pay attention to body signals, and often only realises there's a problem when it's too late. "Maybe this T-shirt will help you finally understand your body," Julia continues. "It's extremely easy to operate, in fact it was designed to be used by older people. The system senses at an early stage when your stress level becomes harmful, and it tells you when you should do a relaxation exercise." Jan looks at his wife sceptically, and says: "You mean I have to learn relaxation exercises? Isn't there a pill for that?" "Come on Jan," retorts Julia. "Don't be such a stick-in-the-mud. You learned the new exercise techniques for your back, after all. And you enjoy it." "Enjoy it? It helps, but I can think of things I'd rather be doing!"

Self-observation and well-being skills:

Behaviour adaptation versus behaviour manipulation in 2030

Christoph is annoyed with himself. The bar of chocolate that he couldn't resist has cost him 35 points. Now he's back behind his friend Sascha again in the league table. And in recent weeks he had been doing so well following the tips and instructions from the "Lifecomputer", a virtual application that is accessible on any device. He adjusted his diet, did more exercise, and even changed his clothing style when the computer told him that doing so would give him a better chance of securing an internship at the bank. "For goodness' sake, Christoph. It's just a silly internet ranking," says his father Jens, trying to console him. "It doesn't matter in the slightest how many points you have."

"But dad, you don't understand," Christoph replies. "This league table is important to me, and you said yourself you think it's good that I don't eat so much junk food any more." Christoph has a point, Jens thinks. Christoph's changed behaviour has definitely been a positive

development. He doesn't complain any more when there's only salad for dinner, and the most he buys from the convenience store is a bottle of mineral water. Ever since the Lifecomputer started awarding points for good grades in school, even the arguments over homework have died down. It's just that Jens doesn't like the way that this change of heart in Christoph has come about. Christoph wears several sensors on his body that permanently measure and record his vital parameters and daily routine, and send this data to an international internet service. Not only that, but other data – such as what he buys, but also his values, future goals and latest school grades – is constantly collected via interactive games. When Christoph decided he wanted to do an internship at the bank, he told this to the computer too. The computer advised him to change his style of clothing, and to take private lessons in maths. The service immediately suggested a suitable offering for both of these. If Christoph makes a lasting change in his behaviour, and if this brings an improvement in his data and parameters, Christoph is given points. He can use these points as payment for subsidised services from partners of the internet service, or to get a discount on the latest tech gadgets. Almost everyone at Christoph's school uses this service, and getting a high ranking has become a serious competition.

The service, which is planning a major stock market launch, is popular not only among young people. As Jens heard on this morning's news, increasing numbers of people of all ages from all sections of society are also using it. And just recently, during his annual performance assessment at work, his boss asked Jens, in passing, what his ranking was. When he told his boss that he had never used the service before, his boss laughed, and joked: "How trustworthy. I would definitely give you a loan!"

Self-observation and well-being skills: New (networked) services in 2030

Katharina receives an email from her health insurance company saying that she can expect to receive a bonus payment. This is the insurance company's reward to Katharina for her good and constantly improving physical constitution. Katharina had specially recorded her health data using various sensors and minicomputers, and sent this data to the insurance company. The insurance firm used this large amount of information to further personalise and optimise the service they offered Katharina. Katharina is quick to share this success with her social network, which has made a not inconsiderable contribution to Katharina's health. For some time now, Katharina has been anonymously posting her physiological data online, and discussing it with like-minded people. In this way, she receives valuable health and well-being tips, such as how to improve her fitness or sleep patterns. In return, she likes to offer advice on maintaining a healthy vitamin and mineral balance. Ever since the network has offered the possibility of not only storing collected health data,

doctors' findings and X-ray images but also linking these to personal biographical data, Katharina has been a really avid user. As an ambitious athlete, she is always interested in optimising her body, and also her lifestyle. Her husband, Niklas, is somewhat sceptical about these new services and technologies. Just this morning, he read that the German world market leader in optical storage media and cloud solutions is planning to buy a company that makes intelligent sportswear and everyday clothing.

By doing this, the company plans to become an international player in the data and storage-intensive healthcare sector. "They say," Niklas tells his wife, "that the goal is to offer customers an all-round medical service. As well as storing the data collected by intelligent clothing, the company also wants to medically evaluate and interpret the data and make medical recommendations. It is not yet clear what this service will cost. Alongside various family and premium tariffs, there is also going to be a package financed by advertising partners." Then Niklas frowns, because he has serious concerns about this news. He doesn't understand how a company that has nothing to do with health can suddenly enter this field, or why anyone should trust a company like this in health matters. He would never share his health data in a social network like Katharina does. Last year's data scandal shocked him too much. The health data of millions of users of an American network – including numerous prominent figures in the media and politics – was stolen. The data happened to include personal data that when viewed in context with the health data enabled conclusions to be drawn about people's lifestyles. Many of the people affected by the data theft, especially those in public life, were blackmailed. When he talks about this with his wife, Katharina, she retorts that she would never trust a foreign service with her data. But the German provider is subject to strict data protection rules, so she completely trusts them. Even though Niklas is very sceptical, he doesn't entirely reject this technology. Only last week, his doctor told him about a tourist who apparently spoke neither German nor English, but still it was possible for her to quickly receive help. Because her health data was available in digital form, the doctor could immediately access the woman's medical history, and a translation computer helped him understand what she was saying. Niklas also has less of a problem with the idea of sending anonymised health data to a research centre, where the data is collected, compared and analysed along with millions of other people's data. The aim here is to gain new insights into various diseases. As an incentive to make their data available to the research community, users receive a discount when they buy a health computer.

Opportunities

Citizens' growing interest in more consciously observing their own bodies opens up avenues for promoting and establishing a new set of "well-being" skills. Such an awareness could help make a lasting improvement to society's overall health, and reduce costs in the health sector.

Well-being skills could have a positive impact on the health of the population as a whole

New developments in many key technologies (e.g. optical sensors, micro and nano-sensors, information and communication technology (ICT), DNA analysis) act as technological drivers, mainly because they enable flexible and tailored products. By 2030, many innovation opportunities and sales markets are expected in the healthcare sector. Good market opportunities exist for European and German technologies.

Challenges

Networked services and the generation of mass health data bring the danger of misuse and could lead to data privacy problems.

Higher comparability of health data, and hence an increase in the ability to compare one's own state of health with that of other people, may result in a sense of social pressure with regard to one's own health. Some people may feel pushed to modify their own bodies, or in the extreme case even to optimise their bodies by external means. A questionable notion that health in all its facets is simply "doable" risks contributing to a breakdown of social solidarity.

The ability to compare one's own state of health with others may create social pressure to conform

It is also conceivable that the results of mass data analysis could both influence personal notions of health, and trigger discussions about accepted medical guidelines. In this eventuality, lay knowledge may conflict with expert medical school knowledge, and therefore create uncertainty among third parties.

3.3 Work colleague computer

By 2030, computers and autonomous robots will be able to assist – or take over – an increasing number of human activities. They will not only carry out complicated production steps completely by themselves, but will also perform thinking activities while delivering advisory and other services for knowledge workers and service providers. On the one hand, this creates new economic opportunities for Germany and its competitiveness against low-wage countries.

Autonomous robots can support citizens at work, in their leisure time, and in their everyday lives

In addition, developments in automation could be one approach to solving the skills shortage and reducing the burden of work on citizens. On the other hand, it is possible that typical white-collar jobs will change in ways comparable to the transformation of activities in manufacturing production during the course of the industrial revolution.



Figure 5: Supporting robots. Illustration by Heyko Stöber at the linking workshop on 17 and 18 February 2014 in Berlin. © BMBF.

Work colleague computer: The world of work in 2030

The morning is still young. Anne, a journalist, sits in her home office, a cup of coffee in her hand. She likes the way her computer has analysed yesterday evening's football World Cup Final overnight, and written up a punchy draft article. News reports have been created automatically for

some time now, and often they are even published on the online news site without human intervention. It's a great thing, Anne thinks to herself time and again, as it means she has more time for editorial work that is more challenging and more interesting. However, she always used to find it relaxing to do the easier work. The computer is also helpful for doing technical research. To start with, it automatically compiles relevant facts on almost any topic. Not only that, it prepares and organises its findings in a presentation. While she was sleeping, it did her research for an upcoming interview, with a professor of informatics, about autonomous computer systems. It's interesting to think where it all might lead to. She quickly skims through the prepared summary of the current state of development. The presentation ranges from automated business analysis to the evaluation of gigantic data volumes to detect all kinds of dangers, to the percentage of doctors who currently use intelligent diagnostic systems on an everyday basis, which frees up time to spend talking to their patients. This figure recently reached 85 percent. Anne is continually surprised at how the significance of technology is changing in many occupations. Her personal digital assistant, for example, has become indispensable. In her home office, "Edward" – as she calls him – performs all the secretarial duties. He routinely arranges appointments, places orders, answers calls and helps her with management tasks. Occasionally, the question occurs to her: Now that he does so many jobs for her, is Edward an assiduous assistant, a friend, or almost a competitor, who works around the clock, never gets tired, and doesn't make any careless mistakes? Before her train of thought reaches a conclusion, Edward informs her in a quiet voice that her virtual interview with the informatics professor will start in five minutes. She goes into the adjoining room, where, thanks to a holographic projection system, she sits directly opposite her interviewee. Anne saves a lot of time, as she now only rarely needs to leave the house for interviews. On the other hand, she is already looking forward to the editorial meeting at the publisher's this afternoon. She almost never misses these meetings, because it's nice to actually meet with people in person.

Work colleague computer: Production in 2030

Christian has worked in production for an aircraft manufacturer for more than twenty years. He is glad that for the last two years, he has had a mobile robot assistant by his side to help him with all the assembly work. The robot lifts heavy parts and sometimes even fits a tiny screw, if it's too fiddly for Christian. Christian quickly learned to work with the robot assistant intuitively, but nevertheless he is glad that he took a training course to show him what his robot assistant is capable of. After a phase of getting to know each other that lasted several weeks, the robot learned to understand every word that Christian said, and even to recognise his gestures and facial expressions. A few weeks ago, the robot rushed to Christian's aid when it saw that his face was contorted by pain. He had

trapped his foot, but the robot quickly managed to free him. The aircraft manufacturer now uses more than one hundred robot assistants in production just at this site, and has significantly expanded its global market position. Christian is certain that the robot assistants have made a large contribution to this success, even though some production jobs have been lost. Cost-intensive work to rectify assembly defects is now rarely necessary. But Christian sometimes feels pleased when a robot assistant occasionally breaks down or reports a malfunction. In an internal pilot project, a team of robots is working autonomously on individual assembly steps. Their perceptions, activities and communication with each other are fully monitored by collecting together all the data and information they generate, in a cloud, so that it can be analysed someplace in the world. Initial concerns about data security were allayed. The aircraft manufacturer is one of the global pioneers in using robot assistants in production. The company's management quickly recognised the potentials, and took the investment risk after a pilot phase. For some time now, the company has partnered with a mobile phone provider. They want to make smartphones in Germany, and are interested in the aircraft manufacturer's positive experiences with the robot assistants' fine motor skills. They will soon be ready to relocate production from Asia to Germany, and start making mobile devices for the consumer goods market in Germany again.

Work colleague computer: Services in 2030

The Walter family are looking forward to their summer holiday in Spain. Their suitcases are packed and the driverless taxi is about to come and collect them. Their luggage is checked in automatically at the airport. The family won't see their bags again until they get to their hotel room. Mr Walter is happy that the spare camera battery he ordered only yesterday evening arrived in good time. Last night a parcel drone delivered it to the family's private parcel box in their front garden.

Before the Walter family leave their house, they set the home automation controller to holiday mode. The controller switches lights on and off to make it look like someone's home, and even briefly opens windows safely located on the first floor to the tilt position. From the outside, you would hardly know that the house is unoccupied. Actually it's not really vacant, as to Mrs Walter's delight her new home robot will water the flowers and tell her straight away if anything untoward happens in the house or garden. The Walter family can relax as they get into the driverless taxi. Except Mrs Walter thinks from time to time of her mother, who will be helped with everyday tasks by a robot assistant while the family are away. The care service that lends out the robots insists on a one-week trial phase before family members go on holiday. Her mother, who lives alone and only needs simple care, was happy with the arrangement, and in an emergency help would arrive very quickly thanks to the online link to the care centre.

Mr Walter enjoys the almost silent journey in the separate taxi lane. Journey times have fallen dramatically because of the taxi lane, and accidents have become a rarity. The city centre has been turned into a pilot area for testing autonomous transport systems, and is even closed off to private cars. Most passenger and goods transportation takes place via autonomous and driverless taxis, buses, trains and parcel drones. The journey ends almost directly in front of the check-in machine. This is possible because the luggage was transported separately in advance, which means it takes much less time to get out of the car. As they have some time to spare, the Walter family go into a fast-food restaurant. They place their order at a display terminal, pay and receive an order slip. They can use this to log in at any table they like, and the food is automatically delivered to the table. A service robot with a keep-warm function serves them. Although this is less personal than before, it does mean that the food is still piping hot when it arrives at the table. Many restaurant chains now use service robots like this, which enables them to stay open 24 hours a day. When the Walter family board the plane and fly to Spain, they are all pleased that a flight attendant brings them their drinks, not a robot!

Work colleague computer: Choosing a career in 2030

At 21 years old, Kai has already worked for some time as a freelance designer in advertising. While still a teenager, he was able to draw attention to his creativity via social networks, as many people now do. He has an impressive client list for someone of his age. Whereas, in the past, it was usually the big agencies that got the best assignments, in 2030 the market has changed into an open, global creative competition. The best ideas count, and even for large companies it's "in" to award assignments to less well-known designers. Following a downturn in sales in recent years, this has now led the established agencies to adopt new business models.

These changes have been caused not least by new automation technologies, which make it possible for aspiring one-person design agencies to present clients with professional product designs. For example, Kai produces demonstrations of his designs overnight on a 3D printer. In the past, it used to take model-makers days to build product designs by hand. There are many customers, especially in other countries, whom Kai no longer meets in person. Instead, he has virtual meetings with them. That means he can work where and when he wants. Because of his success, he can afford to turn work down occasionally when he needs time out for an extended holiday. But he knows too that for his clients, the next designer is just a mouse-click away. His parents would have liked him to study at a renowned international university. This has become easier in 2030, as nearly all universities worldwide offer affordable distance learning courses. But as Kai had worked part-time as a designer even while he was still in school, he saw good opportunities to be successful in

the market with creative products, even without a degree. Markus, Kai's younger brother, will soon finish school, and isn't sure yet what career he wants to choose. Although he sees that his brother is successful, he thinks that studying for a degree would give him a good basis for his future professional life. Six months ago, Markus visited the careers guidance service, and this confirmed his desire to study economics so that he can become a tax adviser. Even the online "choose your career" game created by the careers guidance service ended up recommending that he study to become a tax adviser. After he read an article a few days ago titled "Computer Beats Tax Advisers", he wonders whether by the time he completes his degree, in a few years, there will even be enough jobs for tax advisers, or what roles and functions they will perform then. A new cognitive computer system competed against several tax advisers to analyse five case examples and make recommendations. In three cases, the computer's findings were more comprehensive and authoritative than the human competition's results. Today Markus has an interview, arranged at short notice, at a large tax consulting firm. If he's lucky, the firm will enable him to study at a private university that compiles course content according to what individual companies specifically want from universities in Germany and other countries. The companies share the costs of the course, and successful graduates are guaranteed a job.

Opportunities

In 2030, computers will be so powerful that they will probably be able to take over tasks from knowledge workers. One key driver of this development is that a large part of human knowledge will be stored digitally in the future, and be accessible to computers via cloud computing. With the help of big data, cognitive computer systems can detect hidden patterns, and have become capable of learning, like humans. As a result, work processes can be made more efficient and therefore more profitable. Doctors, nursing staff and so on would therefore once again have more time to spend with patients, and people generally might have more (free) time for conversation, neighbourhood services, family and friends. This opens up opportunities for Germany to increase its competitiveness, and at the same time there is the prospect that future automation technologies will produce interesting new sales markets. Furthermore, a possible skills shortage could be alleviated by using computers and robots in many fields.

Support for knowledge-based work processes could reduce the workload for skilled workers

In factories, robots are able to take over physically strenuous and also difficult work in close proximity to humans. These machines are able to recognise humans and their movements, thus minimising the risk of injury. In the future, robots will also be able to correctly interpret the gestures and facial expressions of humans in their surroundings. As a result, they can be used as flexible and mobile robot assistants, e.g. in assembly. In 2030, robots could be capable of performing delicate and complex production steps that previously could only be done by hand (e.g. assembling a mobile phone). New, fully automated German production facilities would therefore have the potential in the future to compete against factories in low-wage countries. Furthermore, automation opens up a variety of new opportunities to promote inclusion in the working environment. Individual work steps that cause problems can be performed by automated systems, and as a result, humans can retain their position in the value chain.

The use of robots opens up opportunities to improve the national competitive position

It is entirely possible that by 2030, automation will also impact heavily on the service sector. Many service offerings could be improved by automation in terms of the availability and scope of services. By 2030, robots, drones and automatons might be able, 24 hours a day, to serve food, deliver parcels, transport people, offer supermarket shopping, answer calls in call centres without queueing, etc. Significant ecological effects can be expected in passenger and goods transportation as a result of efficiency enhancements and green propulsion technologies.

Many service offerings could be improved by automation

Increasing automation also has the potential to influence people's career choices. Automation systems increase the technological capabilities for becoming self-employed based on one's own ideas. For example, it may be easier for creative people to find support for a good idea – e.g. a new product – and to turn this idea into a reality. Degree courses that are initiated by companies, e.g. via private universities, offer many new students the opportunity for a tailored entry into professional life.

Competition for jobs
between intelligent
machines and humans
could occur in
knowledge-intensive
fields as well

Challenges

More widespread use of computers in the occupational fields of knowledge workers and service providers may lead to competition for jobs between intelligent machines and humans. A new understanding of the future division of labour and role allocation between humans and machines is needed here. The question also arises of the distribution of wealth, if wealth is increasingly generated by machines. Job profiles could continually change with the steady growth of computer power, or lose much of their importance to humans. It is anticipated that many tasks and jobs in management, organisation, reporting and administration could be eliminated. This would result in a constantly changing need for further training and qualifications. At the moment it is still unclear as to which new occupations will be created in connection with managing, monitoring and maintaining robots and networks, data analysis, and software and algorithm development, and how long demand for such new occupations will last.

Especially with the increasing possibilities for digital communication and working, the freedom to do many work activities from home must not lead to an excessive reduction in personal contact. The widespread use of digital assistants and robots makes technical dependencies conceivable, while new questions arise concerning data privacy and data security. As innovations of this kind emerge, protective measures against malfunctions, functional failures and manipulation would need to be developed.

Not only will cognitive computer systems become ever more powerful, in the future they may also be able to optimise themselves, i.e. to change by themselves. These changes should only take place within a defined framework, not in an uncontrolled manner. As they become increasingly powerful and independent, cognitive computer systems have the potential to become competitors for jobs. This is true not only for pure assembly work, but also e.g. for engineering design services.

In the future, cognitive computer systems will be able to develop design proposals independently, while also being open and creative and therefore capable of coming up with completely new designs.

The primary challenges resulting from automation in the service sector are those of job design and preserving jobs. Many job profiles could substantially change as a result of collaboration with computers and robots. Humans should not have to orientate themselves to machines. Instead, machines should orientate themselves to humans. One of the greatest challenges here will surely be to create new fields of activity for employees in areas where tasks are increasingly performed by computers and robots. As humans increasingly deal with robots on an everyday basis, contact between humans will decrease. This could create problems for citizens' social integration – or it may finally provide the necessary freedom and opportunity for person-to-person contact.

The steady progress of automation also makes it difficult to plan young people's education and career choices. If more and more jobs become automated, there will be a rise in uncertainty about which jobs will be affected by automation, and to what extent. Young people need security to plan their future career. Universities should be prepared for these changes, and make their offerings more flexible.

New challenges arise with regard to career choices

3.4 Education for everyone (and everything)

State-of-the-art information and communication technologies, digitally available knowledge and new human-machine interfaces – such as advancements in data glasses and 3D displays – have the potential to shape the global educational landscape in 2030. A wide spectrum of digital and virtual media in education will make it even easier to access educational offerings. Anyone who has sufficient digital and media skills, and is willing to use new technologies, is likely to be able to choose from an immense variety of educational offerings.

Citizens can use new educational offerings that become possible as a result of new human-machine interfaces and digitally available knowledge



Figure 6: Education in 2030. Illustration by Heyko Stöber at the linking workshop on 17 and 18 February 2014 in Berlin. © BMBF.

Education for everyone (and everything): Virtual University in 2030

Today the lecture series by Professor Andersson, a world-famous and renowned professor of biology, finally begins. Leon, who is in his first semester of biology, is delighted to be able to take part in the lecture, as Professor Andersson is very well known and has an excellent reputation. His anticipation is not diminished by the fact that he is just one of no less than 500,000 participants. He hopes that the lecture by Professor Andersson will look good on his CV, despite the high number of participants. He will follow the lecture from home, in a virtual environment. He could watch a recording of the lecture, later that same day, but somehow (and he can't say exactly why), it just feels better to participate in the lecture as it happens. It doesn't bother him that the lecture is given in Swedish, the professor's native language. A software system will simultaneously translate the lecture. Leon still has two hours before the lecture begins. He plans to use this time to complete the practical exercise in the dissection course that has been available online since yesterday. He sets out his dissection kit on the living room table, puts on his data glasses, and starts the application.

Leon's biometric features are checked automatically, as the university wants to make sure that it is really Leon who is taking part in the exercise.

The university similarly checks identities for examinations, to prevent attempts at cheating. Once his identity has been confirmed, a mouse – today’s dissection subject – appears right in front of him on the living room table, and the fragrance diffusers on the glasses spray a scent of disinfectant. Although he has done this several times before, it always startles him for a moment, as the virtual animals look deceptively real. Together with the sprayed scent and the fake background noises, he immediately has the feeling that he is in a lab. The first time he did an exercise like this, he actually had to take his glasses off for a moment to check that there wasn’t really a mouse on the table. After a short briefing by a computer voice that describes the procedure, along with cutting instructions displayed on the glasses screen, he takes the scalpel in his hand and starts cutting. The mouse’s rib cage opens, then the computer voice intones that he has started cutting much too far to the right. At moments like these, Leon is glad that it’s not really necessary these days to dissect real mice. “It’s a shame that not everyone can afford this technology, or wants to use it,” Leon often thinks. His older brother, for example, who has already completed his degree, doesn’t think much of virtual exercises. He thinks that a virtual exercise can never replace practising on the real thing, if only because no two mice are the same. He often jokes that Leon’s generation will become increasingly lonely in front of the computer. It’s an argument that Leon is having none of: besides his network contacts, he does cultivate his “real” contacts too, except he prefers to do so on the football pitch or in a nice restaurant, rather than in the lecture theatre.

Education for everyone (and everything): Inclusion in 2030

Hannah is a young teacher who is glad to be able to work at an innovation testing school. At this school, numerous technical innovations and learning aids are tested in an everyday educational setting. Hannah appreciates the potential applications of the new technical aids, which evolved from the first generation of electronic whiteboards, tablet PCs, data glasses and 3D displays. They make it easier for her to design lessons, and offer new learning environments such as virtual trips to distant countries. Hannah finds it particularly exciting that these aids are also one reason why inclusion at this school is not merely a nice idea but a reality in everyday life. In 2030, state-of-the-art learning aids help teaching staff to deliver more targeted teaching to children with special educational needs. For example, there is software that reads textbooks out loud for visually impaired children. Children at the school are also able to display additional information on a screen during the lesson if there is something they didn’t understand or want to have explained in more detail.

These learning aids facilitate better social interaction, and therefore promote the integration of these children into the classroom group.

Hannah often thinks back to how it was 10 years ago, and how difficult it was then to integrate Fabian – a deaf boy – into the class. Back then, lessons were given bilingually, i.e. with a sign-language interpreter. During breaks, Hannah frequently saw that Fabian had difficulty following his friends' discussions, even if they made their best efforts and learned some basic sign language. Happily things are different today. During lessons and in the playground, she can often no longer tell which of the children has a disability. For example, technologies for augmentative and alternative communication ensure that children in the playground can do what they want to do: play together and relax in a carefree way. However, and this is something that Hannah thinks is a great pity, today hardly any children learn sign language any more.

Education for everyone (and everything): Modular education in businesses in 2030

Ben has started an apprenticeship training position as a mechatronics engineer with a large automobile manufacturer. He is very happy about it, and is keen to see just what the company's modular training programme will be like. In contrast to classical vocational training, which consists of in-company training and vocational school, his employer has selected modules from various teaching courses, and once Ben successfully completes a general basic course, they will train him individually according to his needs and those of the company. The company also takes Ben's potential career path into consideration. In the selection procedure that Ben went through before getting the apprenticeship, it became clear that Ben not only meets the manual aptitude requirements for training as a mechatronics engineer. His analytical thinking and creativity make him suited to working in the engine development department once he completes his training and acquires some practical experience. His preparation for this potential career path will begin while he is training. During his training period, along with practical exercises on real electric engines and fuel cells, he will also take a number of virtual courses, offered by various providers, from home. These include coaching sessions that are individually tailored for him. He is particularly excited by the idea of being able to learn some rudiments in a virtual environment at home, using his data glasses, and so gain a better impression of his future work activities. His girlfriend, Laura, is not entirely enthusiastic about these capabilities. She is worried that it will mean they spend less time together.

Ben's friends have told him that although these virtual exercises are a great thing, they can never replace practical exercises because, in practice, unforeseeable problems occur time and again that cannot be recreated in a simulation. Ben is not particularly concerned about this. His employer has put suitable provisions in place, and additionally offers a practice lab for learning difficult work processes, where these tasks can be practised as many times as necessary.

Despite these good training conditions, Ben feels somewhat ambivalent. He is not entirely sure whether this modular company training programme is as valuable as a typical general vocational training course. Will he be able to move to a new employer at some point in the future without any difficulties, or will he have to learn everything from scratch again? His girlfriend, Laura, has just had exactly this experience. Last year, she completed training as a physiotherapist with a private provider based in another country. Unfortunately she is still waiting for her qualifications from this provider to be recognised in Germany, so she can finally take up her promised job in a medical practice.

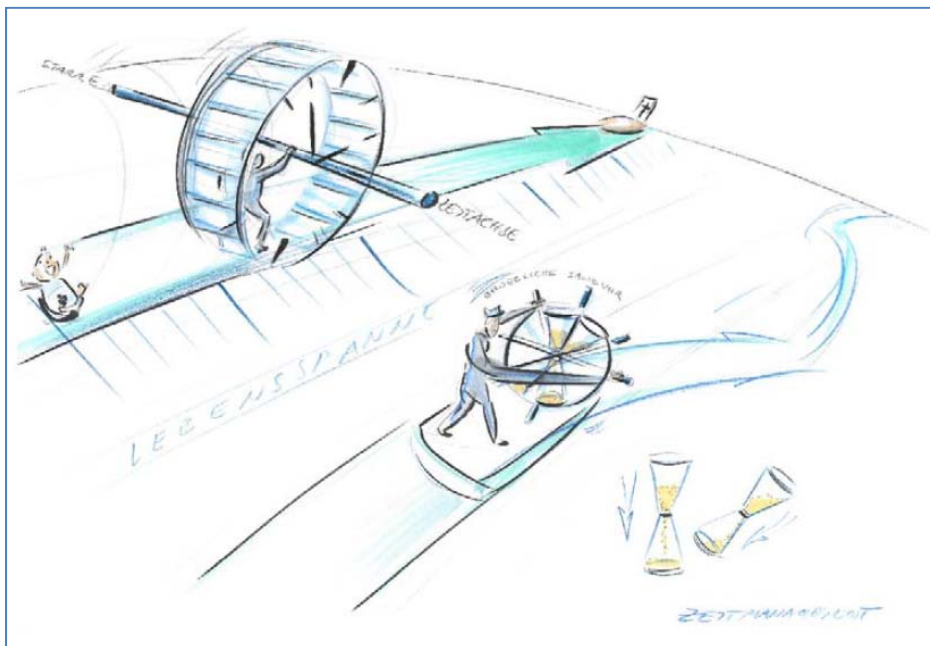


Figure 7: Curriculum vitae and career paths in 2030. Illustration by Heyko Stöber at the linking workshop on 17 and 18 February 2014 in Berlin. © BMBF.

Education for everyone (and everything): New forms of self-education in 2030

When people used to ask Johanna whether her husband was good with his hands, she could only laugh. Her husband, Simon, has many talents, but doing DIY jobs around the home was definitely not one of them. Even simple tasks like the proverbial hammering a nail into a wall are a challenge for him. However, when it comes to electronics and software, it's a whole different story. He is currently sitting bent over their fully automated coffee machine, repairing it. Yesterday, when the machine displayed an error message, Simon went online straight away to search for a solution. He found out that the error was caused by a badly soldered circuit board, and can be fixed in a few easy steps. He quickly discovered that this is a known fault with the coffee machine. The manufacturer will repair faulty machines free of charge, but that means having to send in the machine. If customers don't want to wait several weeks for repairs, the manufacturer offers to guide them through the simple repair job at home. With the machine on the table in front of him, and with a live video stream to a service technician, Simon is walked through the repair step by step. As he repairs the faulty machine, he also learns a lot about how it works. If it needs repairs in the future, he might even attempt the job without assistance.

Generally speaking, it has never been so easy to access education as it is in 2030. If you have sufficient digital skills, the motivation to learn, and the minimum technical requirements, you can choose from an immense variety of self-education offerings. Johanna, for example, has just started a virtual skiing course, and is already eager to see whether the movements she has learned can be put into practice on her next winter holiday. She is still a bit sceptical, as her daughter Lena has previous experience with a virtual painting course. Although she learned a lot and had great fun, there were some painting techniques that she would have preferred to receive help with in person, from a professional teacher. Although it is so easy to access education, Johanna finds it increasingly difficult to keep track of all the different education providers. While there is an immense range of possibilities, there is a similarly enormous market for providers. They range from global major players in the education services industry to social learning platforms and individual education freelancers. She finds it particularly difficult to offer her children guidance in educational matters. She herself finds it very hard to answer questions such as which providers and courses are good, or which ones might help her children later in their career or education, and wishes she could get some qualified advice. The digital rating systems fall far short of covering this need for guidance.

Furthermore, for some time there has been a public debate about how to prevent situations where courses are not recognised because they fail to follow quality standards, or where unreliable information is taught under the guise of a serious course offering. Johanna's husband recently had a

painful experience of this kind. During some recent repairs, he blindly trusted the instructions and cut through the wrong wire. His furious curses at getting an electric shock are still ringing in her ears. Luckily no one got injured, but the next time he will take more care over whose repair tips he follows.

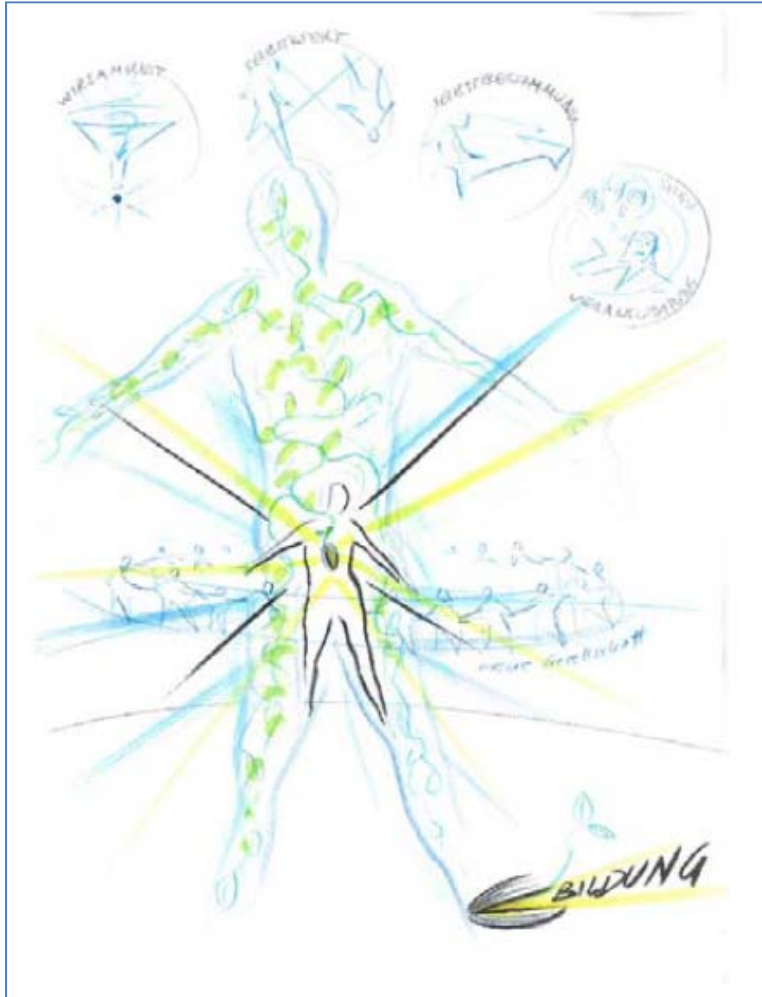


Figure 8: Education in 2030. Illustration by Heyko Stöber at the linking workshop on 17 and 18 February 2014 in Berlin. © BMBF.

Opportunities

The possibilities of a digital educational landscape give citizens access to educational content that goes far beyond what their respective local educational facilities can offer. Barriers to access, such as the number of participants, and languages, will play hardly any role any more in 2030.

Education and training options - and excellent education in general - become accessible to all

It is likely to be possible for citizens to choose from a gigantic range of education and training options. Excellent education, including from overseas, will therefore become more accessible and available to all. In Germany, there is the prospect of new ways for “Made in Germany” education to become established internationally. As a result, education as a whole becomes more diverse. The basic requirements here – as is already the case today - are media skills and an understanding of the value of lifelong learning.

In schools too, digital media will be an elementary component of lesson design. Virtualisation and digitisation of learning materials provide teaching staff with ways to better combine group work and individual support, and facilitate the integration of children with a migration background or special educational needs. In addition, digitally supported teaching directly enhances children’s media literacy and so prevents potential educational disparities.

Digitisation and virtualisation flexibilise and facilitate access to various educational offerings, and could therefore help to counteract a possible shortage of skilled workers.

Digitisation in the educational landscape opens up new avenues for enhancing the quality of learning and teaching, e.g. through learning analytics. This involves analysing teaching-related big data that occurs in digital forms of education. Via learning analytics, it is possible to observe how students approach online texts and course materials. This enables the development of personalised and particularly motivating forms of learning, and means that teaching methods can be improved.

New training formats could emerge to address the need for highly skilled workers

Vocational education with a modular structure following completion of a basic training course is one conceivable educational format for supporting job-related, individualised learning, and it addresses the growing need for highly specialised skilled workers. Vocational education comprises a large number of educational offerings, and can take place any time, any place thanks to the digitisation and virtualisation of course offerings. This could enable businesses to train people on a more tailor-made basis, in line with their needs.

On the whole, the new forms of self-education have the potential to become an important pillar in the education system. These forms are made possible by the wide range of educational offerings and the free availability of knowledge in the internet. As a result, conditions for lifelong learning by citizens are significantly improved.

Challenges

There is a need for empirical evidence to determine which forms of learning, type of knowledge transfer, and what types of learning content can be usefully digitised and/or virtualised, and lead to better learning and teaching experiences.

A digital and virtualised educational landscape could give rise to or amplify educational disparities, if the skills required to use new forms of education are lacking or unequally distributed. Citizens who have poor digital skills or who are not interested in lifelong learning would therefore be excluded from particular educational offerings.

If very large numbers of students go through the same training, it is possible that monocultures of doctrines and beliefs could arise in certain cases, which in this form would be a new phenomenon and require new answers.

It is also important to investigate the consequences of digitisation and virtualisation on social contacts, and what impacts independent and self-regulated learning have on the “learning experience” and students’ motivation.

Another challenge consists in safeguarding the value and comparability of qualifications and knowledge. It is therefore necessary to ensure that the new education market which may be emerging, with its plethora of providers, is transparent. It should be easy for all actors to answer questions such as which are good-quality educational offerings, and which educational offerings will be widely recognised.

With modular vocational education courses that bring specialisation in particular working methods and fields, there is the danger that employees will limit rather than expand their opportunities in the job market.

It is entirely possible that it will become very much more difficult to find one’s way in the education market because of the extensive range of offerings, while at the same time, solutions for educational orientation will become increasingly important. In this context, great importance attaches to easily accessible advisory services that are independent of educational providers.

In a more digital educational landscape, new forms of data misuse and identity theft could occur in some circumstances, and would need to be countered with technical and/or social innovations. This also applies to learning analytics data, which raises questions with regard to ownership and openness of data, and privacy protection. The challenge consists in enabling appropriate use of the data, while addressing the risk of misuse.

It is vital to have the skills required to use the new forms of education. People who do not have these skills will be excluded from some educational offerings

3.5 Act locally - cooperate globally

For Germany, there are opportunities for new forms of partnership in the global division of labour, and for fair value chains

Emerging countries have so far been regarded as the “workbenches of globalisation”. In the future, they will increasingly develop into thought factories and innovation hubs, as the Asian emerging countries in particular train significantly more natural scientists and engineers than the United States or Europe. Furthermore, many of these countries pursue national strategies to promote innovation and growth, which in addition to education and research policy also cover aspects such as taxes, trade, industrial policy, standards and public procurement. With this geographical shifting of innovation centres, the quality and form of innovation could change. New mass markets are emerging e.g. in the fast-growing big cities of Asia and Africa. Frugal innovations, for example, could be one way of developing these markets. These are innovations that are strongly oriented to specific local needs and in some cases limited means of production. As a result, opportunities could open up for new forms of partnership in the global division of labour, and for fair value chains. Fair value creation could grow beyond its niche status in the future, to become the basis for a sustainable strategy for stable and consensual access to markets and resources.



Figure 9: New structures in a global world. Illustration by Heyko Stöber at the linking workshop on 17 and 18 February 2014 in Berlin. © BMBF.

Act locally - cooperate globally: Global competition in 2030.

Jan is a successful fund manager who specialises in emerging economies. In many developed Western countries, he sees problematic interdependencies between growing social disparities, an unfavourable age structure in the population combined with high youth unemployment, and immense public debt. Jan wouldn't be surprised if the 2030s become a third "lost decade" for some of these countries. To him, Asia's dynamic growth and the prospects of many African countries seem more promising. While good and comprehensive economic data and computer-generated analyses are available in 2030, direct encounters with the country and its people remain a key element for Jan in deciding the investment strategy for his fund. He has noticed, for example, that a country's successful industrialisation is strongly dependent on the population's openness to change and on their sense of initiative and willingness to cooperate. In Jan's experience, the best way to assess these attitudes is by being in the country itself. He regularly travels to Brazil, Russia, India and China. However, the acronym BRIC is hardly ever used now in 2030, as economic and socio-political conditions have developed so differently in these four countries over recent years. Despite all the differences, Jan notices in many countries that he visits that standards at certain universities and research institutions have risen significantly in recent years, and have exceeded the level of Western institutions in ever more areas. In his political analyses, Jan frequently finds that this progress is accompanied by an innovation policy that in recent years has increasingly often taken the form of an active, coordinated industrial policy. For him, these are positive signals that he should give closer consideration to a country. He also spends a lot of time in African countries. Especially in Africa, Jan observes large differences between individual countries owing to high cultural diversity. In a number of countries, he can follow true success stories up-close – for example an African insurance company that does business exclusively via mobile IT devices. Early investments in ambitious African companies like this have made substantial profits for Jan's fund in recent years.

In 2030, networked manufacturing technologies, generative processes, autonomous robots, cyber-physical production systems and new forms of telecommunication have created many new freedoms globally when it comes to questions of location and the composition of value chains. When he is looking to make investments, Jan favours businesses that profitably exploit these new freedoms. It surprises him how well some German companies – unlike many competitors in Europe and the U.S. – have managed to benefit from change in the structure of global competition, and the new production possibilities.

These companies have been able to position themselves well in a number of industries as providers of complex system solutions. They may have been helped by the fact that for many years, strengthening German companies' system solutions expertise had been an objective of government support, and that German SMEs were assisted at an early stage in the global search for competent partners. It's lucky that he had shares of several of these companies in his portfolio at the right time, Jan thinks to himself.

Act locally - cooperate globally: Fair value creation in 2030

Anna has been working for fifteen years. She leads an environmentally aware and sustainable lifestyle. This includes buying fair products, something which is very important to her. This wasn't always the case, although fair-trade food items were available even during her childhood. When, as a teenager, she became aware of the poor working conditions that were still widespread in textile production in many countries, her views changed. Anna still clearly remembers the outrage that she felt at that time. Back then, she didn't particularly trust companies' public statements about factory conditions, so she joined social networks relating to fair value creation to form an independent opinion. Her empathy with people in the producing countries grew as a result of the contacts she made. Consequently, during her youth, Anna was one of the first people to use a "fair" smartphone. Today she remembers with some amusement the sometimes endless debates in the relevant forums about what exactly constitutes a fair smartphone.

Today, in 2030, Anna is a longstanding member of her environmental association, which she represents in citizens' forums and panels as an advocate of fair value creation. In recent times, businesses have increasingly been inviting her to advise them on how to make their global value chains fair. Anna has got to know a number of SME owners whose personal ethical and moral stance is the key factor driving their commitment to fair value creation. But she is also aware that many companies are primarily concerned with their image and reputation, and that customer demands are often the trigger. Anna is now well-versed in launching online campaigns to draw attention to fraudulent labelling. However, she has noticed a slow but steady increase in the number of companies that practise what they consider to be genuine fair trade, and which also generate substantial profits by doing so. For Anna, this means establishing fair contractual conditions with suppliers and partners, and also obtaining guarantees from them with respect to fair conditions locally. Anna has been told by some companies that fair business practices boost employee motivation. For many businesses, these increasingly complex, global supply chains bring increased risks. Businesses therefore in some cases opt for a fair business relationship with their suppliers as a

way of ensuring that the items they procure are of better quality, and to avoid political and legal uncertainties in some supplier countries. The additional control possibilities are also viewed positively, as is better compliance with environmental and social standards. It is noticeable that in many industries, greater transparency regarding production conditions along the value chain was first demanded by consumers, and then implemented. Because this has resulted in many shortcomings gradually coming to light, the group of consumers which prefers fair products has grown from a marginal phenomenon into a truly broad movement.

Anna is currently involved in a project with a bicycle manufacturer that wants to develop a self-driving one-person electric car for urban transport, with a completely fair value chain. In this project, Anna is paying particular attention to making sure that services comply with social standards. She believes that this even creates a business opportunity for German certifiers, who could position themselves as a “TÜV” (the German testing and certification organisation) for fair services in a globalised market.

In politics, large income disparities have for many years been regarded as a risk factor for the global economy. Anna has noticed that social cohesion is being taken increasingly seriously in public debate as a condition for sustainable growth and global economic stability. She is pleased to see the beginnings of European regulation of certification labelling for fair products. The only thing is, she is worried that standards for fair value creation could get watered down as a result. But she knows that she would pull out all the stops in the internet if that happened.

Act locally - cooperate globally: Frugal innovation in 2030

Leonie is an enthusiastic electrical engineer who works for a German medium-sized global market leader in medical technology. Now, in 2030, her first major project since completing her studies takes her to a country in Asia where she will work as a development engineer for three years. Initially, and for a number of years, her employer had tried selling its established products via sales subsidiaries in the largest metropolitan regions in this country. This was not much of a success, as the devices kept developing faults that had never occurred when they were used in developed countries. Other troubles for the company were caused by Asian providers who flooded into the market with cheap products, and created further cost advantages for themselves by offering virtually zero customer service for their products.

Because the competitor products failed even more frequently, interest in these products dropped off sharply in the country as a whole – the market more or less died out within a few years. With Leonie's project, her employer is now turning to the example set by a number of pioneers. Leonie's brief is to develop a product directly in the country itself, with her own team. Along with a German technician, her team includes young, well-educated electrical engineers who come from this country and have precise knowledge of local limitations and how users want to use and operate the product. A major weak point turned out to be the multifunctional but consequently highly complex power supply units. Together with her partners, Leonie is now employing the concept of frugal innovation. Leonie understands this to mean innovations that are a creative response to local limitations on resource availability, and which therefore result in technically simple, cheap and robust products. The plan is to make the new power packs using only one-tenth as many components, and they will be specifically designed to cope with the expected voltage fluctuations, the subtropical climate, and the devices' significantly higher usage intensity. The partnership receives public-sector support as part of a bi-national initiative. One of the goals is to boost value creation in the country. Leonie therefore also needs to take the limited production capabilities into account in the design. Leonie and her team are working on completely new types of design that she has never encountered before, neither during her studies nor in her company, which derive in part from the practical experiences of the Asian team members. Her employer hopes that they will also be able to market the new product in other countries that have an unstable electricity supply. Leonie likes this kind of project work in an international and intercultural team. She is already thinking about what she will do after the project ends in Asia, and she could easily imagine going on to manage a similar project in an African country. She would like to put her fresh experiences with frugal innovation to use in Africa, to develop particularly simple and robust system solutions.

Opportunities

The growing number of competent international partners opens up wide-ranging potentials for a global division of labour in the economy, and for international cooperation to solve global challenges. If ever more emerging countries develop economically, this creates the opportunity to reduce existing imbalances between countries. This could contribute to greater economic stability on a global level, and indirectly to political stability too, and trigger positive effects in respect of migration.

It is certainly possible that fair value chains will help to spread and establish social, economic and environmental standards internationally, if fair products grow beyond their niche status to become new global mass products.

The growing number of competent international partners opens up wide-ranging potentials for a global division of labour

Frugal innovations offer the potential to try out new innovation approaches and access growing markets in emerging countries. This could make a significant contribution to safeguarding German competitiveness while opening up opportunities for small and medium-sized enterprises, and simultaneously encouraging sustainable development.

Challenges

Changes in the global innovation landscape demand new efforts to safeguard German competitiveness while continuing to develop key technologies. The new global division of labour would need to be shaped in such a way as to generate added value for Germany in economic respects and with regard to solving global challenges. At the same time, it is essential to precisely observe and analyse shifts in the international distribution of responsibilities. Based on insights gained in this way, new long-term partnerships in research and innovation can be established.

The new division of labour should create added value for Germany, and help to solve global challenges

Actors in research and innovation face continued growth in cultural diversity as more and more countries become relevant as competitors and/or partners. This diversity is increasing e.g. in respect of languages, manners and behaviours.

The geographical and virtual mobility of workers is increasing – especially in the field of research and innovation. The employment market is becoming increasingly global, and competition for talented, qualified people is becoming even more intense. At the same time, interest is increasingly focusing on those countries which have not attracted much attention so far, but which could become globally competitive in certain fields in the future.

Fair products require particular efforts in respect of transparency and traceability. Independent quality marks and monitoring bodies may be necessary to build up customer trust, but also to counteract free-riders and tendencies towards “fair-washing”. There is also a need for a dialogue process in society between the various actors concerned to decide what “fair” means, and for which product groups fair value chains are particularly important and relevant. It may also be necessary to address any information deficits with regard to ecological balances, regionally and globally interlinked value chains, and fair resource management.

Fair value chains require confidence-building transparency and control mechanisms to prevent “fair-washing”

Frugal innovations require a change in thinking when it comes to innovation processes and forms of organisation, especially in small and medium-sized enterprises. A culturally entrenched tendency towards technical perfection in Germany needs to be reconciled with systematically adopting the perspective of customers in emerging countries, and the demand for a high degree of robustness and simplicity in frugal products. It may be necessary to give a stronger weighting to robustness and simplicity as principles in the development of products and services even in (fundamental) research. Such a change in thinking would also offer the opportunity to increase the resilience of businesses in dealing with crises of all kinds.

3.6 Data-intensive governance

The speed and frequency of data collection, the level of detail in the data, and increasing possibilities for the combination of data influence governance processes¹ at practically all levels: from the urban and municipal level to the *Land* and federal level (in Germany) to the international and global level. With the aid of future high-volume analysis, data that is collected and combined in real-time from businesses, e-government, or environmental research can be utilised to make governance more efficient. At the same time, language, speech and telepresence technologies can help with the social integration of citizens into governance processes. Because data always needs to be understood and interpreted, however, a future data glut could make governance processes more complicated, or slow them down. Very large and complex data volumes are anticipated in urban regions, which will be home to around 60% of the world's population by 2030. Cities could therefore become pioneers and “global laboratories” of data-intensive governance.

The increasing availability of data influences governance processes at all levels

¹ The term ‘governance’ is “acknowledged to be ambiguous” and means “government and governing, but also rules, regulatory mechanisms, order, leadership, not only in state and politics, but more generally everywhere in society that individual interactions and social transactions follow systematic patterns of action, fixed rules, orders.” – from *Lexikon der Politikwissenschaft*, D. Nohlen and R.-O. Schultze (eds.), Verlag C.H. Beck, Munich, 4th edition, 2010.

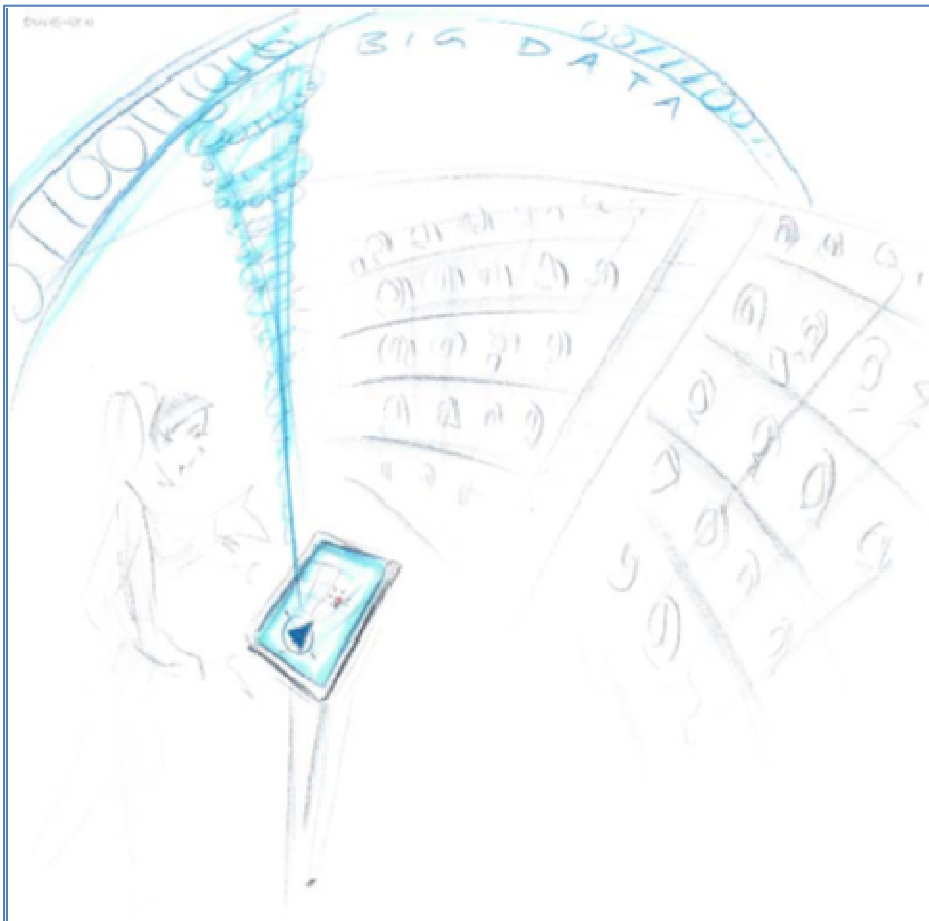


Figure 10: Mass data in governance. Illustration by Heyko Stöber at the linking workshop on 17 and 18 February 2014 in Berlin. © BMBF.

Data-intensive governance: Urban governance in 2030

Julia works in administration, and in 2030 she has many years of experience in municipal transport planning. For several years, the big city that she works in has used a comprehensive internet platform to inform users in real-time about traffic flows, congestion, roadworks and accidents. The platform is based on data from the municipal authorities, which is made openly available. But all road users can contribute information as well. She recently started working on a concept that examines ways to further improve the traffic situation in the metropolitan region via state-of-the-art sensor technology, software, and an expansion of the open data access policy. The goal is to be able to use the internet platform not only for information but also for transport planning. It would then be possible, for example, to simulate planned measures in advance on the platform, such as upgrading a road or a new bus route. Citizens would then have the opportunity to comment on plans, based on the simulation. They would also be able to access the data and simulation programs themselves, so that they could develop their own suggestions.

It is a lucky coincidence for Julia that the results of a scientific comparative study on simulation-assisted transport planning with public participation have just been published in 2030. Julia is surprised to find that the study attaches such great significance to differences in urban and political culture in the cities that were investigated. Previously, her work had focused strongly on technology, costs and system compatibility. Now she intends to pay closer attention in her concept to existing structures among the citizenry and in urban policy.

Data-intensive governance: Dealing with mass data in 2030

Even in 2030, now that he has retired from his professional career in the IT sector, Thomas still has a keen interest in everything to do with information technologies and data privacy. This evening, he is once again heading out to a citizens' event. It is concerned with the question of in what ways and under what conditions particular kinds of data that are generated in public administration may be used by the administration itself, in research, or by third parties, and whether the administration should be permitted to supplement its information with data from private providers. Digitisation and intelligent systems are widespread in 2030: e-government, intelligent power grids, intelligent traffic management, surveillance and security systems for public buildings, networked public institutions and more mean that mass data is available in the administration too. This evening's citizens' event will examine a proposal that strategies to combat obesity should be optimised through a combination of health, income and mobility data, and information on friendship networks and predictive behavioural research. "Unfortunately I know more about this topic than just the IT perspective," Thomas muses, patting his stomach as he reaches the civic hall.

Data-intensive governance: Language, speech and telepresence technologies in 2030

Sebastian is a trained interpreter, and in 2030 he works in Brussels for a large European public-sector institution. The institution's mission statement – to promote the social inclusion of all European citizens – is something it takes very seriously, and it works to eliminate unequal treatment of migrants, people with disabilities, the elderly, children and young people with special needs, and so on. Sebastian plays his part by reducing language barriers as far as possible to facilitate citizens' interaction with his institution. Sebastian originally studied Slavonic studies, partly through a desire to travel frequently – e.g. to accompany businesspeople.

During the early years, when he first started working as an interpreter, Sebastian noticed the growing influence of information and communication technologies. For example, there was an increasing number of requests to work in video conferences, yet interpreters were reluctant to work in this way. So Sebastian began to acquaint himself with language technologies. When it came to finding a job in Brussels, it was fortunate for Sebastian that the institution wanted to expand its offerings in Slavonic languages. Sebastian noticed that progress in language technologies in the internet often took place in barely perceptible steps, but over the years these steps added up to a real leap in quality. For example, Sebastian thinks that machine translation has become amazingly good in 2030, and it can be used directly on websites for ever more purposes. However, this works best for the most common languages, for which extensive digital resources exist. With a number of the less widespread Slavonic languages, the quality of the available software is often not high enough for Sebastian's needs. His current task is to examine whether holographic video conferences in 2030 have become so high-quality that an interpreter can reliably detect and take into account the non-verbal context of the spoken word as well. Sebastian is also integrating new software components to expand the institution's website into a portal that can be used and operated by voice, without a screen. He is evaluating systems that turn speech into text and vice versa, as well as tools for searching and analysing audio content. Sebastian's bosses are pushing this development because they want to implement new formats for internet-assisted public participation. They envisage discussion forums that include written and spoken contributions, and which allow all users to participate in their respective native language. However, Sebastian is somewhat conservative in his estimate of when this will actually be possible for all Slavonic languages. Detecting computer-generated discussion contributions is causing him quite a headache, but this is necessary to prevent any manipulation of discussions and to ensure high acceptance of these new participation possibilities. Sebastian likes the international atmosphere of his job in Brussels, and the fact that he is helping Europe grow together. Plus he is able to travel from time to time, even if not quite as often as he had originally imagined. But now he has also come to enjoy travelling via telepresence.

Data-intensive governance: Global environmental data in 2030.

Claudia is a world-renowned environmental researcher, and in 2030 she has been appointed as the founding chairwoman of an international scientific body that will coordinate comprehensive reporting on the state of the Earth. Creating these reports will involve the continuous integration of newly available data, and automatic updating at least in some cases. Environmental research in 2030 can draw on gigantic data stores from environmental monitoring. This data is obtained e.g. via remote sensing and sensor networks, but also through the use of autonomous terrestrial, flying and marine robots. The international scientific community had

campaigns for years, across national and continental boundaries, for better international strategic coordination and cooperation with regard to the measurements as well as their collection and analysis. Some key data was measured multiple times simultaneously, while other equally important data was not measured, or not in sufficient quality. Ultimately the scientific community was successful: the scientific survey of the state of the Earth is set to begin in 2030. Claudia is proud to have been elected chairwoman, and is pleased at the trust that has been placed in her. Now, together with her scientific colleagues, she is pursuing the vision that the new form of reporting will provide a foundation of scientific information that guides not only environmental policy in many individual countries, but also multilateral cooperation on environmental issues. Time and again during her scientific career, Claudia has found that it is difficult for people outside the scientific community to understand complex global change processes and their interdependencies. She therefore intends to place particular emphasis on using the latest methods to create understandable visual representations of the available, scientifically validated simulations and models of these complex processes, and make these available to the public. She is convinced that this is ultimately the best way to ensure that scientific expertise influences decision-making processes in society. Claudia is also planning to use the reporting to identify knowledge gaps and so contribute to science's understanding of itself and scientific priority setting. One of Claudia's first tasks will be to decide whether the report should also include knowledge and databases on the state of the deep sea and near-Earth space. In Claudia's view, their increasing development as resources in the long term suggests that the data should be included in the report. Claudia also thinks that the report should perhaps include data on biodiversity and the spread of genetically modified organisms. "I've got some exciting and challenging times ahead," Claudia thinks to herself. She is looking forward to her new role.

Opportunities

Especially at city level, data-driven governance may be one element in solving urban management problems. Possible applications include improving civil protection, traffic flow management, and efficiency in the waste, water and energy sectors.

Mass data from different sources – including the administration and e-government – could play a supporting role in nearly all policy areas and levels of governance if it is used to improve the knowledge base and thus facilitate the development of targeted interventions. This would include, for example, the areas of transport, health and business.

The availability of up-to-date information enables faster and more efficient political and administrative action, and a more balanced knowledge base

Speech, language and telepresence technologies have the potential at international and EU level to open up new opportunities for public participation, and to help overcome language barriers. In international terms, Europe is in a good starting position in the field of language technologies because of its language diversity.

Simulations of complex change processes offer the opportunity to assist decision-making especially at global level, and they promise to make fundamental contributions to solving global challenges. Successful visual representations or interactive simulations can improve knowledge transfer and promote the participation of various actors including citizens.

Challenges

With all forms of technological assistance for governance processes at the various governance levels, acceptance among the persons involved is essential. This depends in turn on the trustworthiness, security and reliability of the technology in question. Critical points in many cases could be data protection, safeguarding privacy, and preventing manipulation. Extensive data use or public calls for such use require there to be a clear and verifiable distinction from surveillance and spying activities against citizens.

Privacy and protection against manipulation are essential conditions for data-driven governance

Cities can serve as experimentation spaces for data-intensive governance, and could be pioneers. One challenge is likely to consist in precisely understanding the cultural characteristics of cities and working out which experiences can be transferred to other governance levels. In highly simplified terms, it might be expected for example that instruments which work in over-indebted cities would also work, perhaps with some modifications, in heavily indebted nation states. But no doubt a variety of factors would need to be taken into account in assessing the suitability of experiences from cities for other governance levels.

Cities are potential experimentation spaces for data-intensive governance

Another challenge consists in understanding which problems are subject to clear cause-effect mechanisms and can be solved “technocratically”, and which are not. For example, it was possible to identify the spread of CFCs as being the main cause of the hole in the ozone layer, which made banning CFCs a sensible solution strategy. Yet rather few (global) political problems are of this kind. The use of mass data may not simplify the nature of the underlying problem, but it could help with problem analysis.

Many global challenges are highly complex problems which can be termed “wicked problems”. Wicked problems are difficult or impossible to solve because the solution depends on how the problem is understood, different actors have a completely different understanding of the problem, and the basic parameters of the problem change over time. Global climate change is a prominent example of a problem in this category. It is a particular challenge to publicly acknowledge that problems have this character, and to handle with confidence the inevitable uncertainties – especially when mass data and a broad knowledge base concerning the problem are available. Even in these cases, data-driven approaches could help to deal with the problem, but they will not make such problems easy to solve, nor will they lose their difficult character. It is suspected that many of the known global challenges fall into this category of problem.

Evidence-based policy approaches could receive a boost through data-driven governance. Such policy approaches always require monitoring and evaluation instruments, e.g. to gather evidence for or against the effectiveness of particular interventions. The challenge here is to ensure a suitable balance between the costs of a policy intervention and the costs and management required for its evaluation and monitoring.

As a result of increasing automation and digitalisation, mass data will occur in nearly all areas of life. Through public discourse, it would be necessary to establish who the respective data belongs to, which data can be used for which governance purposes, and also who is allowed to collect their own data for what purposes.

At the same time, it should be kept in mind that data always requires interpretation, and will therefore become the subject of negotiation processes and power interests. Furthermore, mass data may increase the complexity of problems, since the quality, validity and transparency of the collection of data influence its interpretation.

3.7 Experiment together for solutions for the future

People increasingly agree that solutions to urgent social needs can only arise if new forms of cooperation are combined with new technologies. Such links only come about as a result of the various groups involved repeatedly negotiating and experimenting to see which approaches lead to a solution. What form might “solution labs” take, in which research of this kind can take place?

There is a need for debate in society to establish which types of data can be used for which governance processes

Citizens need experimentation spaces to develop potential solutions to urgent social needs

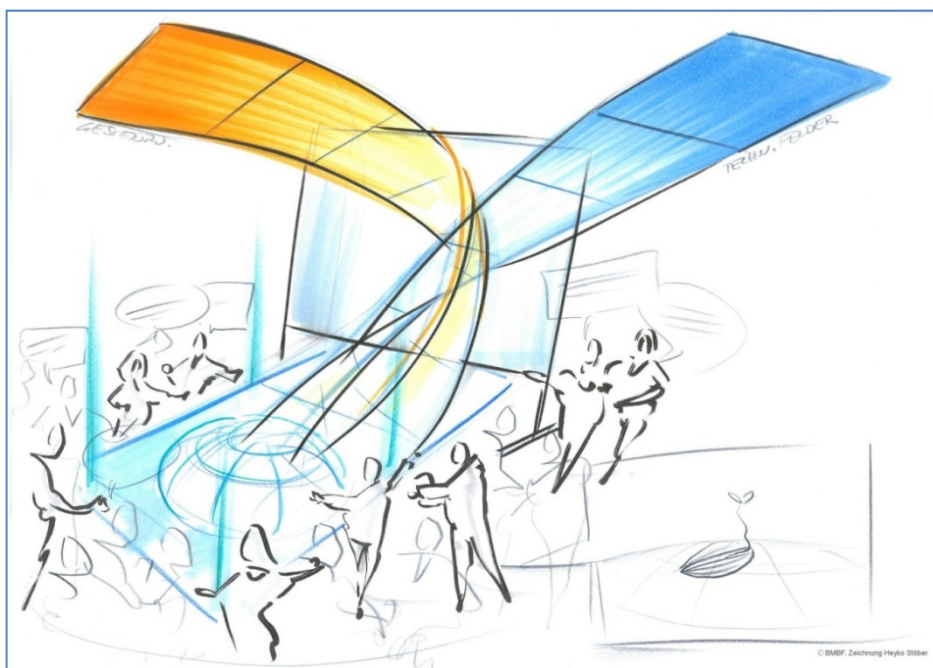


Figure 11: Finding solutions together. Illustration by Heyko Stöber at the linking workshop on 17 and 18 February 2014 in Berlin. © BMBF.

Solution labs: Energy-efficient housing in 2030

Doris lives in a small village near Hamburg, where for the last three years she has worked in the “ENERGISCH” solution lab. At the lab, 35 neighbours work together with a research team comprising electrical engineers, architects, designers and sociologists from universities and businesses on finding ways to reduce the village’s energy usage. This includes technology-based approaches such as smart metering, new insulation and ventilation technologies, and advanced control system concepts, as well as new organisational forms such as group buying and sharing the use of cold rooms. Doris is a systems mechanic in the building sector, and her participation in the solution lab is recognised as training. ENERGISCH is in the final project phase, which involves extensive discussions with other villages that are in a similar situation. Doris has been on two trips so far to pass on the experiences of ENERGISCH and support similar projects.

Solution labs: Movement in 2030

Lutz is a journalist. For days, he has been working on a reportage about solution labs that his newspaper is publishing to mark ten years since the first solution lab was set up in August 2020. Today, he is interviewing Boris – a sports scientist – and Julia – a businesswoman – who are both members of the core team at a recently formed solution lab called “Mind and Body Movement Zones”. He quickly skims over the short description:

“A network of child daycare centres together with educators, sports scientists, IT developers and urban planners is conducting research into ways of linking learning and movement outdoors. Apart from the children and their daycarers, parents are also increasingly taking part in the joint development of ‘mind and body movement zones’, which are designed to blend seamlessly into the urban environment so that movement is integrated into adults’ daily routines as well.”

Boris and Julia arrive, and the interview can begin:

Lutz: How did the solution lab get off the ground?

Boris: It was actually the three child daycare centres that came up with the idea. They raised the alarm because children increasingly didn’t want to play outdoors at all. They had tried all sorts of things, but they felt that they were just scratching the surface. Even the parents avoid any kind of physical activity. So then they posted a “need for research” on the solution labs platform.

Lutz: How did this result in a solution lab research team?

Boris: It soon emerged that a fair number of people were thinking along the same lines. It wasn’t long before the core team for the solution lab met up on the platform. A group of sports scientists, three urban planning offices, one playground equipment manufacturer, two parkour groups, psychologists and educators, someone from the city administration, an obesity support group, a parents’ initiative and a research team from the German Centre for Health Research got together within a few days. We met up a few times, wrote the short application, and then the solution lab advisory committee invited us to begin the process, because they judged the topic to be a serious social challenge. Via crowdfunding, we very quickly raised the required own contribution. Half a year later, we gained approval for the full solution lab process. By that time, we had been joined by an IT team, because it had become apparent that the new mobile devices can be a very useful tool, if they are developed in a suitable way.

Lutz: How did you acquire the skills to implement a solution lab like this?

Julia: Our core team members took the solution lab course. The first open space event takes place next week. All the actors involved get together to consider what the most important aspects are. More than 100 people have signed up, including many children and a few parents who want to take part in the research teams. We are very excited, and glad that we decided to call in one of the professional solution lab moderators.

Lutz: What has been your most interesting experience so far?

Boris: Well, I’m a sports scientist – as you know – and we have a lot to do with education, so it was easy for me to imagine what it would be like to partner with the child daycare centres, even though that was new for me. But then when the medics joined us, I thought it couldn’t possibly work out well, because they don’t understand anything about children’s everyday

lives. The medics probably had similar doubts, or so I was told later (laughs). As we went through the preliminary stage for the solution lab, it was interesting to see how quickly we found a common language, thanks to the methodology. But the moderation of the open space event next week – now I'm sure that will be a very special experience.

Lutz: So what will the research programme specifically consist of?

Boris: OK, so first of all, at the moment, we are going through the finding phase in the solution lab process. Five mixed solution lab research teams will conduct experiments at various locations in the local area. The exact constellation will depend on the outcome of the open space process. Then, after a year, there will be a review meeting involving everyone together, and at that point the task definition might shift again.

Lutz: For the last five years, the government has offered a solution lab toolkit that is designed to help implement a solution lab. Do you use this toolkit?

Julia: Yes, we learned about the variety of methods in the toolkit during the course, and we had the materials sent to us. In particular, we use the solution lab toolkit to represent the situation in our neighbourhood, e.g. the routes that children and adults take every day. We will probably use the serious gaming tools as well. But above all we need the moderation process as a way of making sure that we all agree on the direction we are working in, so that the whole thing doesn't fall apart. We are also planning to use the solution lab scenario cards every month.

Lutz: Several of you – yourself included - work full-time. How do you manage to fit everything in?

Boris: Most of us, including me, are given some time off work by our employers so we can participate in this process. Others have requested time off for training, as taking part in a solution lab has been recognised as training for the last three years. Sure, we put a lot of work into it, but all of us see it as a unique life experience, which is ultimately what we're looking for in our free time as well. Some of the young people get the solution lab recognised as part of their education – three doctoral theses and five student research projects are based around the solution lab.

Lutz: Julia, you are a businesswoman and you pay to take part. Why?

Julia: It is very important for us to know what's going on here. We make fitness equipment and we need to understand how it will change in the future. On several occasions, we have seen solution labs develop things here in Germany for which a similar demand develops later on in China and India. So we see the contribution that we pay as being an investment in research and development. We have also seconded a developer to work in the core team. We hope to gain a lot from the fact that she is working with the mobile device developers and the childcare workers, as this will inject new impetus and fresh ideas into our business.

Lutz: Thank you for the interview and all the very best with the solution lab!

Solution labs: Food in 2030

Hannes is a cook in a restaurant in the main town of the region. For the last month, he has been working two days a week at the REGIO-TISCH solution lab. A team of nutritional scientists, supermarkets, food producers and haulage firms as well as administrative staff from the three participating municipalities is researching new approaches to a sustainable food supply in the region. The team has devised various possible solutions, and implemented these in a simulation, with the help of a design student. All the proposed solutions are played out in the simulation, which reveals the advantages and disadvantages for example if greater quantities of certain foods were to be produced in the town once again. For the last six months, they have run a stall at weekly markets in the region to discuss the various alternatives with citizens from the town and region, based on the simulation. Hannes' employer has given him time off work to participate in the solution lab. Both hope that the regional economy will benefit if REGIO-TISCH develops a practicable solution.

Solution labs: International perspective in 2030

Eva Herkano is the mayor of a city in Indonesia that has just awarded a contract to develop new transport infrastructure to a German consortium. Their offer includes setting up a solution lab. Eva worked very hard to ensure that this consortium was awarded the contract, since Germany has the longest experience in setting up and implementing solution labs. She is just explaining her thoughts to a group of UN workers who want to support the project.

“We have had a fairly disastrous experience here with top-down planning approaches that looked good on paper, but at the end of the day our city was still choked with traffic and our air quality has steadily deteriorated. This time, we want a solution that truly begins with society – not only new transport concepts, but also ways of organising things to reduce traffic and, above all, to ensure that the former fits with the latter. We see solution labs as being the best approach, because they bring together the very different sections that are affected by traffic.”

Eva's colleague adds: “We were very impressed with the way that solution labs have demonstrably improved social cohesion in many German cities, and conflicts have decreased. Here too, we have some conflicts of interest, especially where traffic is concerned. We hope that the solution lab's moderation approaches will help in this respect.”

A UN employee asks: “But can the concept be transferred so easily? The culture here is completely different when it comes to negotiation processes.” “That is completely true,” Eva agrees. “So to begin with, a mixed team from both countries will modify the approach to suit our circumstances.”

The UN team is convinced: “We will support the project, especially because we think that both countries will learn from each other. Internationalisation of the solution lab approach fits perfectly with our strategy of strengthening cooperative approaches to solving global challenges, on a worldwide basis.”

Opportunities

Approaches such as solution labs offer the opportunity to develop forward-looking links between technical and social innovations as solutions to complex areas of need in society (in particular: food, movement, security, education, housing, sustainability). Through a structured but open process of searching for far-reaching solutions, it is possible to tackle problems in a more sustained, more in-depth manner.

The concept of solution labs and the approaches developed in them may provide an innovative basis for opening up new markets in other parts of the world.

Innovation means always combining new elements to create solutions. If solution labs become established in Germany, this would strengthen innovative capacity in the long term as participants learn to continually form new combinations of very different ideas and perspectives. In particular, they could get better and better at combining social and technical solutions into new systems. This capacity for flexibility in developing systemic solutions will become increasingly important in the future, because for many major challenges that we will face, we need not only new technologies but also, above all, innovative forms of organisation.

Joint development of solutions across various different groups in society offers the chance to improve social cohesion and strengthen key skills such as teamwork and interdisciplinary communication.

Solution labs have the potential to improve mutual understanding between science, business and society.

Challenges

Developing suitable financing models represents a significant challenge. Various combinations of public and private financing are conceivable, for example with the involvement of foundations, businesses and individuals via crowdfunding.

Approaches such as solution labs could provide a way to address problems in complex areas of need in society on a longer-term and more in-depth basis

Many major challenges not only need new technologies, they also and above all require innovative forms of organisation

Another challenge is the transparent and appropriate selection of solution labs that will receive public funding. The composition of the selection panel for these solution labs will no doubt be different to that of the advisory committees for typical funding instruments. It is also conceivable that the panels will meet in a different interactive format. The selection criteria too will probably need to be designed and discussed very carefully, since not every problem can be tackled in the same way.

It is likely that the utmost transparency and traceability of criteria and decisions will be important for acceptance.

Developing a suitable methodology for these experimentation spaces could be another challenge. As indicated in the “solution labs” vision of the future, a variety of approaches that could be useful in this respect already exist today – such as participative design methods (“co-design”), and “citizen science”. Integrating these into an overall concept that can be flexibly adapted to very different contexts, yet provides a structuring framework, will probably require considerable effort. Key aspects include quality assurance for this kind of collective research, and validating the transferability of the developed solutions.

For the knowledge system, recognition of the outlined types of research will present a challenge since these cannot necessarily be measured using typical output criteria such as impact factor in academic journals.

On the whole, it can be assumed that a functioning approach to socio-technical experimentation can only emerge from a long learning process.

A functioning approach to socio-technical experimentation will require a long learning process

3.8 Collaborative economy

For a long time, because of the spread of the internet and smartphones, and with the increasing digitisation of content, it has been getting easier and cheaper to make contacts, coordinate activities, and collectively develop knowledge over long distances. As a result, age-old customs such as sharing, giving, neighbourliness and swapping are growing and diversifying far beyond the immediate environment. People are already increasingly participating in services in the internet as providers and users – with or without payment and/or mediation via commercial platforms. The boundary between businessperson and customer, producer and consumer is becoming increasingly fluid. While this holds the prospect of many benefits, especially a more efficient use of resources, it also leads to conflicts between various interests. It is not yet clear which forms will become established and which fields will change. What might a “collaborative economy” in 2030 look like, which focuses on access instead of ownership? Like a society that has succeeded in using the opportunities created by the new coordination possibilities? What are the

Modern communication provides citizens with new ways of sharing, giving and swapping

It is still open as to what a collaborative economy society might look like

infrastructures of a collaborative economy that is geared to the common good?

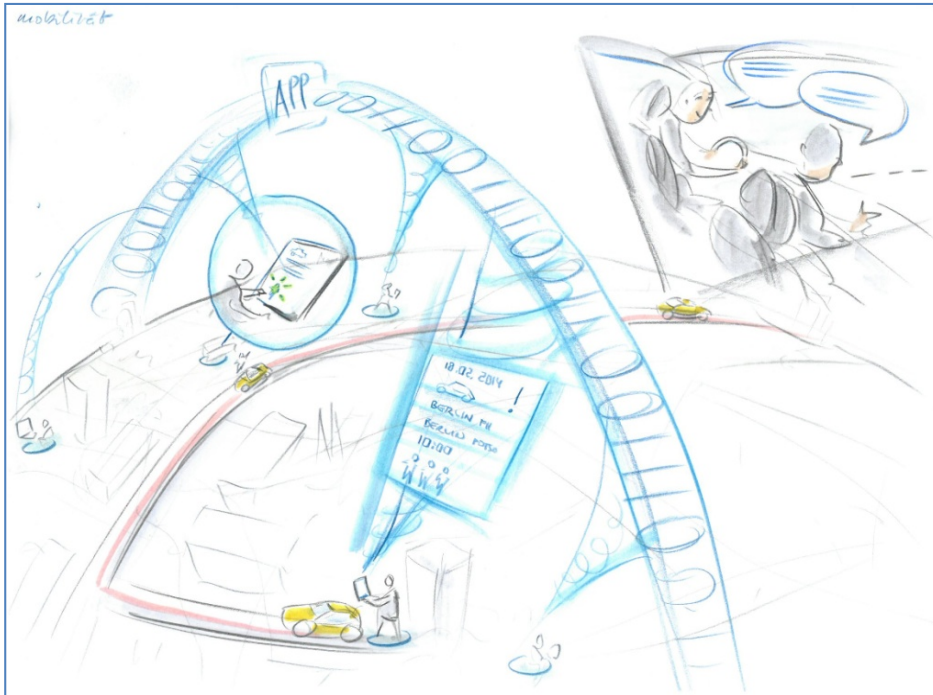


Figure 12: Mobility in a collaborative economy. Illustration by Heyko Stöber at the linking workshop on 17 and 18 February 2014 in Berlin. © BMBF

Collaborative economy: Extended household in 2030

Tobias is an apprentice in a very popular university town, and he has to get by without much money. He was lucky to find a small attic room. There is no space for a washing machine, and the small kitchenette is suitable for making coffee but not much else. This is particularly unfortunate for Tobias, as he loves cooking and also likes to cook for many people. Recently, however, he made arrangements to gain access to these resources and, in doing so, he even made his first contacts in the town. Via the local online portal, he joined a “neighbourhood laundromat restaurant” run by Viola, an elderly lady in a wheelchair, who lives in an old villa that has a large kitchen and a basement with a laundry room. As a member of the neighbourhood kitchen, Tobias can use the excellent kitchen facilities and the washing machine. In return, he goes shopping for Viola when she posts a request on the “active shopping list” in the portal. Every so often he cooks for small groups who meet on Viola’s platform – he enjoys this activity and he earns a few bonus points in the portal each time. He uses these points not only for doing his laundry but also for occasional journeys via the “shared rides” feature on the local portal. Viola has just told him that she is thinking about granting limited access to the villa’s garden as common land. Tobias thinks this is a good idea: “And why not make the lawnmower available through Gregor’s sharing group?” he suggests.

Collaborative economy: Access instead of buying in 2030

Gregor runs “Gregor’s sharing group”. It all began with his aquatic sports gear. Time and again, friends and acquaintances would borrow items, and in return would add new items. Then suddenly the DIY store where he was manager went out of business. Sales had been steadily declining, in part because increasing numbers of people didn’t really want to buy tools and machinery that just took up room and were rarely used, while housing space in the increasingly popular neighbourhood became ever scarcer. So Gregor decided to turn his private lending operation into a professional business. He used the sharing starter kit that was available for free from the new local portal that the town had recently launched. It contained all the necessary information that enabled him to run his sharing business legally, and he launched his sharing platform initially only for aquatic sports equipment. It was an immediate success. Within the first three weeks, more than fifty members had signed up. Once he gained certification for the sharing group, which confirmed the secure and transparent management of identities and data, its popularity surged. Soon afterwards, the platform expanded to include a variety of areas such as garden tools, photographic equipment and books. Many of the private individuals who lend out their property are registered as micro-entrepreneurs, and also offer advice and assistance with using the equipment. At first, the members were mainly students, like Kim. She is a mechanical engineering student, and she likes to spend time working on her motorbike. She doesn’t have the space or money for expensive tools, so she registered her own tools with Gregor, and in return she can use the full range of more than 1,000 tools on the site. As she only uses her motorbike at weekends, and otherwise always rides her bicycle, she has put her motorbike in a peer-to-peer vehicle sharing group. The motorbike is popular and is often booked. She can use the resulting income she gets as a “micro-entrepreneur” to fund her holiday travels. Recently, the sharing platform has increasingly been attracting users who are “light owners”, i.e. high-earners who have made concepts such as “light living” and “access instead of ownership” into a way of life.

Collaborative economy: Business perspective in 2030

Anna is a manager for a machine tool manufacturer. For a number of years, she has headed the “collaborative economy” working group for a trade association. In this role, she helps businesses in all sectors to benefit from the growing economic importance of the collaborative economy. She is constantly amazed at how difficult it is for some businesses, even now, to adapt their business models to the collaborative economy. Despite all the association’s educational work, many member firms went bankrupt towards the end of the 2010s because the change from product ownership to access and the rapidly growing importance of independent user platforms had taken them completely by surprise.

Many manufacturers of physical goods thought until recently that digitalisation would only change business models in areas such as music, films and books, which could be easily digitised, whereas in traditional industries it would merely lead to the optimisation of well-established processes. Now they were witnessing how their customers organised the use of their products more efficiently, without the firms themselves playing much of a role.

Anna has a background in service design, and in her company she began very early on to systematically reconsider all processes from the customer experience perspective. Even back in 2020, she developed special product-service offerings for customers who wanted to coordinate their resources, such as the “Kollabo” product line. This line of machines is particularly robust and flexible, and appeals to customers who want to make the machines available in a sharing group. If required, they can be supplied with an interface to the sharing group management system already fitted. In parallel, Anna’s company started using some resources jointly with other companies, and achieved considerable cost savings as a result.

Anna’s personal favourite activity is running information workshops on the collaborative economy, which she regularly organises for the association. She is pleased to see that Gregor from Germany’s very first sharing group has just confirmed he will attend, as has Lily, the famous journalist and pioneer of the collaborative economy. “This is sure to be exciting,” Anna thinks, “especially for businesses in the textile industry; they may be next in line for a surprise if Lily’s theories are right,” she reflects, and checks the time. So late already! – once again, she won’t make it home in time to buy bread for breakfast. So she takes a look at the active shopping list on the local portal that she joined years ago. Tobias, the apprentice who lives in the attic room, is about to go to the baker’s. Anna quickly post a message on the list saying that she needs a baguette.

Collaborative economy:

Change in values towards light ownership in 2030

Lily is a journalist who is always on the move around the world, and she is a dedicated adherent of “light ownership”. She recalls with horror the chock-a-block attics and basements of her childhood, and also how back then there would sometimes be perhaps ten identical pieces of garden machinery lying around in sheds in the same street, only to be used once a year. Today this seems a barely conceivable waste of resources and space. She has systematically dematerialised her own household; there are only a very few things that she owns herself. She is a member of CoCo, the international collaborative consumption network, via which she can easily borrow items in many countries.

Objects or services are often provided by private individuals in the CoCo network who live close to her specified travel route. But sometimes she uses local lending shops that have sprung up in an increasing number of cities at airports and railway stations, where CoCo members can borrow equipment. Especially in Berlin, she always tries to call in at “Leila”, one of the world’s first lending shops². Lily recently realised an old dream. Together with several friends from around the world, she began to develop an “open wardrobe” via CoCo, that allows people to lend and borrow clothing worldwide to suit the culture and weather. She is currently working on an article for the neighbourhood portal about the reasons for setting it up ten years ago. After enquiries on this topic kept coming in from Germany and other countries, she decided to add a “history” section to the portal. She types:

“Back in 2015, the city administration was one of the first in Germany to decide to develop a collaborative infrastructure with a neighbourhood portal. At the time, increasing numbers of cities and towns had developed into collaborative economy pioneers, such as Seoul, which declared itself a sharing city in 2013. Once it was seen that quality of life increased significantly in these areas, a “Collaborative Consumption City” strategy was adopted in many regions. Some cities set up common land schemes that enabled them to establish new infrastructures for collaborative production – such as sharing and swapping spaces, and community gardens – on unused farmland and in public spaces that had deteriorated as a result of outward migration. Although the economy stagnated by official measures, citizens’ satisfaction increased, with the result that people started moving back into the city. One study showed that many people who had previously been unemployed or precariously employed found success and satisfaction working in the collaborative economy. Many older people also found that this was a way they could contribute. Thus many people achieved a higher quality of life. At the same time, the movement was supported by highly skilled persons who reduced their working hours so that they could work according to self-determined rules and for self-set goals.

Another factor driving the development of the collaborative economy from the outset was the more efficient use of resources and avoidance of waste as a result of finding ever new ways to use the resources circulating in the network. There was slight disillusionment at one point, when a research project that conducted a long-term study of fifty collaborative projects found that the ecological footprint was only reduced under very specific conditions.

In many cases, the benefits were wiped out by the fact that savings were spent on new purchases. However, the good practice guidelines for “green

² <http://www.leila-berlin.de/>

collaboration” that were drawn up by the research project spread like wildfire among the many sustainability-oriented collaborative economy actors, with the result that considerable improvements were achieved within a short time. Developing the collaborative economy has therefore once again been an element of our city’s sustainability strategy since 2025.”

“That’s enough for today,” Lily thinks. “Tomorrow I should perhaps also point out the many contradictions and conflicts that can be found in this trend – and mention the role of the new progress indicators and the debate over basic income.”

Collaborative economy: Infrastructure in 2030

Ahmed is a software developer with a German company that devises online reputation mechanisms and identity management processes for collaborative economy activities such as lending, swapping, the procurement of micro-services, and contributions to collective commons-based online development projects. The company’s flagship is a “privacy by design” collaborative system that enables trust to be established between co-producers without having to disclose private information. This system was developed by a European consortium of universities and businesses that was coordinated from Germany. Ahmed was involved as project manager. The press department has just sent out a newspaper article that recalls the system’s launch ten years ago. Ahmed is sitting with colleagues at the coffee bar, and he reads out loud: “Today, the system is regarded as the backbone of the collaborative economy, and as having paved the way for its breakthrough in Europe. Germany’s leading role in tapping the potentials of peer-to-peer production methods is often attributed to the certification system that was developed here.” Ahmed shakes his head, and comments: “Well that’s something of an exaggeration. It was really the social trends that were the key factor.” A colleague adds: “And I think the computer game scene made just as big a contribution.” Everyone laughs, as they all know that the colleague in question is extremely active on this scene, and has even cut down her working hours so she has more time for computer game programming. “Don’t laugh,” she says. “If we hadn’t got so much feedback from gamers for our first beta version, we would never have made so much progress so quickly.” “That’s true,” a third person chimes in. “But I think that the active villages and towns were also very important. What was the name of that city with the first neighbourhood portal, where that sharing group was started up straight afterwards?”

If hadn't been for them, the hype would have quickly died out." Ahmed comments: "One thing is for sure though: if the glitches had continued like they did before our system was launched, it would have soon spelled the end for the community services. Just think of the first scandal with the active shopping list, when there were suddenly loads of purchases that nobody had ordered!" There is laughter again, as it was Ahmed who developed this service. "I agree," says his colleague from the legal department. "But even that wouldn't have been enough if a number of regulations hadn't been modified at the same time. Do you remember these 'anti-social apps' and semi-legal transactions that went on back then? Legally, that was a pretty grey area. A lot of that is illegal today." "Definitely," says Zoya, the works council member. "The works council protested at the time, when outsourcing to cheap micro-entrepreneurs started, as they would work day and night without any kind of decent working environment. Today, micro-entrepreneurs are certified, as are the sharing groups." Ahmed wanders back to his desk and ponders: "Back then, we had no idea what the core of this movement is. It only emerged gradually, if it did so at all.... Some things that seemed all the rage ten years ago are banned now, and other things have been taken over by big business. Who knows where it will all lead?"

Opportunities

A collaborative economy offers the opportunity to use materials, time, space and money more efficiently

A collaborative economy offers the opportunity to use resources such as materials, time, space and money more efficiently. It can make it possible to satisfy needs without placing a greater burden on the environment, and establish a sustainable economy (green economy).

For many people, a collaborative economy would result in a better quality of life as they would gain better access to a greater variety of resources.

Furthermore, the collaborative economy provides the opportunity for new connections to form between different people, for trust and a sense of security to grow, and for social cohesion to strengthen. For certain groups of people, such as older people with restricted mobility, it produces new possibilities for participating in social life.

Regular involvement in various collaborative activities may strengthen communicative and organisational skills, and make it easier to preserve and pass on experience-based knowledge and special abilities. Such networks and skills facilitate better handling of potential future crises, and therefore support a society's resilience.

For businesses, there is an excellent opportunity to exploit high value-creation potentials via business models based on collaborative services, and build lasting customer loyalty.

For cities and regions, it is advantageous to use the collaborative economy in a targeted way for urban development, e.g. for neighbourhood development, the management of unused land, or to solve social challenges (such as a shortage of space or isolation among older citizens).

Cities could use the collaborative economy in a targeted way for urban development

Challenges

A collaborative economy creates a number of conflicts with legal provisions, as is already becoming apparent today (protests against Uber taxis, bans on accommodation-sharing platforms in some cities). Questions regarding liability, taxation and social security systems for actors in a collaborative economy require clarification. In general, it is important to avoid a situation where the collaborative economy slips permanently into a legal grey area, as this would make it much more difficult to exploit opportunities for society and for business.

The collaborative economy could entail new costs. For example, there is the doubtful question of how to address damages that arise, which then have a greater impact on society.

Interactions between the collaborative economy and the welfare state also require clarification, to counteract accusations that the self-organisation of society is being abused as a way to cut welfare services (cf. the discussion about “big society³” in the United Kingdom).

Interactions between the collaborative economy and the welfare state require clarification

It is also possible that collaborative platforms could be misused for illegal purposes: either for criminal activities, such as stealing borrowed items after providing a false identity, or for unscrupulous transactions in which bona fide “collaborators” are exploited for commercial purposes. Instances like this would have the potential to rapidly discredit a collaborative economy. In addition, web-based cooperation may be used for socially problematic purposes, such as surveillance of citizens (cf. e.g. Neighbourhood Watch).

Some critics believe that a collaborative economy holds the danger of human relationships becoming commercialised, and of a decline in the willingness to help others without expecting something in return. Profit-oriented utilisation of public goods could also be problematic (anti-social apps, e.g. charging for information about vacant parking spaces).

³ “Big society” was a strategy by the British Conservative Prime Minister David Cameron that relied heavily on citizen participation in social services and was criticised as being a covert policy to cut spending. Cf. e.g. <http://speri.dept.shef.ac.uk/2013/03/08/big-society-neoliberalism-rediscovery-social-britain/> (accessed on 17 August 2014).

The possibility of increasing exclusiveness in the collaborative economy and the exclusion of certain groups having limited social and material resources could present a problem (sharing divide).

At least in a transitional phase, conflicts of interest are conceivable between established and new collaborative forms of value creation. As has been clearly shown in the music industry, it is entirely possible for entire industries and value chains to undergo restructuring.

Individual actors who operate enormously large platforms could acquire highly detailed knowledge about citizens' everyday lives, as well as far-reaching capabilities to manipulate social processes.

3.9 Privacy in transformation

Citizens'
understanding of
privacy is changing

The understanding of privacy will change fundamentally in the future. As a result of the increasing digitalisation of our everyday lives and new technological applications, many areas of life and activities will be more convenient and more secure in 2030. An intelligent home environment, for example, will reduce everyday organisational activities by networking household items. However, sensors on these devices will make it possible to generate a wide variety of personal data in the so-called outernet, which could then be sent to the device manufacturers, for example. In cities and pedestrian zones, automatic security gates and public cameras will be capable of enhancing safety and security in the future. Yet too many security checks could be regarded as a nuisance. Moreover, it is

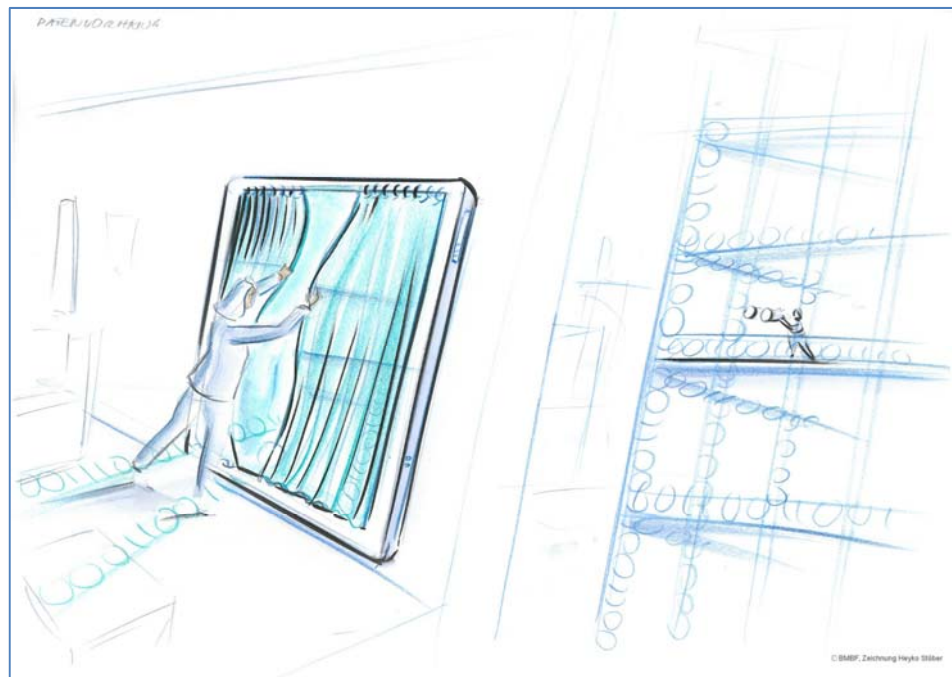


Figure 13: Privacy. Illustration by Heyko Stöber at the linking workshop on 17 and 18 February 2014 in Berlin. © BMBF.

conceivable that people's every move could be monitored by private cameras; private video recordings could then end up in the internet, in an unwanted way. It would then be possible, using face recognition, to search through any kind of image material using ordinary search engines to find particular persons and generate individual movement profiles.

Privacy in transformation:

Glut of data from domestic appliances in 2030

Paul is relieved that his new home server is finally set up. A new installation means having to go through the house room by room, and individually register and authenticate every domestic appliance via a wireless link. He began in the kitchen with the hob and the microwave. They receive information from a central control display about the dishes that are being cooked. Marie, Paul's wife, was initially very sceptical about this cooking aid. But she has to admit that pots never boil dry now. Since the hob knows what's being cooked, it automatically switches off depending on the dish. The link between the refrigerator and the central, holographic control display that also shows cooking recipes is particularly useful. If any ingredients are missing, they are marked in red. The oven automatically heats up to the right temperature. Sensors inside the food cupboards read RFID tags on food packaging. Now Marie hardly ever throws away out-of-date food. Paul has also registered the toaster and kettle on the home server, so that they can alert him if there is a fault, e.g. overheating. The bean-to-cup coffee machine gives advance warning when its periodic servicing is due, if rubber seals start to leak, or if internal mould sensors are triggered. In the bathroom, Paul first registers the electric toothbrush. It has pressure and position sensors so that Paul and Marie can check how well their youngest daughter brushes her teeth. He had to adjust the permission settings on the bathroom scales, as his wife didn't want him or the home server to know her weight.

Marie had noticed that while the permissions were set to public, she suddenly started receiving a lot of adverts for diet products. However, Marie is pleased that she receives advertising for food items, as she has already saved a lot of money thanks to being notified about current offers in her local area on products that she consumes regularly. Tom – Paul and Marie's son – will soon turn 18, and he is a computer freak. He helped his father install the home server, but anonymised his personal profile in the process. Anonymisation is not supposed to be possible with this low-cost type of server, but Tom discovered he could trick the server by automatically deleting the user profile and re-registering each day. While his parents are not worried about big brand domestic appliance manufacturers misusing their stored personal data, Tom thinks that it is only a matter of time before millions of profiles are stolen and sold on by hackers.

Privacy in transformation: Live video streaming in 2030

Ina is so excited that she can't sleep. In four hours, at 2 a.m., her alarm clock will go off, so that she can visit a flea market with her friend Heike. A hippy clothes flea market is being held at Venice Beach. Heike is currently on holiday in California, and is more than 9,000 kilometres away from Ina. At 2 a.m. on the dot in Germany, and 5 p.m. local time in California, Ina and Heike excitedly wave hello to each other on the portable display. "I'll switch over now," says Ina, and suddenly Heike can see a colourful stand with flower-power shirts. From now on, Heike can see everything that Ina sees. Ina is wearing video-streaming sunglasses. Despite the large distance, the time delay is minimal. "Look over there on the right, the orange shirt with the green flowers," Ina calls. Heike takes the shirt and turns it in all directions. "Perfect – I want it," says Ina. This isn't the only item, and the next morning, Ina's mother is not pleased when she finds out how much money her daughter spent at the clothes market. Michael, Ina's brother, shakes his head when he hears about his sister's night-time shopping trip. It annoys him that Ina uses a cheap provider for her video streaming, whose terms and conditions allow them to automatically save the live video streams in their freely accessible database. Several times, he has had very unpleasant experiences with the numerous publicly available video databases in the internet. Since mini-cameras are invisibly built into data glasses, sports helmets, leisure caps and clothing, and young people especially think it's cool to show their friends what they're doing at any given moment, the number of video platforms in the internet has exploded. One large search engine operator lets people easily search, for free, through these videos for specific faces and people.

At Michael's 16th birthday party, he had a long, animated conversation with a girl. It was too long for his girlfriend, who was sick at home, and later just wanted to see what the party was like. Just recently, Michael applied for an internship with a pharma company. He is studying biology, and would like to work there when he finishes his studies. However, his application was rejected – because according to the pharma company, he has repeatedly taken part in demonstrations against animal experiments. The would-be employer expressed concerns that animal rights activists might apply for internships specifically so that they could gain access to internal information. After lengthy consideration, Michael has decided to shave off his conspicuously styled beard. He suspects that this is particularly easy for the search engine to recognise.

Privacy in transformation: Automatic security checks in 2030

Tim is irritated. The journey to the World Cup Final had been going well, but now at the entrance to the stadium, nothing is moving. It must have often been like this in his father's day, he thinks. Today, in 2030, thanks to automatic security checks in designated zones, it is unusual for there to be long delays at major events any more. Multi-detection gates check arriving football fans for weapons, drugs and explosives at transport hubs such as train and bus stations. Suspicious persons are searched early on and taken out of the crowd if necessary. As a result, there are now hardly any delays at the stadium entrances. Tim was just in the metro station and he witnessed two men suddenly being taken to one side to be searched. Perhaps they were carrying fireworks? Everyone ought to know by now that you can't smuggle those into stadiums any more. The gate sensors can detect even small amounts of explosives from a distance. Or perhaps the video surveillance systems in the railway station identified the two men as known suspects. The more frequently someone attracts negative attention, the more frequently they will be targeted by automatic face recognition. He didn't think there was anything out-of-the-ordinary about the two men, so it seems unlikely that the security system was triggered by conspicuous behaviour. Perhaps, without their knowledge, their clothes got contaminated with minimal quantities of drugs on the train. "Whatever," thinks Tim, coming back to the moment. He is pleased to see that the queues are finally moving. A voltage fluctuation had brought down the automatic security check systems. A technician had to clear the fault in all of the machines, and now the waiting crowds can quickly enter the stadium.

Opportunities

Privacy is a valuable asset that needs to be protected even in the "Facebook-plus" age. German businesses have the opportunity to position themselves as trusted pioneers of secure services and products, in a similar way to the "Made in Germany" label.

The internet connectivity of everyday products (e.g. domestic appliances), in conjunction with the use and analysis of big data, offers ease of use and operation as well as new sales channels and business models for services. Secure products and sufficiently high technology acceptance among consumers are essential and necessary conditions for demand and growth. In turn, there could be efficiency gains in fields such as communication, energy, mobility, and health and nutrition.

Germany has the opportunity to become a trusted pioneer of secure products and services

Meanwhile, because of their trustworthiness in comparison with cheap products, German products will be in a position to succeed in markets again in the future. The market for technical security mechanisms will continue to prosper in the future, and has great international growth potential.

Public debate to find a balanced solution between maximum security and minimal surveillance

It is conceivable that automatic security checks and video surveillance will help to reduce waiting times at major events, airports and train stations etc., and enhance public security. A consensus-oriented debate in society offers the opportunity to find a balanced solution between maximum security and minimal surveillance.

Challenges

The acceptance of digital services and sales channels along with networked technologies is having, and will increasingly have, substantial impacts on the economy. All sectors face the challenge, to an even greater extent than today, of continuously adjusting their offerings so that they can participate in the markets for networked services.

Networking and digitalisation have the potential to influence social relationships between people. Future communication technologies will mean that personal interaction increasingly takes place in virtual spaces, while aspects such as security and trust will become even more important.

It is important for society as a whole to gain digital skills and be educated about data privacy

Society's understanding of privacy is heterogeneous and is undergoing transformation. The challenge consists in creating suitable conditions in the information and knowledge society so that citizens can freely decide which personal information about themselves they wish to give out. It is important for society as a whole to gain digital skills and be educated about data privacy.

Through social negotiation processes, a balanced relationship can be developed between privacy and the use of big data. There is an opportunity here to counteract potential problems with regard to technology acceptance at an early stage. Personal profiles must not be created, used or disclosed without the explicit consent of the persons to whom they belong. Giving blanket approval to incomprehensible terms and conditions is not sufficient in this case. The same applies to the increasing use of miniaturised cameras in glasses, clothing and other objects. A violation of personal rights has already occurred when video data is stored on the respective service provider's servers in another country. Automatic security checks also must not lead to unnecessary intrusions into privacy, e.g. as a result of misidentifications.

4 OUTLOOK

With this third and final results report, the results of the search phase of the second cycle of the BMBF Foresight process are now available in full. The authors have carefully and systematically outlined future trends which the German innovation system should give more attention to in the future. They have produced a large survey of key future debates with exciting development paths, linked to a large number of research questions.

In every BMBF Foresight cycle, the search phase is followed by a transfer of the results into the spheres of business, science, society and politics. This transfer began at an early stage in the search phase, and continued as the search phase progressed. Thus Foresight has already provided a source of ideas for the German federal government's new "High-Tech Strategy".

Furthermore, all three results reports will be of interest to many other actors in the innovation landscape. The first results report comprises a balanced inventory of social changes that have a bearing on the future and which are significant to persons and organisations promoting research and innovation.

The second results report provides a comprehensive account of research and technology perspectives with a generally consistent level of complexity and granularity. It is therefore well suited to providing non-technical people with an overview, while offering specialists in particular disciplines detailed insights into neighbouring fields.

The stories presented in this third volume link social challenges to research and technology perspectives. This highlights possible socio-technical lines of development. Any discrepancies between the possible developments as portrayed in the stories, and desirable developments from the reader's point of view, are indicative of organisational tasks which will ultimately need to be addressed via a society-wide debate. The stories are intended to provoke such discussions.

In this spirit, the authors hope to provide much future-oriented food for thought, which will help businesspeople, scientists, policymakers and society as a whole meet the major challenges of the future.

Dear readers,

Usually an extensive bibliography would appear at this point. Our omission of a bibliography is deliberate in order to emphasise the fundamentally fictional character of our “stories from the future”.

Nevertheless, these stories are derived from a method and criteria-based process which made extensive use of secondary and primary literature.

For an overview of the literature used and other information sources, please see the first two volumes for the Foresight process (Future Technologies, vol. 103 and vol. 101 [only available in German]).

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