Nationaler IT Gipfel
Stuttgart 2009

Prospects and Opportunities of Information and Communication Technologies (ICT) and Media

International Delphi Study 2030

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Bundesministerium für Wirtschaft und Technologie

Prospects and Opportunities of Information and Communication Technologies (ICT) and Media

International Delphi Study 2030

Contents

Foreword by the Federal Ministry of Economics and Technology

The International Delphi Study 2030 is a project from the German IT summit, which aims to strengthen Germany as a location for ICT. The findings of the study provide insights into the world of tomorrow and deliver valuable information and a strong basis for discussion for the IT summit at the start of December 2009 in Stuttgart.

I am pleased that, in its second phase, the "Prospects and Opportunities of Information and Communication Technologies (ICT) and Media" study is now looking into the medium to long-term future and has chosen to take an international approach to do so. This Delphi Study shows the extreme importance that developments in information and communication technologies (ICT) will have for society, business, academia and politics in the years and decades ahead. The study clearly illuminates how extensive ICT-related change will be in the next 20 years. High economic potential and number one driver of innovation – that is already the case for information and communication technologies today. And, as the study shows, this development will continue to gain momentum.

Research has shown that it is primarily the ICT skills of all citizens in their private and professional lives that will help to decide how ICT will evolve in the coming years and what impact it will have on society and business.

Increasing digitization will mean that adults and children will need more and more ICT skills in the future. As I see it, the key lies in the broad dissemination of knowledge about how to use the Internet and its services across all social classes. In doing so, we should better exploit the potential of digital natives, that is to say, the generation that has grown up with the Internet.

The study underlines the central importance of a high-performance communication infrastructure. With its broadband strategy, the federal government has set the right course for nationwide broadband coverage and new, modern networks. The study also shows that continued advances in ICT base technologies will further boost acceleration in innovation processes in many sectors of the German economy. We will address this development at the IT summit in Stuttgart and discuss specific examples.

The joint project "Prospects and Opportunities of Information and Communication Technologies (ICT) and Media" of Münchner Kreis, EICT, Deutsche Telekom, TNS Infratest and the partners and supporters Siemens, Vodafone, Focus, VDE, SAP, the Alcatel-Lucent Foundation, IBM and BMWi is a good example of how various organizations and companies from different fields can come together for a project and successfully implement it. I would like to thank all of the participants for this and I am sure that the findings and recommendations of the study will feed into the formation of the federal goverment's future ICT policy.

Dr. Bernd Pfaffenbach
State Secretary in the
Federal Ministry of Economics and Technology (BMWi)

Foreword by MÜNCHNER KREIS

On the cusp of a new decade and ten years after its study "2014 – The Future of Information, Communication and Media," published in 1999 and highly thought of at the time, MÜNCHNER KREIS together with a network of partners from academia, business and politics has taken another look ahead to future developments in information and communication technologies, their areas of application, benefits and problems; this time, with a time horizon to 2030.

In the first phase of the study (2008), the status quo and the future prospects of the German ICT industry were analyzed in terms of their strengths and weaknesses and initial action areas were identified for the players – business, academia and politics. The findings were included in the federal government's 2008 IT summit process, among other things.

As in the 1999 study, in the second part of the study that has now been published, the scientifically based, international Delphi Method was used to investigate the longer-term prospects for the information, communication and media world and future developments were forecast.

In the course of the project, a carefully prepared web-based survey of more than 550 selected experts from various fields of work was conducted in spring/summer 2009. In order to ensure an international perspective, the experts came from Europe, North America and Asia. In addition to their specialist knowledge, the experts brought their instincts for the "conceivable" and the "feasible".

From their assessments, it is possible to estimate developments for the next ten to twenty years and identify important opportunities and challenges.

The future study gives in compact form an account of the current future estimates of experts across a broad spectrum of subject areas and experience and aims to provide guidance in the increasingly complex and fast-changing world of ICT and media. Although everyone is aware that events may often develop differently from how they are represented here, the value of the research lies in the systematic structuring and methodical consolidation and overview of forward-looking expert judgments, which the readers of the study incorporate into their own considerations and actions in order to improve them. Particularly revealing is the comparison of the widely differing views and development prospects of the different regions of the world, which gives rise to a need for additional action.

The study was conducted by TNS Infratest on behalf of Münchner Kreis, EICT, Deutsche Telekom, TNS Infratest and the partners and supporters Siemens, Vodafone, Focus, VDE, SAP, the Alcatel-Lucent Foundation and IBM and was supported by the Federal Ministry of Economics and Technology (BMWi) within the scope of the fourth IT summit in 2009. We thank all experts, companies and organizations for their considerable commitment in making this research possible and hope that, despite all the uncertainties regarding future developments, the results can provide assistance in shaping the information society and its dynamic development.

Prof. Dr. Dres. h.c. Arnold Picot
Ludwig- Maximilians-Universität München,
Chairman of the Board
MÜNCHNER KREIS e. V.

Prof. Dr.-Ing. Jörg Eberspächer
Technische Universität München,
Chairman of the Research Committee
MÜNCHNER KREIS e. V.

Foreword by Deutsche Telekom

The pace of change in the world in which we live today is accelerating drastically. Worlds which until only recently were unconnected are growing ever closer together and merging. This affects above all information and communication technology due to the convergence of fixed network and mobile communication, information technology and telecommunication services or telephony, Internet and electronic media. However, this change is also increasingly manifesting in a social and cultural context. Connected life and work increasingly shapes the modern information society.

So how will changed consumer behavior and technological advances affect our lives? What impact will digitization and virtualization have on our society? What influence will politics and regulation have on our industry? What are the issues that we, the ICT and media sector, should or must drive forward? Where are we strong and where can we still be successful in the future in a globalized world?

We already began to answer these kinds of questions last year when we gave an account of the status quo of Germany as a location for ICT, identified relevant trends for German ICT, assessed medium-term developments and highlighted initial action areas.

In order to assess the substance of these issues even more thoroughly and evaluate long-term developments and trends and their implications with reference to their timing, in our international Delphi Study "Prospects and Opportunities of Information and Communication Technologies (ICT) and Media" we asked more than 550 high-ranking industry experts from all over the world to evaluate the rate of diffusion of various future scenarios in the form of trends, developments and innovations in ICT and media up to 2030. In the spirit of open innovation, partners from a number of companies and organizations worked on preparing the Delphi survey and evaluating and interpreting the findings and made many valuable contributions to the study and thus to the future of our industry.

I would like to offer my warmest thanks to all those involved for their dedicated, oftentimes controversial, but always constructive struggle for trend-setting, supportable assertions about the prospects and opportunities of information and communication technologies and media.

The findings of this study provide valuable impetus for politics, society, and the future of our companies. Finally, the study should provide suggestions for a course that will facilitate a successful information and knowledge society that enables Germany and Europe to continue playing a leading role in the world in the future.

Christopher Schläffer
Chief Product & Innovation Officer,
Deutsche Telekom AG

Methodology

This study is a continuation of the Delphi Study "2014" published ten years ago by the Münchner Kreis and conducted by TNS Infratest. The objective of the approach of the "Prospects and Opportunities of Information and Communication Technologies (ICT) and Media" study, for which the methods have been extended, is to assess the developments, trends and innovations in the ICT and media sector for the next 20 years. The project comprised two consecutive phases, the second building on the first. The first phase entailed an account of the status quo of Germany as a location for ICT and assessing medium-term developments.

The findings were published in December 2008 under the title "Prospects and Opportunities of the German ICT." The second phase, which is now underway, focuses on assessing long-term innovations, trends and developments up to 2030. At its core is an international empirical survey of experts using the Delphi Method.

Delphi Method

The Delphi Method, named after the ancient oracle, is a future research method. It was developed in the USA in the middle of the last century and is used for making forecasts. The method is enjoying ever growing popularity, most likely due to the constant increase in the complexity of forecasts on technologies and their societal impact. Furthermore, it is scarcely possible today for any expert to have an overview of several interacting areas of expertise. For this reason, Delphi surveys ask a range of experts with specialized knowledge for their assessments. The survey process entails two or more stages. From the second round (or wave), the experts are given the summarized findings from the previous round. Each expert is free to decide whether to revise his opinion of an issue in light of these findings or to stick to his original opinion regardless.

For this study on "Prospects and Opportunities of Information and Communication Technologies (ICT) and Media", the Delphi Method was executed via the Internet in two waves in April/May and June/July 2009. Each expert was given a personalized access link which allowed him to interrupt the questionnaire at any time and return to it later. Of the 795 contacted experts, 551 took part in the first wave, and 439 in the second. This was an extremely good response rate, with 69 percent in the first wave and 80 percent in the second.

Theses generation

In the first step of the study, desk research was used to map out the ICT and media situation for 2008 and assess it for the coming years up to 2012. In the second step of the study, these results were used as a basis from which to generate theses projecting the development and implications for the future of technologies that already exist today. In addition, further theses were submitted by the project partners, and ICT and media experts named by them, on future trends and innovations. In this way, a total pool of more than 300 future theses was compiled. In workshops with the team of experts involved in the project, central theses were identified from this pool, discussed, formulated and compiled in a list of theses.

Overall, 144 theses and several additional questions were presented to the experts in two Delphi rounds and assessed by them. Each expert was given a maximum of 75 theses per round. Theses for which a high degree of consensus was found in the first round were not included in the second round. All the other theses were put to the experts again, together with the summarized findings from the first round. Furthermore, in the first round, the experts were also asked to estimate what impact the issues represented in the theses would have on various areas, e.g., economy or society, if they were to occur. In the second round, the experts chose from two lists the three strongest drivers and barriers for selected theses that would facilitate or prevent the occurrence of those theses.

Recruitment of experts / composition of the panel of Delphi participants

The study is based on the assessments of various expert groups. The expert panel comprises representatives from business, academia and politics, who were personally invited to take part in the study on the basis of their knowledge and experience in certain subject areas, from the networks of the project partners Münchner Kreis, EICT, Deutsche Telekom, TNS Infratest, as well as Siemens, Vodafone, Focus, VDE, SAP, the Alcatel-Lucent Foundation, IBM and the Federal Ministry of Economics and Technology (BMWi). In order to contrast the opinions of experts on the future of ICT and media with those of young, ICT-savvy people, members of the DNAdigital group were also asked for their opinions. The group comprises IT decision-makers and digital natives who largely provided assessments for Germany.

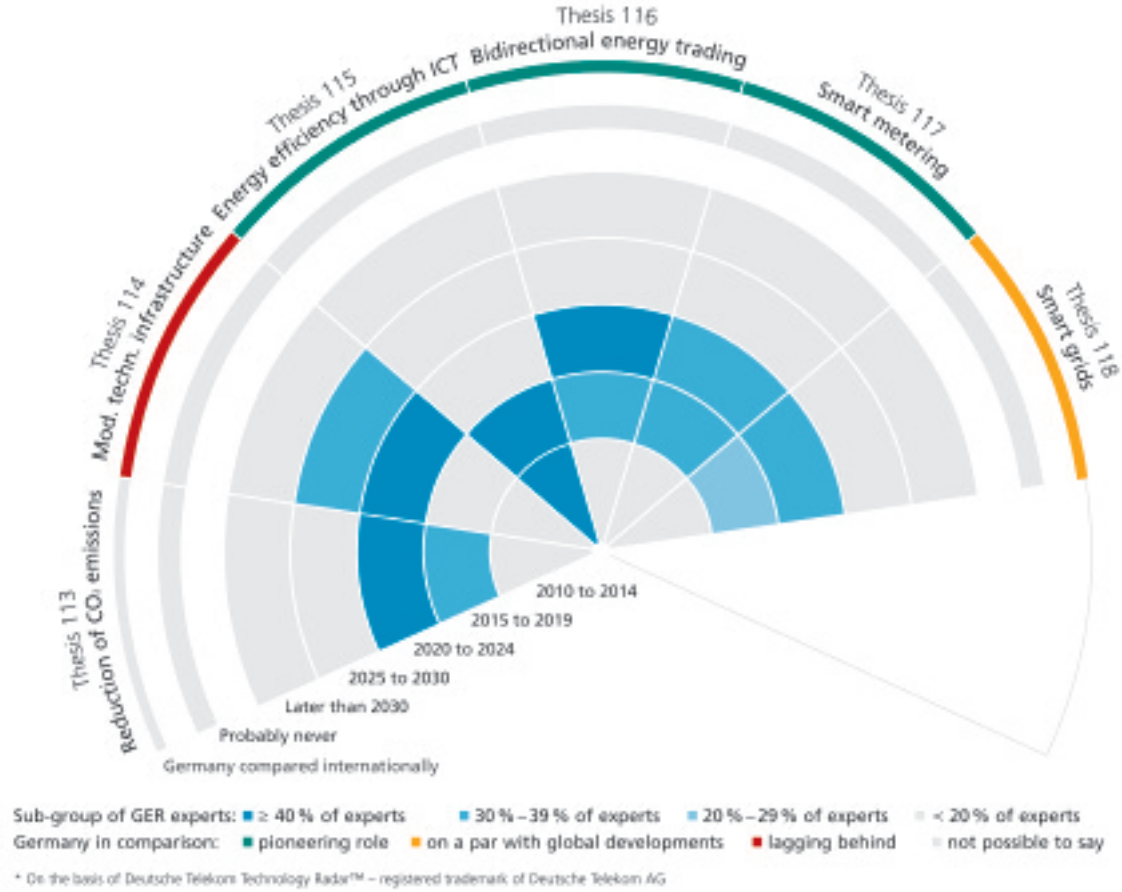
In the pre-registration for the study, experts could state the subjects in which they consider their personal expertise to be high. Some of the theses – 36 core theses in total – were presented to all the experts. However, the majority of the theses were only put to experts who had indicated that their expertise lay in that particular area.

In this registration, the experts' geographical focus was also recorded. Based on this, for theses for which the country-specific background was significant for the study, the experts were asked about the country they had specified. The experts were subsequently divided into five groups: The experts for Germany are designated as "DE experts," experts for other European countries (excl. Germany) as "EU experts", experts for the USA as "USA experts", experts for other countries worldwide (excl. Germany, Europe and the USA) as "Other int. experts" and respondents from the DNAdigital group as "DNAdigital".

Future radar

The findings of the Delphi Study are thematically summarized below in 37 articles. At the start of each section is a "future radar". The future radar provides a quick overview of the findings of the study. First of all, there is the assessment of when certain scenarios or theses will occur (in Germany). Using blue tones, the future radar shows the period in which a thesis will occur according to the Germany experts. The darker the blue, the more experts consider the respective period to be realistic. The further out the position of this blue to dark blue period, the later the thesis will occur. In addition, the second ring from the outside shows whether the surveyed German experts assess the occurrence of a thesis or scenario as fundamentally unrealistic. This is illustrated by the "probably never" category.

Example future radar*:



* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

At the same time, however, the future radar also ranks Germany as a location compared internationally. The outermost ring signalizes Germany's position compared internationally, based on when the theses will occur for the different regions.
If, for a thesis, the segment is highlighted
• green, Germany will play a pioneering role,
• yellow, Germany will be on a par with global development,
• red, this shows that Germany will lag behind in this area and therefore action must be taken.
If a segment is highlighted gray, no international comparison was possible for the thesis.

Illustration of the theses

At the end of each of the articles, which discuss in a problem-based approach the key findings of a thesis from the perspective of the experts of the project team, the results of all theses put to the experts are given in detail. The blue bar shows the findings of the German experts, the symbols in various colors show the experts' assessments for other countries and the assessments of the DNAdigital group. Only those groups are shown for which at least ten experts answered a question for the respective thesis. If, for a thesis, the additional question was asked of what effects the experts assume for various areas, these responses will be found after the relevant thesis under the keyword "relevance." For each instance, the top two and bottom two values are given. If the experts have also provided an assessment of the most important "drivers" and "barriers", these will also be included directly after the corresponding thesis.

Summary

The essence of the wide-ranging subjects and assessments will be presented in the Executive Summary: The experts have given us their assessments of the developments, trends and innovations in ICT and media for the next 20 years. These future scenarios will not fulfill themselves. With their differentiated view, the experts indicate where Germany could be in 20 years and the international environment in which it will have to position itself. Making these scenarios reality or preventing them from occurring, still lies in the hands of politics, business, academia and society. The next step will be to set the right course to do this and to develop the available future potential of ICT and media. The fact that this will require all sides to pull together is highlighted not least by the public-private combination of the project partners involved in this study.

We are delighted to present to you the findings of the second project phase, which afford such a broad insight into the world of tomorrow. And we look forward to the ensuing discussion – at the IT summit process as well as in further joint initiatives.

Robert A. Wieland
Managing Director, TNS Infratest GmbH, Member of the Research Committee MÜNCHNER KREIS e. V.

Dr. Udo Bub
General Manager, EICT GmbH

Dr. Heinrich Arnold
Head of Innovation Development, Deutsche Telekom AG, Laboratories, Member of the Research Committee MÜNCHNER KREIS e. V.

Methodology profile

Method

Internet-based Delphi survey

Survey period

Wave 1: April 24, 2009 to May 18, 2009

Wave 2: June 19, 2009 to July 13, 2009

Interviews conducted

Wave 1: n_1 = 551 (response rate of 69 %)

Wave 2: n_2 = 439 (response rate of 80 %)

Selection of experts

Representatives from business, academia and politics who were personally invited to take part in the study on the basis of their knowledge and experience in certain subject areas, from the networks of the project partners.

Composition of expert team

Based on their stated geographical focus, the experts were asked about the country they had specified for theses for which the country-specific background was significant for the study.

GER experts	n_1 = 374,	n_2 = 299
EU experts	n_1 = 73,	n_2 = 63
U.S. experts	n_1 = 34,	n_2 = 23
Other intern. experts	n_1 = 34,	n_2 = 25
DNAdigital	n_1 = 36,	n_2 = 29

Pre-registration

Questions on:

- Geographical focus
- Areas of expertise
- Professional experience, etc.

Content of the questionnaires

- 144 theses from various subject areas on the future and sustainability of ICT and media,
- 29 questions about the relevance of a thesis for various areas
    - Overall economy
    - Society
    - Environment
    - ICT sector
    - Media sector
    - Media use/behavior
- 25 questions on drivers and barriers that can influence the occurrence of a thesis, e.g., social acceptance, technical advances, investments by the state or private enterprise,
- 7 special questions.

Executive Summary "International Delphi Study 2030"

I. The study at a glance

The top objective of the "International Delphi Study 2030" is to support and stimulate discussions about the significance and future development of information and communication technologies (ICT) and media. It represents the current status of aggregated expert knowledge about future developments in an international environment. By acting as a platform for discussion, the findings should help to make the future more tangible and thus more easily shaped.

Almost ten years after the highly regarded Delphi Study "2014", produced in 1999, the MÜNCHNER KREIS together with partners from business and academia returns to look again at future developments in the ICT and media industry. Those involved in the project are pursuing two objectives with the current "International Delphi Study 2030":

• Highlighting central developments, challenges and opportunities in ICT and media and

• Forecasting future trends and innovations in ICT and media.

551 international experts from business, academia and politics assessed 144 future scenarios in two consecutive survey waves by mid 2009. The development and use of ICT and media up to 2020 were assessed under four focal issues:

1. Social implications of ICT development

2. ICT innovation policy

3. Infrastructure development and key technologies

4. ICT drivers of innovation in central areas of application

The study illuminates the perpetual dynamism with which information and communication technologies change the world in which we live today. In particular, the digitization of all areas of life – especially the Internet, with its burgeoning services and functionalities – has brought about radical changes in society, business and academia in the last 20 years. Indeed, in the coming years, the economic and social potential of ICT will grow even more; the impact on our society is sweeping and global. This development is driven by high investment rates in base technologies, an abundance of new applications, still growing global competition and fundamental structural changes for manufacturers, network operators and service providers.

II. Core messages

Message 1: Digitization and the still increasing penetration of ICT into all areas of professional and private life will be even more all-embracing in molding the information society in the future.

In just ten years, ICT will shape our entire lives: Comprehensive networking will link private, professional and public areas together and thereby influence both society and politics. In ten years at the latest, more than 95 percent of the adult population in Germany, Europe and the USA will actively and regularly use the Internet and its services. That is one of the central findings of the study. The biggest challenge in this will be to overcome the digital divide, i. e., to create access options, broadband service and skills.

It should be noted that development of the information society is not simply automatic, arising necessarily from the rapid technological advances and the accumulation of knowledge. Above all, social conditions must keep pace with the changes and, at the same time, any risks arising must be integrated. The right regulatory framework also has to be defined and put in place in time. The findings of the study show that Germany is not currently one of the leading countries in this area. The responsible, social, political and economic forces are called on to make considerable efforts:

• Politics and business should strategically promote citizens' skills in using the Internet and digital data in order to increase acceptance and use of ICT.

• Introducing children and young people to the Internet at an early stage in schools and day care centers is necessary to achieve greater skills in using digital data and information and thus to enable responsible, competent participation in the information society of the future.

• It must be communicated that the constant new and further developments in technologies and the changes that they bring about will require lifelong learning – more importance must therefore be placed on educating adults in educational institutions and in companies.

• Awareness of the political and social significance of all media is an education responsibility: "Media studies" should be established on a broader basis as a subject in schools.

• Every individual should learn that accessing and using ICT in the future will be crucial for coping with all areas of life and will determine opportunities for participation in society.

Message 2: People's acceptance and trust in using ICT is the foundation for developing a modern and open information society.

In as little as six to ten years, tools and connected digital assistants that allow people to use their digital data in all kinds of usage contexts and enable them to manage their (multiple) identities on the Internet will be widespread in Germany and throughout Europe. The individual's complete control over the use of their personal data on the Internet remains a key but, as things stand, not entirely achievable goal. Central issues in dealing with a person's digital identity have not yet been resolved worldwide. Programs that facilitate access to stored data over long periods of time and provide data reliably are also an ongoing problem. Opportunities and markets for ICT in this area could develop in Germany and Europe:

• It must be the responsibility of politics, business and academia to protect private individuals and companies from the misuse of personal data and to guarantee this beyond institutional and organizational boundaries. For this purpose, suitable IT security measures must be implemented worldwide, e. g., secure e-signatures, secure e-mail communications, safeguarding of digital identities and reliable, easy-to-use identity management for all. Only in this way can secure and reliable digital communications between people and also increasingly between people and machines be ensured.

• Politics has the task of communicating to the general public the paramount importance of future digital life and our identity on the Internet and to make these issues the center of attention.

• Secure, long-term availability of personal, professional and cultural data in the face of the constantly increasing flow of data and fast-changing storage and access technologies must also be taken up and ensured by politics and academia.

Message 3: High-performance communications infrastructure is a vital precondition and a strategic success factor for an open and competitive information society.

The expansion, availability and performance of broadband networks will have a positive impact not only on the ICT and media industry, but far beyond this, on society and the economy as a whole as well. A modern communications infrastructure acts as a multiplier for all the economic sectors of an information society; it enables innovations, boosts productivity, increases sustainability and opens up new sales markets. Broadband networks are the main arteries of modern information societies and must therefore keep pace dynamically and continuously with the state of the art and the diversity of applications in an international context. It will not be possible to successfully realize developments such as the Internet of Things, embedded systems or cloud computing unless the performance of the broadband infrastructure is enhanced. Sustainable and transparent investment concepts are the key to success.

Globalization and technical advances will hugely raise the number of users and the number of services provided via the Internet and its infrastructure. If developments should unfold as currently foreseeable, Germany will not play a pioneering role internationally in the future either in terms of modern technical infrastructures, infrastructure provision, broadband usage and availability or development of fiber-to-the-home. Substantial initiatives and efforts will be needed to effectively counteract the relatively negative forecasts for infrastructure development in Germany:

• New, bold and farsighted investment plans of private network operators and investors – as key supporters of broadband expansion – should be supported by politics and business in the long term and the framework conditions for such plans should be improved.

• Politics is called upon to provide appropriate incentives for private investments in a high-performance, nationwide communications infrastructure as well as to create the relevant conditions. The EU and its member states must create the foundation necessary for this purpose, if a lasting contribution is to be made to economic and social development. These investments require a reliable, forward-looking legal framework at EU and national level, that ensures that cooperation can take place and innovations be realized.

• Public-private partnership concepts are effective alternatives in areas that cannot be fitted up entirely from private investments, in order to achieve nationwide provision. Corresponding initiatives must be effectively encouraged by providing funds and appropriate regulatory frameworks (incl. state aid law).

• Ensuring and maintaining the security of critical infrastructures is of national importance and thus a top mandate for politics.

• In the wake of globalization, systems technology for critical infrastructures (e.g. for telecommunications networks) is purchased from global suppliers. Customers must have the skills to specify products and functions and to eliminate security risks. The technology must be expanded further and maintained on an ongoing basis.

• Politics, business and academia must strategically promote key technologies such as long-term archiving, source code security, embedded systems, convergence of networks, passive optical networks, (beyond) NGMN, future network architecture, fixed-mobile convergence, semantic web and knowledge management.

• Memory and processor chips are key components of the future and the potential of these developments must be strategically exploited.

Message 4: The mobile use of the Internet and its services will have a lasting impact on the information society and create independent new areas of application.

The mobile Internet will be one of the central developments in the coming years. In the modern and developed countries of the world, mobile communications infrastructure is an important complement to the stationary structures and will drive the convergence of networks. In particular, the interface between complementary mobile and stationary applications and services will be crucial for each kind of usage. In many developing countries, by contrast, it will be a good few years before many forms of Internet usage, IPTV for example, are available, since for the time being, use of the Internet in these countries relies largely on mobile infrastructure.

Mobile Internet functions that could potentially be successful in the future include countless applications related to position- and location-based services, communities, assistants, and Augmented Reality. This requires a high-performance, forward-looking mobile infrastructure solution that must be developed in parallel with the applications. The further development of nationwide, mobile broadband technology will stimulate all areas of the economy. This will also counteract the digital divide. Germany would thus give itself the opportunity to become a global leader, under certain circumstances:

• Politics, business and academia must recognize mobile use of the Internet and its services as a central trend for the future and encourage its development.

• State and industrial funding measures must be initiated for the development of high-performance, innovative infrastructure solutions and network architecture and the associated base technologies, hardware, software and services. As a prerequisite for high-performance, local mobile access networks, the systematic development of the fixed network infrastructure must be ensured.

• It is technically possible to provide nationwide mobile broadband coverage for all of Germany, but this requires additional frequencies below 1 GHz to be made available now and an environment to be created that provides incentives for investments. The state and its institutions are called on to reserve the necessary frequency bands and to support expansion by private companies.

Message 5: Dynamism in the ICT base technologies will drive innovation processes and have a serious impact on all key industries in the German economy.

In particular, in central German industries, automotive, automation/mechanical engineering, energy, media and in the healthcare sector, ICT will act to accelerate growth and drive innovation in the coming years. Industrial and technology policy in the coming years must deliberately stimulate technology transfer and technological development in and between the economic sectors in order to develop and strengthen new areas of application in the economy and society. As a result, internationally competitive business models should arise in the relevant markets. By promoting and implementing Open Innovation at an early stage, research and development can in the future take on a pioneering and leading global competitive position, e. g., as an innovation leader in the forward-looking issues of "energy efficiency," "green technologies," "smart grid and smart meters," "electric cars," "automation," and in the media sector:

• Politics and business must ensure the development of key ICT technologies and encourage research and development in their own country in order to achieve a lasting competitive advantage for Germany as a business location.

• For the research and development units of German industrial companies and universities, the particular challenge lies in closing the innovation gap with the USA and, in some segments, with East Asia.

• Concepts like Open Innovation are to be promoted, since they make a substantial contribution to overcoming communications barriers and thus to clearing the way for innovation beyond industry and organizational boundaries and to accelerate the development of new approaches.

• Green IT and e-energy have a lot of potential to make an active contribution towards global climate protection and safeguarding Germany as a business location and should be intensively fostered and strategically promoted as areas of innovation by politics, business and academia.

• Standardization and standards are catalysts that provide cross-industry momentum, especially when they are fast and have a high degree of focus. What is needed here are clear political initiatives that enable supranational coordination of central standardization processes.

III. Summary of the focal issues

1. Social implications of ICT development: In 2020, large areas of our lives will be digitized

The findings of the Delphi survey are impressive in showing that the rate of diffusion with which ICT is having a permeating and lasting effect on society, the economy and academia, has in no way lost momentum: It is expected that within six years, or at the latest within fifteen years, so between 2015 and 2024, more than 95 of the adult population in Germany, Europe and the USA will actively and regularly use the Internet and its services.

In global terms, however, it will be at least another 20 years, probably longer than that, until more than 75 percent of the world population actively use the Internet several times per week. Overcoming the digital divide will therefore continue to be a huge challenge for decades to come. In 2020, more than half of the population in Germany will regularly maintain their social contacts using "social media" (Web 2.0) applications and services in and via the Internet. At around the same time, web 2.0 will also be used on an everyday basis in Europe and the USA. Whether and to what extent this trend will impact positively or negatively on the development of (the information) society, remains to be seen, especially with regard to dealing with the personal data of every single user on the Internet.

The fact is that, despite the extensive, rapid dissemination of the Internet and its services, especially the social network, large segments of the population will not yet have the skills to use these technological facilities. In this context, the skills of an individual must mean first and foremost treating their own personal data with care. It must be assumed that it will not be until 2020 – if at all – that 75 percent of the population in Germany will be well-versed and competent in dealing with personal data on the Internet. For the USA and internationally, it can be assumed that general competence in dealing with personal data on the Internet will be established five years earlier than this. Competent use of the Internet will become more and more important, including in people's work: In as little as six to ten years, command of the Internet will become a necessary prerequisite to conducting everyday business for at least 75 percent of the employed population in Europe and Germany.

In the future, users, when dealing with their digital data in all kinds of usage contexts, will be supported by tools for administering (multiple) identities on the Internet, which will be widely disseminated in Germany and throughout Europe in as little as six to ten years.

A worldwide unified solution for identity management (authentication and integrity) between any number of communications elements will be available in the distant future, but not until 2020 at the earliest, and potentially at a much later date, or possibly not even at all.

Whether and to what extent each individual will have full control over the use of their personal data on the Internet is still unknown: It can be assumed that, internationally and in particular for the USA, this ambitious goal will be reached in six or, at the latest, ten years, i. e. by 2019. In Germany, however, the idea that the individual has complete control over the use of their personal data on the Internet or that this is guaranteed (the right to informational self-determination) will seem utopian. Nevertheless, there will never be state censorship of access to Internet content in Germany, Europe or the USA – the individual's right to digital self-determination will remain protected. This point is more critical in respect of limitations on freedom of opinion by exercise of state influence in an international context. In many countries, this democratic barrier can already be deemed to be broken today.

In summary, it can be seen that the area of conflict between openness and transparency due to the evolution of the Internet, will continue to develop dynamically. In the future, this will require scientific and political solutions – the shaping of this future has already begun. It should be noted that, because of their complexity and the inherently long period of time it takes to implement them, fundamental und pivotal decisions, e. g., regarding IT security or broadband expansion, will have to be initiated today if they are to take effect in the foreseeable future.

By 2020 at the latest, Internet use will be largely mobile

One of the central developments, which in the next few years will add considerable momentum to digital life, is the trend towards mobile use of the Internet and its services: It can be assumed that there will be a large number of originally mobile applications and services that will substantially increase the intensity of mobile Internet use in Germany in the next six to ten years (as already suggested by the flood of applications in connection with position- and location-based services). This development will mainly be driven by further technical advances, especially in the development of terminal equipment and expansion of the network infrastructure.

In just six to ten years, i. e., from 2015, more people in Germany will regularly use the Internet and its services via mobile devices than through stationary computers. Compared internationally, this trend in Germany will be in

line with that in Europe and the USA – in many other countries, this is already the case today, since a lack of stationary infrastructure is already substituted by mobile infrastructure.

The intensity of this mobile use in particular will rise hugely in the coming years: In six to ten years, 75 percent of cell phone users in Germany will access the Internet on a daily basis through their mobile device. A similar development can also be seen in the rest of Europe and the USA.

A series of application scenarios and content will decisively expedite mobile Internet use:

- the merging of work and living spaces,
- location-based services,
- media use and
- mobile commerce.

The merging of work and living spaces will be expedited by the fact that, by 2024 at the latest, employees in Germany will universally use one and the same wireless device, which administers several telephone numbers (including for private telephony at home, on the move or at work). In the USA, this trend will take hold somewhat earlier, and in Europe as a whole, similarly by 2024.

For the further development of location-based services it is vital that navigational and positioning systems (e. g., Galileo, GPS) are established as fixed components of every mobile device (e. g., cell phones or digital cameras) in the next five years.

In the following six to ten years, so by 2019 at the latest, 75 percent of cell phone users in Germany and Europe will access location-based services on a daily basis through their mobile device – in the USA this trend will take hold with a five year delay, so by 2024 at the latest.

With regard to media use, the following scenario can be observed: Not until 2020 will more than 75 percent of the population in Germany and Europe use a multimedia mobile device as the unifying element for conventional media (books, newspapers, magazines, television and Internet) for displaying text, images, music and videos.

It will be a relatively long time, not until 2020 or later, that it will also be possible to use a single standard technology worldwide to pay at retail outlets and restaurants through mobile devices (mobile wallet).

2. ICT innovation policy: In 2020, the boundaries between countries and also between subject disciplines are obsolete

Evidently, Europe will not manage over the next few years and decades to catch up with the USA and its general competitive lead in the ICT industry. Nevertheless, targeted investments in research and development and in software expertise mean that Europe will take a leading role in some segments of the global ICT industry in as little as six to ten years. Leadership opportunities will lie in the areas of telecommunications services, telecommunications infrastructure, but also in IT services and software.

Generally, it will be more difficult in the future for Europe and Germany to sustain their position internationally in terms of their own "local" research and development. However, the declared trend of the last few years towards relocating ICT research and development (manufacturers and network operators) to Asia will not result in a complete removal – although the Asian countries themselves will continue to encourage such a trend.

Globalization and technical advances will lead to radical changes in value chains. First, the number of parties involved in the processes will drastically increase around the world; value chains will become value networks. Second, the competition will bring about a move from "walled gardens" to open systems, which will include customers and users in the innovation process to a much greater degree. This holds great potential to improve one's own opportunities and close gaps. Open Innovation refers to the ability to include heterogeneous participants from the outside world in the innovation process and to link up with innovation networks. By as early as 2015, and by 2019 at the latest, Open Innovation will have taken root in leading German companies as the standard. In Europe, this process will take five years longer and will be complete in 2024. In as few as six to ten years, the cross-disciplinary collaboration of engineers on the one hand, and social scientists, designers and artists on the other will be a prevailing method in the innovation process of business in Germany and Europe.

In a relatively short period, globalization will give rise to considerable challenges: Although it is unlikely that the integrity and functionality of critical ICT infrastructures in Germany will be compromised in the future due to dependence on international system suppliers, the potential threat posed by such a scenario cannot be ruled out altogether. This problem will apply similarly in the USA and the rest of Europe.

If political decisions in Germany are expected to push the ICT infrastructure supply to international peak levels, this will not happen until 2015 at the earliest. For the rest of Europe, there will be country-specific differentiations: The northern and, in particular, Scandinavian countries will continue to play a pioneering role worldwide, the southern countries will tend to lag behind. It will take six to ten years before models for collaboration between private industry and public funds become established as positive drivers in the development of capital-intensive ICT infrastructure for underserved areas of Germany. The rest of Europe will have to wait 11 to 15 years for these supporting measures. At the same time, cooperation within private industry to expand the ICT infrastructure will become common custom in Germany to cover and allow a better spread of constantly high investment costs for the modernization.

3. Infrastructure development and key technologies

The availability of stationary broadband not only has a positive impact on the ICT and media industry, but far beyond this, on the economy as a whole, on media use in particular, and on society in general. From 2020, which is to say, in about ten years' time, 100 MBit/s will be available for both uploads and downloads nationwide in Germany for stationary Internet use. An international comparison shows wide-ranging differences in broadband infrastructure development: While development in Europe is generally in line with that in Germany and 100 MBit/s will be available Europe-wide from 2020, in some countries of the world, this state of affairs is already on the brink of becoming reality, i. e., from 2010. In the USA too, nationwide provision of 100 MBit/s can be expected five years earlier than in Germany. For many years to come, access networks based on optical fibers will only be available in urban areas in Germany. Not until 2025 will fiber-to-the-home be used Germany-wide. In this point, many European countries will have overtaken Germany by five whole years and already have nationwide optical fiber-based broadband networks by 2020.

In addition to the availability of infrastructure, the use of these networks is a key indicator for a country's sustainability. Parallel to the availability of 100 MBit/s for stationary Internet, from 2020 at the earliest, 95 percent of Internet users in Germany will have broadband connections with a speed of at least 100 MBit/s for upload and download, although this may not be the case until 2030. The further development of average bandwidths for stationary Internet access will progress rapidly in Germany, even though these high bandwidths will not always be (able to be) used nationwide at the same time: For example, assuming average use of 36 MBit/s in six years in 2015, this will increase to 101 MBit/s in 2020, rising to 195 MBit/s in 2025 and 406 MBit/s in 2030, according to the average expectations of the Delphi experts surveyed.

With the immense potential of mobile applications and services, mobile broadband will also be developed nationwide in the coming years. From 2015, 50 MBit/s will be available Germany-wide for mobile broadband upload and download. In parallel to this, 50 MBit/s will also be available in the USA and Europe in six years. With the development of high-speed mobile networks, users' use of them will also increase in coming years: In Germany, average bandwidths of 7 MBit/s will be used for mobile Internet access in 2015. Five years after that, in 2020, average bandwidths used will already have reached 20 MBit/s, in 2025 they will be 47 MBit/s and in 2030 84 MBit/s.

Location-based services will develop in close co-evolution with the mobile broadband networks and their usage. This presupposes a viable high-performance infrastructure solution: In 2019, Galileo will be the standard for positioning and localization services in Europe.

The Internet of Things is also seen as an infrastructure with huge spillover effects. In 2019, RFID will be the standard technology worldwide and will be used everywhere in the area of production and logistics and, for example, will have replaced the barcode in the consumer goods sector in Germany. The wide range of applications and the use of embedded systems will have a sustained impact on the economy as a key technology for the future. From 2020, these so called "autonomous intelligent embedded systems" that learn from other intelligent systems and communicate with them on an automated and completely independent basis will be the basic standard of various applications and products.

Another much-vaunted future trend is in cloud computing. This development, which is also referred to as a "net-centric approach" will give rise to huge changes in both private and business applications in the coming years. From 2025 at the latest, more than 75 percent of private data in Germany, such as private documents, pictures and music, and business data, such as business documents or company databases, will be located on the Internet. Ten years before that, from 2015, software will no longer be stationary on local computers or mobile end devices, but rather on an "on-demand" basis as "webware" in and via the Internet.

As part of these changes, the structure of the Internet will also be modernized: In 2019, IPv6 will replace the current standard (IPv4) and be established as the norm. The current

Internet protocol (IP) will not be replaced as the base technology of the Internet until after 2030, if at all.

Internet usage will also change radically in the coming years. A key development here will be in the transition from the traditional Internet to the semantic web. In 2019, semantic web technologies will be an integral part of the Internet and usage and quality for the user will change substantially. Five years after this, in 2024, suppliers of these semantic technologies will have brought about a shift in power in the Internet markets and replaced the original offerings and suppliers.

The changes in mobile and stationary infrastructures, the mutating and expanding areas of application for ICT and the new forms of using the Internet and its services will also bring with them constant developments in hardware and in particular in memory and chip technologies: By 2019 at the latest, traditional silicon-based memories and processors will have been pushed to their performance limits due to increasing miniaturization and conventional photolithographic technology will be replaced as the standard technology for the production of chips, e. g., by technologies such as nano-imprint or maskless lithography.

4. ICT driver of innovation in key industries: As a driver of innovation in key industries, ICT has immense potential to achieve or secure leading positions worldwide

Especially in key industries, ICT acts to accelerate growth and drive innovation in the coming years: in the media sector, the energy industry, the automotive industry and the healthcare sector.

Digitization is shaking up and transforming the media sector for the long term

In the course of convergence processes in media use initiated by digitization and thus in the media sector, there will be complex changes for recipients as well as for media professionals in the coming years: In 2024, the Internet will be the number one medium for entertainment in Germany, Europe and many other countries of the world. In Germany and Europe, the conventional, "traditional" media consumption formats will continue to predominate: "Media snacks," i. e., short formats in the form of three-minute clips, such as those already found on YouTube, or entertainment content based on user-generated content will only be used in certain contexts and will by no means dominate media use. Also, public-law broadcasters will continue to be responsible for democratic opinion-shaping processes in Germany. There is no risk from readily available, high-quality information.

Changes are expected in the use of media: From 2020, it will be normal for 75 percent of media users in Germany to access one and the same media content by means of various devices (e. g., newspaper articles on a mobile device, television broadcasts on the PC or Internet content on the television. In parts of Europe, this media convergence trend will become reality five years earlier than in Germany, from 2015.

Traditional print media, such as newspapers and magazines, will remain much as they are to begin with. Ultimately, they will be supplemented and their use expanded convergently. For example, newspapers and magazines in Germany also continue to be available in traditional print formats in the coming decades, and not just as digital versions on the Internet. If at all, then from 2020 at the earliest, 75 percent of the populations in Germany and Europe will use individually compiled daily e-newspapers in parallel with the conventional paper version. The use of electronic media will also change: In 2024, more than half of the population in Germany will use on-demand media and services in their daily media consumption instead of conventional linear television. In the USA and Europe, television viewers will already be renouncing fixed and scheduled programs by 2019.

In 2015, it will be equally normal for more than half of the Internet users in Germany, Europe and the USA to pay for retrieving from the Internet professionally produced media content (films, electronic newspapers and magazines, music, etc.). Only outside of these regions will paying for digital content by users not be recognized until 2020. And yet another revenue element in addition to direct payment for media content has changed: advertising. From 2015, consumer opinions and experiences of Internet communities and consumer portals will have a greater influence on the success of products and brands in Europe and Germany than the current, immensely important traditional adverts.

In the area of electronic television media, the coming years will bring a number of changes in the technology: For example, from 2020 in Germany, and from 2015 in a number of European countries, the majority of television content will be transmitted via IP-based broadband networks. From 2015, high-definition television (HDTV) will be the

standard quality of television transmission in Germany – in parts of Europe and other countries, this is already the case, or will be very soon. 3D television will be available across Germany and Europe from 2030 at the earliest – internationally, this development will take place five years earlier, from 2025.

Resource efficiency through ICT: Green IT and e-energy to safeguard our future

Not least climate change requires a rethink or an adjustment of energy systems in Germany. A possible solution to counteract climate change could be the implementation of ICT innovations: Already today, but at the latest in five years, ICT infrastructures in energy supply will be indispensable for ensuring energy efficiency and reliable provision in Germany. For Europe, there will be no reliable provision at all by 2019 at the latest without ICT infrastructures. In addition to the guarantee of energy efficiency and reliable provision, ICT offers high efficiency in the e-energy sector: By 2020 at the latest, by using ICT in diverse application industries (traffic, telematics, energy, house building, etc.), CO_2 emissions will have been reduced by a further 15 percent worldwide.

Social awareness of the importance of sustainable use of energy resources will lead to a holistic nationwide modernization of the technical infrastructure, devices and services in Germany and Europe from 2020. In the USA and in many other countries of the world, this modernization will kick in from 2015, which is five years earlier. The use of new ICT components will lower energy consumption of communications networks in Germany alone by over 90 percent over current consumption values in 2025 to 2030. In the USA and Europe, this potential will be exploited five years earlier.

The potential in ICT-supported renovation of buildings is also high: From 2020, ICT-based concepts in intelligent buildings ("smart homes") will contribute to savings of more than 30 percent on energy consumption compared to 2009. In Europe, this trend will take five to ten years longer. A specific example in this context is green technologies and their use in buildings: In 2019, energy-saving IT components, automated device switches and renouncement of the standby-function will be the standard in more than 75 percent of buildings (private households and commercial buildings) in Germany. Such a high degree of penetration will not be seen in Europe until six years later, from 2025.

Supporting the demographic change: ICT promotes independence and support

In 2024, the medical healthcare standard in Germany, the USA, and many European countries, will be "round-the-clock" care of individuals (senior citizens, patients) in their own home by means of ICT systems.

Five years before this, in 2019, entirely new forms of prevention, diagnostics and treatment will be available in Germany thanks to ICT combined with vital functions monitoring. Five years later, intelligent electronic medical implants will link to and interchange with ICT systems and will be used by more than 25 percent of the population.

ICT will increase security and efficiency in vehicles

ICT innovations will also play an decisive role in one of the most important sectors: transport in general, and the automotive sector in particular. Sustainable mobility concepts will become much more attractive over the next few years. From 2020, this will impact on private vehicle purchases.

The expected high potential of new systems for vehicle communication in reducing accident rates and traffic jams will be exploited. From 2025, there will be a common communications infrastructure in Germany that links security applications, traffic applications, and commercial services. Ten years before this, from 2015, the Internet will become the means of central communications access in the vehicle regarding journey-related information (e. g., route planning, traffic information, danger warnings) on Germany's roads. Five to ten years after this, 50 percent of all new cars in Germany will exchange information about traffic, the environment, etc. among each other and thus enable real car-2-car networking. The technological course being followed in Germany and Europe have been confirmed by the experts. In addition, the introduction of commercial services, provides a possibility for refinancing some of the investments that must be made in the infrastructure.

Autonomous driving, however, remains a distant dream. It will not be until after 2030 that driving in the car of the future, without the "driver" actively controlling the vehicle, will become reality in some subsections of the traffic system.

I Social implications of ICT development

From a social perspective, the development of the Internet and its services is creating profound processes of adjustment, learning and innovation, as a consequence of which, social structures and principles have changed radically and will continue to change even further. Thus the penetration of all areas of life increases personal opportunities for the individual on the one hand, but on the other, leads to unforeseen questions and risks, which at present are still insufficiently identifiable.

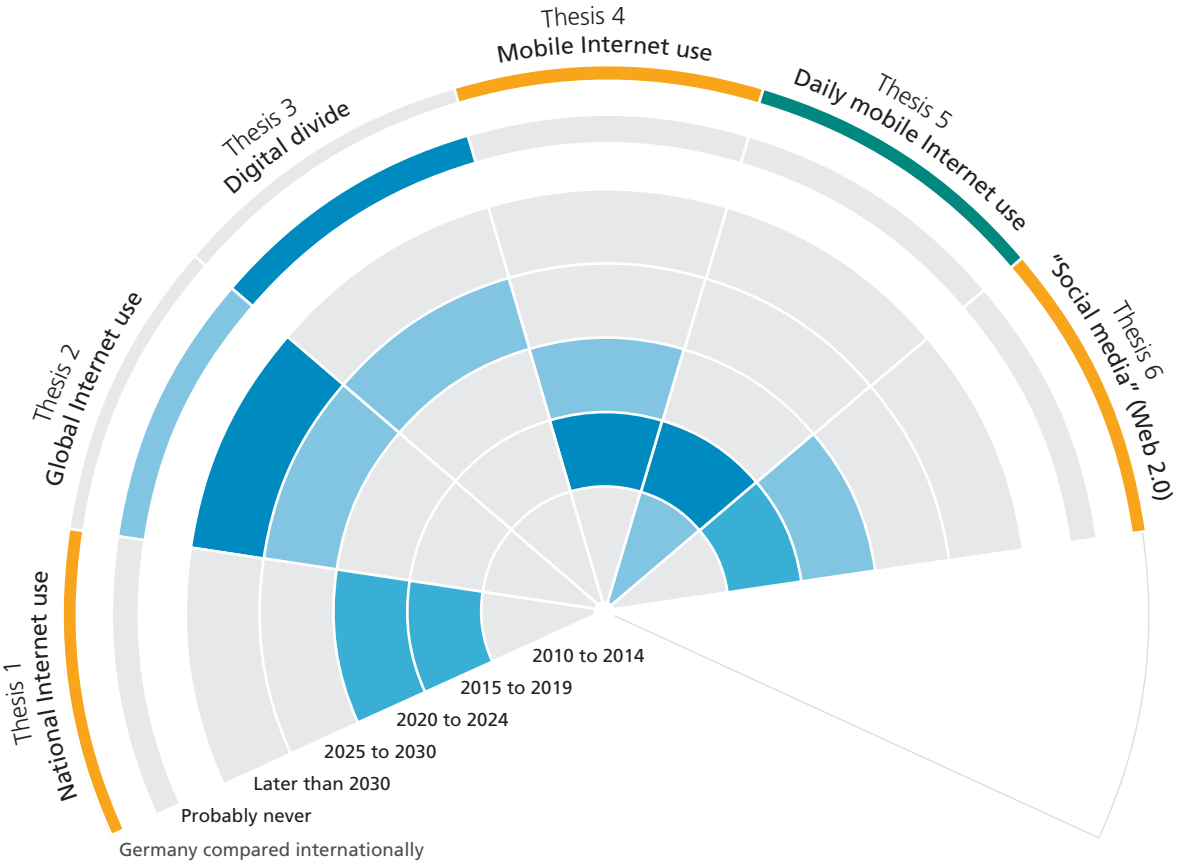
The findings of this study show in many different ways that the constantly improving performance of information and communication technologies (ICT) and the ubiquitous availability of all kinds of information and content are leading to a new information society. For example, journalistic media content and user-generated content exist side-by-side, sometimes interwoven (see in particular section IV.2.3); almost everyone has options for accessing guidance and technical information as well as knowledge blocks from all areas, but also to every kind of entertainment on offer, facilities for contact and collaboration, and economic transactions (see in particular section I.1.2). In this profoundly altered society and economy, the individual has to cope with an increasingly digital environment and life. How people cope and negotiate their way through this changing world, whether privately or professionally, can be formulated as one of the central challenges and tasks facing modern society and economic systems (see section I.2.4). Decisive impetus for solutions will be won in particular from the respective formative political agenda, from contributions from educational and scientific systems, and not least from the evolutionary process of trial and development of suitable patterns of behavior and action.

Information society of the future 2030 – brave new world?

The immense economic and social potential of information and communication technologies have a comprehensive impact on both our modern society and the world in which we live. The future ubiquitous availability of information – and not least of personal data – in and via the Internet will result in hitherto unknown potential for transparency, the consequences of which few experts are aware at present, even though it reaches the heart of every single individual's personal sphere and daily activities. The ability to navigate through this digital map of our world will pose a significant challenge for many people in the future (see section I.3.2). This digital world ranges from an apparently unconcerned openness (e. g., MySpace), withdrawal or targeted refusal ("intentional nonliners"), or new forms of crime (e. g., identity theft), new media skills (blogging, multitasking), and flexible, productive participation in society and enterprise (networking, teamwork), through to particular social innovations (e. g., self-organized open communities as platforms for accessing knowledge, increasing knowledge and innovation).

These areas of conflict between openness and transparency will produce a social dynamic which, in the future, will require scientific and political solutions.

I.1.1 Internet use, Web 2.0 and digital divide
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 1: National Internet use
More than 95 percent of the adult population in Germany actively and regularly use the Internet and its services.

Thesis 2: Global Internet use
More than 75 percent of the world population actively use the Internet several times per week (in 2008, approximately 16 percent, or 1.2 billion people worldwide used the Internet).

Thesis 3: Digital divide
The digital divide in the German population has virtually disappeared.

Thesis 4: Mobile Internet use
More people in Germany regularly access the Internet through mobile devices than stationary computers.

Thesis 5: Daily mobile Internet use
In Germany, 75 percent of cell phone users access the Internet on a daily basis through their mobile device.

Thesis 6: "Social media" (Web 2.0)
More than half the german population regularly maintains social contacts on and over the Internet using "social media" (Web 2.0) applications and services.

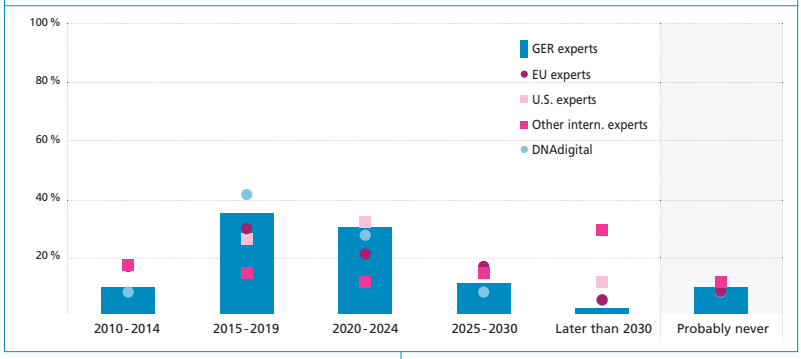
* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

Internet use – Overcoming the digital divide through responsible and competent participation

How quickly, thoroughly and sustainably information and communication technologies (ICT) impact on and pervade society, business and academia can be seen in the development of the Internet and its services. In just over 15 years, the Internet, as we know it today, has become available to the general public. In 2010, well over 70 percent of people over 14 in Germany will at least have access to the Internet and its services (estimate based on (N)OA 2009). Conversely, this means that 25 to 30 percent of adults in Germany will still fall at the first hurdle of Internet use – basic access. A small proportion of these people consciously refuse to use the "new medium." But in view of the immense importance of the Internet for almost all private and professional situations and phases in life, a proportion of 25 to 30 percent "non-users" poses a huge challenge for society and its political leaders, because it is in no way acceptable for such a large percentage of the population to be "left behind."

Thesis 1: More than 95 percent of the adult population in <country> actively and regularly use the Internet and its services.



In the future, descriptions of the digital divide that were previously common, such as access, use and competence, will have to be more acutely differentiated. In parallel to the development of the Internet, there will be new forms of analysis for the digital divide. For example, we are already beginning to describe the divide by different types of access: whereas previously the issue was basic access to the Internet, we now talk about a "broadband divide," i. e., people who have access to broadband Internet via DSL or broadband cable, etc., and people who are denied such access for a variety of reasons, be it cost or availability (see section III. 1).

In the near future, the divide debate will extend to mobile access, shortly thereafter, to broadband mobile access. But the digital divide is not just restricted to Internet access, differences are also emerging in Internet use, e. g., active or passive.

The next section presents the future development of access to the Internet and its services based on the findings of the study and further estimates the intensity of Internet use in the coming years based on the survey of experts.

Internet use will not be universal for another ten years

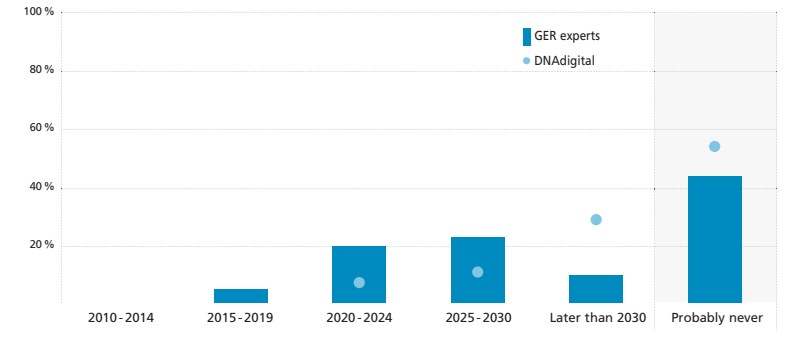
65 of the ICT and media experts for Germany surveyed in this Delphi Study do not expect the proportion of active, regular Internet users in the adult population of Germany to reach 95 percent until 2015 to 2024 at the earliest (see Fig. 1.1). In fact, the majority of experts surveyed (35 percent) consider the first five years of this time span, i. e., 2015 to 2019, to be the probable time that the Internet will be used regularly by large parts of the population. Germany is currently way behind the leading European countries. Take for example Iceland or Norway, where already well over four fifths of adults aged between 16 and 74 regularly use the Internet (see Eurostat 2008).

Of all the experts surveyed, the DNAdigital group give the most positive forecasts for the development of Internet use: 42 percent of this particularly Internet-savvy, younger target group expect 95 percent of the adult population in Germany to be online by 2015 to 2019; another 28 percent consider the period 2020 to 2024 to be most likely. The majority of experts for Europe (51 percent) also estimate that this thesis is likely to be realized in the period from 2015 to 2024; however, 17 percent of the experts surveyed for Europe forecast an even later period of 2025 to 2030 and are thus somewhat more pessimistic with regard to Internet use. 58 percent of U.S. experts also estimate that 95 percent of Americans will actively and regularly use the Internet in the period 2015 to 2024.

Furthermore, as part of the study, the experts were asked to assess how broad dissemination of the Internet will affect the overall economy, society, or other areas (see Fig. 1.2). 93 percent of the experts surveyed for Germany expect widespread use of the Internet and its services in large sections of society to have a positive or very positive effect on the development of the ICT sector in Germany. The strength of widespread Internet use as a basis for a modern economy can also be seen in the fact that more

than three quarters (78 percent) reckon with at least a positive effect on the overall economy. It is interesting that, although a clear majority (65 percent) of the experts surveyed also expect a positive influence on the media sector, at the same time, around a fifth of them expect universal Internet use to impact negatively on the media sector. In total, 50 percent expect at least positive effects on society, whereas a good third assess the social effects neutrally and 14 percent expect negative effects. The expected impact on the environment is also interesting: 47 percent expect it to be at least positive, whereas 46 percent assess it as neutral and only 7 percent as negative. Overall therefore, the vast majority of the experts forecast advantageous potential for society, the overall economy, directly affected industries, and the environment as a consequence of universal use of the Internet.

Thesis 3: The digital divide in the <national> population has virtually disappeared.



In this study, the experts were also asked to assess the central drivers they deem to be most important for the realization of a thesis and the central barriers they deem to pose the greatest hindrance to realization. According to the Germany experts, privacy issues are the greatest barrier to the target of universal Internet use (see Fig 1.4). Competence in dealing with personal data and the confidence of users in the systems are important hygiene factors on the road to the information society. In second and third position for the greatest barriers come a lack of education and excessive costs, which backs up the findings of the driver question: according to the experts (65 percent), the most important driver for the dissemination and use of the Internet among the majority of the population is low costs (see Fig. 1.3).

45 percent of those surveyed underlined the frequently emphasized importance of nationwide availability of broadband infrastructures for the further development of Internet use in Germany (see also section III.1). More than two fifths of those surveyed deem the promotion of education and training to be an important driver for achieving the goal of universal Internet use in the population, which means that media skills are a central anchor in dealing with new media.

Digital divide unbridgeable, even in the long term

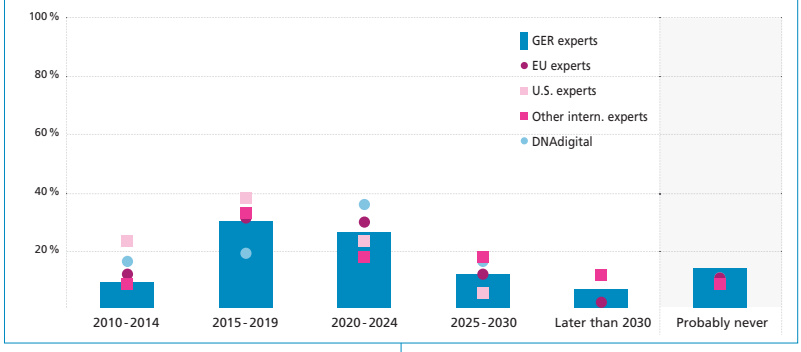
Nevertheless, the experts for Germany do not expect the digital divide, which can be differentiated into the three factors of access, use and competence, to be bridged in the foreseeable future. Around half of those surveyed (44 percent) believe that the digital divide in German society can never be bridged (see Fig. I.6). The experts for Germany base this opinion primarily on the issue of competence in dealing with personal data – they believe that there will always be differences due to variations in user competence (see the last point in section I.3.2). In this connection, the opinions of the DNAdigital group, whose outlook on bridging the digital divide in society is even more critical, are highly interesting. 29 percent of the surveyed experts from this group expect the digital divide cannot be bridged until after 2030; indeed, another 54 percent believe this scenario will never be realized.

The experts surveyed were given the opportunity to specify factors that will promote a bridging of the digital divide in Germany. With one interesting exception, these coincide with the above-mentioned drivers that promote universal Internet use in the population. Here too, education, infrastructure development, and lower costs rank highest. Furthermore, and this is particularly interesting, the demographic development of society is named as a central factor in bridging the divide.

The issue of ageing societies was also addressed in the first closing report to this study. In the German population, the ratio of people aged 65 or younger to people aged over 65, which is currently four to one, will shrink to two to one by 2050 – there will be more than twice as many older people as young people. Today, around 40 percent of Germans are over 50 (see BMI 2008, VDE 2008). According to the experts, the digital divide will be bridged in 20 years as a result of this demographic change – this relates primarily to access and simple use of the Internet. Because it is highly probable that the propagation of the Internet in our everyday lives as well as in our professional lives will

increase even further, it is necessary to integrate older generations in new technologies and applications now. It is here that penetrating society with ICT in general and use of the Internet specifically holds considerable potential (see the last point in section I.2.4). The majority of those surveyed expect the bridging of the digital divide in society to impact positively on the overall economy, society and the ICT and media sector.

Thesis 6: More than half the <national> population regularly maintains social contacts on and over the Internet using "social media" (Web 2.0) applications and services.



Digital divide in the global population

While the experts for Germany expect that the vast majority of the adult population in Germany will actively use the Internet in 11 to 15 years, the estimate in relation to the global population is substantially different: The question of when it can be expected at the earliest that more than 75 percent of the world population will actively use the Internet several times per week, is dated by 44 percent of Germany experts to sometime after 2030. The U.S. experts (41 percent) and the group of international experts (44 percent) also give similar estimates (see Fig. I.5). The DNAdigital group take a similar view: 48 percent of the experts from this group said that the scenario will not be realized until after 2030. This opinion is held even more strongly by the experts for Europe: as many as 51 percent of them estimate realization after 2030.

At any rate, 36 percent of U.S. experts expect realization between 2020 and 2024. Based on these findings, bridging the digital divide worldwide will remain a huge problem for decades to come, which if not achieved, will make it even less likely that living conditions will tend to level out. This highlights the immense global challenges that are still to be mastered over the next few decades in connection with the consequences of globalization.

Rapid increase in use of social networks to be expected in large sections of the population

The pace with which the Internet is penetrating social life – the relationships between people – can be seen in the example of the estimated further development of Web 2.0, i. e., "social networks." Whereas today, only very active and young Internet users can be counted among those active in Web 2.0, 30 percent of the experts surveyed for Germany expect more than half of the population in Germany will regularly maintain their social contacts using "social media" (Web 2.0) applications and services in and via the Internet by as early as 2015 to 2019 – another 26 percent expect this to be realized in the five years after that (see Fig. 1.13). In fact, it is the Internet and Web 2.0-savvy DNAdigital group that expect this development to take around five years longer; the majority expect the thesis to be realized between 2020 and 2024. A comparison of the groups shown in the study shows no great differences overall: 38 percent of U.S. experts expect the thesis to be realized for the U.S. as early as 2015 to 2019, another 24 percent in the five years after this (which combined is 62 percent), which makes it the most optimistic group. The other international experts and experts for Europe do not differ significantly, with 33 percent and 32 percent respectively for the period 2015 to 2019. However, the picture for 2020 to 2024 does show variations: The experts for Europe are considerably more optimistic here. Overall, 74 percent of them expect the thesis to be realized by 2024. By contrast, the "other international experts" have more pessimistic views for their countries; at least, 30 percent do not anticipate realization until after 2024, which clearly shows that countries such as India, China, etc., will have a lot of catching up to do in the coming years.

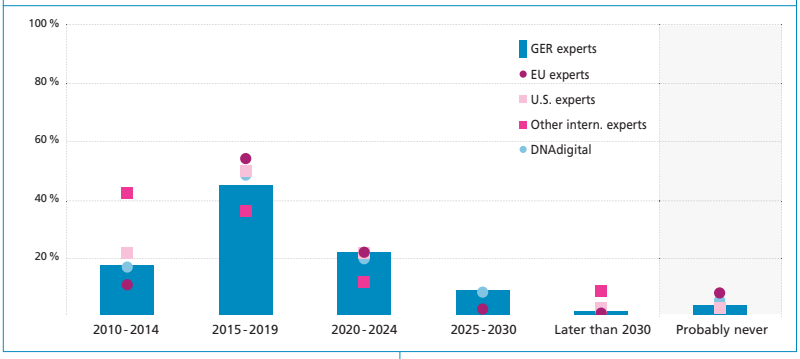
More than four-fifths of the experts for Germany estimate that the forecast increased use of "social media" (Web 2.0) in Germany will have a positive effect on the ICT sector (see Fig. 1.14). Estimates regarding the impact on society vary. While 39 percent of those surveyed expect positive effects on German society, 34 percent of the Germany experts anticipate negative effects if more than half of the population in Germany regularly maintain their social contacts using "social media" (Web 2.0) applications and services. This is a highly critical finding that should provoke further discussion on the significance of the development of the Internet.

Internet use largely mobile in six years' time

One of the central developments in the next few years, which will add considerable momentum to digital life, is the trend toward mobile use of the Internet and its services. Internet applications will no longer be initially programmed specifically for stationary use via large computer screens and processors and only then offered as mobile applications, as is common today. Rather it can be assumed that there will be a raft of original mobile applications and services.

For example, there will be a whole host of applications relating to positioning and location-based services, as well as just convenient, location-independent use of countless data and communication services. The majority of Germany experts surveyed confirm this trend toward regular Internet use through mobile devices. 45 percent expect that more people in Germany will use the Internet via mobile devices than through stationary computers from as early as 2015 (see Fig. I.8). Another 18 percent expect this to be the case within the next five years, 22 percent in the period from 2020 to 2024. Thus 85 percent of all the Germany experts believe that regular use of the Internet via mobile devices will be common practice by 2024. Two thirds of the DNAdigital group estimate that this thesis will be a reality for Germany by 2019 at the latest.

Thesis 4: More people in <country> regularly access the Internet through mobile devices than stationary computers.



In an international comparison, it can be seen that the "other international experts" group above all forecast a very rapid, positive development of mobile use of the Internet – 78 percent expect the described development to be realized for their countries within the next ten years. 65 percent of the experts for Europe and 72 percent of the U.S. experts estimate the same for their own countries.

The intensity of mobile use will also increase substantially in the next six to ten years according to the experts for Germany (see Fig. 1.12). 46 percent of the Germany experts expect immense growth in the use of mobile devices and estimate that 75 percent of mobile phone users in Germany will access the Internet on a daily basis through their mobile device by 2015 to 2019. The DNAdigital group's expectations are even more positive: more than half of the experts surveyed (51 percent) deem the period 2015 to 2019 to be realistic. The international comparison shows that 67 percent of the Europe experts and 50 percent of the U.S. experts expect that within ten years, 75 percent of mobile phone users in these countries will access the Internet on a daily basis through their mobile devices.

The extent to which all the experts are convinced overall by the described developments is emphasized particularly by the fact that almost none of the surveyed experts fundamentally ruled out this development.

Overall, 88 percent of the experts surveyed for Germany expect regular Internet use through mobile devices by people in Germany to have positive to very positive effects on the ICT sector. 73 percent of the experts surveyed also expect a positive impact on the overall economy (see Fig. I.9). They also expect another positive effect on media usage habits in Germany (67 percent). Nevertheless, a fifth of the experts surveyed anticipate negative effects on the environment. In connection with the increasingly mobile use of the Internet by the majority of people in Germany, three quarters of the experts for Germany see one of the main drivers of mobile Internet use to lie in technical progress, in particular in relation to developments in terminal equipment and advances in the expansion of the network infrastructure. Furthermore, falling usage charges will encourage mobile use of the Internet and its services; at least, more than 70 of the experts surveyed believe this to be the case. The third main driver, albeit "only" mentioned by just over two fifths of the experts surveyed, is investments in the necessary infrastructure.

The main barriers to realization of the thesis that more people in Germany regularly use the Internet via mobile devices than through stationary computers are overly high costs (67 percent), technical problems (42 percent) and too low investments in infrastructure (34 percent).

Summary

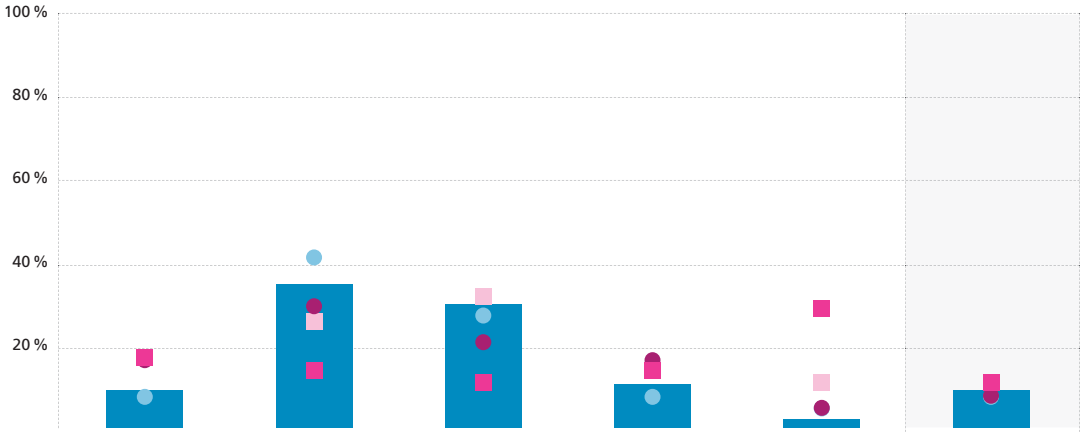
The findings underline the need to encourage people to participate responsibly and, in particular, competently in the information society. They highlight investments in modern infrastructures as the basis for use, as well as the special role of education. Overcoming the different variations of the digital divide will remain a priority nationally as well as globally over the coming decades.

The experts surveyed also gave clear forecasts for the "mobile Internet" mega trend, which will result in entirely new applications, forms and patterns of use off the back of increasing mobile use of the Internet and its services.

Theses on "Internet use, Web 2.0 and digital divide" in detail

Fig. I.1: Thesis 1 National Internet use

More than 95 percent of the adult population in <country> actively and regularly use the Internet and its services.

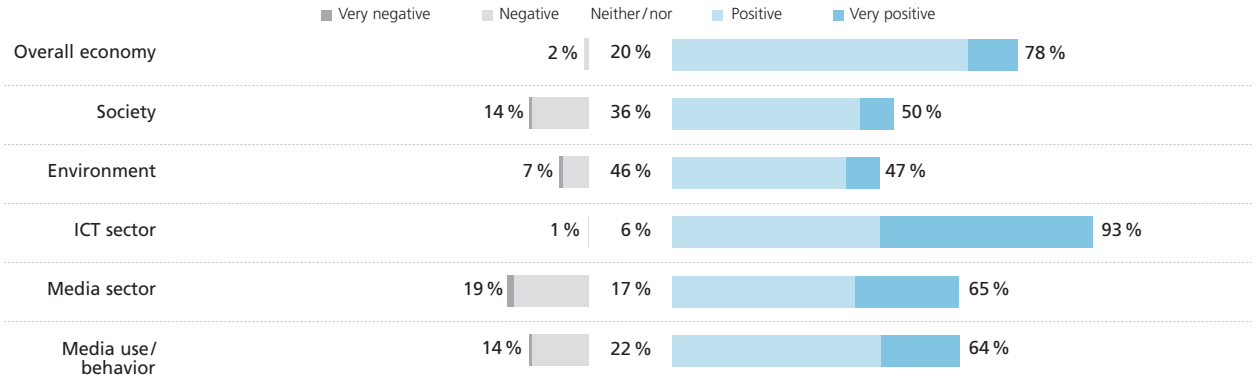


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 371)	10 %	35 %	30 %	11 %	3 %	10 %
EU experts (n = 70) [1]	17 %	30 %	21 %	17 %	6 %	9 %
U.S. experts (n = 34)	18 %	26 %	32 %	0 %	12 %	12 %
Other intern. experts (n = 34) [2]	18 %	15 %	12 %	15 %	29 %	12 %
DNAdigital (n = 36)	8 %	42 %	28 %	8 %	6 %	8 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. I.2: Thesis 1 National Internet use – relevance

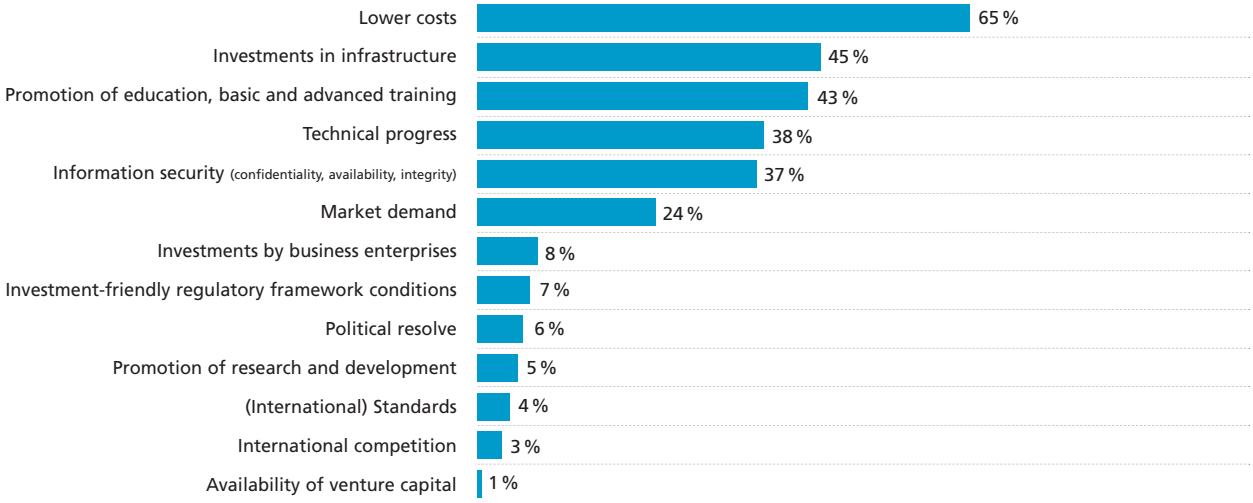
What impact will the validity of Thesis 1 above have on the areas listed below?



Basis: All people surveyed; Sub-group: GER experts, at least n = 361

Fig. I.3: Thesis 1 National Internet use – drivers

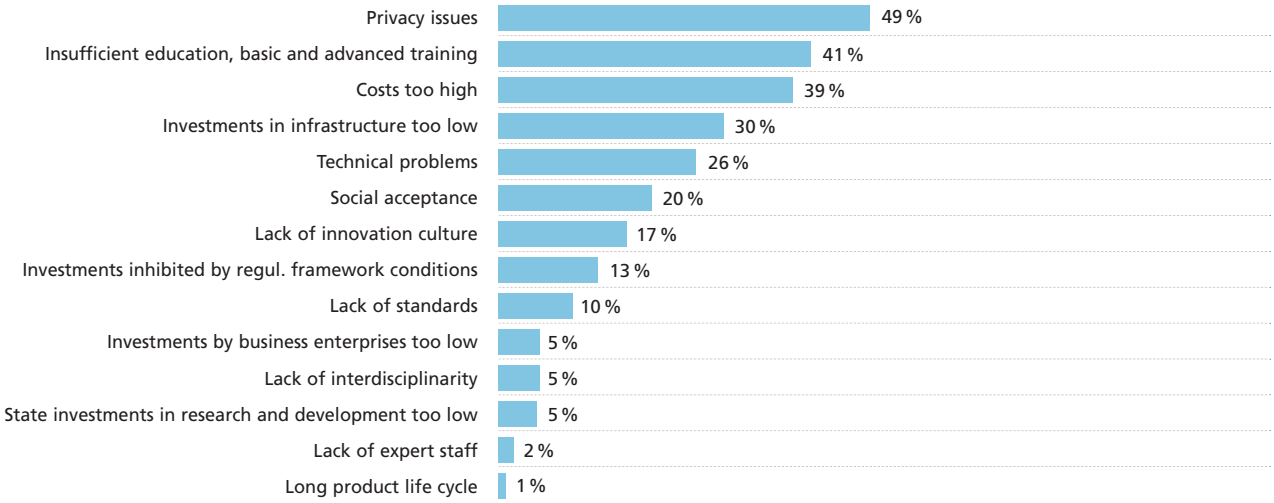
Select up to three drivers from the following list that you consider to be most important for realization of Thesis 1 above.



Basis: All people surveyed; Sub-group: GER experts, n = 297

Fig. I.4: Thesis 1 National Internet use – barriers

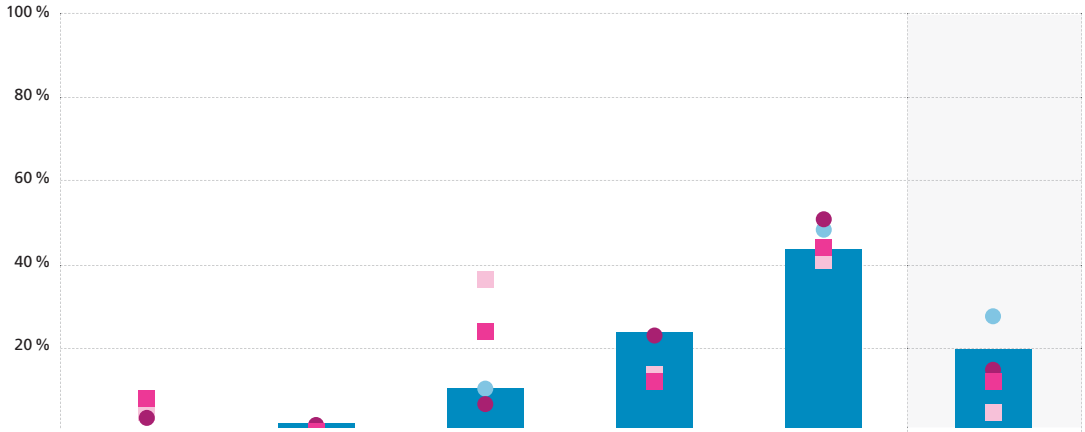
Select up to three barriers from the following list that you consider to be most important for realization of Thesis 1 above.



Basis: All people surveyed; Sub-group: GER experts, n = 298

Fig. I.5: Thesis 2 Global Internet use

More than 75 percent of the world population actively use the Internet several times per week (in 2008, approximately 16 percent, or 1.2 billion people worldwide used the Internet).

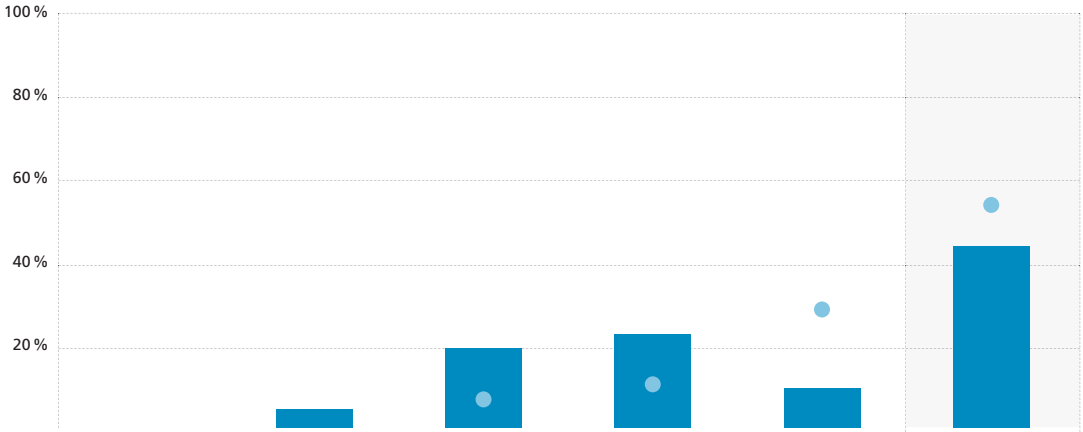


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 295)	0 %	2 %	11 %	24 %	44 %	20 %
EU experts (n = 70) [1]	3 %	2 %	7 %	23 %	51 %	15 %
U.S. experts (n = 34)	5 %	0 %	36 %	14 %	41 %	5 %
Other intern. experts (n = 25) [2]	8 %	0 %	24 %	12 %	44 %	12 %
DNAdigital (n = 36)	0 %	0 %	10 %	14 %	48 %	28 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. I.6: Thesis 3 Digital divide

The digital divide in the <national> population has virtually disappeared.

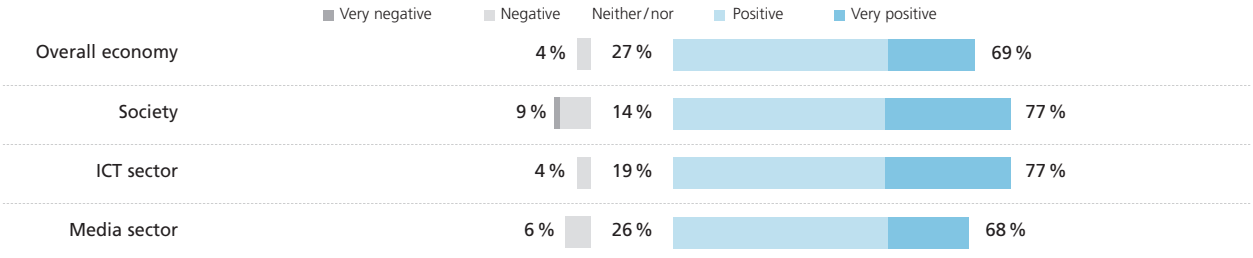


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 62)	0 %	5 %	19 %	23 %	10 %	44 %
DNAdigital (n = 28)	0 %	0 %	7 %	11 %	29 %	54 %

Basis: All people surveyed with special expertise in the topic area

Fig. I.7: Thesis 3 Digital divide – relevance

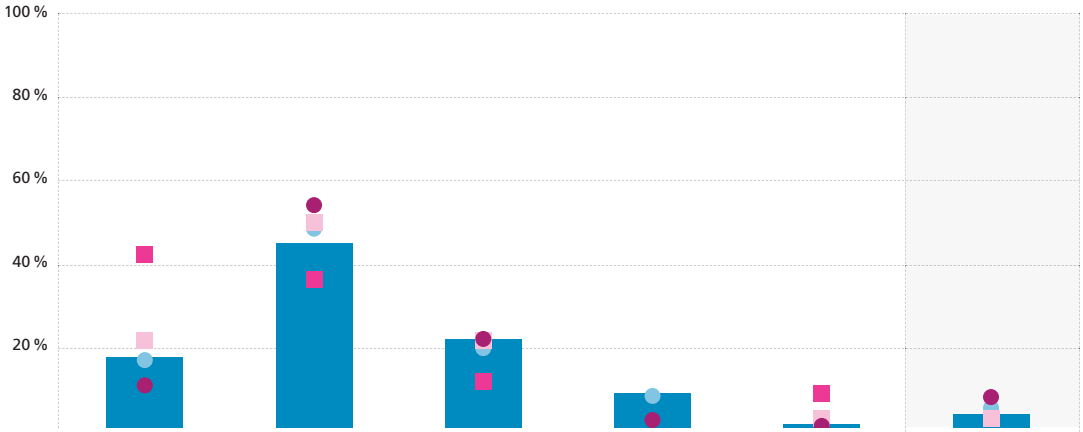
What impact will the validity of Thesis 3 above have on the areas listed below?



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, at least n = 77

Fig. I.8: Thesis 4 Mobile Internet use

More people in <country> regularly access the Internet through mobile devices than stationary computers.

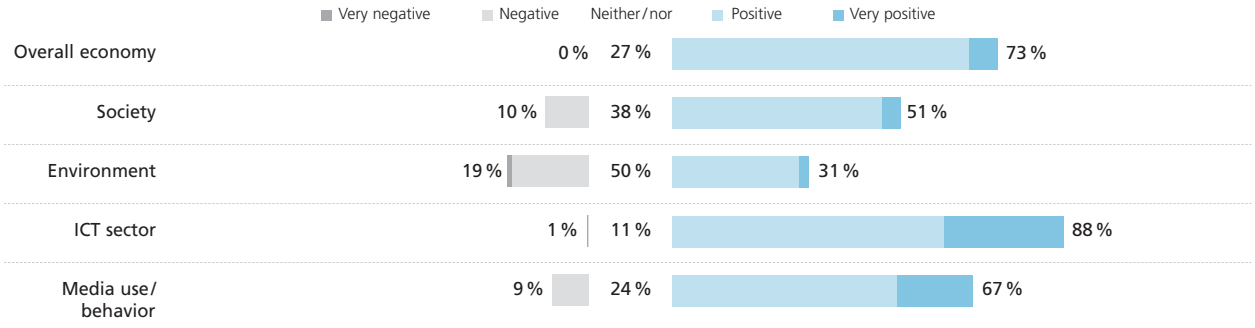


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 367)	18 %	45 %	22 %	9 %	2 %	4 %
EU experts (n = 72) [1]	11 %	54 %	22 %	3 %	1 %	8 %
U.S. experts (n = 32)	22 %	50 %	22 %	0 %	3 %	3 %
Other intern. experts (n = 33) [2]	42 %	36 %	12 %	0 %	9 %	0 %
DNAdigital (n = 35)	17 %	49 %	20 %	9 %	0 %	6 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. I.9: Thesis 4 Mobile Internet use – relevance

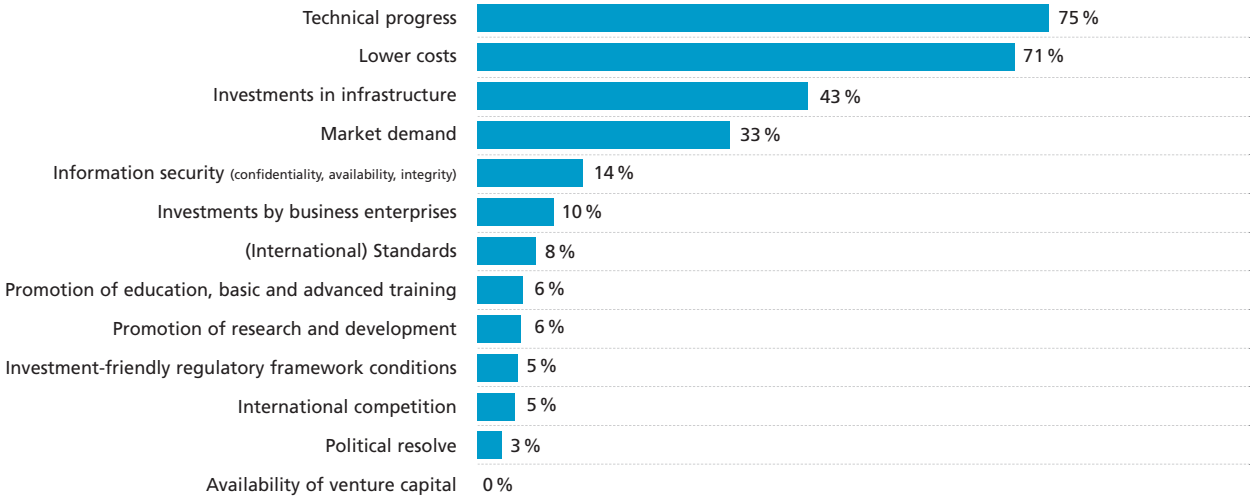
What impact will the validity of Thesis 4 above have on the areas listed below?



Basis: All people surveyed; Sub-group: GER experts, at least n = 350

Fig. I.10: Thesis 4 Mobile Internet use – drivers

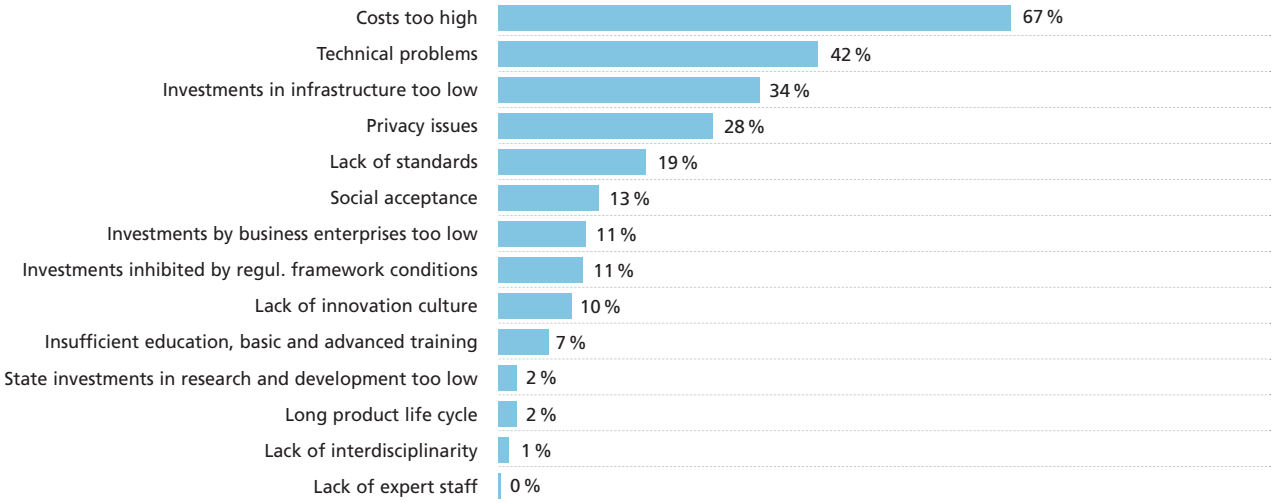
Select up to three drivers from the following list that you consider to be most important for realization of Thesis 4 above.



Basis: All people surveyed; Sub-group: GER experts, n = 295

Fig. I.11: Thesis 4 Mobile Internet use – barriers

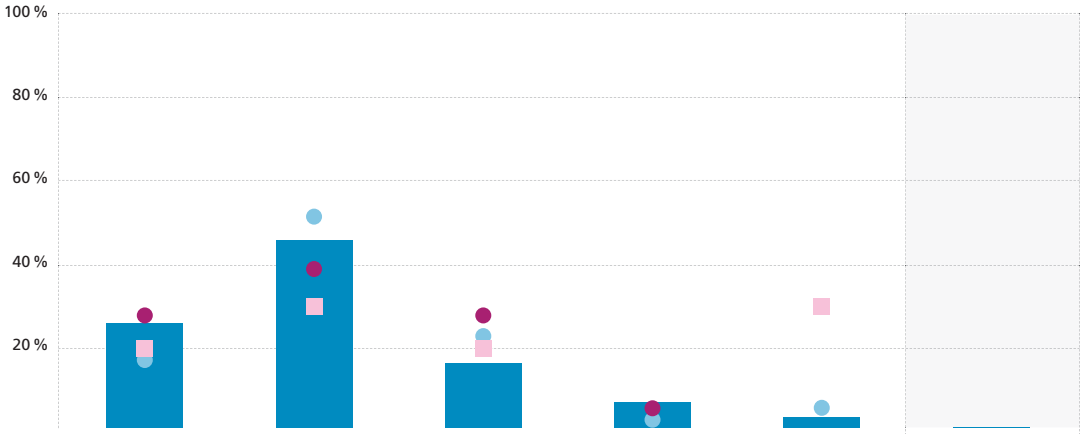
Select up to three barriers from the following list that you consider to be most important for realization of Thesis 4 above.



Basis: All people surveyed; Sub-group: GER experts, n = 289

Fig. I.12: Thesis 5 Daily mobile Internet use

In <country>, 75 percent of cell phone users access the Internet on a daily basis through their mobile device.

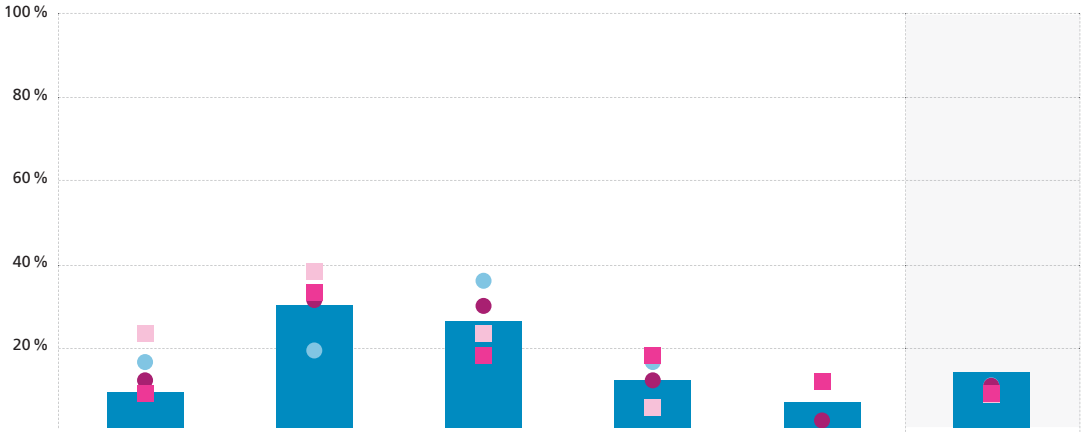


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 85)	26 %	46 %	16 %	7 %	4 %	1 %
EU experts (n = 18) [1]*	28 %	39 %	28 %	6 %	0 %	0 %
U.S. experts (n = 10)	20 %	30 %	20 %	0 %	30 %	0 %
DNAdigital (n = 35)	17 %	51 %	23 %	3 %	6 %	0 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. I.13: Thesis 6 "Social media" (Web 2.0)

More than half the <national> population regularly maintains social contacts on and over the Internet using "social media" (Web 2.0) applications and services.

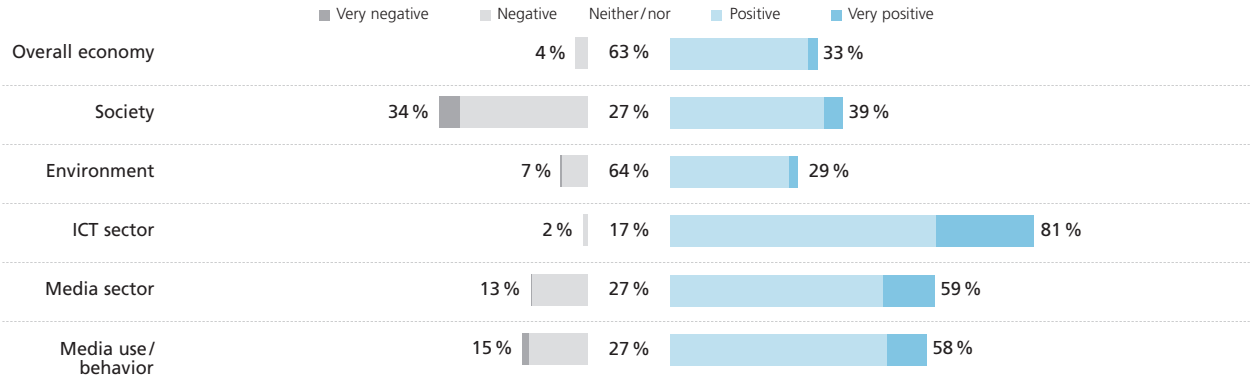


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 363)	9 %	30 %	26 %	12 %	7 %	14 %
EU experts (n = 73) [1]	12 %	32 %	30 %	12 %	3 %	11 %
U.S. experts (n = 34)	24 %	38 %	24 %	6 %	0 %	9 %
Other intern. experts (n = 33) [2]	9 %	33 %	18 %	18 %	12 %	9 %
DNAdigital (n = 36)	17 %	19 %	36 %	17 %	0 %	11 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

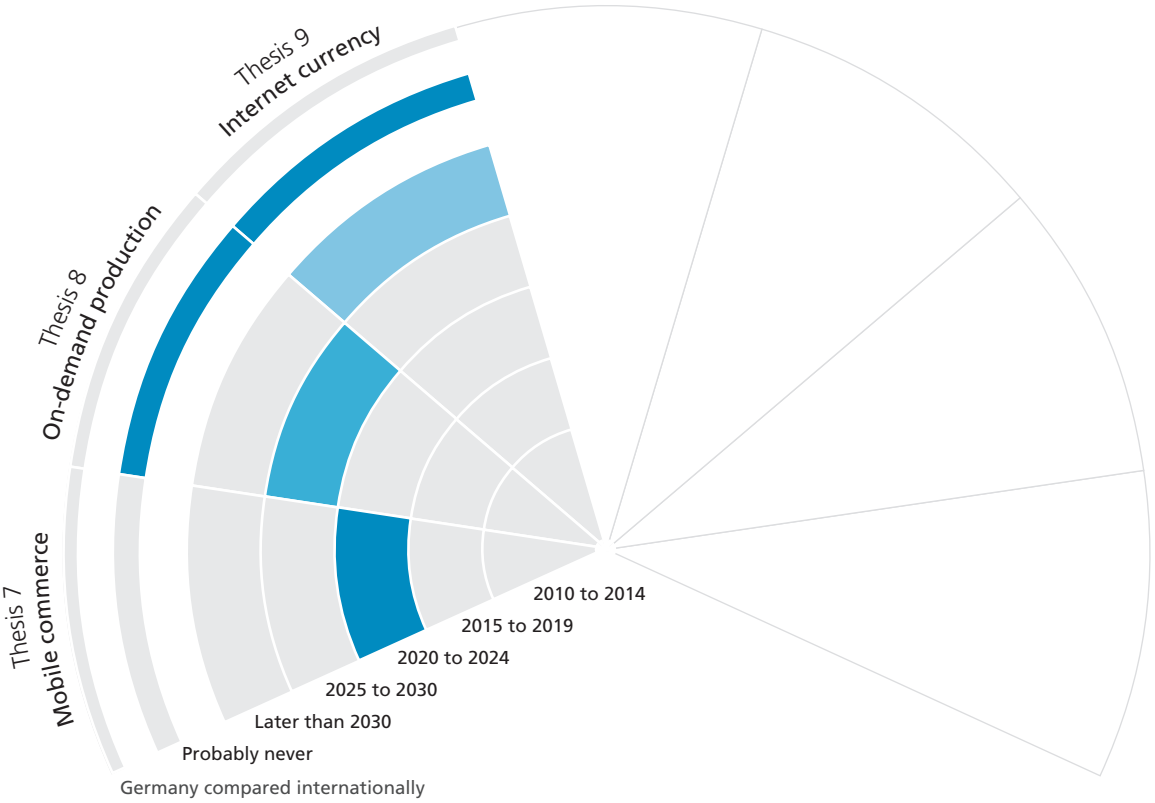
Fig. I.14: Thesis 6 "Social media" (Web 2.0) – relevance

What impact will the validity of Thesis 6 above have on the areas listed below?



Basis: All people surveyed; Sub-group: GER experts, at least n = 346

I.1.2 E-commerce
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 7: Mobile commerce

A single standard technology makes it possible to pay in retail outlets and restaurants worldwide through mobile devices (mobile wallet).

Thesis 8: On-demand production

More than 75 percent of consumers in Germany regularly use "on-demand production" to design and customize everyday products (clothes, food, etc.).

Thesis 9: Internet currency

An independent, globally accepted Internet currency has been established, replacing traditional currencies (e. g., EUR, USD).

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

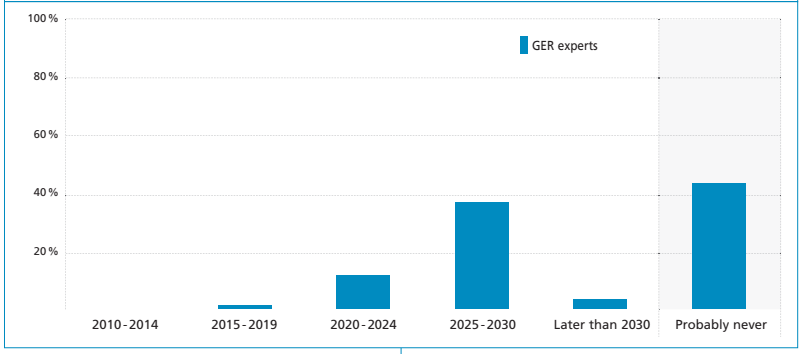
The number of Internet users who shop online has risen steadily by between one and five percent a year for the last five years. In 2008, 31 million Germans were already making purchases on the Internet, i. e., 63 percent of 14 to 64-year-old Internet users purchased goods and services online. In its assessment of the future development of online trade from November 2008, the German E-Commerce and Distance Selling Trade Association (bvh) forecast revenues for Germany to rise again in 2009, despite the current financial and economic crisis.

As part of this study, therefore, the question was asked, how online trade will develop and what role "on-demand production," i. e., specially shaped and adapted products, will play in online trade in the future.

Web 2.0 – now also for everyday products?

In particular, offers such as "http://uk.mymuesli.com" which allow end customers to adapt everyday products to their own needs and desires and have them delivered to directly to their door, have facilitated entirely new forms of production and sales in and via the Internet that seem to be ushering in a new business-to-consumer era. Apart from customized muesli mixes, this trend has already spawned a whole string of other examples such as customized chocolate, tea, and t shirts; some projects have been enjoying success for years, from tour operators and insurance providers, through to producers of dental implants and sneakers, who have seized upon the idea of personalizing, adapting and delivering everyday products. The study asked to what extent the principle of "on-demand production" can really be expected to completely penetrate buying habits.

Thesis 8: More than 75 percent of consumers in <country> regularly use "on-demand production" to design and customize everyday products (clothes, food, etc.).



The Germany experts are somewhat skeptical about the thesis that more than 75 percent of the consumers in Germany will use "online-demand production" to shape and adapt products they use in their everyday lives (clothes, food, etc.): Almost half of the experts surveyed (44 percent) deem it unlikely that a majority of the population in Germany will ever use customized products for everyday life (see Fig. 1.18). A further third of the experts surveyed for Germany expect it to take many more years before "on-demand production" becomes accepted by the majority of the population; they forecast a period of 2025 to 2030.

Mobile payment – future alternatives to current payment methods

Pay the restaurant bill anywhere in the world using your mobile phone, or at the supermarket, whip out your mobile phone instead of your wallet? Is mobile payment a utopian ideal, or already a reality? The basic idea behind "mobile payment" is to allow people to make cashless payments using their mobile device, e. g., their mobile phone, instead of having to deal with the numerous cards in their wallet and their PINs, as at present.

According to the analyst firm Gartner, the "mobile payment" market will grow steadily – for 2009, users of the mobile payment method are expected to grow by more than 70 percent. Forecasts suggest that, by 2012, the market will already have more than 190 million users worldwide and will be well established (see Gartner 2009).

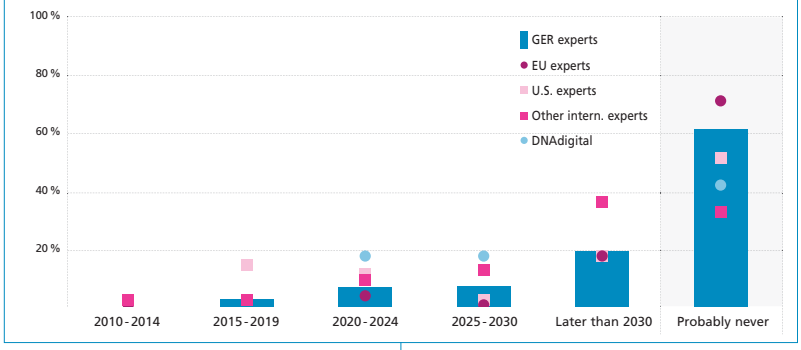
Despite these very positive forecasts by analysts, an international comparison shows that the dissemination of "mobile payment" cannot yet be seen as a basic standard everywhere. Compared to the pioneer market of Japan, where mobile payment methods have been used successfully for years, the dissemination of "mobile payment" on the German market lags well behind. Nevertheless, at the beginning of 2008, there was a spirit of optimism in Germany, triggered by the cooperation of Vodafone and O_2 with "mpass" and Deutsche Telekom's "Mobile Wallet" project. Yet these model projects failed to help "mobile payment" achieve a major breakthrough in Germany, since the right methods are still lacking there, and the payment options are not yet widespread.

Consequently, the experts were asked in the Delphi Study when a standard technology will make payment transactions possible worldwide in retail outlets and restaurants through mobile devices (mobile wallet). 49 percent of the experts for Germany believe that such an application will not be realistic until 2020 to 2024 (see Fig. 1.15). Experts for the rest of Europe expressed similar expectations (57 percent stated the period 2020 to 2024).

By contrast, the U.S. experts in the study expressed a completely different view on global dissemination of the mobile wallet: 80 percent believe it will be possible to make payment transactions without any difficulty in retail outlets and restaurants worldwide through mobile devices by 2019 at the latest, which is just ten years from now.

The experts surveyed consider the dissemination of mobile payment to crucially depend above all on the establishment of international standards (62 percent) and technical advances (44 percent) (see Fig. 1.16). The cornerstone for this last requirement may already have been laid by the new, widespread standard of Near Field Communication (NFC) technology. Nevertheless, it remains to be seen to what extent NFC will penetrate the market.

Thesis 9: An independent, globally accepted Internet currency has been established, replacing traditional currencies (e.g., EUR, USD).



Although customers and traders have recognized the advantages of mobile payment methods, the Germany experts believe above all that security aspects should not be forgotten. The experts surveyed do not have confidence in the ability of the current technologies to optimally guarantee security of the transferred information (see Fig. 1.17). Another barrier to the dissemination of mobile payment methods according to the Germany experts is social acceptance. This is because the departure from cash, which enables anonymous payment, entails the risk of the "transparent citizen," whose every transaction and thus usage habits could effectively be comprehensively traced in usage profiles.

Internet currency – a logical step in the digital age?

"Credits," "Klamm Lose," and "Linden dollars" – virtual payment methods on the Internet are many and varied. Most notably since the appearance of the virtual Internet currency used in Second Life (Linden dollars), which has an actual, albeit limited, equivalent value to conventional currencies, it appears that an internationally recognized, common Internet currency can no longer be ruled out. This study looked into the extent to which a worldwide accepted Internet currency should be expected in the future and whether a common currency can really exist alongside the U.S. dollar, euro, etc.

The experts in the Delphi Study broadly agree that no worldwide accepted Internet currency will be established. 62 percent of the GER experts, 71 percent of the Europe experts and at any rate more than half of the U.S. experts believe that a worldwide accepted Internet currency will not be established and consider this scenario to be completely unrealistic (see Fig. 1.19). Only the experts for other countries are somewhat indifferent: While 37 percent are of the opinion that this currency could become reality at some point, even if it is after 2030, around a third of them believe that a worldwide accepted Internet currency will not become widely accepted.

When asked what impact they would expect if, contrary to their forecasts, a worldwide accepted Internet currency were to be established, 48 percent of the Germany experts said that the Internet currency could have a positive effect on the overall German economy (see Fig. 1.20). Crucial drivers for this could primarily be strong political resolve (60 percent) and demand on the market for this currency (40 percent). The Germany experts deem the barriers to introduction to be first and foremost a lack of social acceptance (71 percent) as well as a lack of standards (53 percent).

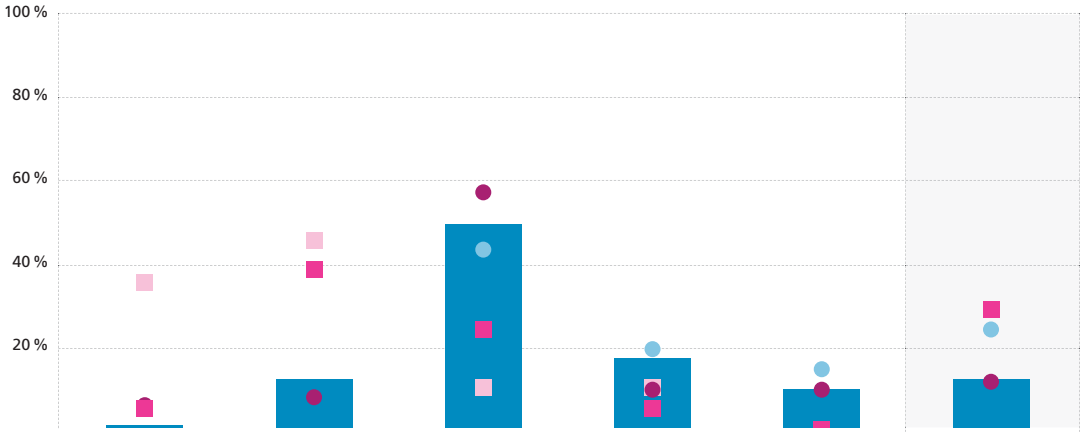
Summary

Digitization gives rise to a proliferation of new applications that could certainly make life easier – paying only by mobile phone instead of using lots of cards, customizing products as desired, etc. But the findings of the study have made it clear that not all of the new applications will establish themselves on the mass market in the short to medium term, since technical improvements or standards may be necessary for these applications to become useful for average customers.

Theses on "E-commerce" in detail

Fig. I.15: Thesis 7 Mobile commerce

A single standard technology makes it possible to pay in retail outlets and restaurants worldwide through mobile devices (mobile wallet).

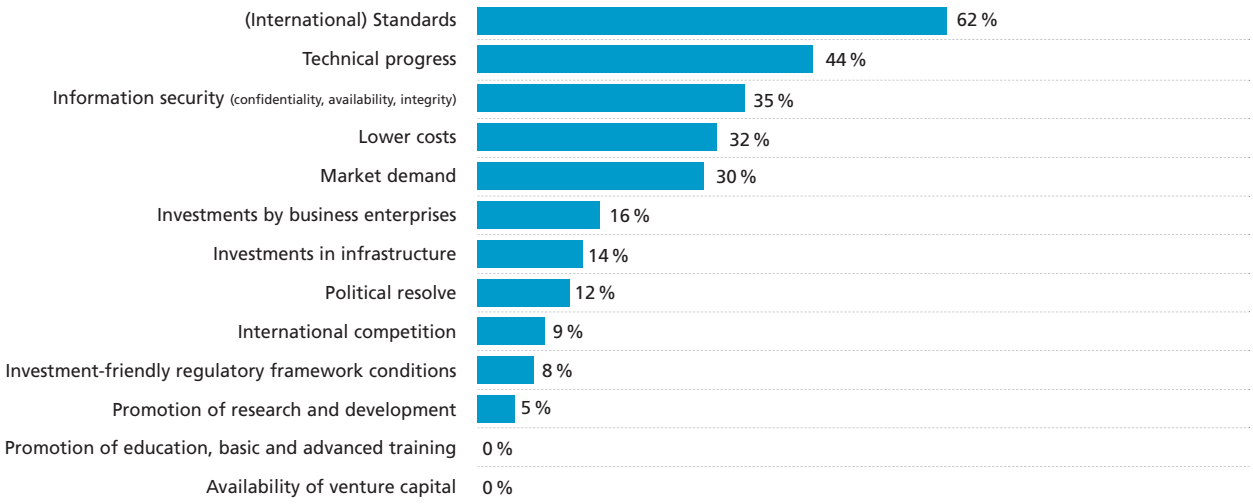


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 243)	1 %	12 %	49 %	17 %	9 %	12 %
EU experts (n = 53) [1]	6 %	8 %	57 %	9 %	9 %	11 %
U.S. experts (n = 20)	35 %	45 %	10 %	10 %	0 %	0 %
Other intern. experts (n = 21) [2]	5 %	38 %	24 %	5 %	0 %	29 %
DNAdigital (n = 21)	0 %	0 %	43 %	19 %	14 %	24 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. I.16: Thesis 7 Mobile commerce – drivers

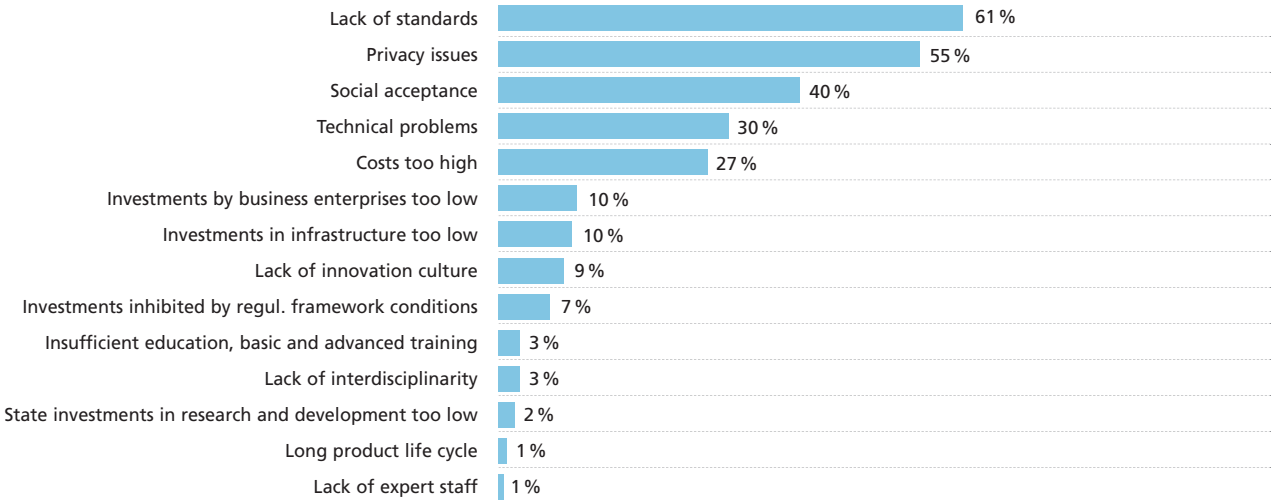
Select up to three drivers from the following list that you consider to be most important for realization of Thesis 7 above.



Basis: All people surveyed; Sub-group: GER experts, n = 279

Fig. I.17: Thesis 7 Mobile commerce – barriers

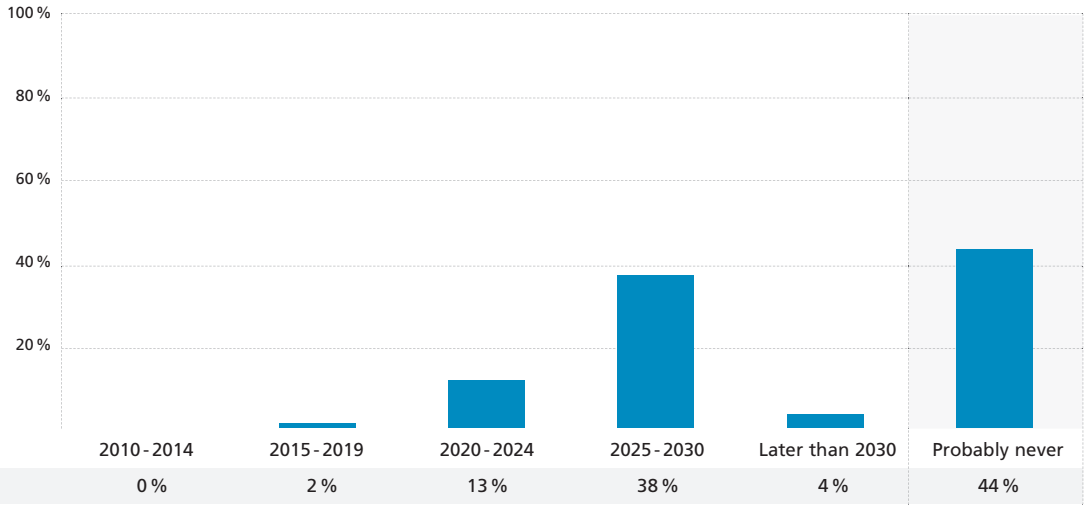
Select up to three barriers from the following list that you consider to be most important for realization of Thesis 7 above.



Basis: All people surveyed; Sub-group: GER experts, n = 281

Fig. I.18: Thesis 8 On-demand production

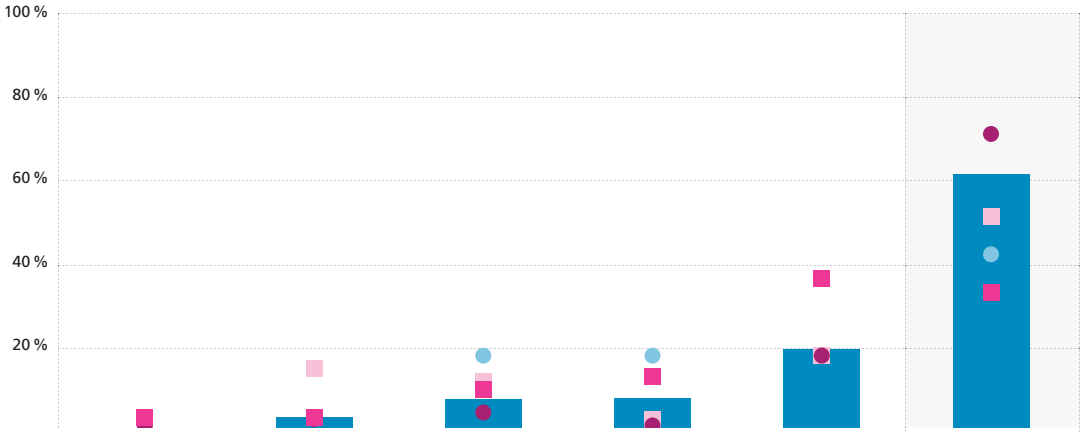
More than 75 percent of consumers in <country> regularly use "on-demand production" to design and customize everyday products (clothes, food, etc.).



Basis: All people surveyed with special expertise in the topic area

Fig. I.19: Thesis 9 Internet currency

An independent, globally accepted Internet currency has been established, replacing traditional currencies (e.g., EUR, USD).

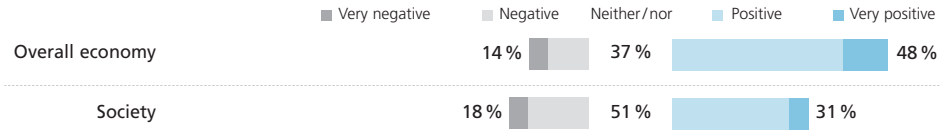


	2010-2014	2015-2019	2020-2024	2025-2030	Later than 2030	Probably never
GER experts (n=356)	0 %	3 %	8 %	8 %	20 %	62 %
EU experts (n=66) [1]	2 %	3 %	5 %	2 %	18 %	71 %
U.S. experts (n=33)	0 %	15 %	12 %	3 %	18 %	52 %
Other intern. experts (n=30) [2]	3 %	3 %	10 %	13 %	37 %	33 %
DNAdigital (n=33)	0 %	3 %	18 %	18 %	18 %	42 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. I.20: Thesis 9 Internet currency – Relevance

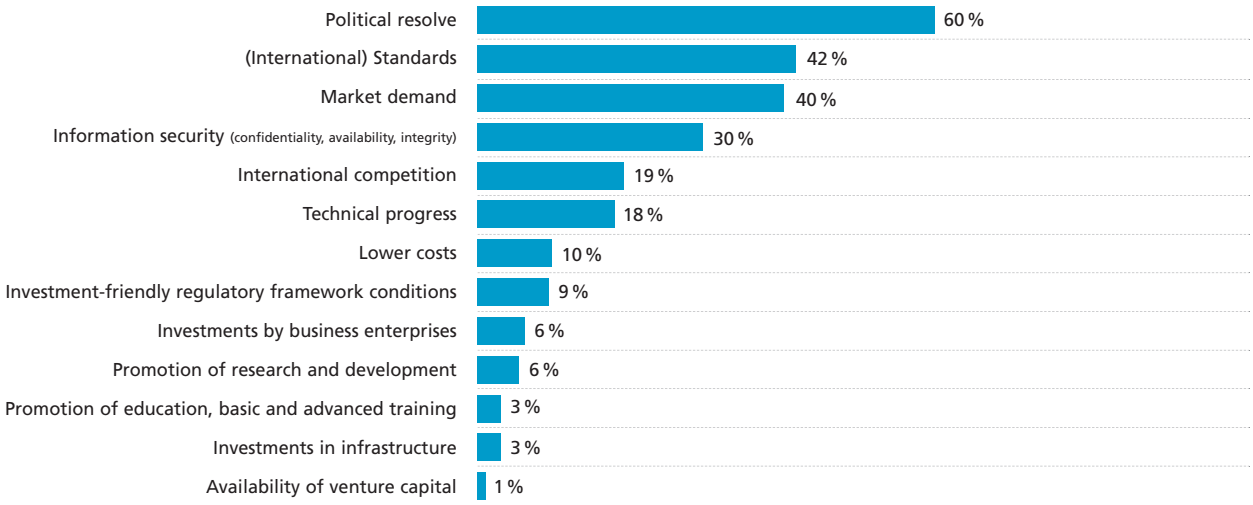
What impact will the validity of Thesis 9 above have on the areas listed below?



Basis: All people surveyed; Sub-group: GER experts, at least n=291

Fig. I.21: Thesis 9 Internet currency – drivers

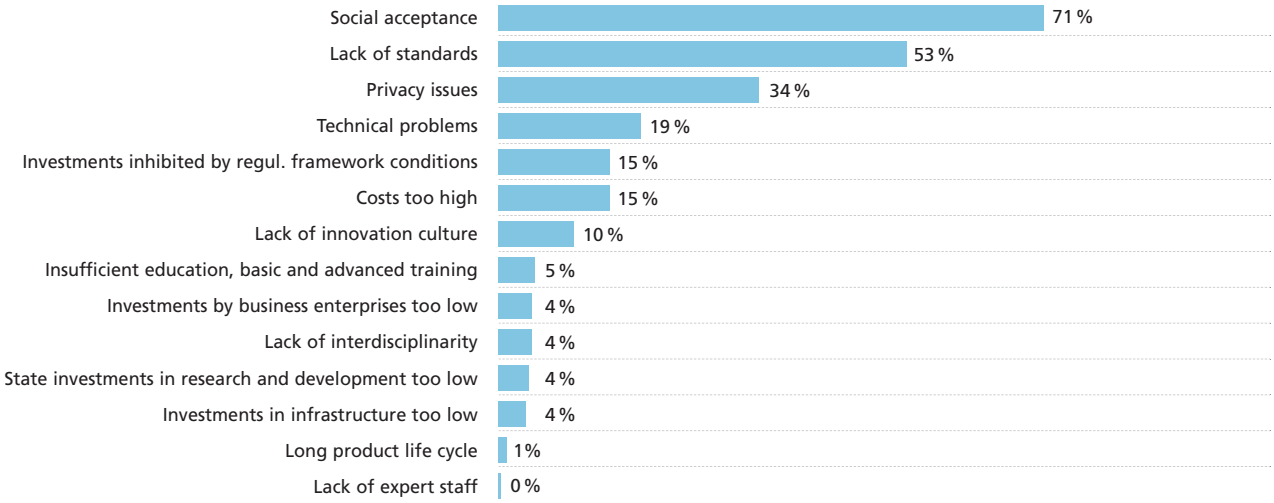
Select up to three drivers from the following list that you consider to be most important for realization of Thesis 9 above.



Basis: All people surveyed; Sub-group: GER experts, n = 253

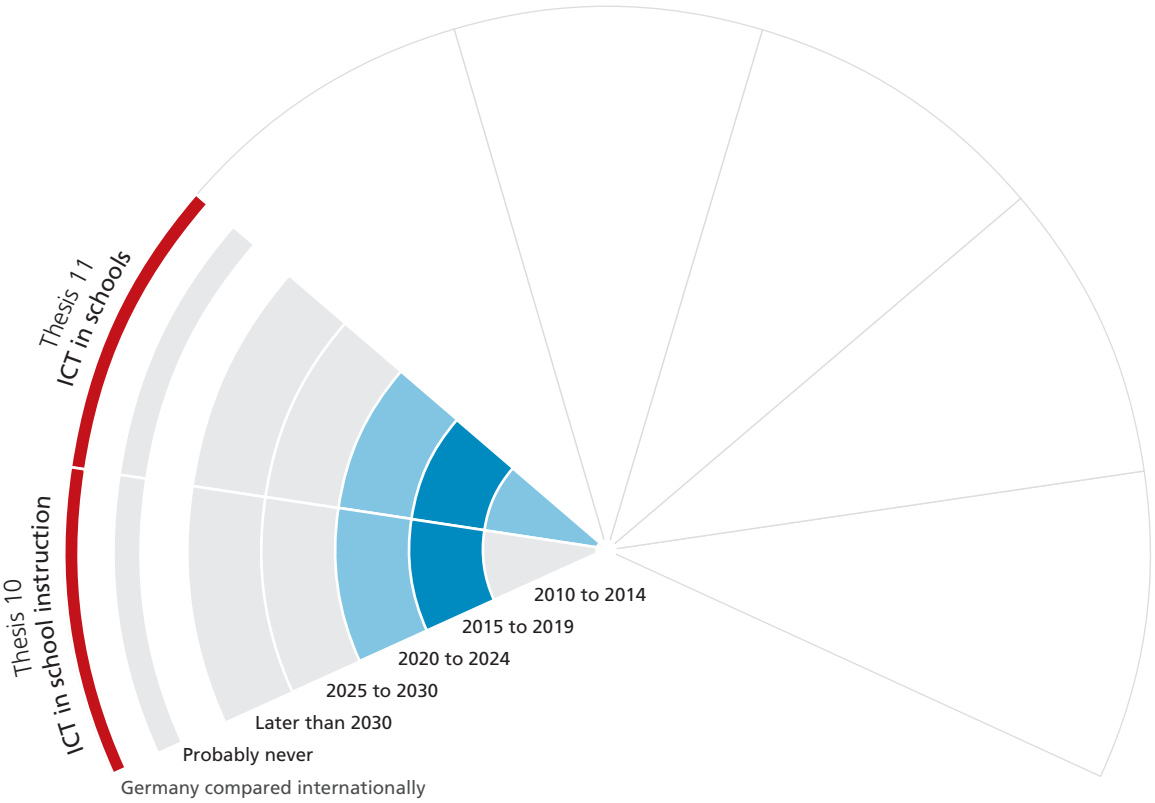
Fig. I.22: Thesis 9 Internet currency – barriers

Select up to three barriers from the following list that you consider to be most important for realization of Thesis 9 above.



Basis: All people surveyed; Sub-group: GER experts, n = 273

I.2.1 ICT in schools
Future radar*: Forecast occurrences



Sub-group of GER experts: ■ ≥ 40 % of experts ■ 30 % – 39 % of experts ■ 20 % – 29 % of experts ■ < 20 % of experts
Germany in comparison: ■ pioneering role ■ on a par with global developments ■ lagging behind ■ not possible to say

Thesis 10: ICT in school instruction

A personal electronic device (e. g., laptop) is a basic component of school instruction in Germany.

Thesis 11: ICT in schools

The constant use of ICT infrastructure (e. g., computers, Internet, e-books, school servers) is an integral part of everyday school life in Germany.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

Future of education and training with command of the Internet and ICT

The Internet can be a valuable tool in school education. For it to be useful, it is crucial to first of all teach "Digital 101" in schools, to both students and teachers. On the road to a digital information society, schools would thereby share in the responsibility of giving young people a command of the Internet and enable them to deal with information responsibly. These media skills should teach them to be careful with their own digital identity and to be critical about the source and quality of web data. In a private as in a professional context, this knowledge will increasingly mean that every individual will have basic skills.

However, according to the findings of a 2007 study by the EU Commission and BITKOM, it is very clear that, in 2006, German schools were lagging well behind other European countries in terms of ICT equipment. In a European ranking, Germany came only 18th. Specifically, this means that in German schools, up to eleven students have to share a computer, whereas, for the top performers in Denmark and Norway, there are only four students to a computer (see Monitoring IuK 2009). It should be noted, however, that the availability of sufficient PCs is only the prerequisite for the targeted use of the Internet in schools; it is crucial that media skills are also learnt.

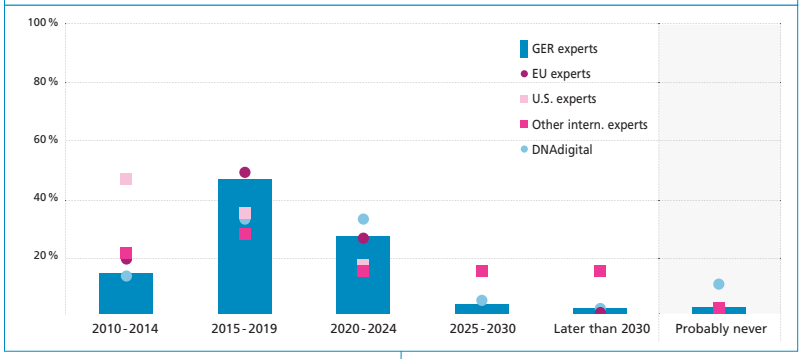
In the schools of tomorrow, ICT will be part of the standard equipment

The inclusion and the effects of information and communication technologies on schools and school instruction has been a hotly debated issue for years. While studies have shown the use of laptops in lessons to improve students' writing skills, some schools are discontinuing their trials with laptops. For instance, a study by TNS Sofres as part of the major French project "One school student, one laptop" showed that 80 to 90 percent of the French school students often only used their laptops to play games, because the teachers failed to get to grips with the new medium and consequently did not set students appropriate tasks (see Conseil général des Landes 2009).

As part of the Delphi Study on the prospects of information and communication technologies and media, the experts submitted their assessment of whether and by when ICT will be used in school instruction and schools in the future.

Almost half of the experts surveyed for Germany (47 percent) believe that an electronic device (e.g., laptop) will be a basic component of school instruction in Germany in six to ten years (see Fig. I.23). Experts for Europe also expect a similar trend: 49 percent of the Europe experts also anticipate the occurrence of this development between 2015 and 2019. The U.S. experts are far more optimistic than their colleagues: more than 80 percent of them believe a personal electronic device will be a basic component of school instruction in the U.S. by 2019 at the latest. And almost half of them (47 percent) forecast that the use of electronic devices such as laptops will be standard in classrooms by 2014 at the latest. One possible reason for the difference in forecasts could be that the use of ICT in schools is already far more advanced in the U.S. than in Europe. U.S. schools began to distribute laptops to students and banish the predominant textbooks from school instruction right back in 2003. After a few teething difficulties, huge strides forward can already be seen in the use of ICT in school instruction. The necessity of using electronic devices in schools is also recognized in Germany. The Federal Ministry of Education and Research (BMBF) recently declared that every school student needs a laptop in order to learn how to use this medium properly. But initiatives such as the City of Würselen's LEMMON ("Learning with Modern Media Online") or "Schulen ans Netz e.V." ("schools online") are also pioneer projects in Germany.

Thesis 10: A personal electronic device (e.g., laptop) is a basic component of school instruction in <country>.



The view of the experts surveyed on the constant use of ICT infrastructure as an integral part of everyday school life is similar to their view on the use of electronic devices in school instruction. More than 70 percent of the experts for Germany believe that the constant use of ICT infrastructure by every single school student will become a reality between 2015 and 2024. The experts for Europe anticipate this step even earlier – according to 42 percent of the experts surveyed, ICT will already be an integral part of everyday school life by 2014 (see Fig. I.24).

Use of ICT in school instruction requires teaching concepts to be adapted

The study clearly found that ICT will be used in everyday school life in the future. The experts for Germany believe that constant use of ICT infrastructure by every single school student will become reality by 2024 at the latest. The majority of the experts expect a personal electronic device will be a basic component of school instruction by 2015 to 2019.

However, it is of immense importance that the schools and teachers get to grips with the new media thoroughly before it is used. Merely replacing the current materials with electronic devices will not make the most of the opportunities of ICT. On the one hand, ICT offers the chance to make school instruction more lively, topical and interesting; on the other, it also requires a new, critical awareness of the quality of the content and the risks of using it.

Summary

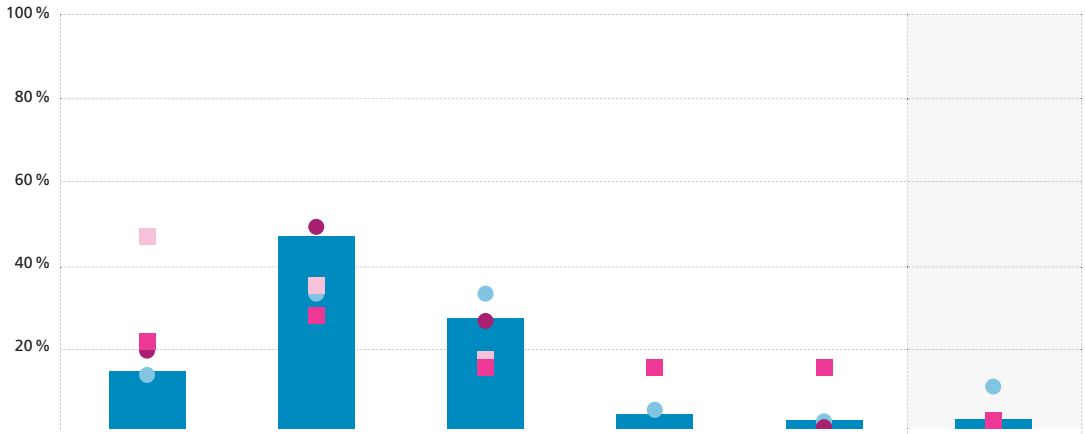
In summary, it can be seen that introducing children and young people to the Internet at an early stage, and (continuous) training of both teachers and school students are essential to achieving a strong command of the Internet. Responsible and competent participation in the information society of the future begins not only in the home, but also in educational institutions.

They should require and encourage an awareness of the opportunities and in particular of the risks pertaining to the use of modern ICT. To this end, they should provide the appropriate financial, infrastructural and, above all, didactic resources.

Theses on "ICT in schools" in detail

Fig. I.23: Thesis 10 ICT in school instruction

A personal electronic device (e. g., laptop) is a basic component of school instruction in <country>.

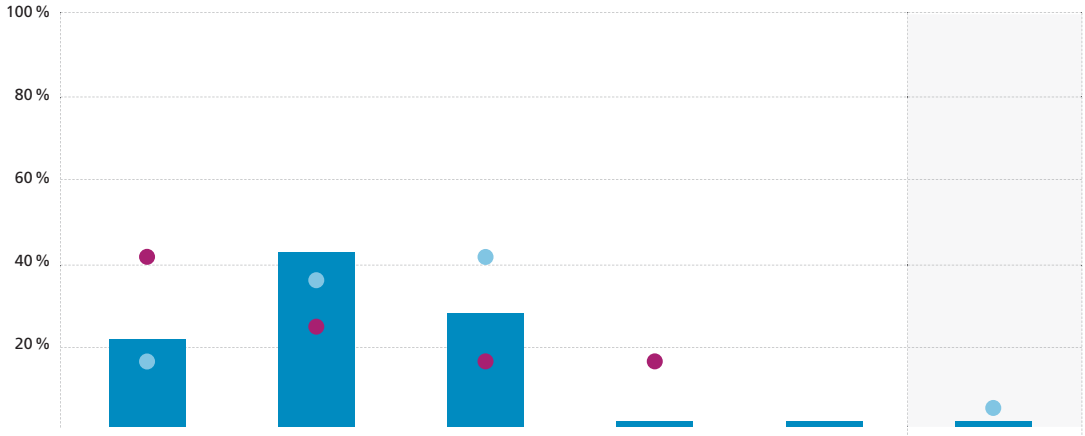


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 364)	15 %	47 %	27 %	4 %	3 %	3 %
EU experts (n = 71) [1]	20 %	49 %	27 %	0 %	1 %	3 %
U.S. experts (n = 34)	47 %	35 %	18 %	0 %	0 %	0 %
Other intern. experts (n = 32) [2]	22 %	28 %	16 %	16 %	16 %	3 %
DNAdigital (n = 36)	14 %	33 %	33 %	6 %	3 %	11 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. I.24: Thesis 11 ICT in schools

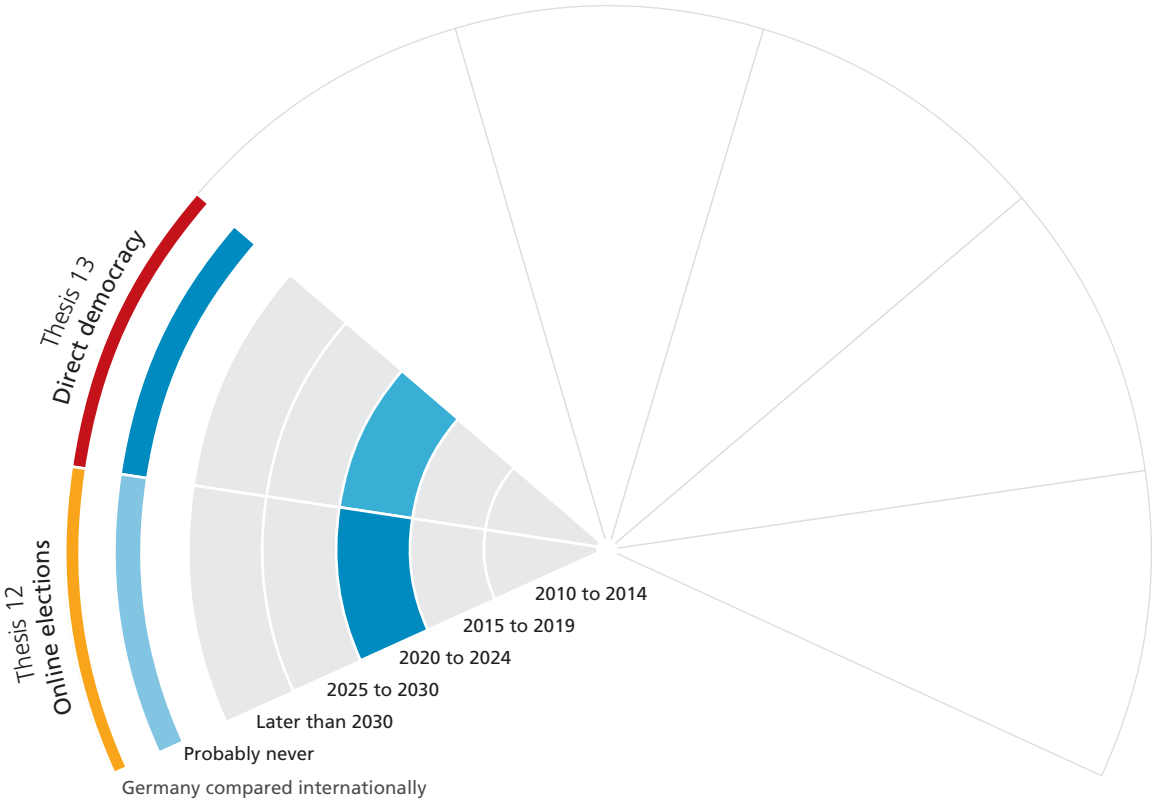
The constant use of ICT infrastructure (e. g., computers, Internet, e-books, school servers) is an integral part of everyday school life in <country>.



	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 82)	22 %	43 %	28 %	2 %	2 %	2 %
EU experts (n = 12) [1]*	42 %	25 %	17 %	17 %	0 %	0 %
DNAdigital (n = 36)	17 %	36 %	42 %	0 %	0 %	6 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

I.2.2 E-democracy
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 12: Online elections

Democratic elections in Germany are mostly conducted online and do not rely on actual polling stations.

Thesis 13: Direct democracy

Online government resolutions in Germany have strengthened citizen participation in democratic decision-making processes (increase in number of referenda).

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

E-democracy – opportunities for greater election and citizen participation through the Internet

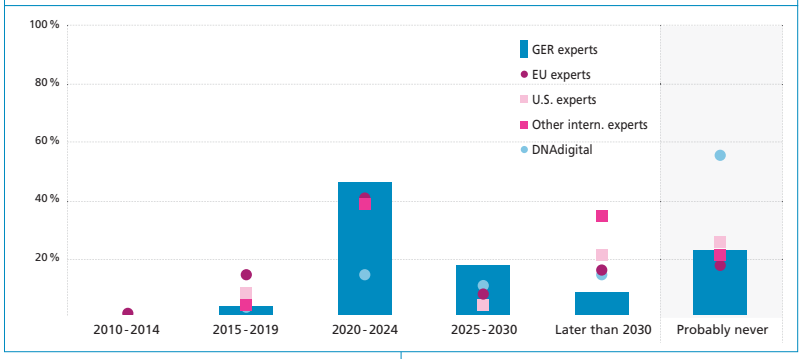
"The Internet and the resulting new information and communication possibilities have immense potential for promoting democracy and civil society," said the eParticipation 2009 initiative. There are not only hopes of significantly increasing election participation through online elections (i. e., elections conducted via the Internet), e-participation is also expected to increase citizen participation, since citizens can also get involved in political and social decision-making processes quickly and easily, and above all regardless of where they are. At the same time, these positive development scenarios are clouded by a series of critical aspects, for instance, how they can be brought about by shifting public, democratic discourse about socio-political processes from the "real" world, which is accessible to all, to a digital world, which is still not sufficiently accessible to all citizens. Experts fear that e democracy will lead to a kind of information autocracy and the exclusion of further sections of the population.

Experts believe there is a basic openness to online elections

50 percent of the GER experts surveyed in this study anticipate that by 2024, democratic elections in Germany will mostly be conducted online and will not rely on actual polling stations (see Fig. 1.25).

Experts for Europe (58 percent), the U.S. (48 percent) and other countries (43 percent) also anticipate this trend. By contrast, more than half (56 percent) of the surveyed experts from the DNAdigital group rejected this scenario with the answer "probably never". This makes them decidedly more skeptical; they base their opinions on security considerations and concerns about manipulation. They doubt that online elections will largely replace paper votes by 2030. The other main reasons for their general skepticism are presumably the frequent lack of the basic prerequisites for online voting, namely personal Internet access and, above all, the lack of social acceptance. As long as there are still citizens who do not have access to the Internet and its services and who do not have the skills to use them, online elections must remain as only an additional option. But the expert's assessments also reflect German citizens' basic openness to e-elections. According to a BITKOM survey from 2009, 47 percent would already vote electronically in elections. As for Internet users in general, this proportion is even higher among 18 to 29-year-olds: 57 percent of them would like to vote electronically (see BITKOM 2009). This testimony gives hope that online elections would boost election participation.

Thesis 12: Democratic elections in <country> are mostly conducted online and do not rely on actual polling stations.



The UK, the U.S. and Switzerland have already had their first experience of online elections for local elections. In fact, Estonia held its first online vote in 2007 for the parliamentary elections.

First online participatory budgets strengthen citizen participation

But in addition to strong election participation, the Internet could facilitate greater citizen participation. Initial attempts, for example, online participatory budgets in which citizens can get involved in the financial aspects of municipal budgets via the Internet, have already been successful. They show that it is possible to generate a high level of citizen participation over the Internet in a short space of time.

After just a few days, Cologne's online participatory budget for 2008 recorded 1,000 registered citizens who submitted an equal number of proposals. Bergheim's participatory budget saw a substantial increase in the number of participants and the number proposals thanks to the use of the Internet.

Despite the forecast increase in citizen participation through e-participation, the surveyed Delphi experts' vary considerably in their assessments of whether government-initiated online resolutions in Germany will strengthen citizen participation in democratic decision-making processes (see Fig. 1.26). For instance, the experts for Germany are highly skeptical: 53 percent of them believe that it will never be the case that government-initiated online resolutions in Germany

will strengthen citizen participation in democratic decision-making processes.

The experts for the rest of Europe are of an entirely different opinion: 67 percent anticipate that, by 2024, government-initiated online resolutions will have been introduced in the countries they assessed and will have strengthened citizen participation. Nevertheless, 27 percent also share the skeptical standpoint of the Germany experts. This could be due to the fact that, unlike in Germany, in several other European countries (e. g., Switzerland), referenda are already proven and accepted socio-political decision-making processes and the step towards online resolutions is expected in the not too distant future, if it has not already been implemented. But it is also possible that the Germany experts do not expect the possibility of online resolutions to automatically result in stronger participation, as was seen in the study "Prospects and Opportunities of German Information and Communication Technologies (ICT)" (Münchner Kreis, Deutsche Telekom AG, TNS Infratest, EICT 2008): "Although the Internet can facilitate participation, it is more difficult to generate the resolve for it".

Summary

In summary, it can be said that, although online elections by 2024 are deemed possible by more than half of the Germany experts, the majority believe it to be improbable that online resolutions will strengthen citizen participation in democratic decision-making processes. This is because although online elections and resolutions can facilitate access to participation, they cannot generate the interest or the resolve for participation in elections.

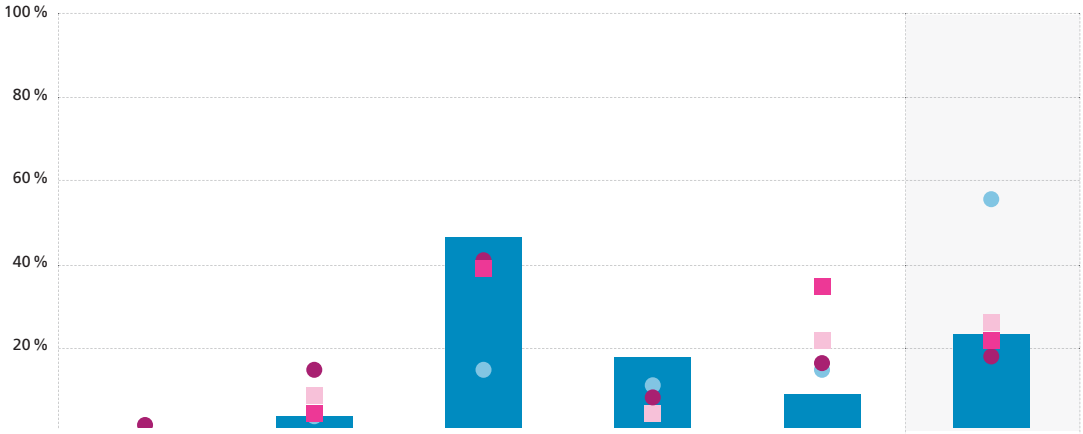
The Delphi Study shows that the Europe experts generally have a more positive attitude towards online resolutions. They see them as providing an opportunity for greater democratic participation.

However, it is generally true to say that, for democratic participation via the Internet to be possible, first and foremost every citizen must be provided with Internet access as well as the media skills. At the same time, it will be necessary to create corresponding acceptance of participation via the Internet. To this end, security risks must be eliminated and reliable access created for citizens.

Theses on "E-democracy" in detail

Fig. I.25: Thesis 12 Online elections

Democratic elections in <country> are mostly conducted online and do not rely on actual polling stations.

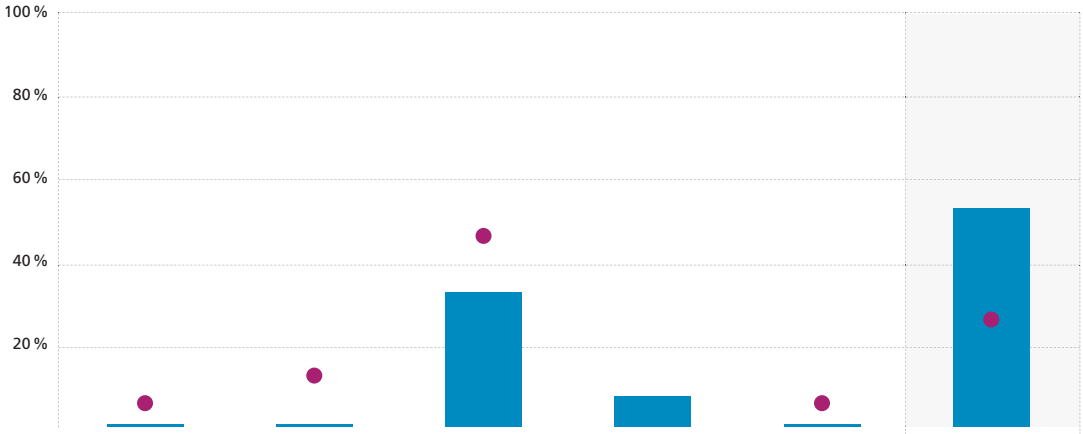


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 293)	0 %	4 %	46 %	18 %	9 %	23 %
EU experts (n = 61) [1]	2 %	15 %	41 %	8 %	16 %	18 %
U.S. experts (n = 23)	0 %	9 %	39 %	4 %	22 %	26 %
Other intern. experts (n = 23) [2]	0 %	4 %	39 %	0 %	35 %	22 %
DNAdigital (n = 27)	0 %	4 %	15 %	11 %	15 %	56 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. I.26: Thesis 13 Direct democracy

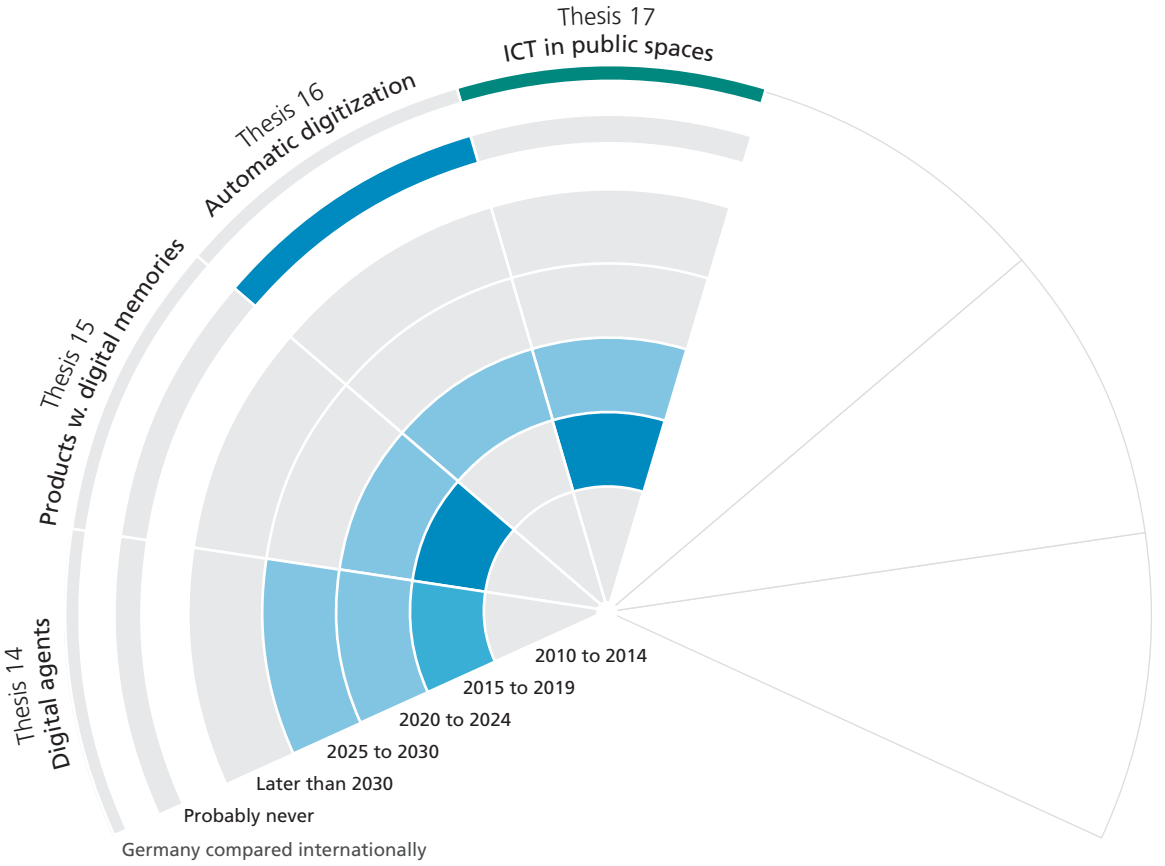
Online government resolutions in <country> have strengthened citizen participation in democratic decision-making processes (increase in number of referenda).



	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 60)	2 %	2 %	33 %	8 %	2 %	53 %
EU experts (n = 15) [1*]	7 %	13 %	47 %	0 %	7 %	27 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

I.2.3 Personal digital assistants
Future radar*: Forecast occurrences



Sub-group of GER experts: ■ ≥ 40 % of experts ■ 30 % – 39 % of experts ■ 20 % – 29 % of experts ■ < 20 % of experts
Germany in comparison: ■ pioneering role ■ on a par with global developments ■ lagging behind ■ not possible to say

Thesis 14: Digital agents carry out routine tasks

Digital assistants detect the needs of their users automatically and on a self-teaching basis, and complete routine tasks independently (e. g., during Internet use, management of terminal equipment, software and services of all kinds).

Thesis 15: Products with digital memories

Products are equipped with digital memories so that they can maintain "diaries" (e. g., logging function, whereabouts, history of use, error messages).

Thesis 16: Automatic digitization of life

Large parts of people's lives are automatically digitized in real time (images, sounds, geographic data, vital functions, etc.), i. e., recorded, archived and indexed, by personal terminal equipment and services. A massive pool of images, films and audio recordings exist throughout the entire lifespan of a human being.

Thesis 17: ICT in public spaces

At central public locations, interactive information and communication systems (e. g., intelligent displays) have become the norm and are regularly used by more than half the population in Germany (e. g., city information systems, shopping assistants).

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

Personal digital assistants (PDAs)

For a long time, there have been efforts to design digital assistants that know their user's preferences, put together information, and support people in decision-making. Over the years, the term PDA (personal digital assistant) has evolved from its original sense in the 1990s, which described a device, to increasingly refer to a functionality, an intrinsic function in programs or devices that cover wide-ranging areas of application. Future scenarios conceive digital assistants with such broad application that they will actually trigger a structural shift in our living habits and the way in which we deal with information and knowledge in the future society. Our everyday lives are already increasingly influenced by electronic assistants. Reaching for an electronic notebook is already a thing of the past. Many people routinely use integrated mobile phone or laptop/PC functions to plan their day, set themselves reminders, or find the information they need. Digital assistants are becoming an indispensable feature of people's everyday personal lives, living spaces, or simply to have about their person. The same trend can be seen in professional contexts with a much greater degree of specialization: Expert systems act as digital assistants in the healthcare sector, the financial sector, and administration. Furthermore, digital assistance systems are taking over the operation of equipment, systems and machines. Technology can be better controlled using assistance systems (e. g., digital cameras, cars); in some cases, complete or efficient control may not be possible without these systems (e. g., machines, airplanes). New areas will emerge every day, but this is just the precursor on the way to electronic assistants becoming a ubiquitous embedded function. Major research and development projects around the world have had a hand in this: Especially in Germany, research projects have been and are being carried out for uses in all kinds of areas. Take, for example, "SerCHo," the "Service Centric Home," led by BITKOM with support from the Federal Ministry of Economics and Technology (BMWi).

Rapid proliferation of the range and types of digital assistants

The diversity of new areas of application for digital assistants is giving rise to a broader differentiation of types:

- Personal digital assistants: These assistants help to structure and more easily organize everyday life, with its ever rising flood of information.
- Control and function assistants: These assistants are becoming a relevant part of user interfaces and open up new functionalities in equipment, machines and systems.
- Knowledge and expert assistants: These assistants help in the collection of knowledge, as technical support or expert systems.

In penetrating the wide-ranging areas of application, the use of specialist application knowledge is at the forefront. A few examples should help to illustrate this:

- The car (see section IV.6) has become an exemplary application area, using a broad spectrum of digital assistants, for instance, traffic assessment (navigation, traffic sign recognition), avoidance of collisions with people, improvement of night vision, and recognition of people, energy efficiency, breaks (ensured spacing, collision protection), parking assistance, and also electronic coupling.
- The healthcare sector (see section IV.5) is a particularly broad field for assistants, e. g., in the area of medical diagnostics (x-ray), healthcare (health monitoring, e. g., Inprimo and Partnership for the Heart), medication reminders, through to assistants for people with various impairments, such as smart assistants for wheelchair users.
- The home (see section IV.1) with smart home functions for home master control, energy optimization, and digital cooking assistants, etc.; smart living to open up the living environment, or the latest research area "Ambient Assisted Living (AAL)." Ambient assisted living particularly brings home the whole breadth of assistance systems and their potential applications.

Digital assistants help to cope with social problems

The demographic change is altering our country: By 2035, Germany will have one of the oldest populations in the world. More than half of the people in the country will be over 50. Every third person will be over 60 – a trend that is already posing a huge challenge for society, the economy and politics. One possible answer to the question of what senior citizens' lives might be like in the future, is: self-determined and largely independent, thanks to smart assistance systems. At European level, the development of these systems is being debated under the concept of Ambient Assisted Living (in Germany, the concept is called

"Assistenzsysteme im Dienste des älteren Menschen"). This umbrella term encompasses concepts, products and services with the common goal of developing user-friendly support systems suitable for everyday use and networking these systems with the social environment of senior citizens.

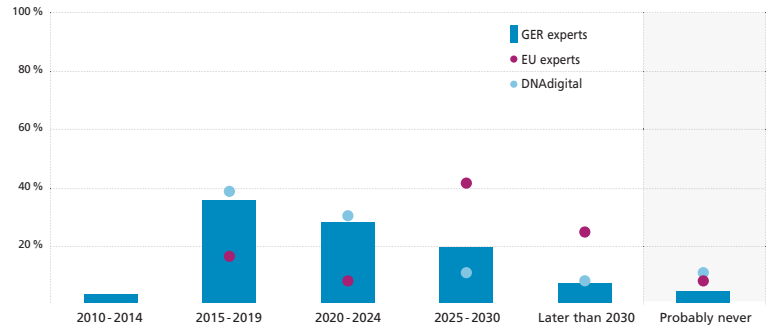
In this connection, the Federal Ministry of Education and Research (BMBF) is sponsoring an accompanying study on "user-dependent innovation barriers in the field of assistance systems for the elderly," because it is not possible to tap into the multi-faceted dimensions of the AAL technologies purely through technological research projects. In the conflict between the opportunities of technical assistance and the risks of electronic "superintendence," there is rather a need to look closely at the ethical, social, legal and economic aspects. The aim is to avoid technological solutions which may be excellent, but are controversial or unacceptable. Demo systems, such as inHaus2 or BAALL make it possible to try out concepts at an early stage and inform (soon-to-be) senior citizens about structural and technological opportunities and how independent living can link into quality of life.

PDAs complement everyday life

Digital assistants detect the needs of their users automatically and on a self-taught basis, and complete routine tasks independently (e. g., during Internet use and to control end devices, software and services of all kinds). Digital assistants adapt to the needs of their users by automatically recognizing their context, i. e., their immediate environment, and independently carrying out routine tasks such as short-term information needs, controlling devices and other services.

40 percent of the Germany experts forecast that digital assistants will in this way help us to cope with practical aspects of our daily lives by 2019. Another 28 percent expect this to be the case by 2024 at the latest (see Fig. I.27).

Thesis 14: Digital assistants detect the needs of their users automatically and on a self-teaching basis, and complete routine tasks independently (e. g., during Internet use, management of terminal equipment, software and services of all kinds).



Only 5 percent are pessimistic and believe that this scenario will probably never occur. The experts for the other European countries paint a different picture: The majority of them (67 percent) do not expect digital assistants to be used for practical purposes until after 2024 (42 percent between 2025 and 2030, 25 percent not until after this, and 8 percent probably never); on the other hand, 17 percent of them expect this scenario to occur by 2019 and another 8 percent by 2024.

PDAs use product memory

So we will be surrounded by digital assistants. They will support us in everything we do and be able to advise and assist us through inference on the semantic web. When asked about equipping digital products with memories that also act as "diaries" of life (e. g., logging whereabouts, history of use, error messages), as many as 80 percent of the Germany experts expressed the opinion that this will be common practice by 2024 at the latest (see Fig. I.28). Only ten percent expect this to occur later, another ten percent never. This result is no surprise, since the function is a prerequisite for the implementation of digital assistants. From this perspective, the general opinion of the experts for the other European countries is reflected here, albeit with delayed penetration. Overall, 58 percent of them expect this scenario to occur by 2024, and 42 percent after 2024.

PDAs offer long-term memories

The logical extension of this digital diaries scenario gives rise to a vision of individuals' entire lives being digitally captured using automatically indexed sounds and images (including geographic data and personal vital functions), resulting in a massive pool of images, films and audio recordings. 23 percent of the Germany experts expect this thesis to occur between 2020 and 2024 (see Fig. I.29). 50 percent of the Germany experts believe that automatic digitization of life will never become reality.

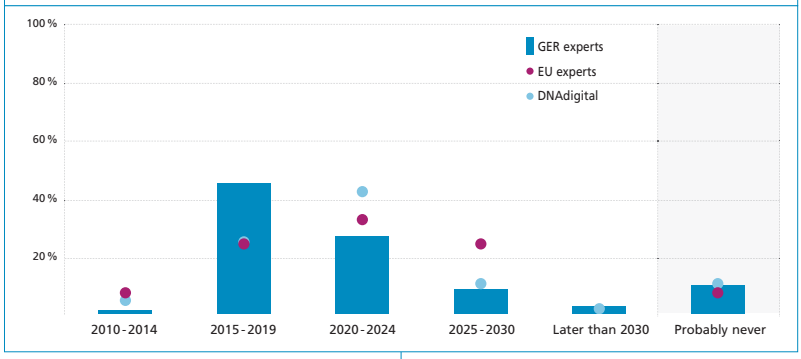
The opinions of Europe experts were as follows: 9 percent deem the period 2020 to 2024 to be realistic, 18 percent do not expect this thesis to occur until 2025 to 2030, 36 percent until after 2030. The DNAdigital group is even more skeptical than the Germany experts: 55 percent of them believe that this scenario will never occur. Clearly, the benefits of digital assistants are easy to imagine, despite a number of reservations. There is skepticism about the usefulness of recording entire lives in image and sound, although in technical terms, this can be deemed resolved. It looks as if the aspect of usefulness for the individual is overshadowing the issue of research and development costs, which still poses a challenge for digital assistants. If the benefits of recording an entire life are at issue, this vision pushes to the fore the following concerns: what happens to the data once they are in existence and can there be any guarantee that the individual will have complete self-determination of the data until their death? In an age when state and private organizations are becoming increasingly interested in accessing and using digital data, this appears to be less than clear. Consequently, research and development for smart assistants must be placed high up on the list of priorities. This also includes standardization in global committees such as W3C (World Wide Web Consortium).

Functional principles as a basis for rapid dissemination of "Points of Information"

Finally, the thesis was surveyed of the extent to which interactive information and communication systems (e. g., intelligent displays) have become the norm at central locations in public spaces and are regularly used by more than half the population (e. g., city information systems, shopping assistants).

The Germany experts are more optimistic in this regard than the experts for other European countries: More than three quarters of the surveyed experts for Germany expect this scenario to occur by 2024 at the latest, compared with just two thirds of the experts for the other European countries (see Fig. 1.30). The diverse experience with digital assistants will have a positive impact on the ease of use and basic functions of public interactive information and communication systems and result in intuitive user interfaces that adapt to the user and thus significantly increase acceptance.

Thesis 17: At central public locations, interactive information and communication systems (e. g., intelligent displays) have become the norm and are regularly used by more than half the population in <country> (e. g., city information systems, shopping assistants).



The skepticism of the experts surveyed for other European countries can be interpreted as an indication of a more realistic estimate of the research and development costs. On the one hand, a range of interesting information systems are springing up in the world wide web, which make implementation entirely conceivable and provoke optimism. However, the cost of realizing unobtrusive and useful assistance systems is immense, even if the roadmap seems clear. Moreover, the gap between feasibility and general availability for use can only be bridged with adequate standardization. This will only succeed when the issue grows sufficiently mature in technical, social and legal terms. Furthermore, the experts for the other European countries may express greater skepticism about the mastering of data protection or, more precisely, informational self-determination (see section 1.3.2).

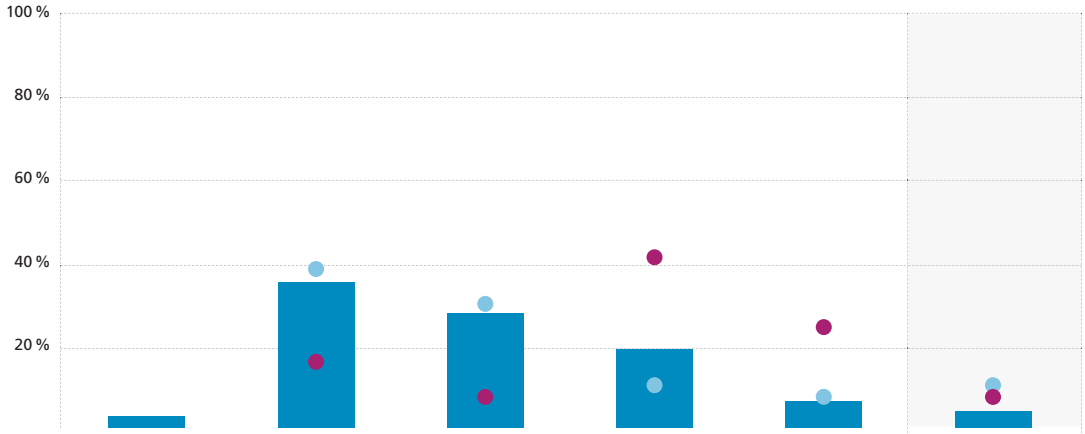
Summary

Compared to the Europe experts, the Germany experts appear to be positively optimistic about digital assistance and recording of life and deem the development costs to be surmountable. The experts are most optimistic in their assessment of publicly available information and communication technology. The unanswered question of informational self-determination will create greater skepticism as long as its specific benefits remain hidden. The issues surrounding digital assistants and associated subject areas will have to be prioritized on the research agenda if we want useful, socially responsible and relevant solutions to become ubiquitous in the next 11 to 15 years, like the use of mobile phones is today. The complexity of the connected areas of life covered by digital assistants demands cross-disciplinary collaboration of sociology, psychology, the cognitive sciences, information technology and other applied disciplines. Research topics range from semantic networks and the related ontologies through to data protection and non-invasive sensor technology for vital functions.

Theses on "Personal digital assistants" in detail

Fig. I.27: Thesis 14 Digital agents carry out routine tasks

Digital assistants detect the needs of their users automatically and on a self-teaching basis, and complete routine tasks independently (e. g., during Internet use, management of terminal equipment, software and services of all kinds).

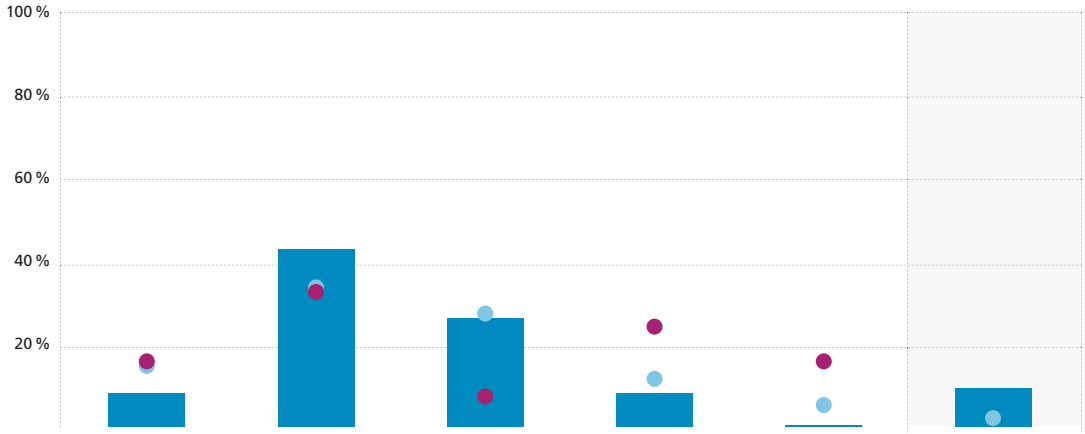


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 81)	4 %	36 %	28 %	20 %	7 %	5 %
EU experts (n = 12) [1]*	0 %	17 %	8 %	42 %	25 %	8 %
DNAdigital (n = 36)	0 %	39 %	31 %	11 %	8 %	11 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. I.28: Thesis 15 Products with digital memories

Products are equipped with digital memories so that they can maintain "diaries" (e. g., logging function, whereabouts, history of use, error messages).

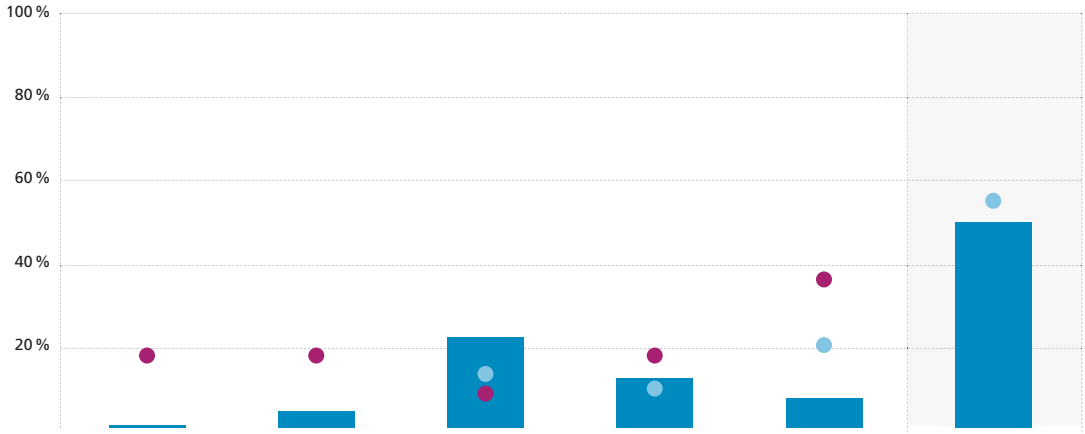


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 78)	9 %	44 %	27 %	9 %	1 %	10 %
EU experts (n = 12) [1]*	17 %	33 %	8 %	25 %	17 %	0 %
DNAdigital (n = 32)	16 %	34 %	28 %	13 %	6 %	3 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. I.29: Thesis 16 Automatic digitization of life

Large parts of people's lives are automatically digitized in real time (images, sounds, geographic data, vital functions, etc.), i. e., recorded, archived and indexed, by personal terminal equipment and services. A massive pool of images, films and audio recordings exist throughout the entire lifespan of a human being.

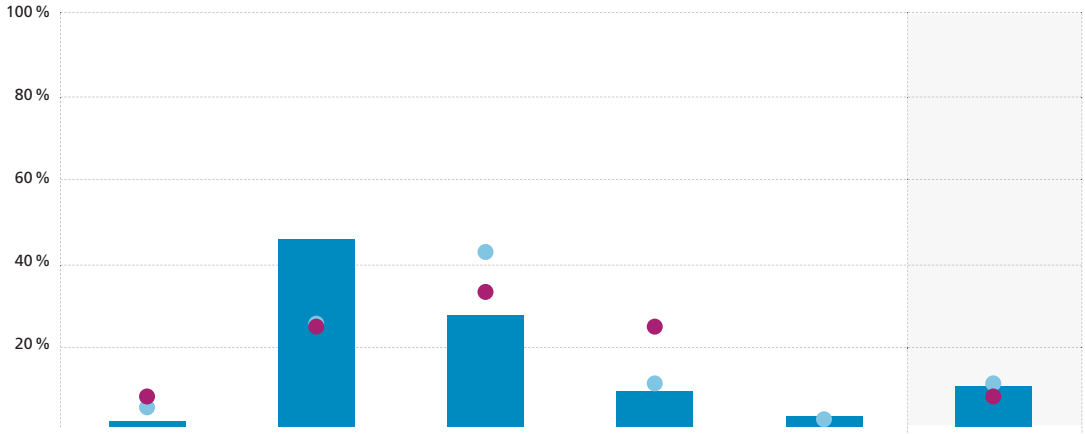


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 62)	2 %	5 %	23 %	13 %	8 %	50 %
EU experts (n = 11) 1*	18 %	18 %	9 %	18 %	36 %	0 %
DNAdigital (n = 29)	0 %	0 %	14 %	10 %	21 %	55 %

1 Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. I.30: Thesis 17 ICT in public spaces

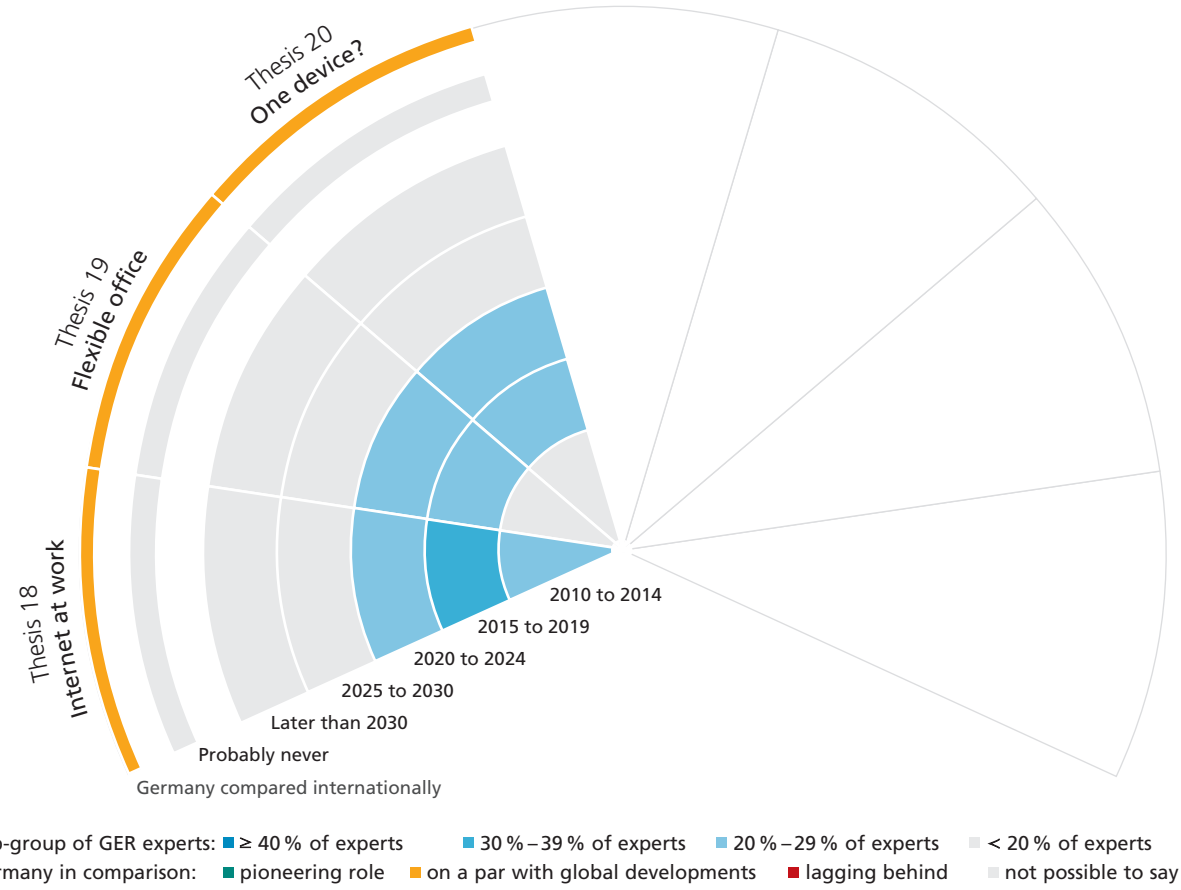
At central public locations, interactive information and communication systems (e. g., intelligent displays) have become the norm and are regularly used by more than half the population in <country> (e. g., city information systems, shopping assistants).



	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 83)	2 %	46 %	28 %	10 %	4 %	11 %
EU experts (n = 12) 1*	8 %	25 %	33 %	25 %	0 %	8 %
DNAdigital (n = 35)	6 %	26 %	43 %	11 %	3 %	11 %

1 Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

I.2.4 Skills for a digital work environment
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 18: Internet at work

For approximately 75 percent of the employed population in Germany, command of the Internet has become a necessary prerequisite to conducting everyday business.

Thesis 19: Flexible office

ICT systems have made it possible to work flexibly in terms of time and location. More than 75 percent of office employees in Germany regularly use the home or mobile office.

Thesis 20: One device – for personal and professional use

Employees in Germany use one and the same wireless device at all times, which administers several telephone numbers (including for private telephony at home, in transit or at work).

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

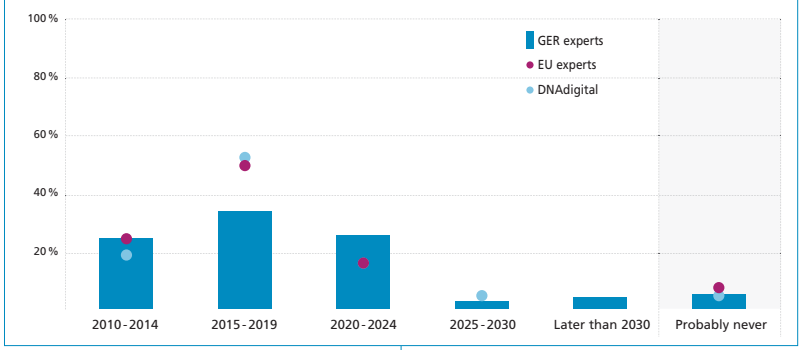
Skills for a digital work environment

"The digital work environment has reached the executive boardrooms," exclaimed Welt Online on September 20, 1999 (!) (Welt Online 1999); "ICT is changing the way people work," was the finding in the final report of the first phase of the 2008 future study (Münchner Kreis, Deutsche Telekom AG, TNS Infratest, EICT 2008). "There are hardly any workplaces left where you can survive without computer skills," said Manfred Kremer, President of the Federal Institute for Vocational Education and Training (BIBB) at the education trade fair Didacta in Hanover in February 2009; "These days, anyone who cannot use the Internet has either a huge problem – or a secretary," quipped a participant of the conference "Digital informiert – im Job integriert" (Digitally savvy – part of the job) (Schattenblick 2008). The Internet is giving rise to an economic, social and societal change that will shape the future of the work environment – according to the central thesis of DNAdigital's manifesto in 2009 (see DNAdigital 2009).

Command of the Internet – necessary prerequisite for the digital work environment

When asked whether they consider command of the Internet to be a necessary prerequisite to conducting everyday business, six out of ten Germany experts said they expected this will apply for approximately 75 percent of the employed population in Germany within the next ten years. Conversely, this means that only around a quarter of the employed population will be able to conduct everyday business without a command of the Internet (see Fig. 1.31). Only 6 percent of the Germany experts believe that command of the Internet will probably never be a necessary prerequisite to conducting everyday business.

Thesis 18: For approximately 75 percent of the employed population in <country>, command of the Internet has become a necessary prerequisite to conducting everyday business.



Experts surveyed from the DNAdigital group and the experts for other European countries are even more emphatic: Around three quarters of them anticipate that, within the next ten years, 75 percent of the employed population will need a command of the Internet to successfully conduct everyday business. Like the GER experts, 6 percent of the DNAdigital experts and 8 percent of the experts for other European countries expect that command of the Internet will probably never be a necessary prerequisite.

14 percent of the experts for Germany have concerns about the potential negative effects of this trend on society, right down to fears of being unable to cope with the demands of everyday working life and thus being overtaxed. However, the majority of the Germany experts surveyed (53 percent) also see opportunities for society. This trend will give a great boost to both economy as a whole (74 percent) and to the ICT sector (87 percent) (see Fig. I.32).

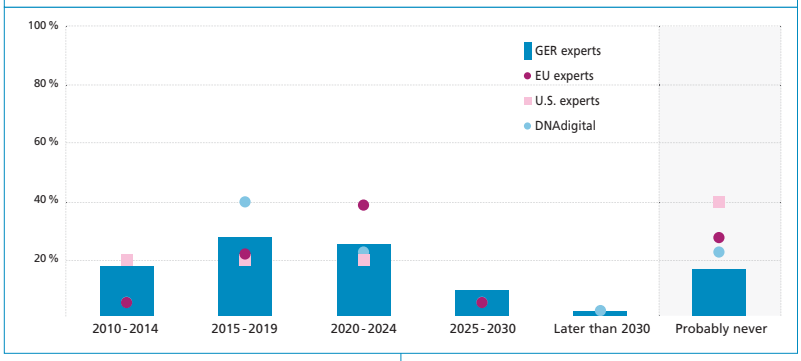
Boundless flexibility in the digital work environment – wherever, whenever

ICT systems make it possible to conduct professional tasks flexibly in terms of time and location. Thus working in an office in a traditional nine-to-five job, which for many of the now young Internet generation is a hangover from the industrial age, is rendered obsolete. Around six out of ten of the experts for Germany expect that more than 75 percent of office employees in Germany will regularly use the home or mobile office by 2024 at the latest (see Fig. I.33). However, around one fifth of the Germany experts surveyed believe that this scenario will probably never occur, partly because this scenario depends on the industry or company culture, or because personal contact will continue to be important.

These developments will not only blur the lines between office, home and on the move, people's mobile devices for work and for personal use will cease to be separate: around three quarters of the experts surveyed for Germany believe that within the next 15 years, employees will universally use one and the same wireless device, which administers several telephone numbers (see Fig. I.34). The experts surveyed from the DNAdigital group have equally positive expectations for this trend: some 46 percent are of the opinion that a single wireless device for professional and private use will already be common practice by 2019, 23 percent of the DNAdigital experts, however, believe that this will probably never be the case. Around a fifth of the experts surveyed for Germany (17 percent) expect that one

and the same device will probably never be common practice and people will continue in the future to maintain separate devices for private and professional use (in many cases, also by the employee's choice). The U.S. experts are much more skeptical in this regard: Four out of ten of those surveyed expect this scenario will probably never occur.

Thesis 20: Employees in <country> use one and the same wireless device at all times, which administers several telephone numbers (including for private telephony at home, in transit or at work).



Summary

The increasing flexibilization of the work environment gives employees the chance for greater freedom and means they are no longer office-bound and tied to their desks, allows them to run errands in between times, have time for friends and family, etc., and organize their workflows flexibly. On the other hand, the demand for flexibility is also increasingly blurring the lines between work and private life, the private sphere is in danger of no longer being a protected space, and employees are required to be available everywhere and at all times.

In order to make the best possible use of the potential of ICT in a digital work environment in light of this, the following is required, in addition to the technological skills:

- On the part of companies: A change in culture and way of thinking, so employees are no longer measured by their attendance in the office, but rather by the results they produce

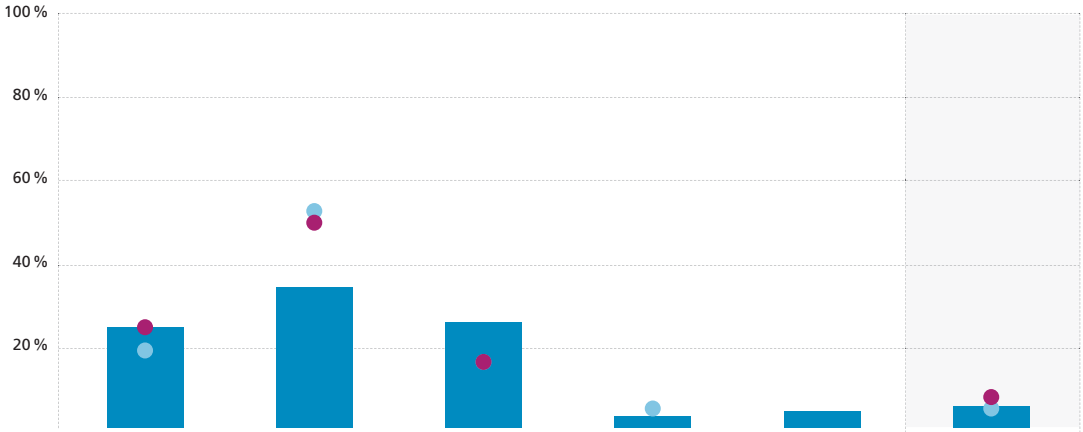
- On the part of employees: A greater degree of self-management and structuring, in order to cope with expectations of availability and reachability

- On the part of the ICT sector: The development of technologies, terminal equipment and framework conditions (e. g., data protection provisions), that facilitate the flexibilization of working life and at the same time meet the needs of employees to protect their private lives and autonomy.

Theses on "Skills for a digital work environment" in detail

Fig. I.31: Thesis 18 Internet at work

For approximately 75 percent of the employed population in <country>, command of the Internet has become a necessary prerequisite to conducting everyday business.

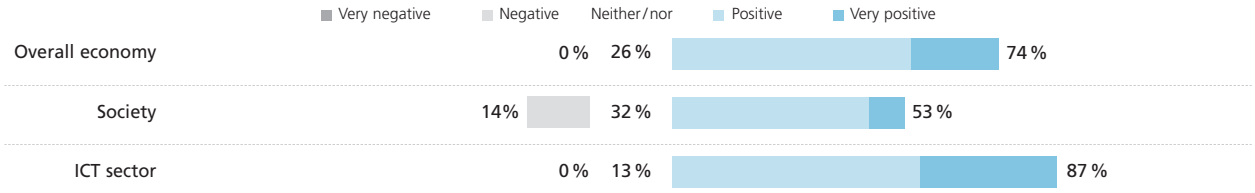


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 84)	25 %	35 %	26 %	4 %	5 %	6 %
EU experts (n = 12) [1]*	25 %	50 %	17 %	0 %	0 %	8 %
DNAdigital (n = 36)	19 %	53 %	17 %	6 %	0 %	6 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. I.32: Thesis 18 Internet at work – relevance

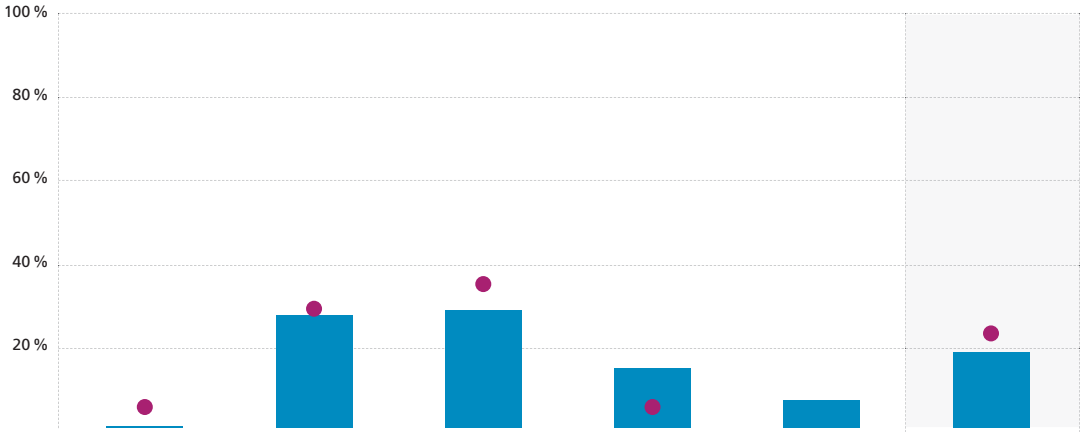
What impact will the validity of Thesis 18 above have on the areas listed below?



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, at least n = 76

Fig. I.33: Thesis 19 Flexible office

ICT systems have made it possible to work flexibly in terms of time and location. More than 75 percent of office employees in <country> regularly use the home or mobile office.

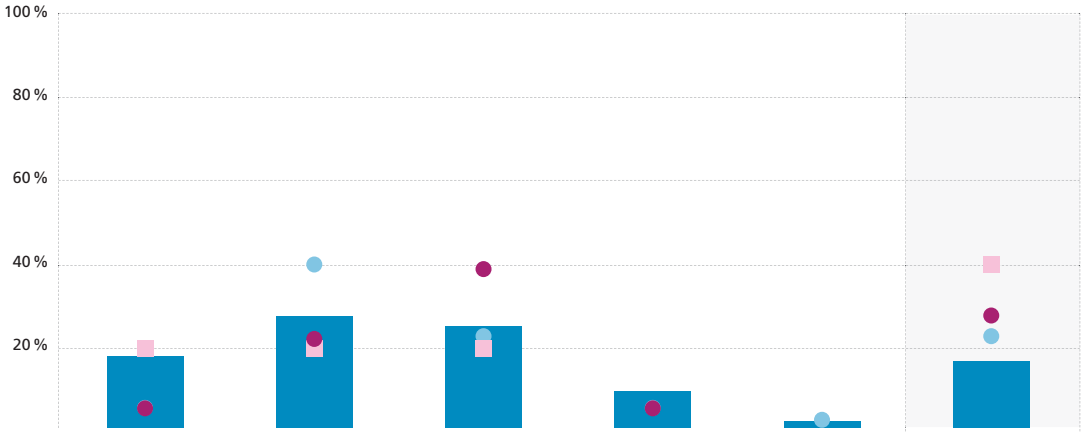


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 79)	1 %	28 %	29 %	15 %	8 %	19 %
EU experts (n = 17) [1]*	6 %	29 %	35 %	6 %	0 %	24 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. I.34: Thesis 20 One device – for personal and professional use

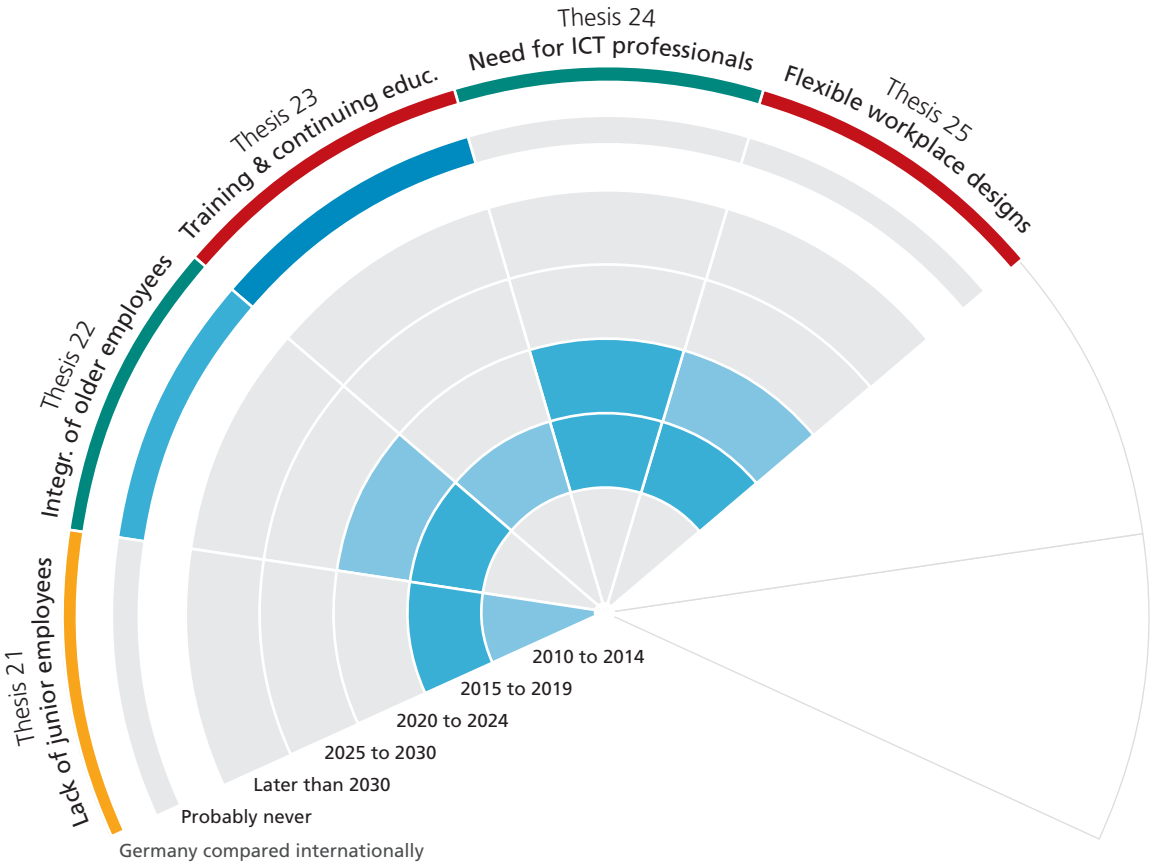
Employees in <country> use one and the same wireless device at all times, which administers several telephone numbers (including for private telephony at home, in transit or at work).



	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 83)	18 %	28 %	25 %	10 %	2 %	17 %
EU experts (n = 18) [1]*	6 %	22 %	39 %	6 %	0 %	28 %
U.S. experts (n = 10)*	20 %	20 %	20 %	0 %	0 %	40 %
DNAdigital (n = 35)	6 %	40 %	23 %	6 %	3 %	23 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

I.2.5 Shortage of specialists and remediation
Future radar*: Forecast occurrences



Sub-group of GER experts: ■ ≥ 40 % of experts ■ 30 % – 39 % of experts ■ 20 % – 29 % of experts ■ < 20 % of experts
Germany in comparison: ■ pioneering role ■ on a par with global developments ■ lagging behind ■ not possible to say

Thesis 21: Lack of junior employees

Due to the demographic change in Germany, it is no longer possible to overcome the shortfall of trained professionals in the ICT sector with junior employees from Germany itself.

Thesis 22: Integration of older employees

New approaches to human resources that have promoted the integration of older employees in the ICT sector have successfully offset the shortfall in trained professionals.

Thesis 23: Training and continuing education

Training and continuing education in Germany guarantee that the growing demand for ICT professionals in Germany can be covered by home-grown ICT professionals.

Thesis 24: Need for ICT professionals

The need for ICT professionals in Germany has doubled compared to 2009.

Thesis 25: Flexible workplace designs

Flexible, ICT-supported and mobile workplace designs have led to a substantial increase in the overall representation of women in the workforce in Germany compared to current statistics.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

The growing shortage of specialists is alarming for the economy and above all the industry

The shortage of specialized staff is one of the central problems in many leading industrial nations. However, the consequences are more serious for Germany than for the other countries owing to the large proportion GDP accounted for by industry and the country's high level of exports. Experts primarily consider the lack of specialists to be worrying because research work and innovation potential are especially important for tapping into new markets and business areas – and could help to overcome the crisis. However, there are presently grounds for fears that the shortfall in specialized staff could become structurally entrenched. A study by the Institute for Economic Research (IW) forecasts that, by 2014, there will be a shortfall of some 220,000 engineers, scientists and technicians. Due to the demographic change, this figure will swell in the future (see Handelsblatt 2009).

If the measures to counteract this shortfall are not effective, the study predicts a deficit of 425,000 STEM professionals (science, technology, engineering and mathematics) by 2020. BITKOM, the associations for engineers VDI and VDE, the Federation of German Industry (BDI), and the Federation of German Industries also warn that there are not enough qualified engineers, computer scientists or scientists today and, more particularly, nor will there be in the future. Noticeably, a severe shortfall is also making itself felt in the training professions, as required above all by Germany's small and medium-sized companies. Because the post-war baby boomers will be reaching retirement age in the next few years, IW forecasts that companies will need 37,000 engineers a year. From 2015, this will rise to 42,000 professionals a year. But these figures do not even allow for expansion or the establishment of new companies.

According to the German Philological Association there was also a shortfall of around 40,000 teaching staff across Germany in fall 2009 (60 percent more than in 2008) – there are especially too few teachers for mathematics, computer science, physics and chemistry (see DPhV 2009).

Another weakness is the much too low proportion of women teaching these subjects. If we cannot get more young women to be enthusiastic about science and technology, we will be missing out on the creative potential of half of the population. Other countries are much more successful in this regard.

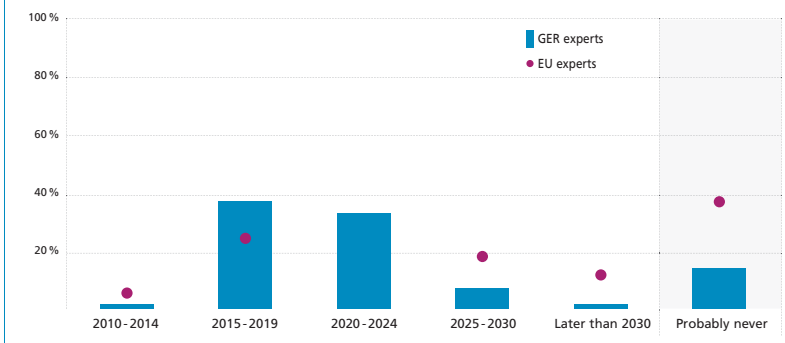
In competition for foreign specialists and top professionals, Germany has the advantages as a business location thanks to its infrastructure. However, its main competition is against the English-speaking world – at present, more German professionals go abroad than foreign professionals come to Germany.

Prospects for the next few decades: Demand will rise, shortfalls will grow

The expert survey in this Delphi Study emphatically supports these findings and underlines their huge significance for modern economies. Internationally, the situation varies greatly, as is reflected in the regional differences in the expert survey.

The experts predict that the demand side, i.e. the need for specialists, will grow substantially (see Fig. 1.39). 75 percent of the Germany experts estimate that this need will double compared to 2009 by 2024, 38 percent anticipate this doubling by as early as 2015 to 2019. Only 15 percent of the experts surveyed do not expect this need to increase in the long-term. The opinion of the Europe experts is split: 25 percent expect that the need will have doubled by 2015 to 2019, whereas 38 percent expect that this will never happen. This is possibly partly due to structural differences in several European countries.

Thesis 24: The need for ICT professionals in <country> has doubled compared to 2009.



Understandably, Germany's strong economic position as one of the world's leading industrial countries means it will have a greater need for specialized staff in these key technologies over the next few years, whereas the situation in the rest of Europe is accordingly not considered to be as critical.

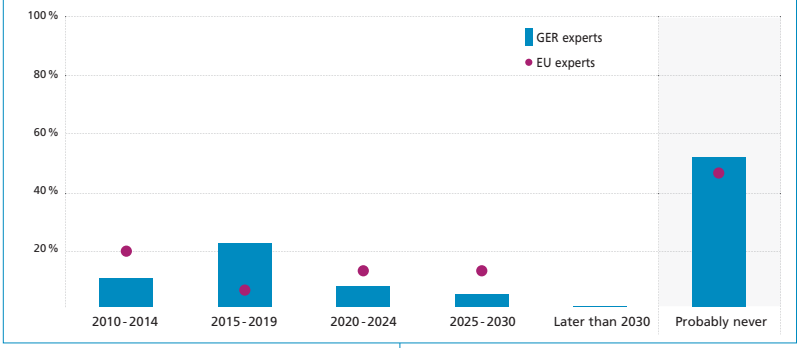
The problem is also intensified by the fact that, owing to the demographic change, it no longer seems possible to overcome the shortage of specialists in the ICT sector with junior employees from Germany itself (see Fig. 1.35): The majority of the experts agreed with this, with 61 percent of

the Germany experts forecasting this crisis to occur in the next ten years, i. e., by 2019. The U.S. experts are more optimistic: 40 percent believe that it is entirely possible to overcome the shortfall in the U.S. with junior employees from the U.S. itself. However, it is unclear whether the experts surveyed counted immigrant workers as already belonging to the country's own employees. In many cases, a considerable proportion of ICT professionals in the U.S. are not natives.

Remedial action will only have a limited effect

What remedial action seems promising to the experts, what doesn't? The study has shown very clearly that neither the Germany experts (52 percent) nor the Europe experts (47 percent) believe that training and continuing education in their own countries will be enough to overcome the shortfall of specialists (see Fig. I.38). The experts surveyed expect more potential from better use of the expertise of older employees (see Fig. I.37). 32 percent of the experts for Germany expect this resource will relieve the labor market by 2015 to 2019, another 23 percent expect this success to be felt five years later. However, another 30 percent do not believe that this measure will have a positive impact. The experts for European countries are particularly skeptical: 63 percent are of the opinion that such integration will not help to offset the shortfall. 43 percent of the DNAdigital group also tend to discount the possibility of a positive impact.

Thesis 23: Training and continuing education in <country> guarantee that the growing demand for ICT professionals in <country> can be covered by home-grown ICT professionals.



There is a glimmer of hope on the horizon with regard to "increasing the representation of women in the workforce through ICT," as shown by the highly uniform findings overall: 81 percent of the Germany experts expect that this high potential will be much better exploited by 2024 (see Fig. I.40). 17 percent of the experts for Germany expect successes already in the next five years, 35 percent in the five years after that, and 29 percent between 2020 and 2024. The Europe experts are even more optimistic as far as the next five years are concerned: 28 percent believe the representation of women will increase substantially in this period. This corresponds to the observation that the representation of women in the workforce is already much higher in many European countries outside of Germany than in Germany. A key reason for this is the better integration of children and family in the everyday lives of working women, e. g., through new childcare concepts.

An agreed bundle of measures to offset the shortage of specialists

There is a general consensus among the experts about the massive shortage of specialized staff. Opinions about the success of the measures to be implemented vary widely. As an industrial nation, Germany probably has to overcome the biggest problem. But there is certainly also optimism in the country that agreed measures in society, politics and the economy will make a difference for the better in the battle against the shortfall in specialized staff in the next few years.

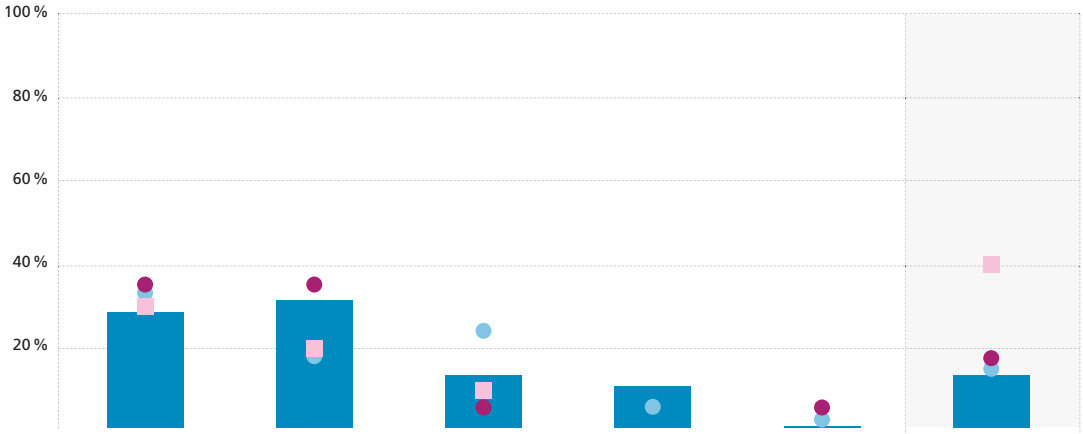
In view of the latent potential of female STEM professionals, additional offers for girls and young women in nurseries, schools and universities, and accordingly improved teaching concepts will be necessary to help to smash outdated gender stereotypes and credibly convey career prospects. Another measure for alleviating the skills shortage in the short and medium term is to recruit foreign specialists and top professionals. To this end, Germany's attractiveness as a working environment must be substantially improved. According to the German Philological Association, for instance, the use of appropriately trained Eastern European teachers in German schools is an entirely plausible option for alleviating the teacher shortage, especially since, according to the association's estimates, some 300,000 of the 770,000 teachers currently working in German schools will retire in the next ten years. In the field of education, it must be ensured as a priority that more young people in Germany gain an interest in scientific and technical professions.

The main starting point, however, is education. Offers relevant to STEM subjects must be substantially stepped up in nurseries, schools and universities, and teaching deficiencies dealt with quickly, especially in the key subject of mathematics. Action is required at universities in particular: The training of future school teachers should be significantly expanded and degree programs for specialized staff should be given a much more practical focus. It remains to be seen whether the new Bachelor/Master degree programs have a positive impact. The high university drop-out rate for STEM subjects is also a problem. Effective concepts, like improving universities' infrastructure and teaching staff, are also required to significantly improve the efficiency of teaching as well as to keep the students interested in the sciences for the longer term.

Theses on "Shortage of specialists and remediation" in detail

Fig. I.35: Thesis 21 Lack of junior employees

Due to the demographic change in <country>, it is no longer possible to overcome the shortfall of trained professionals in the ICT sector with junior employees from <country> itself.

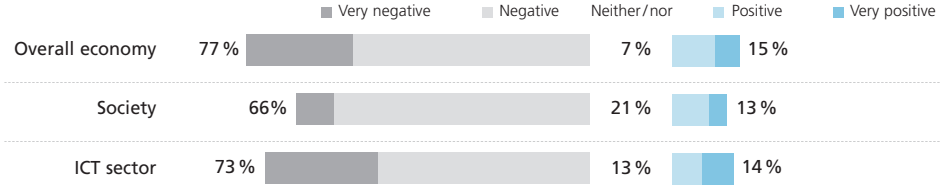


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 73)	29 %	32 %	14 %	11 %	1 %	14 %
EU experts (n = 17) [1]*	35 %	35 %	6 %	0 %	6 %	18 %
U.S. experts (n = 10)*	30 %	20 %	10 %	0 %	0 %	40 %
DNAdigital (n = 33)	33 %	18 %	24 %	6 %	3 %	15 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. I.36: Thesis 21 Lack of junior employees – relevance

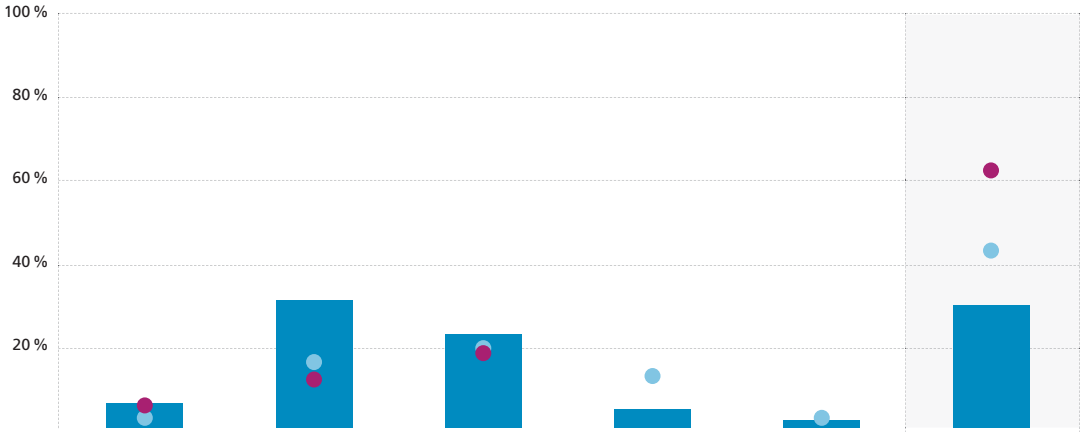
What impact will the validity of Thesis 21 above have on the areas listed below?



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, at least n = 71

Fig. I.37: Thesis 22 Integration of older employees

New approaches to human resources that have promoted the integration of older employees in the ICT sector have successfully offset the shortfall in trained professionals.

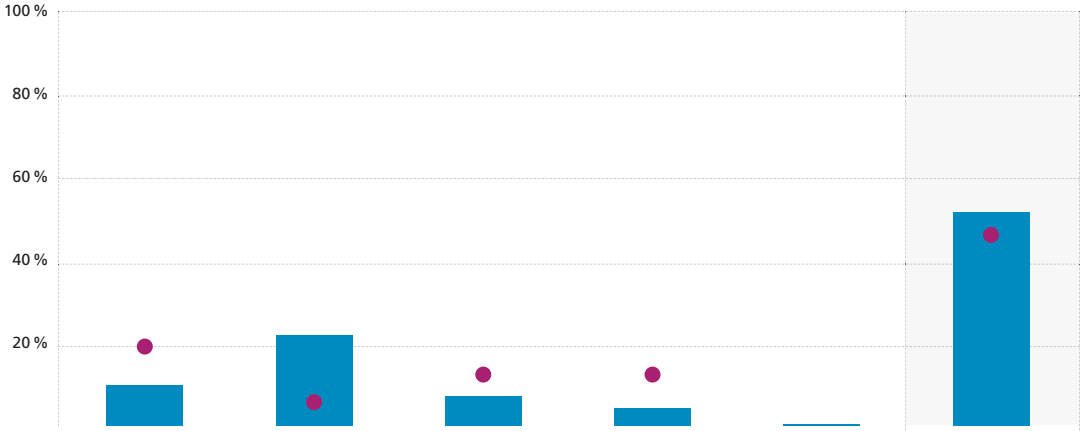


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 73)	7 %	32 %	23 %	5 %	3 %	30 %
EU experts (n = 16) [1*]	6 %	13 %	19 %	0 %	0 %	63 %
DNAdigital (n = 30)	3 %	17 %	20 %	13 %	3 %	43 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. I.38: Thesis 23 Training and continuing education

Training and continuing education in <country> guarantee that the growing demand for ICT professionals in <country> can be covered by home-grown ICT professionals.

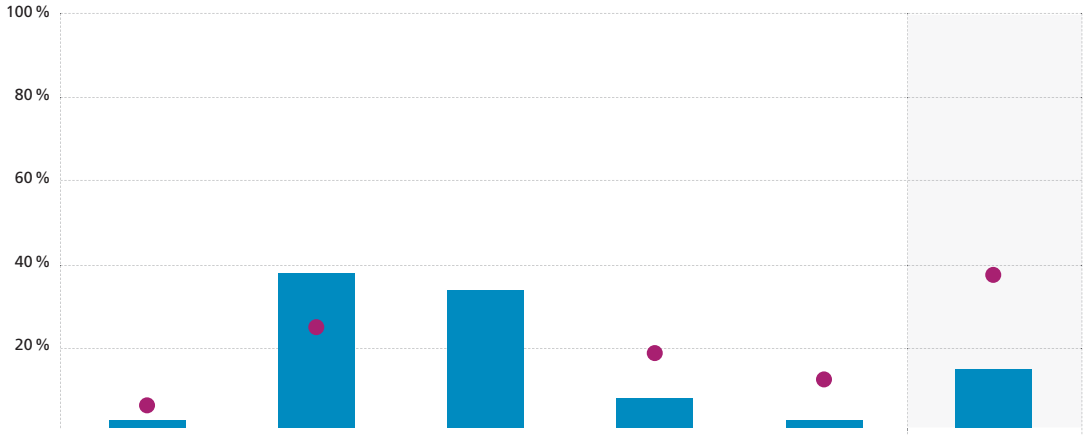


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 75)	11 %	23 %	8 %	5 %	1 %	52 %
EU experts (n = 15) [1*]	20 %	7 %	13 %	13 %	0 %	47 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. I.39: Thesis 24 Need for ICT professionals

The need for ICT professionals in <country> has doubled compared to 2009.

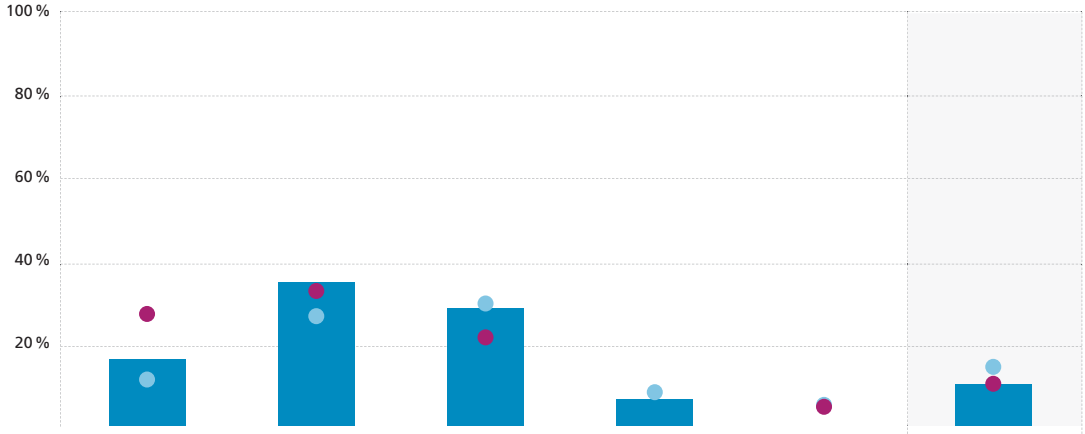


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 74)	3 %	38 %	34 %	8 %	3 %	15 %
EU experts (n = 16) [1]*	6 %	25 %	0 %	19 %	13 %	38 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. I.40: Thesis 25 Flexible workplace designs

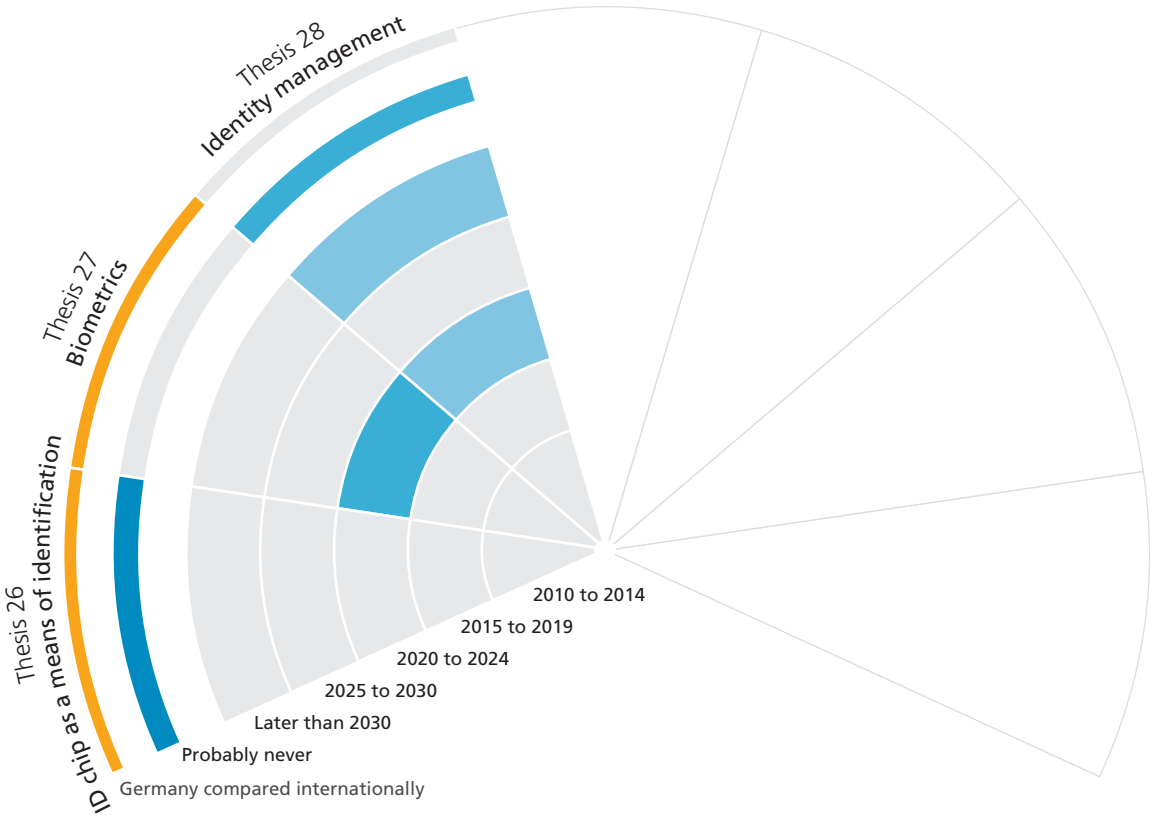
Flexible, ICT-supported and mobile workplace designs have led to a substantial increase in the overall representation of women in the workforce in <country> compared to current statistics.



	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 82)	17 %	35 %	29 %	7 %	0 %	11 %
EU experts (n = 18) [1]*	28 %	33 %	22 %	0 %	6 %	11 %
DNAdigital (n = 33)	12 %	27 %	30 %	9 %	6 %	15 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

I.3.1 Digital identity
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 26: ID chip as a means of identification

An ID chip implanted into the human body has established itself in Germany as a means of identification.

Thesis 27: Biometrics

Biometric techniques (e. g., iris and finger print scanners, etc.) have replaced previous means of identification (e. g., ID cards) and are in use nationwide in Germany.

Thesis 28: Identity management

A single global solution has been introduced for identity management (authentication and integrity) between all elements of communication.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

Digital identity – or "Are you who you say you are?"

Knowing whether the person or virtual person you are communicating with is the real person, that is to say, are who they say they are, is crucial to a trust-based interaction, both in the everyday world and on the Internet. Secure digital identities are therefore a key issue of IT security and are one of the fastest growing areas of ICT (see section I.3.4). They play an increasingly important role in communication between individual people and in communication between machines.

Identity management is the storing of digital identification information (digital identities) in directories on the network or on smart cards, managing and using this information for authentication and authorization, and finally managing digital identities in automated processes.

Digital identities can be used to identify and authenticate communication partners. They are particularly relevant for users in relation to issues such as digital signatures and encryption. Another issue is safeguarding privacy, which counteracts the danger of social habits being tracked.

In the digital world of the Internet and electronic communication, individuals play a number of different roles: private person, citizen, consumer and business partner. These roles each entail specific requirements for digital identities that may not necessarily be the same or have to be unified. Users can, for instance, repeatedly redefine and virtually extend their digital identity in communities, blogs and forums. However, when dealing with public authorities and institutions under the banner of e-government, it is crucial that digital identities are authentic and unique and that the actions carried out under them are confidential (e. g., voting decisions).

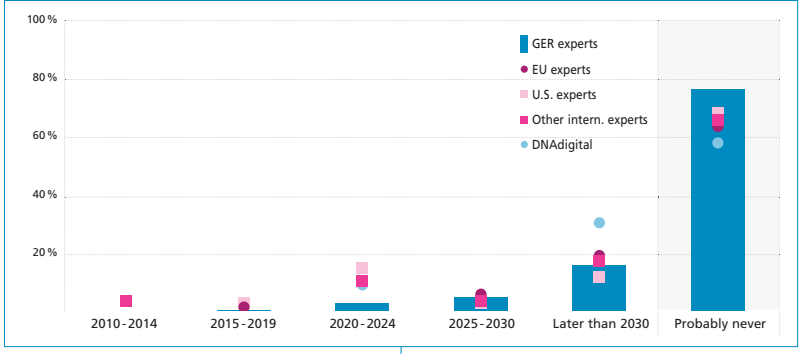
In machine-to-machine communication – a cornerstone of the "Internet of Things" – the need for secure digital identities is also rapidly increasing. There are already more than 50 billion intelligent machine parts that communicate with each other – compared with "just" six billion people. In automation technology, for example, the authentication and authorization of machine parts that communicate with each other is indispensable for reliable interaction between the different components and for safe and secure automation processes. In this context, problems of counterfeiting are also resolved, since authentication ensures that original parts are used.

Digital identities are also used more and more in business processes. They help to meet compliance requirements, play a major role in digital rights management (DRM) and in automated business processes they facilitate cooperation beyond company boundaries.

Electronic identities yes, but no futuristic scenarios

When asked about the implanting of an ID chip into the human body as a means of identification, the overwhelming majority of the Delphi experts surveyed (76 percent of the experts for Germany) agreed that there will probably never be security and identity management mechanisms that interfere with the physical integrity of a person, such as implanted ID chips (see Fig. I.41). Very few of the Germany experts deem this scenario to be probable by 2030 (nine percent). In terms of technology, the reason for skepticism with regard to this scenario is that the digital identity is carried by a chip card or other device assigned to a specific person. However, all current methods (password, PIN, in some cases already biometrics) for linking this device permanently and securely to a person are problematic both in theory and in practice, and even implanted identification is open to all kinds of manipulation and is therefore inadequate for secure authentication.

Thesis 26: An ID chip implanted into the human body has established itself in <country> as a means of identification.



Scenarios that are already technically and socially feasible and, in some cases, already in place, paint a completely different picture: more than half of the experts for Germany (56 percent) expect biometrics such as iris and fingerprint scanners to come within reach of replacing personal ID cards as proof of identification within the next 15 years. The experts for other European and international countries make very similar forecasts for this trend (see Fig. I.42).

Only at first glance is it surprising that a large proportion (38 percent) of the DNAdigital group deems this scenario to be improbable. This view could be explained by the problem known to security specialists that biometrics are

still subject to high and context-dependent "false rates" that are difficult to forecast and are intolerable for many processes. Furthermore, technologies that require physical contact face great opposition from the population, not just in Asia (e. g., huge aversion to fingerprint scanners on ATMs). However, the experts take a considerably more skeptical view of a single global solution for identity management – i. e., a unified global process for authenticating people and their proof of integrity. 55 percent of the Germany experts and 41 percent of the experts for European countries expect this scenario to take shape after 2030, or not at all (see Fig. I.43).

Information security and data privacy – a dichotomy

The experts for Germany and Europe see the growing demand for information security as one of the main drivers of the management of digital identities. 38 percent of the experts also believe that technical advances make solutions feasible and 36 percent think that corresponding demand on the market will prompt a single global solution to identity management (see Fig. I.44). In a huge counter movement to the need for information security from and for the general public, 64 percent of the experts deem the anticipated data privacy problems to be the greatest barriers (loss of confidentiality, possibilities for fraud or counterfeiting).

It is notable that the experts do not deem political resolve to be a driver. This appears to be linked with the barrier of a lack of social acceptance. As the example of the health card shows, it is by no means enough for a concept to be technologically practicable.

Standardization is also important, according to the Germany experts. 42 percent consider this factor to be the main driver, and 40 percent bemoan the (current) lack of standards. In the experts' view, the regulatory framework has no significant role to play in the implementation of identity management. Just like state and private investment, it is significant neither as driver nor as barrier. The experts also deem costs to play a minor role in implementation.

Acceptance by society is the key to market success for digital identity

Secure digital identities and reliable, easy-to-use identity management for individuals across institutional and organizational boundaries serve both the individual (as a private person, citizen and consumer) and society as a whole (public administration and government), as well as the economy. They are a basic requirement for secure, reliable digital communication between people as well as increasingly between machines – and this worldwide. They facilitate private, social and economic processes and offer protection from attacks on identity or Internet fraud and prevent product piracy.

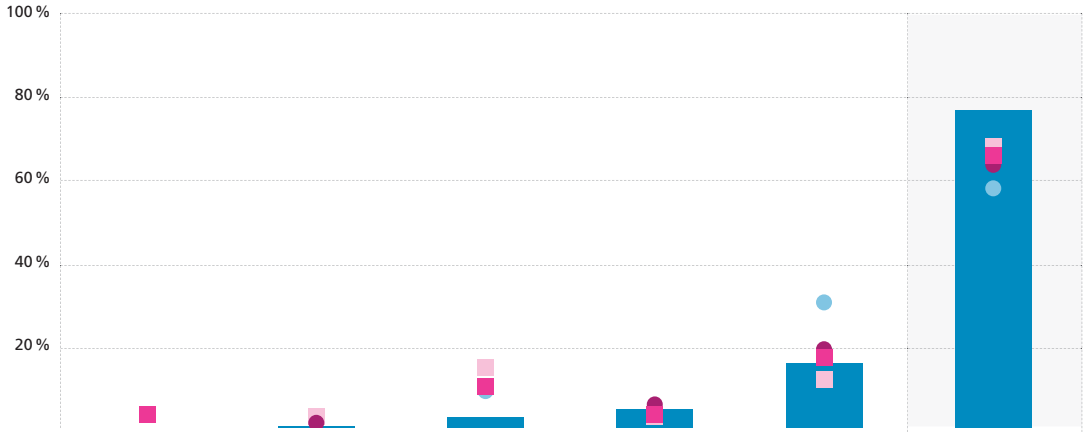
The technological basis for digital identities and identity management is in place in Germany. In terms of the biggest barriers, actual privacy issues should be resolved in the short to medium term and user-friendly identity management solutions should be provided, adapted for particular applications.

The specific benefits for individuals (as citizens, but above all as private persons and consumers), society and the economy should be communicated in an image campaign. This would substantially increase social acceptance. Furthermore, this would create key security requirements for the currently arising market for the Internet of Things and the Internet of Services, which are expanding very rapidly in Germany at present.

Theses on "Digital identity" in detail

Fig. I.41: Thesis 26 ID chip as a means of identification

An ID chip implanted into the human body has established itself in <country> as a means of identification.

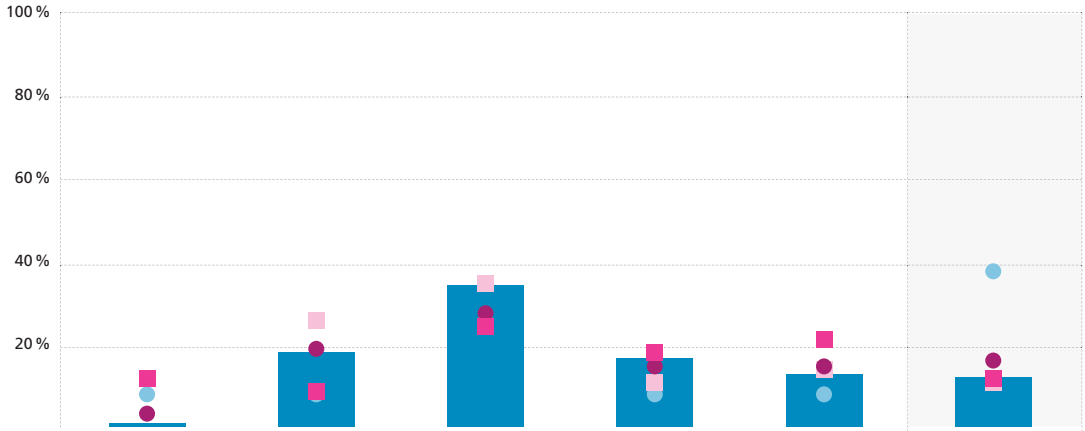


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 356)	0 %	1 %	3 %	5 %	16 %	76 %
EU experts (n = 68) [1]	0 %	1 %	10 %	6 %	19 %	63 %
U.S. experts (n = 34)	0 %	3 %	15 %	3 %	12 %	68 %
Other intern. experts (n = 29) [2]	3 %	0 %	10 %	3 %	17 %	66 %
DNAdigital (n = 33)	0 %	0 %	9 %	3 %	30 %	58 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. I.42: Thesis 27 Biometrics

Biometric techniques (e. g., iris and finger print scanners, etc.) have replaced previous means of identification (e. g., ID cards) and are in use nationwide in <country>.

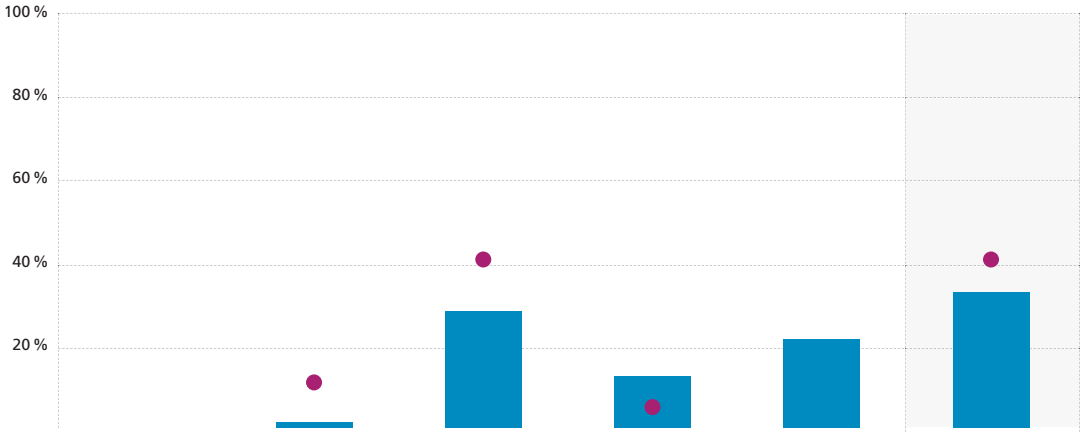


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 354)	2 %	19 %	35 %	18 %	14 %	13 %
EU experts (n = 71) [1]	4 %	20 %	28 %	15 %	15 %	17 %
U.S. experts (n = 34)	0 %	26 %	35 %	12 %	15 %	12 %
Other intern. experts (n = 32) [2]	13 %	9 %	25 %	19 %	22 %	13 %
DNAdigital (n = 34)	9 %	9 %	26 %	9 %	9 %	38 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. I.43: Thesis 28 Identity management

A single global solution has been introduced for identity management (authentication and integrity) between all elements of communication.

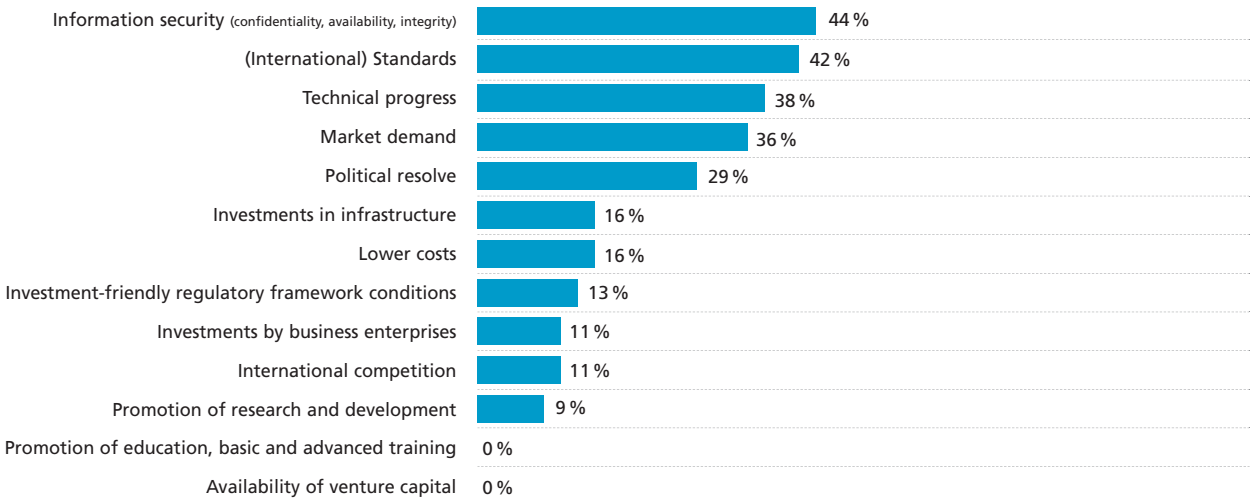


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 45)	0 %	2 %	29 %	13 %	22 %	33 %
EU experts (n = 17) [1]*	0 %	12 %	41 %	6 %	0 %	41 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. I.44: Thesis 28 Identity management – drivers

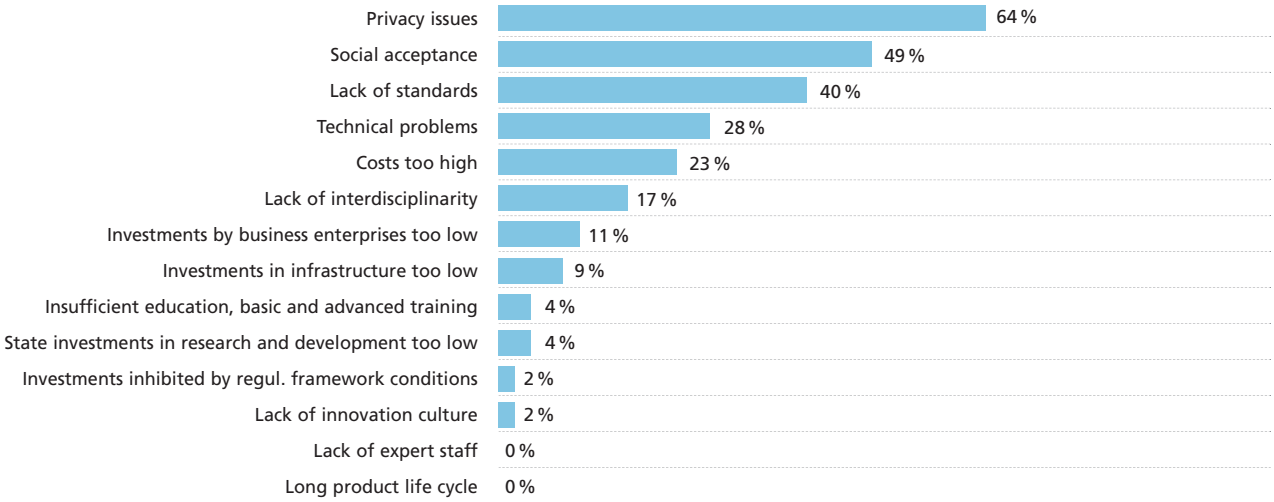
Select up to three drivers from the following list that you consider to be most important for realization of Thesis 28 above.



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n = 45

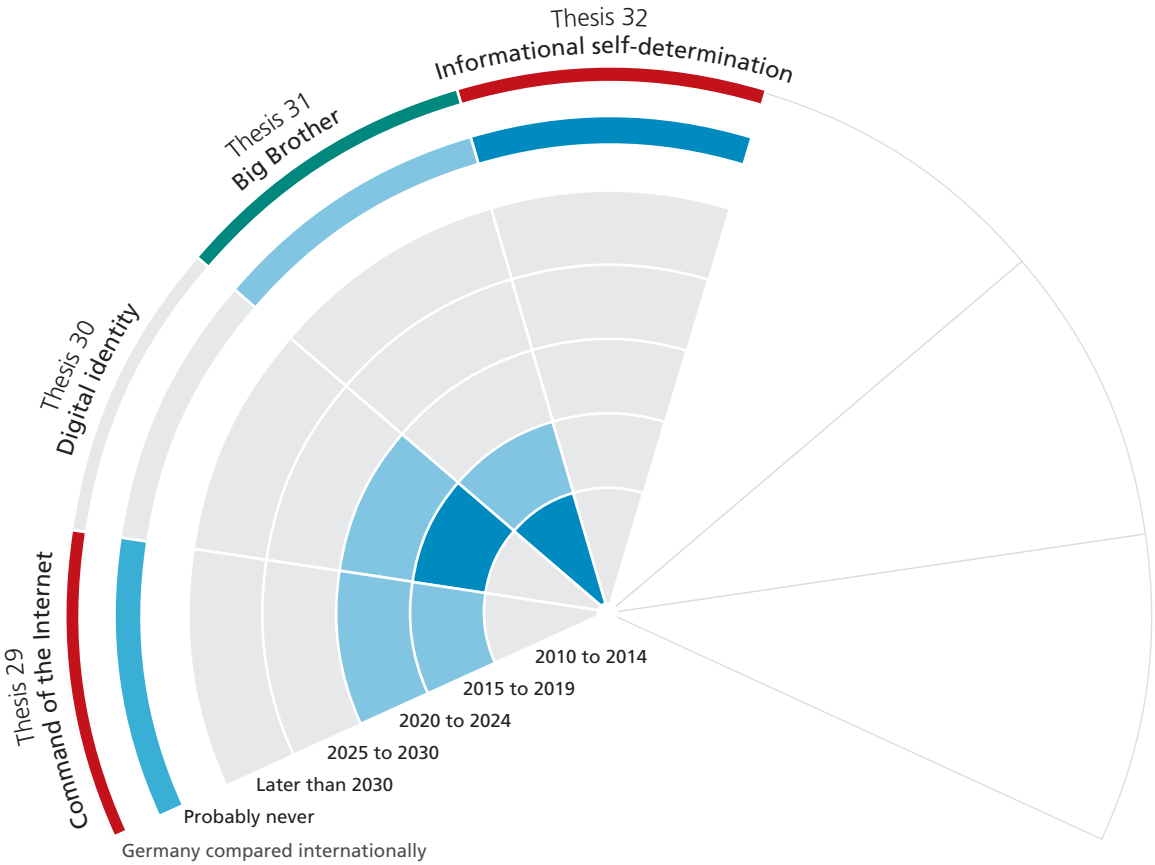
Fig. I.45: Thesis 28 Identity management – barriers

Select up to three barriers from the following list that you consider to be most important for realization of Thesis 28 above.



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n = 47

I.3.2 Personal data in the digital world
Future radar*: Forecast occurrences



Sub-group of GER experts: ■ ≥ 40 % of experts ■ 30 % – 39 % of experts ■ 20 % – 29 % of experts ■ < 20 % of experts
Germany in comparison: ■ pioneering role ■ on a par with global developments ■ lagging behind ■ not possible to say

Thesis 29: Command of the Internet

In Germany, 75 percent of the population is well-versed and competent in dealing with personal data on the Internet.

Thesis 30: Digital identity

Tools for administering one's own identity (or identities) on the Internet are widely disseminated.

Thesis 31: Big Brother

There is serious resistance among the population in Germany to the omnipresent recording of personal data in public spaces by ICT (such as surveillance cameras).

Thesis 32: Informational self-determination

An individual's control over the use of his / her personal data on the Internet is protected by law in Germany (principle of informational self-determination).

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

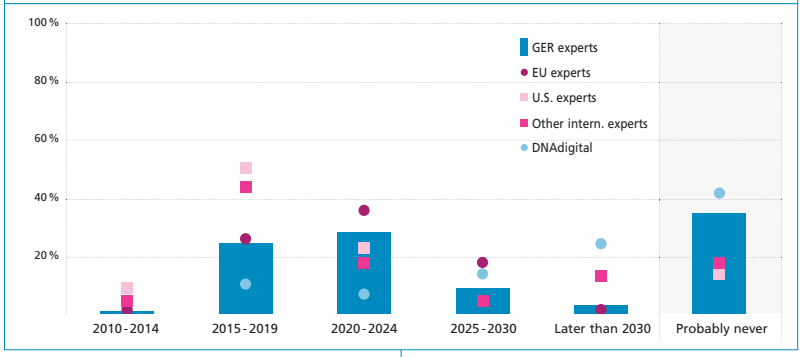
The Internet never forgets – personal data on the Internet

In some ways, headlines about the unlimited storage of Internet users' personal data, as Web 2.0 provider Facebook just recently announced before very quickly taking it back, are unsettling. But surveys repeatedly show that many Internet users are decidedly blithe about disclosing personal information on the Internet and will unreservedly post personal data online, often without considering the potential consequences. Once traces are left on the Internet, they remain permanently visible. This unreservedness is also increasingly exploited by companies which, when recruiting staff, systematically search online for personal data about their applicants, according to a survey by dimap on behalf of the German federal government (see BMELV2009).

The development of Internet users' competence and skill in the digital world will become more and more important.

Consequently, the underlying survey asked the experts for their view on by when 75 percent of the population in the countries they are assessing will be well-versed and competent in dealing with personal data on the Internet. 53 percent of the Germany experts assume that three quarters of the population will have the necessary skills by 2024 at the latest (see Fig. I.46). By contrast, more than one third of the experts for Germany believe that the majority of the German population will never possess the skills and competence to deal with personal data on the Internet. The experts for the rest of Europe expressed similar views in this regard: 63 percent expect this thesis to occur by 2024 at the latest. At 18 percent, the number of skeptics is much lower in this group of experts.

Thesis 29: In <country>, 75 percent of the population is well-versed and competent in dealing with personal data on the Internet.



The U.S. experts are more optimistic on this issue: 59 percent of them believe that 75 percent of the U.S. population will be able to use the Internet securely with regard to their personal data by the end of 2019.

The DNAdigital group's views on this subject are very interesting: 41 percent of them believe that the population will never possess these skills, making them the least confident group by far. Nevertheless, around a quarter of them still believe that the population will achieve the necessary competence after 2030.

In conjunction with this competence, tools for managing digital identities will be widely disseminated: according to 43 percent of the experts for Germany, this scenario will become a reality in six to ten years. This is also a necessity to the extent that a survey by TNS Infratest found that some 80 percent of all Internet users over the age of 14 have already been affected by misuse of personal data on the Internet (see (N)OA 2008). The experts for Europe also take a similar view: 58 percent believe that tools for managing digital identities will be widely disseminated in about six to ten years. Compared with five percent of Germany experts, who expect that these tools will never be widely disseminated, all the experts for Europe believe they will be widely used.

Informational self-determination in the digital world

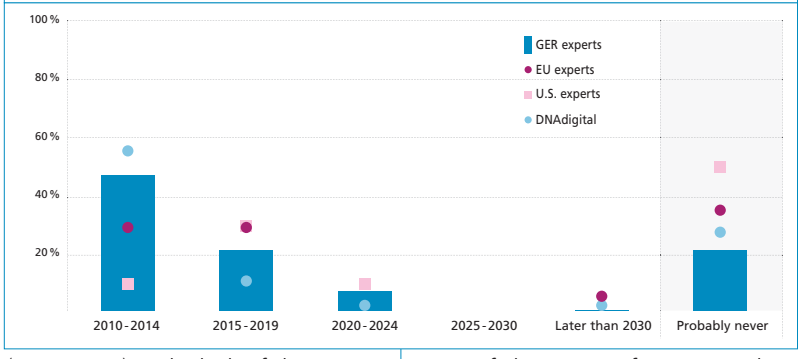
Under German legislation, the right to informational self-determination refers to the right of the individual to determine how their own personal data are divulged and used. However, experts agree that free self-determination in people's personal development is under threat due to modern data processing.

The extent to which it will be possible in the future to guarantee individuals control over use of their own personal data was also addressed in the Delphi Study and the findings revealed very heterogeneous opinions in the different regions (see Fig. I.49).

The experts for Germany are especially skeptical in this regard. More than half of them (54 percent) expect that the control needed for informational self-determination on the Internet will never be possible in Germany. Members of the DNAdigital group delivered a similarly "bleak" forecast: 64 percent, thus around two thirds of them believe that informational self-determination can never be guaranteed. The experts for other countries paint an entirely different picture. 72 percent of the U.S. experts,

54 percent of the experts for Europe, and 55 percent of the experts for other countries believe that informational self-determination will be in place in just the next ten years. If, contrary to the negative forecasts, informational self-determination were to occur, 65 percent of the experts for Germany believe that this will impact positively in particular on society (see Fig. I.50). According to 71 percent of the experts, the validity of this thesis crucially depends above all on the possibility of ensuring information security, but the dissemination of the relevant knowledge is also deemed important (38 percent). Moreover, half of the experts surveyed believe the necessary political resolve to be conducive (see Fig. 1.51). As specific barriers that could block the guarantee of informational self-determination, the experts mainly cited privacy issues (66 percent), insufficient education (45 percent) and a lack of the necessary standards (39 percent; see Fig. I.52).

Thesis 31: There is serious resistance among the population in <country> to the omnipresent recording of personal data in public spaces by ICT (such as surveillance cameras).



Resistance to constant surveillance

In the UK, constant surveillance of public spaces is already widespread.

There are also regular reports in the media about the successes of video surveillance exercises. Nevertheless, this issue has been hotly debated for years. In Germany in particular, there is frequent resistance to public surveillance. This could be due to the fact that the German population has a particularly strong aversion to anything that conjures up associations with a "police state" or "Big Brother state."

Consequently, 47 percent of the experts expect serious resistance to the omnipresent recording of personal data to arise within the next five years (see Fig. I.48). Around a fifth of the Germany experts surveyed take a completely different view, assuming instead that such resistance will never arise in Germany. The DNAdigital experts surveyed were more pessimistic: more than half of them (56 percent) anticipate serious resistance among the population by 2014. The experts for Europe and the U.S. see things very differently. A large part of the U.S. experts (50 percent) and 35 percent of the experts for Europe do not expect any kind of public resistance to the recording of personal data.

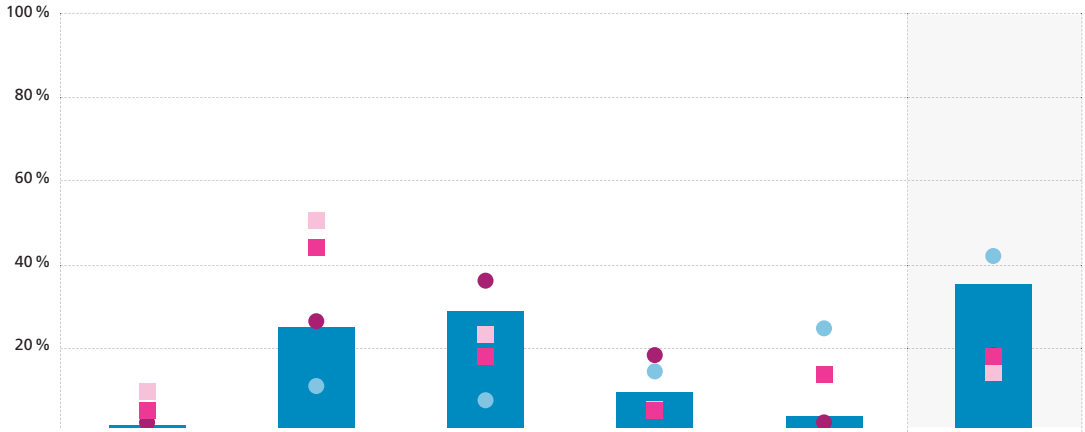
Summary

For the majority of the population, it is impossible to conceive a world without the Internet. But many users still need to learn how to competently deal with their personal data in the digital world. It is therefore crucial to open their eyes to the dangers of careless disclosure of personal information and to provide them with the means to also protect their privacy on the Internet. Because the Internet never forgets!

Theses on "Personal data in the digital world" in detail

Fig. I.46: Thesis 29 Command of the Internet

In <country>, 75 percent of the population is well-versed and competent in dealing with personal data on the Internet.

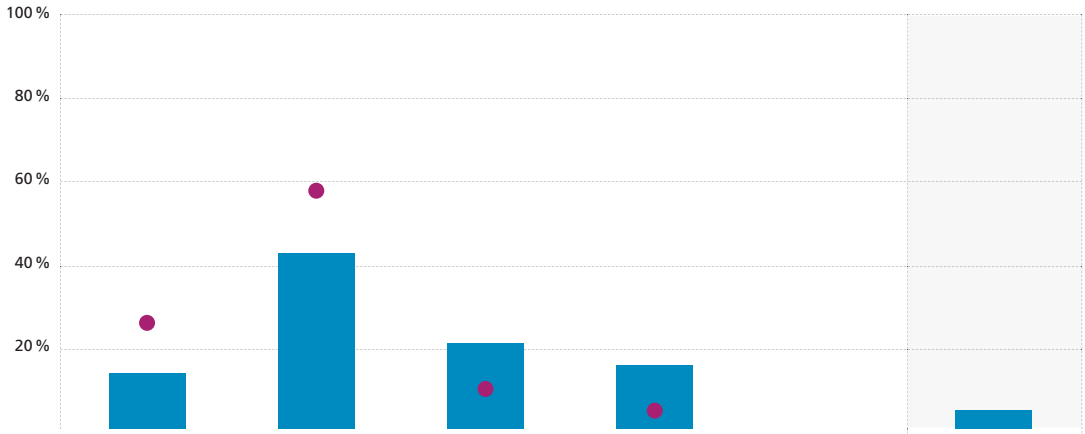


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 295)	1 %	24 %	28 %	9 %	3 %	35 %
EU experts (n = 62) [1]	2 %	26 %	35 %	18 %	2 %	18 %
U.S. experts (n = 22)	9 %	50 %	23 %	5 %	0 %	14 %
Other intern. experts (n = 23) [2]	4 %	43 %	17 %	4 %	13 %	17 %
DNAdigital (n = 29)	3 %	10 %	7 %	14 %	24 %	41 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. I.47: Thesis 30 Digital identity

Tools for administering one's own identity (or identities) on the Internet are widely disseminated.

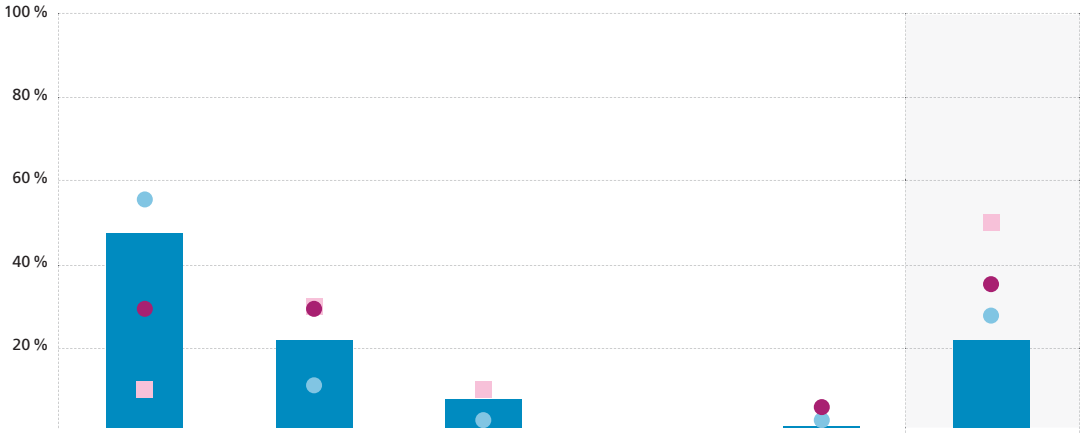


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 56)	14 %	43 %	21 %	16 %	0 %	5 %
EU experts (n = 19) [1*]	26 %	58 %	11 %	5 %	0 %	0 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. I.48: Thesis 31 Big Brother

There is serious resistance among the population in <country> to the omnipresent recording of personal data in public spaces by ICT (such as surveillance cameras).

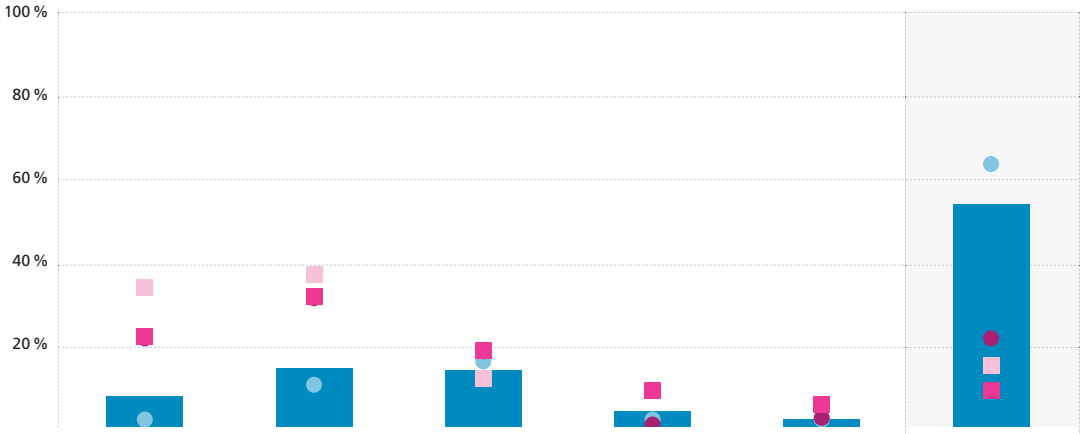


	2010-2014	2015-2019	2020-2024	2025-2030	Later than 2030	Probably never
GER experts (n=78)	47 %	22 %	8 %	0 %	1 %	22 %
EU experts (n=17) [1]*	29 %	29 %	0 %	0 %	6 %	35 %
U.S. experts (n=10) *	10 %	30 %	10 %	0 %	0 %	50 %
DNAdigital (n=36)	56 %	11 %	3 %	0 %	3 %	28 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. I.49: Thesis 32 Informational self-determination

An individual's control over the use of his/her personal data on the Internet is protected by law in <country> (principle of informational self-determination).

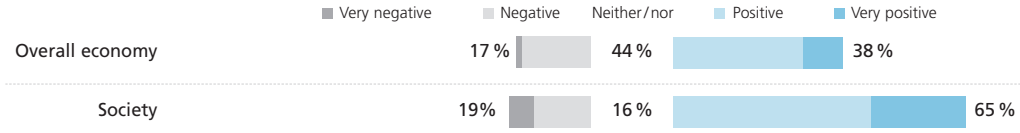


	2010-2014	2015-2019	2020-2024	2025-2030	Later than 2030	Probably never
GER experts (n=357)	8 %	15 %	15 %	5 %	3 %	54 %
EU experts (n=63) [1]	22 %	32 %	19 %	2 %	3 %	22 %
U.S. experts (n=32)	34 %	38 %	13 %	0 %	0 %	16 %
Other intern. experts (n=31) [2]	23 %	32 %	19 %	10 %	6 %	10 %
DNAdigital (n=36)	3 %	11 %	17 %	3 %	3 %	64 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. I.50: Thesis 32 Informational self-determination – relevance

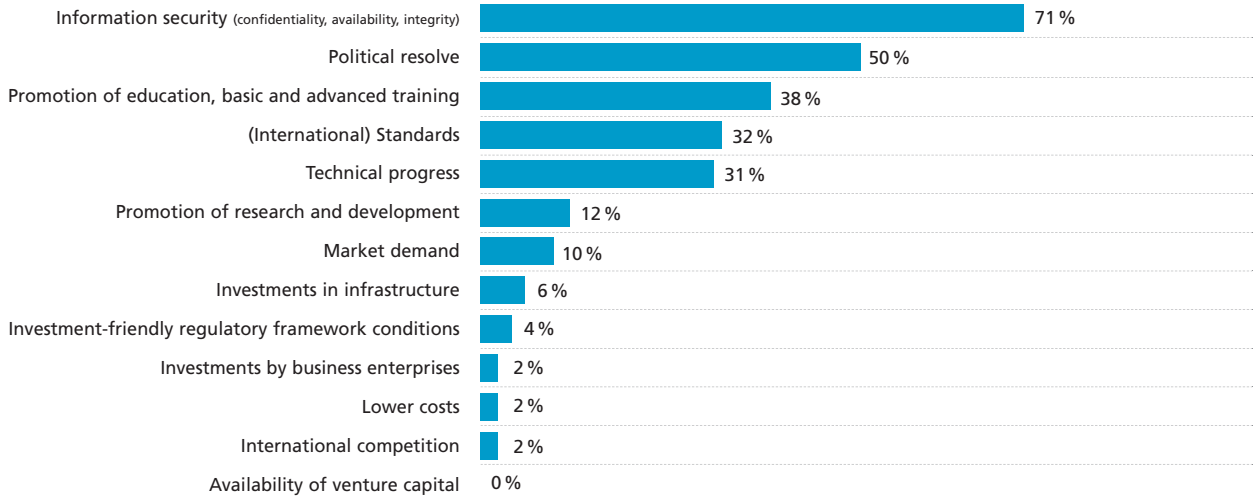
What impact will the validity of Thesis 32 above have on the areas listed below?



Basis: All people surveyed; Sub-group: GER experts, at least n = 326

Fig. I.51: Thesis 32 Informational self-determination – drivers

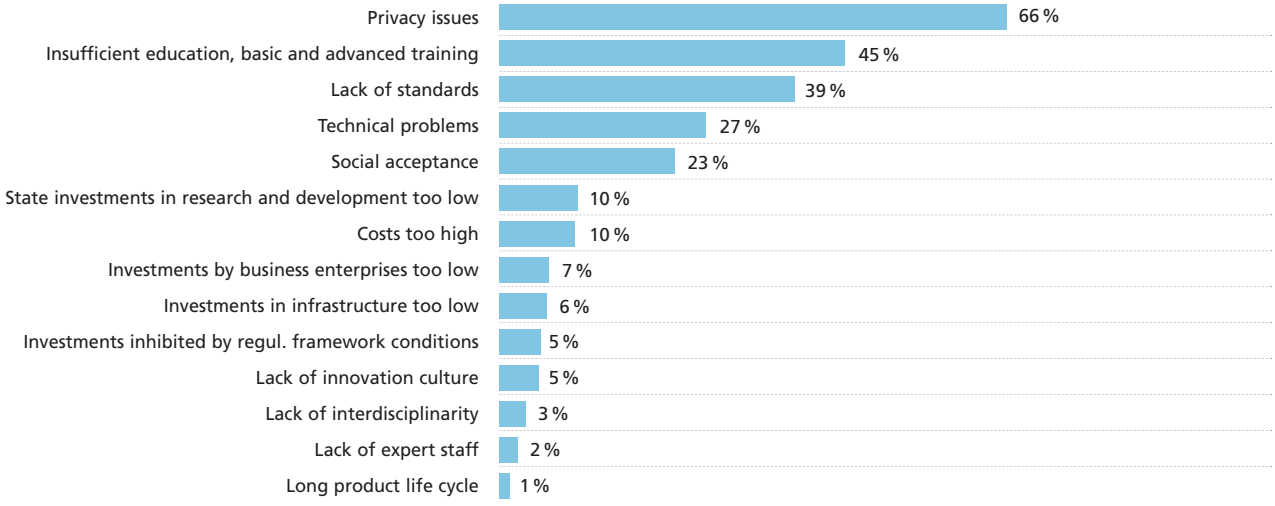
Select up to three drivers from the following list that you consider to be most important for realization of Thesis 32 above.



Basis: All people surveyed; Sub-group: GER experts, n = 286

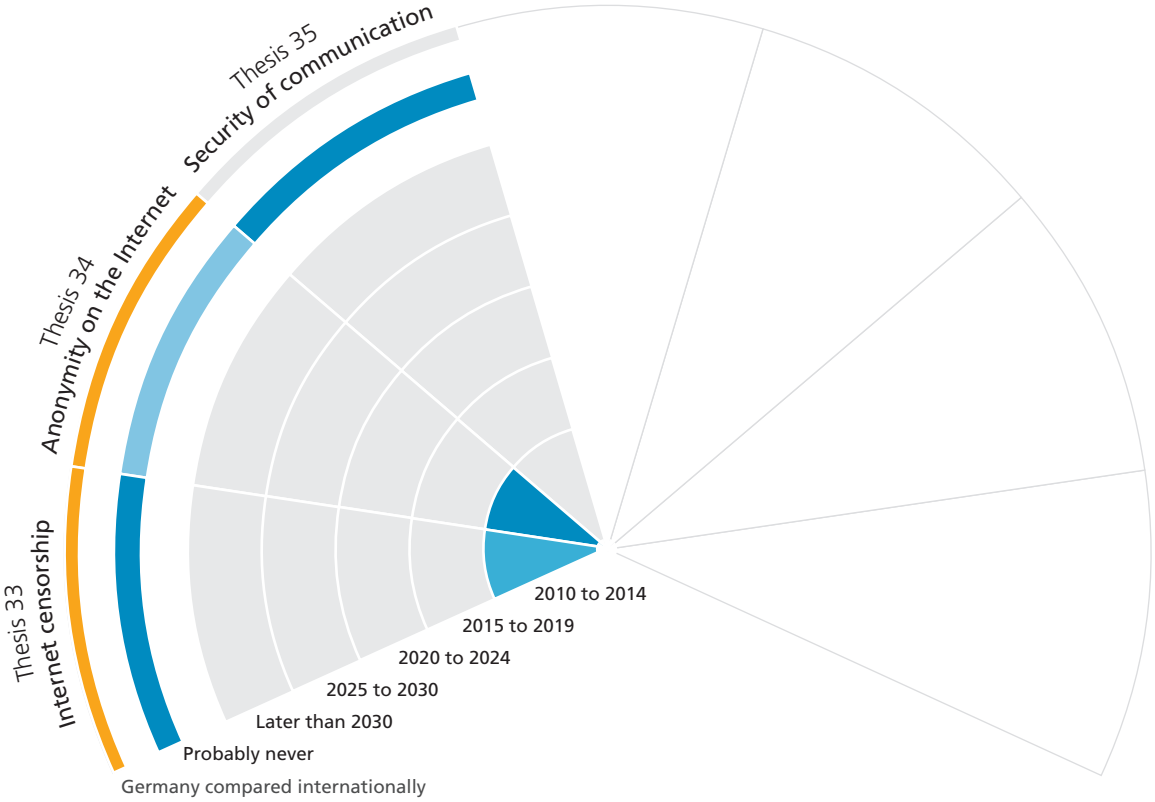
Fig. I.52: Thesis 32 Informational self-determination – barriers

Select up to three barriers from the following list that you consider to be most important for realization of Thesis 32 above.



Basis: All people surveyed; Sub-group: GER experts, n = 292

I.3.3 Access to the Internet of the future – access to information
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 33: Internet censorship

Access to Internet content in Germany is censored by the state (limitations on freedom of opinion by exercise of state influence).

Thesis 34: Anonymity on the Internet

Anonymous use of the Internet is no longer guaranteed in Germany.

Thesis 35: Security of communication

Security problems on the Internet have intensified so greatly that private and business communication via the Internet have been severely impaired worldwide.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

These days, information technology is everywhere and, thanks to the Internet, it gets easier and easier to access information and knowledge. On the one hand, the Internet facilitates free speech and open, unfettered communication across geographical, political and economic borders. On the other hand, states, as well as other non-governmental groups, feel threatened by some publications on the Internet. They try to monitor, prevent or, in some cases, use for their own purposes the publication of certain content, such as political, religious or pornographic material; in short, they try to censor the Internet.

The movement of information on the Internet across national borders gives rise to questions and tasks that are difficult to resolve, since content that is banned by law in one country may be freely available in another and thus procured from there. In Germany, for example, sites that glorify national socialist war crimes or deny the Holocaust are blocked, but they are freely accessible in the U.S.

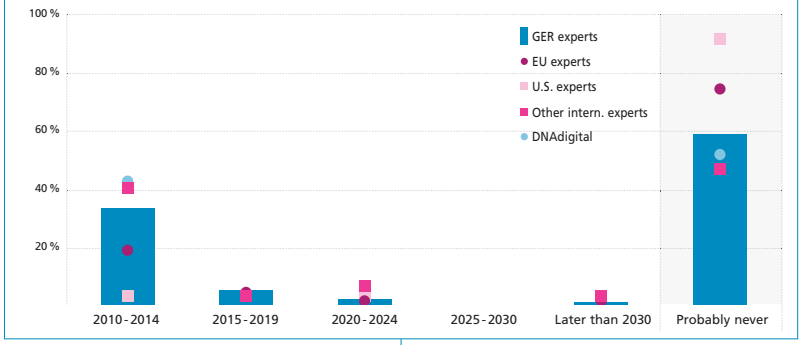
There is no worldwide authority that ensures freedom of opinion globally and at the same time blocks criminal content. Nor is it possible to unify the legal systems of the countries of the world. In addition, an important discussion is currently underway between Internet users and network and service providers within the context of future access to the Internet (download, upload, use of services), on the issue of "net neutrality," which refers to the equal, unbiased carrying of all kinds of data and information on the Internet without interference from access providers or network operators. This relates not to censorship of content, but rather to protection of economic interests: network operators argue that they provide the new infrastructure and that they should be adequately compensated for this. They should therefore also have a say in the rules for use, so that they can, for example, differentiate their treatment of data streams depending on the type and quality of service. In addition to enabling differentiation of quality, technical prioritization may also be necessary for ensuring urgent connections (in extreme cases also emergency calls) on the network and immediate delivery of the relevant data packets even at peak times.

Service providers, however, advocate net neutrality. They argue for networks in which all users and applications are treated equally and point out that innovations, which mostly take place at service level, depend on this kind of open, free and equal network access because otherwise the experimentation and discovery function of competition does not have sufficient scope to unfold.

The tortoise and the hare: censorship and how to get round it

In this Delphi Study, the experts were asked to estimate whether and when anonymous use of the Internet will cease to be guaranteed in individual countries and regions (see Fig. 1.54). Attempts to censor the Internet resemble the hare's situation in its race against the tortoise. On the one hand, the volume of information and the number of websites are multiplying at great speed. On the other hand, the cost of identifying and effectively blocking undesirable sites is immense and great technical creativity is invested in finding ways to avoid censorship. For states, it can be very time-consuming and costly to close the loopholes. It is presumably for this reason that state Internet censorship is only expected to be relevant for the next few years. 33 percent of the experts for Germany and 19 percent of the experts for Europe suppose, for example, that access to Internet content will be censored by the state by 2010 to 2014. A clear majority of the experts do not expect any limitations on freedom of opinion through state censorship, either now or in the future. This applies for the U.S. and Europe experts to an even greater extent than for the Germany experts (see Fig. I.53). However, a surprisingly large proportion of the DNAdigital group (42 percent) expects state censorship of the Internet in the next five years. Presumably the members of this group are particularly intensively involved in the censorship debate.

Thesis 33: Access to Internet content in <country> is censored by the state (limitations on freedom of opinion by exercise of state influence).



With regard to the anonymous use of the Internet, the experts for Germany and Europe expect the timing to be as follows: 59 percent of the Germany experts and 47 percent of the Europe experts expect anonymous use of the Internet to be compromised in the next five years. But 22

percent of the Germany experts and 27 percent of the Europe experts believe that there will never be limitations on anonymous use of the Internet (see Fig. I.54). Regarding security on the Internet, the vast majority of the experts are in agreement: well over half of them believe that security problems do not currently and will not in the future severely impair private and business communication via the Internet (see Fig. I.55).

Views on Internet censorship differ considerably in the U.S. and Europe

The threat to freedom of opinion from censorship is assessed very differently in the U.S. and Europe (see Fig. I.53). 47 percent of the international experts expect their freedom of opinion will "probably never" be censored by the state, compared with a staggering 91 percent of the U.S. experts. This presumably reflects the American self-image and the correspondingly liberal legislation concerning freedom of opinion.

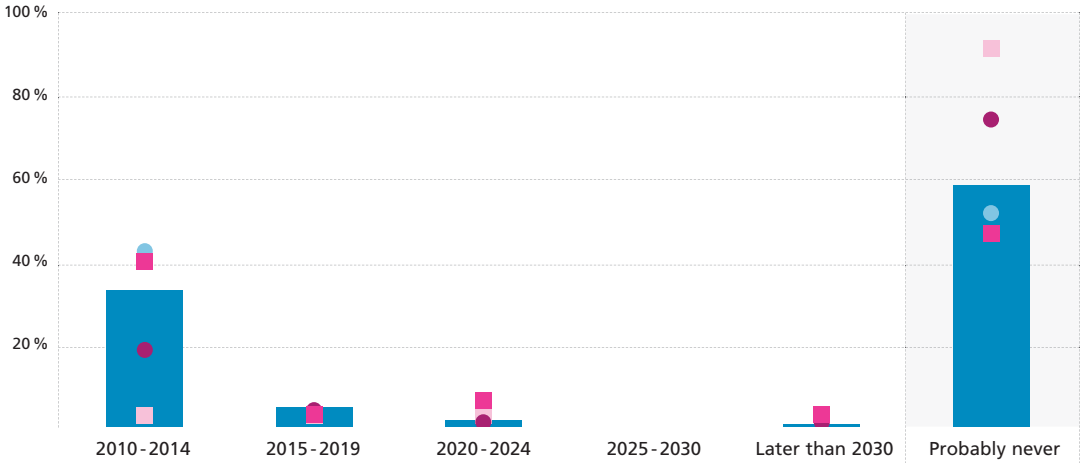
Summary

In terms of technology, it is possible to censor private and business communication on the Internet. The experts' opinions on this issue and experience from politically "unsuspicious" countries like Sweden or Finland suggest, however, that attempting to censor the Internet is the wrong path to take. The required basis is a general public and political culture that permanently defends freedom of opinion and diversity. Because secure private and business communication via the Internet still struggles with considerable problems of acceptance, we need information campaigns and security technologies that are reliable, cost-effective and easy to use – effectively plug-and-play security for the Internet. In terms of net neutrality, political decisions are needed from Brussels that take a balanced account of the interests of all sides of the debate. But at the same time, customers are also invited to select access and network providers who offer the "right" policy for them in terms of net neutrality and service quality.

Theses on "Access to the Internet of the future – access to information" in detail

Fig. I.53: Thesis 33 Internet censorship

Access to Internet content in <country> is censored by the state (limitations on freedom of opinion by exercise of state influence).

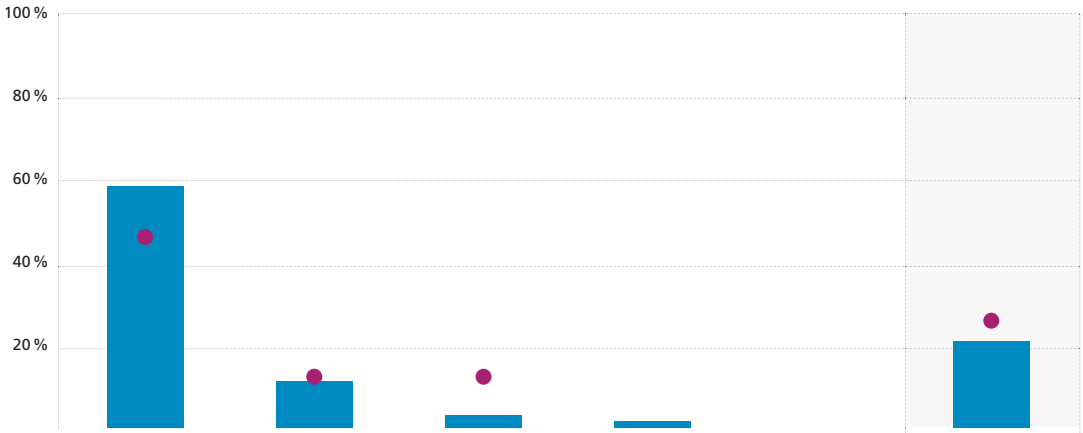


	2010-2014	2015-2019	2020-2024	2025-2030	Later than 2030	Probably never
GER experts (n=350)	33 %	5 %	2 %	0 %	1 %	58 %
EU experts (n=69) [1]	19 %	4 %	1 %	0 %	1 %	74 %
U.S. experts (n=33)	3 %	3 %	3 %	0 %	0 %	91 %
Other intern. experts (n=30) [2]	40 %	3 %	7 %	0 %	3 %	47 %
DNAdigital (n=33)	42 %	3 %	3 %	0 %	0 %	52 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. I.54: Thesis 34 Anonymity on the Internet

Anonymous use of the Internet is no longer guaranteed in <country>.

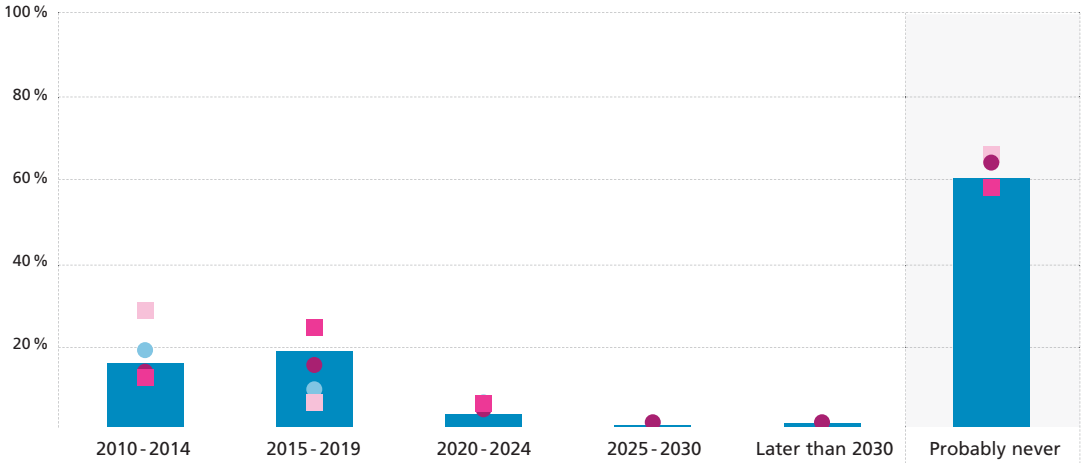


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 73)	59 %	12 %	4 %	3 %	0 %	22 %
EU experts (n = 15) [1]*	47 %	13 %	13 %	0 %	0 %	27 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. I.55: Thesis 35 Security of communication

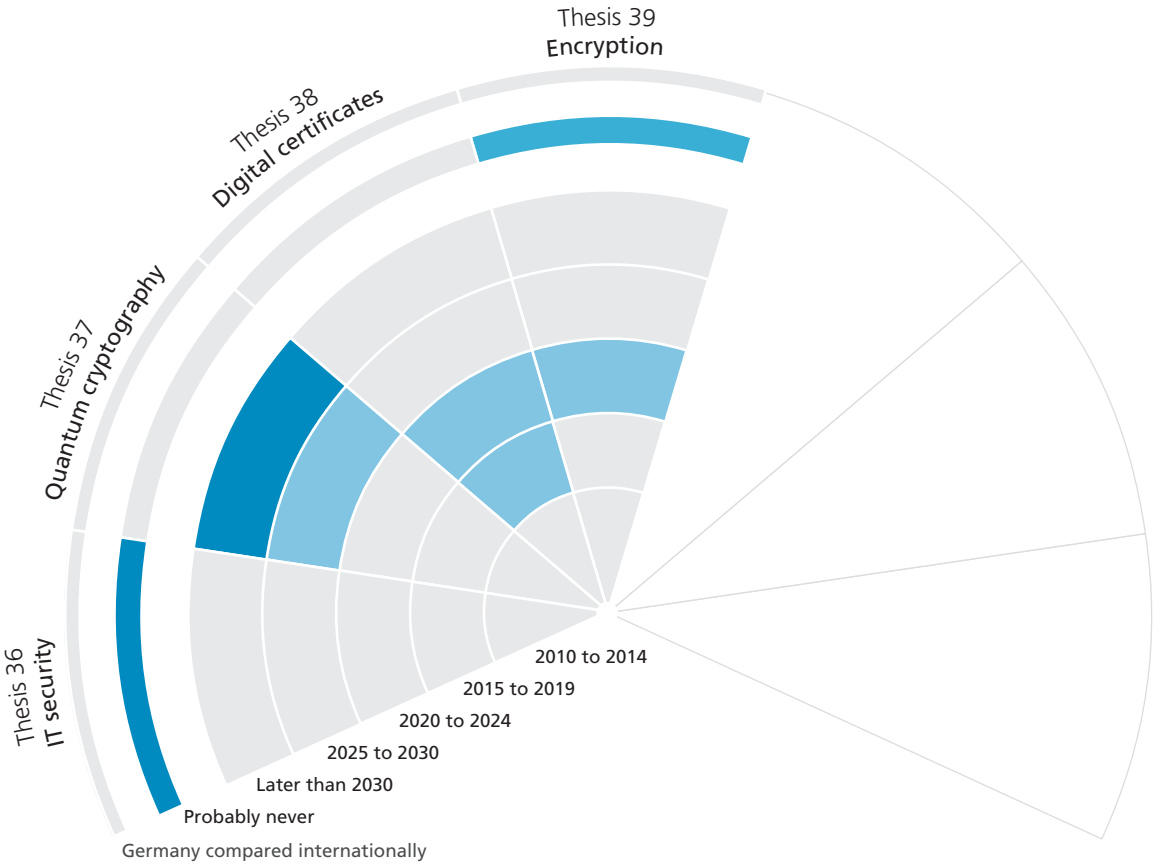
Security problems on the Internet have intensified so greatly that private and business communication via the Internet have been severely impaired worldwide.



	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 350)	16 %	19 %	3 %	1 %	1 %	60 %
EU experts (n = 66) [1]	14 %	15 %	5 %	2 %	2 %	64 %
U.S. experts (n = 32)	28 %	6 %	0 %	0 %	0 %	66 %
Other intern. experts (n = 33) [2]	12 %	24 %	6 %	0 %	0 %	58 %
DNAdigital (n = 32)	19 %	9 %	6 %	0 %	0 %	66 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

I.3.4 IT security
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 36: IT security
Social networks and peer-to-peer-based services are so important in the communication framework that companies have to take security risks (e. g., shutting down customary protective mechanisms like firewalls).

Thesis 37: Quantum cryptography
Quantum cryptography is the base technology of security systems.

Thesis 38: Digital certificates
Through digital certificates, e-mail communication have developed into a legally binding communications standard.

Thesis 39: Encryption
Globally compatible key administration (cryptographic keys, public key infrastructure) is used.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

IT security for the economy and society – a key role of the ICT industry

IT security is gaining a whole new dimension of meaning and complexity, since sensitive information is no longer simply stored on local systems, but is transmitted via the Internet and dispersed throughout the web. On top of this, increasingly large parts of economic processes (logistics, finance, services), public systems (healthcare, transport, administration) and critical infrastructure (electricity, communication) is based on networked ICT solutions and subject to special security requirements (see European Parliament 2009). A "secure information society" is the objective, which grows ever more important under the concept of "cyber security." Greater attention will also have to be paid to the issue of "secure software architecture." The need for this can be illustrated with a few examples:

• **People** need protection from identity theft and misuse of personal data;

• **Companies** need to protect their business information, trading agreements and customer data (e. g., from industrial espionage);

• **Governments** need IT security as a basis for e government solutions, to protect confidential government transactions, to protect technical infrastructure from terrorism and safeguard against virtual attacks on the communication infrastructure.

But IT security solutions are also the key to facilitating a paradigm shift in important new areas of application for ICT, such as the healthcare system, electronic payment systems or (not just digital) ownership and product rights. IT security procedures are also visibly used to protect against product piracy, which is steadily on the rise worldwide and has developed into a serious problem, causing billions worth of losses. These days it is not just software, drugs and luxury goods that are copied and imitated, spare parts, technical equipment and complete industrial systems are also forged. Modern cryptography offers methods for verifying the authenticity of an article. All kinds of specific challenges for IT security are already being discussed and can be identified for the next few years in a broad, digitized society. This section of the study provides information about the experts' assessments of how two fundamental problem areas will develop:

• Coming to terms with new IT architectures, such as Web 2.0 (see also section 1.1.1), cloud communication and virtualization (see section III.5), social networks and peer-to-peer (P2P) based services

• Guarantee of secure data communication, including key management and future encryption methods – all this with its direct impact on the manifold forms of data misuse (see section I.3.2), through to Internet crime and identity theft.

IT security despite diversity of protocols

The findings of the study show that the current forms of peer-to-peer based services and the intrinsic functions of social networks (instant messaging (IM)) may continue to entail IT security risks for the next 15 years. Peer-to-peer communication enables direct exchange between systems on the Internet without intermediate systems acting as coordination management and, in this way, they can provide resources such as information, files, memory, CPU runtime or bandwidths locally and mutually.

Services based on peer-to-peer communication are growing more and more diverse:

• In the last few years, peer-to-peer networks have been established worldwide as an efficient file sharing method and are still growing; bartering of multimedia files – sometimes on the fringes of legality – and professional document distribution are in use worldwide.

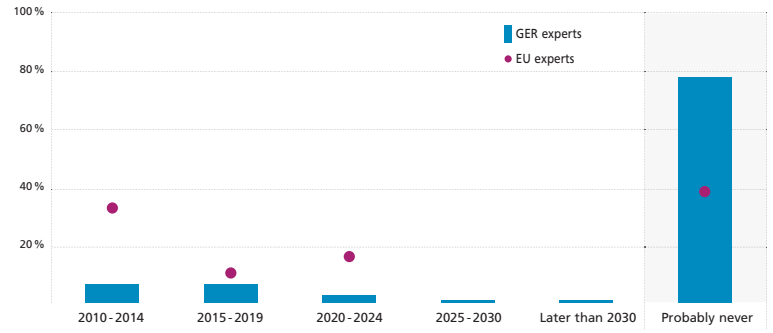
• Instant messaging enables applications designed for the direct exchange of messages between participants, which can be used to inform people, work together and request resources.

• P2P groupware supports communication, cooperation and coordination within groups organized in this way, even beyond company networks and firewalls.

However, since the communication protocols and ports used are not those used for e-mail traffic or browsers, most standard security software does not usually provide adequate protection against unintentional distribution of personal information, the installation of spyware and adware, infection by viruses and worms, or online attacks. The attractiveness of social communities and peer-to-peer solutions and the familiarity of private use could lead to companies taking security risks in order to be able to use these new forms of communication in everyday working life.

The risk that social networks and peer-to-peer based services will become so important in the communication framework that companies will have to take security risks (e. g., shutting down customary protective mechanisms like firewalls), is considered much less likely by the Germany experts than by the Europe experts (see Fig. I.56). Only seven percent of the Germany experts expect such a scenario to occur between 2010 and 2014, another seven percent do not expect it until 2015 to 2019, whereas 33 percent of the Europe experts anticipate that companies in their countries will be affected in the next five years, another eleven percent between 2015 and 2019 and 17 percent by 2024. However, the vast majority of the experts for Germany (78 percent) forecast that companies will not want to take these security risks and would rather do without the functions.

Thesis 36: Social networks and peer-to-peer-based services are so important in the communications framework that companies have to take security risks (e. g., shutting down customary protective mechanisms like firewalls).



This difference implies a high degree of security consciousness in German companies. However, this must not detract from the fact that only improved IT security products with standardized, or at least compatible, security rules will make this problem redundant in the longer term.

Legally binding e-mail communication largely introduced in ten years

73 percent of the Germany experts anticipate the introduction of a standard for legally binding e-mail communication based on digital certificates by 2024 at the latest. This scenario is expected for the rest of Europe by 83 percent of the experts for Europe (see Fig. I.58).

This standard will be extremely relevant for all kinds of business processes, such as orders, agreements or dealings with public authorities, and will make adapted IT systems necessary for e-mail management and e-mail archiving. The experts for Germany believe that the introduction of legally binding e-mail communication will have a positive impact on the overall German economy (82 percent) and society (68 percent; see Fig. I.59).

Public key infrastructure (PKI): International breakthrough of compatible key systems foreseeable for a broad spectrum of applications

Ten years ago, PKI concepts were on everyone's lips as the solution for secure, electronic communication through authentication, encryption and signatures. However, business concepts and projects suffered many setbacks.

Experts named the following reasons for this:

- Unsustainable business concepts for PKI solutions;
- Insufficient focus on specific applications with their benefits;
- Too many different, incompatible isolated applications;
- Solutions insufficiently user-friendly due to inadequate application integration of the PKI client solutions.

The experts repeatedly emphasize that, on top of this, time plays a major role in the introduction of such complex systems, especially because large financial investments in research and development have to be recovered promptly, but the conversion of existing systems and applications comes up against great resistance.

This becomes clear in view of the complexity of a PKI system: PKI is based on a dedicated encryption concept in order to achieve confidentiality, integrity, authenticity and non-repudiability. This subject area entails the constant development of future research topics, such as the identification, interception and pinpointing of attackers, the adjustment to future high speed optical networks, and quantum cryptography.

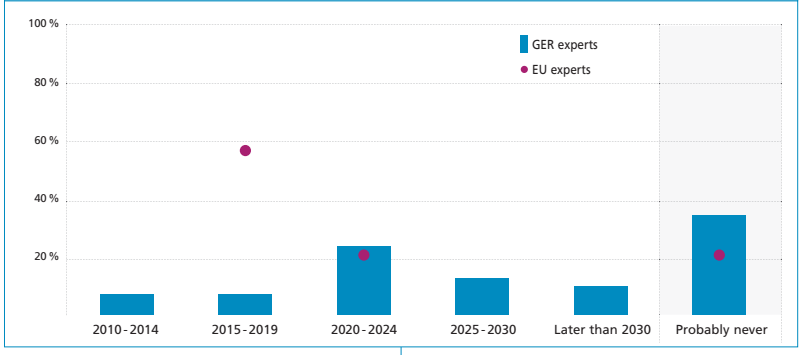
The overall PKI system comprising a certification body, a registry, a digital certificate and additional services, such as a directory service and a revocation service, has to be closely adapted to the relevant applications. There are a great

number of examples of PKI applications and they are growing into mass applications: e-mail encryption/signatures, SSL/TLS encryption, document signatures, file system encryption, VPN encryption and authentication, smart card registration, payment and solutions with mobile devices.

Major practical areas of application for PKI are remote access, as an increasing security requirement for companies (the combination of user name and password is still the most common method in the remote access area, but at the same time, the public key infrastructure is advancing inexorably in the background), billing processes, e government (electronic passports, electronic ID cards) and the health card.

The experts place a high degree of importance on compatible key administration as a major success factor. The Germany experts anticipate rather slow PKI implementation:

Thesis 39: Globally compatible key administration (cryptographic keys, public key infrastructure) is used.



• 40 percent of the Germany experts expect implementation in the next 15 years, specifically by 2024; of them, eight percent expect it to be possible by as early as 2010 to 2014 and eight percent by 2015 to 2019; 24 percent do not expect implementation until 2020 to 2024, and 11 percent see after 2030 as realistic (see Fig. I.60).

• 78 percent of the Europe experts believe that such systems will be implemented within the next 15 years. 57 percent deem this scenario to be possible by as early as 2015 to 2019 – thus the experts for Europe are considerably more optimistic in this regard than the experts for Germany.

When asked about the drivers of this development, the Germany experts (62 percent) first and foremost cited progress in standardization efforts (e. g., CommonPKI), secondly (49 percent), rising market demand, and thirdly (38 percent), political resolve for e government, administrative efficiency, establishment of legal certainty and security of personal privacy (see Fig. I.61).

But there are also potential barriers. The top barrier named by Germany experts (56 percent) is a delay in the adoption and implementation of the necessary standards, secondly (42 percent), privacy problems in implementation in companies and, thirdly (36 percent), social acceptance (handling and legal issues). Practical application problems are clearly deemed to be resolvable: 22 percent see a risk of excessive costs, 17 percent see technical problems in test systems and compatibility. A lack of willingness to invest in companies is only cited by 11 percent and is thus deemed not particularly important, since the anticipated profitability is expected to be considerably higher in the future (see Fig. I.62).

35 percent of the Germany experts believe there will probably never be globally compatible key administration. However, this assessment and the lateness of the forecast occurrence of this thesis are possibly owing to the thorny path of German PKI projects ("...based on the experience of the last 15 years...,"), since only 21 percent of the experts for Europe believe that there will never be globally compatible key administration.

Quantum cryptography will not be the base technology for security systems for the foreseeable future

All IT security processes are based on cryptography. The main feature of cryptography is that it uses secret data ("keys"). The question has always been how these secret keys can be securely transmitted to the relevant users. Before public key cryptography, cryptographic systems could only be initialized through "secure channels," which can be conceived of as special messenger services. Today, keys are generally distributed securely using public key protocols.

The basic problem with public key processes is that their security depends on a small number of mathematical problems that are deemed to be difficult, the difficulty of which cannot be proven however. An example of such a problem

is the factorization of large integers. Every mathematical advance toward resolving this problem threatens the security of the public key processes used at present.

Quantum cryptography – or more precisely, quantum key exchange – promises a permanent, which is to say, provably secure, solution to the problem of key distribution based on quantum physics. Ultimately, it is based on the Heisenberg uncertainty principle, which states that measuring a quantum physical system effects a change in that system. Therefore, tapping into a quantum physical channel effects a change in the condition of the particles being transported via the channel. Together with special, information-theoretically secure key and authentication methods, it is then theoretically possible to create a cryptographic system whose security does not depend on unproven assumptions, but can actually be proven.

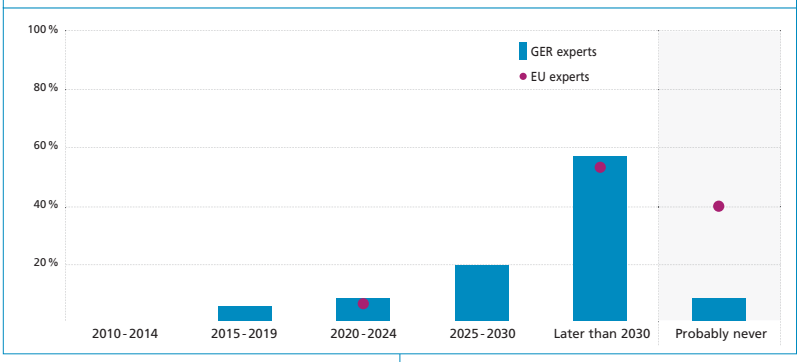
Performance of current quantum cryptographic systems does not satisfy the requirements for broad application

The first examples of applications based on various technological approaches show that quantum key exchange is feasible in practice, but they also clearly highlight the limitations of current possible applications. At present it is only possible to establish secure point-to-point connections; there cannot be any intermediate nodes. The maximum possible distance between the two ends of the line is about 100 km. When the quantum key exchange is coupled directly with a provably secure encryption method, the maximum data throughput is several orders of magnitude less than when a conventional cryptographic system is used. However, what is needed in ICT practice is security procedures that work for any network structures. The procedures should enable high throughput and also offer authentication and non-repudiation, i. e. digital signatures. It is not possible based on the current state of knowledge to implement the concept of digital signatures on the basis of quantum cryptography.

Experts also very reticent about future role of quantum cryptography

The experts for Germany and Europe are very reserved in their assessment of the prospects of broad application of quantum cryptography in the near and medium-term future. Only very few expect it to become the new base technology for security systems in the next 15 years – just six percent forecast 2015 to 2019, and less than ten percent forecast 2020 to 2024 (see Fig. I.57). Not until after 2030 can almost 60 percent of the experts surveyed conceive of this scenario occurring. There is very little discrepancy between the experts for Germany and those for other European countries in this regard (57 percent compared with 53 percent). There are surprising differences, however, in the number of experts who believe that quantum cryptography will never become the new base technology for security: nine percent of the experts for Germany take this stance compared with 40 percent of the experts for the rest of Europe. The reasons given for these assessments are as follows:

Thesis 37: Quantum cryptography is the base technology of security systems.



- Products are still far from being ready for the mass market

- The overall technical effort is too great and there are still huge technical hurdles to overcome on the road to mass production

- Furthermore, the experts specify additional research expenses.

Quantum cryptography for niche applications in the high-security sector

The technological basis of current security systems is conventional cryptography, including public key cryptography; this situation will not change in the foreseeable future. The commercial sector will put up with the drawback that these methods are not provably secure; the practical advantages of current cryptography over quantum cryptography are too great. In the field of state security, there may be niche applications for which security is more important than other aspects. It can be presumed that uses will be found for quantum cryptography here.

Quantum cryptography and quantum computers

Nevertheless, quantum cryptography cannot be ignored and deemed irrelevant for the economy. Whether or not quantum cryptography ever has large-scale technical significance also very much depends on the further development of public key cryptography. This type of cryptography is potentially threatened not only by potential advances in dealing with highly specific mathematical problems. Another possible threat lies in quantum computers (not to be confused with quantum cryptography). If, one day, there should be a quantum computer that can store and process sufficiently long data blocks in quantum registers, all of the public key processes used today would become obsolete in one fell swoop. We would be thrown back, in security technology terms, to the time before public key cryptography was invented in 1976, and quantum key exchange would be a welcome option for resolving the problem of key agreement.

Summary

IT security has become a critical success factor for ICT applications in the economy and society and will contribute hugely to acceptance.

To politics falls the role of creating a legal framework and leading the way to coherent solutions in the domains of government/administration, healthcare, economy, transport, media, domestic security and individual self-determination/freedom, which will be more closely interrelated in the future through ICT solutions.

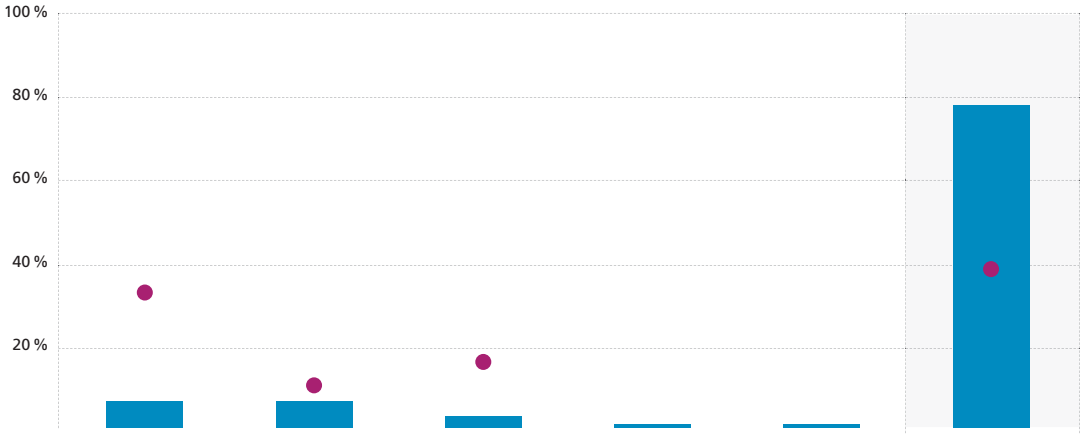
As such, a transdisciplinary understanding of applications is necessary to give direction to the development of technologies and standardization work in such a complex problem area.

In this field, research, testing, piloting, and standardization play a special role, since the majority of future ICT applications will build on this basis, cover all areas of life and entail consequences for economic, social and personal sectors.

Theses on "IT security" in detail

Fig. I.56: Thesis 36 IT security

Social networks and peer-to-peer-based services are so important in the communication framework that companies have to take security risks (e. g., shutting down customary protective mechanisms like firewalls).

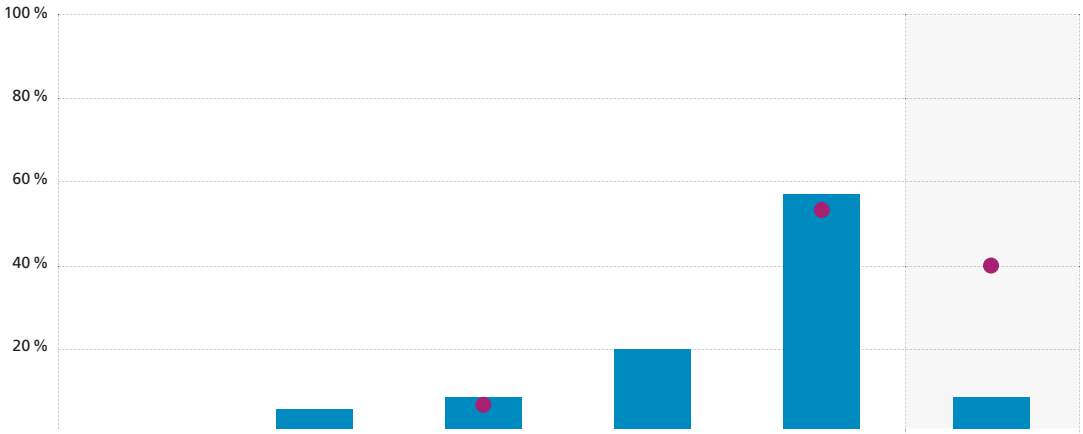


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 55)	7 %	7 %	4 %	2 %	2 %	78 %
EU experts (n = 18) [1]*	33 %	11 %	17 %	0 %	0 %	39 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. I.57: Thesis 37 Quantum cryptography

Quantum cryptography is the base technology of security systems.

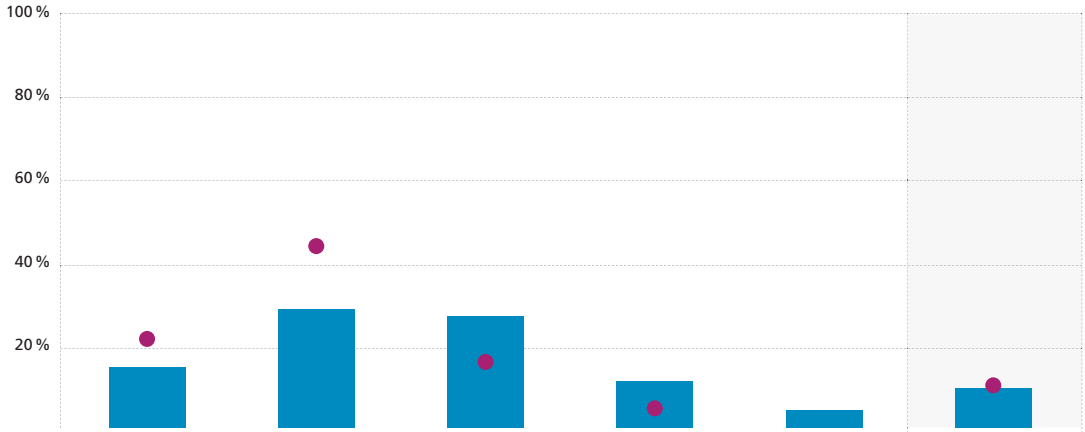


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 35)	0 %	6 %	9 %	20 %	57 %	9 %
EU experts (n = 15) [1]*	0 %	0 %	7 %	0 %	53 %	40 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. I.58: Thesis 38 Digital certificates

Through digital certificates, e-mail communication have developed into a legally binding communications standard.

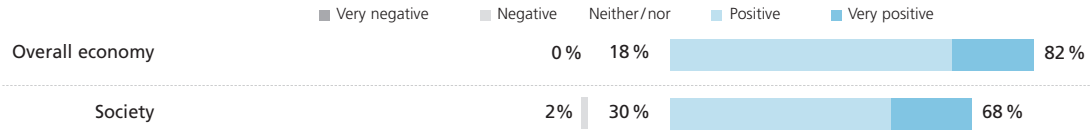


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 58)	16 %	29 %	28 %	12 %	5 %	10 %
EU experts (n = 18) [1]*	22 %	44 %	17 %	6 %	0 %	11 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. I.59: Thesis 38 Digital certificates – relevance

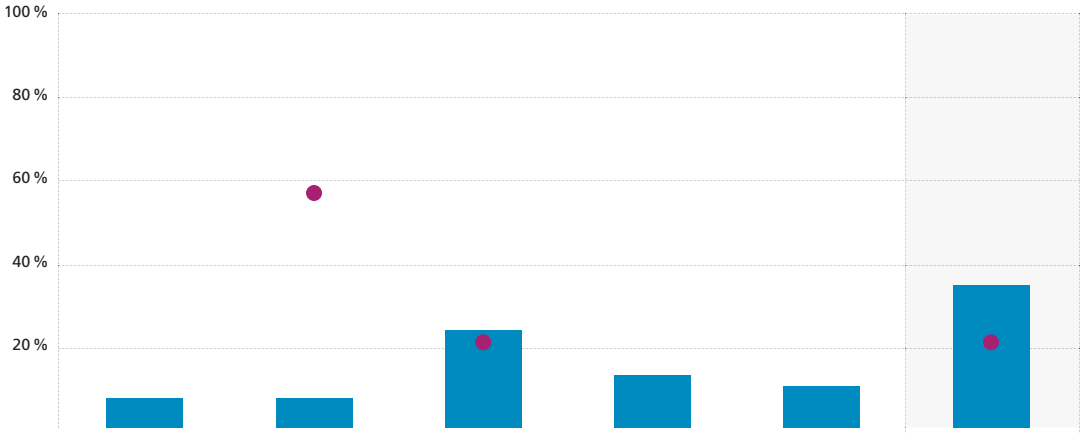
What impact will the validity of Thesis 38 above have on the areas listed below?



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, at least n = 56

Fig. I.60: Thesis 39 Encryption

Globally compatible key administration (cryptographic keys, public key infrastructure) is used.

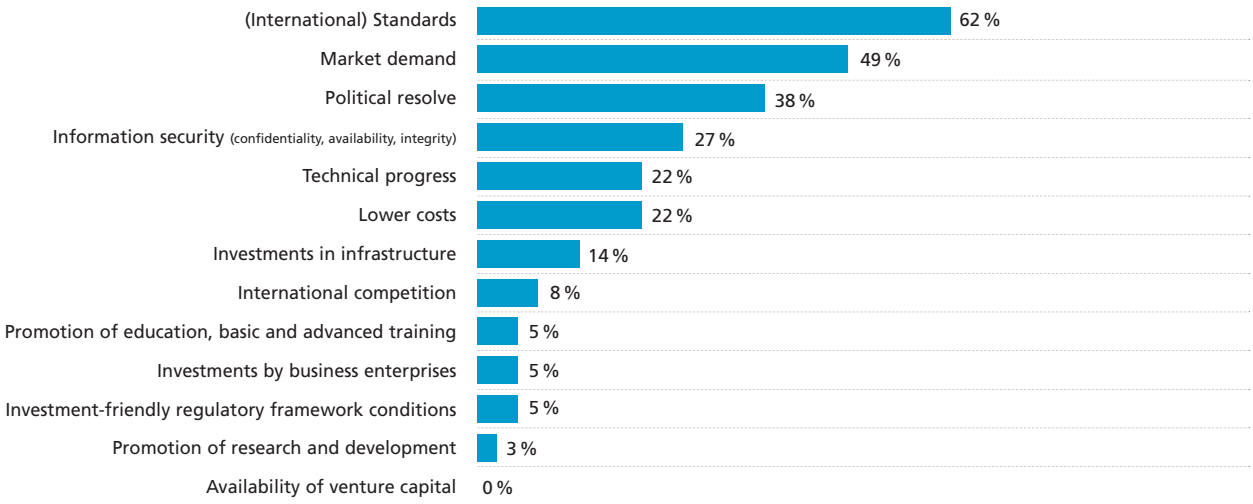


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 37)	8 %	8 %	24 %	14 %	11 %	35 %
EU experts (n = 14) [1]*	0 %	57 %	21 %	0 %	0 %	21 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. I.61: Thesis 39 Encryption – drivers

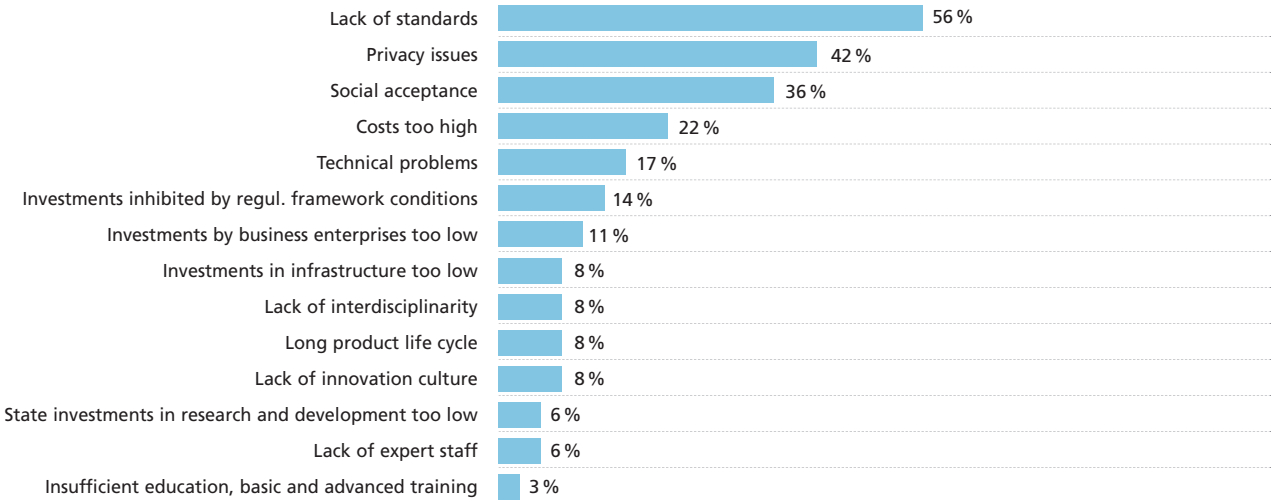
Select up to three drivers from the following list that you consider to be most important for realization of Thesis 39 above.



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n = 37

Fig. I.62: Thesis 39 Encryption – barriers

Select up to three barriers from the following list that you consider to be most important for realization of Thesis 39 above.



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n = 36

II ICT innovation policy

Information and communication infrastructures, along with media, are taking on a central role in business and society. The positive development of ICT and media is highly dependent on future-oriented structures and location factors. When we consider Europe as a center of business, it is clear that the U.S. has taken the lead in some ICT areas.

This study acknowledges this fact and investigates which specific framework conditions are required to enable Europe to retake the lead in the ICT sector. Section II.1.1 describes how experts see the future strongholds of ICT and the potential impact that the increasing outsourcing of research and development to Asia will have on Europe.

In addition to assessing the future of the European ICT industry, the study also focuses on globalization and technical progress and discusses, for example, which innovative development methods will prevail on the market in future. After all, we can already see how globalization is changing value chains:

- The number of process participants is increasing
- Competition is forcing players to exit "walled gardens" in favor of open systems
- Customers and users are increasingly becoming involved in the innovation process

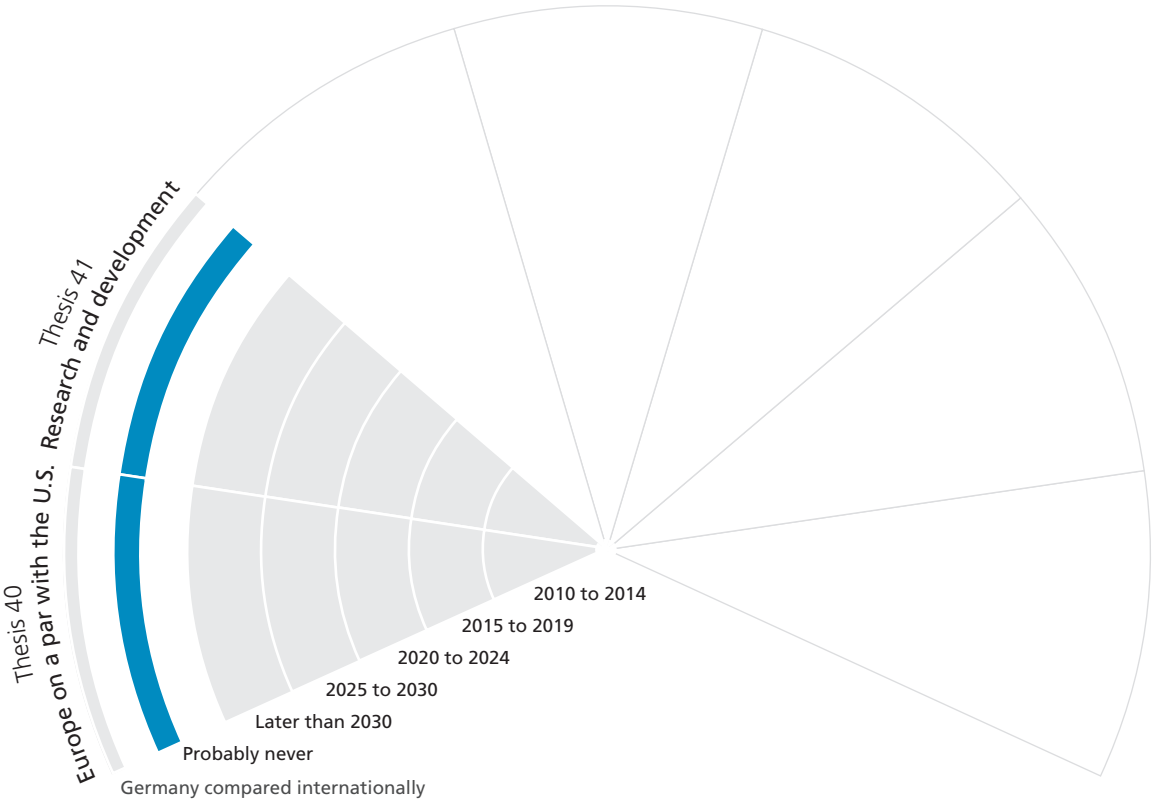
Accordingly, section II.1.2 examines (novel) approaches to innovation research, such as open innovation and open source, in more detail. It investigates potential barriers, as well as the possibility that these new approaches in ICT companies' innovation processes will take root in the long term.

Investments in infrastructure to overcome the digital divide

Overcoming the digital divide is one of the main political and social challenges of the future: large bandwidths are a prerequisite for new services; they are the foundation for connected life and work. Powerful broadband connections are essential to ensuring people's ability to participate in the information society of today and tomorrow. Germany and Europe cannot afford to miss the boat when it comes to the development of infrastructure for new high-speed networks. But rapid installation and expansion of these networks require investments in the billions. To achieve this, we will need a review of existing framework conditions, along with an investor-friendly political and regulatory environment. Section II.2 examines the effectiveness of the efforts in this area to date, as well as promising new approaches.

One thing is clear: in the coming years, Germany must succeed in upgrading its ICT infrastructure to match the best in the world. This is a prerequisite to securing Germany's place among the world's top ICT locations, which in turn is essential to Germany's knowledge economy.

II.1.1 The future strongholds of ICT
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 40: Europe on a par with the U.S.

Through targeted investments in research and development as well as software competency, Europe has closed in on the USA's lead in the ICT sector.

Thesis 41: Research and development

The majority of research and development in the ICT industry (manufacturers and network operators) takes place in Asia.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

Change through globalization

Information, communication and media technology has become a major business and innovation factor for Europe, and for Germany in particular. In the areas of device and system technology for telecommunication, in particular (communication network infrastructure, devices, switching equipment and services), Europe was an early leader in research and development (R&D) and still is in many markets. The clear global leader in cellular technology, GSM (Global System for Mobile Communications), and new developments such as UMTS (Universal Mobile Telecommunications System) and LTE (Long Term Evolution) were invented completely or at least primarily in European labs. In contrast, the European computer (hardware) industry has been less successful in the past 50 years, notwithstanding the useful innovations contributed by German subsidiaries of American companies (IBM, for example). In the business software sector, however, the German company SAP holds its own among the global leaders.

Media technology and the media sector do not present a uniform picture, either. While the consumer electronics (devices) sector has almost completely left Europe, European – and particularly German – media companies continue to be powerful, best of class players. Many innovations took place here as well, for example the widespread MP3 audio encoding, the new H.264 video encoding standard and DVB (Digital Video Broadcasting), which was developed and standardized worldwide under the leadership and active participation of German experts.

Even DAB (Digital Audio Broadcasting) deserves mention, despite the fact that it has failed to gain wide recognition in Germany so far, as its processes and enhancements for multimedia are highly significant for today's low-bandwidth broadcasting technologies and have taken root in many countries.

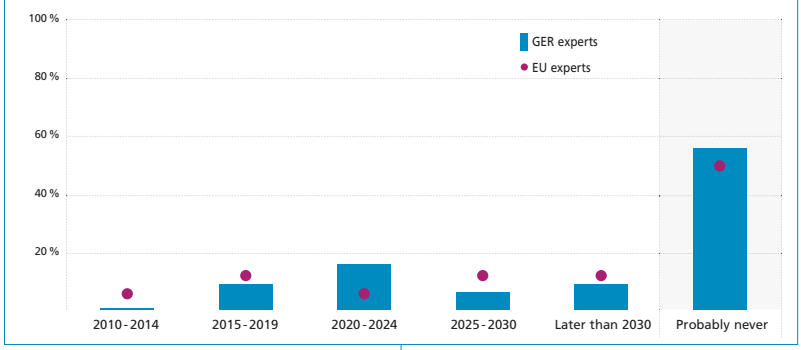
While the rise of the Internet did not initiate globalization, it has accelerated its pace significantly. Combined with the latest ICT technology, it is now more relevant than ever, and has drastically changed the situation described above. In addition to the U.S. as the historical ICT leader (although cellular technology remains a clear exception, as it continues to be dominated by Europe) and Japan for consumer electronics, new players from Asia have entered the game – from Korea, China, India and other nations. A common characteristic of these countries is that they have developed top-class, innovative engineers and software technicians, i. e. R&D resources, enjoy access to huge local markets and – last but not least – are subject to an entirely different business framework with regard to labor costs, regulation, government support and so on.

It is a fact, for example, that Chinese telecommunication equipment manufacturers have gained significant market share among European network operators and are slowly beginning to dominate the market. Market share and rankings are being lost. The question at hand: can this development be reversed or substituted, at least partially? These conditions are the framework in which the theses assessed in the Delphi Study must be considered.

Europe vs. the U.S.: can Europe catch up? Yes in some sectors, but not overall

Experts for Europe are highly skeptical: 50 percent don't believe that it will ever be possible to catch up to U.S. competitiveness levels in the ICT industry (see Fig. II.1). The experts for Germany are just as pessimistic – the doubters here number 56 percent. Seen positively, as many as 34 percent of those surveyed believe in the possibility that things could change by 2030. The overall opinion is clear: "only a dim light at the end of the tunnel."

Thesis 40: Through targeted investments in research and development as well as software competency, Europe has closed in on the USA's lead in the ICT sector.



However, this statement only applies to a general ICT analysis. The answers are different when the questions involve the perspectives of individual ICT sectors. According to the experts, it could be possible to take a "leading global position" in some subsectors and markets relatively soon, in the next five to ten years (see Fig. II.2). This seems most likely in the areas of telecommunication services (51 percent) and infrastructure (40 percent). In contrast, the outlook is extremely poor for IT hardware (two percent) and poor for telecommunication devices (eleven percent). Software (24 percent) and IT services (27 percent) take a middle position. Based on the experts' statements on embedded systems, it seems likely that this innovative area could represent an exception to the hardware and embedded software expectations.

Europe vs. Asia

Neither experts for Germany (59 percent) nor experts for Europe (48 percent) expect research and development to take place "primarily" in Asia in future (see Fig. II.3). It is no surprise that experts for non-European countries believe the opposite: only 20 percent of them think that Asia will never take a leading position in R&D. This dramatic trend of outward migration of R&D is expected in the following time frames: around half the experts for non-European countries and more than 40 percent of the experts for European countries assume that Asia will assume a dominant position by the year 2015-2024 – in line, for example, with the facts on the current supplier situation for ICT infrastructure described above.

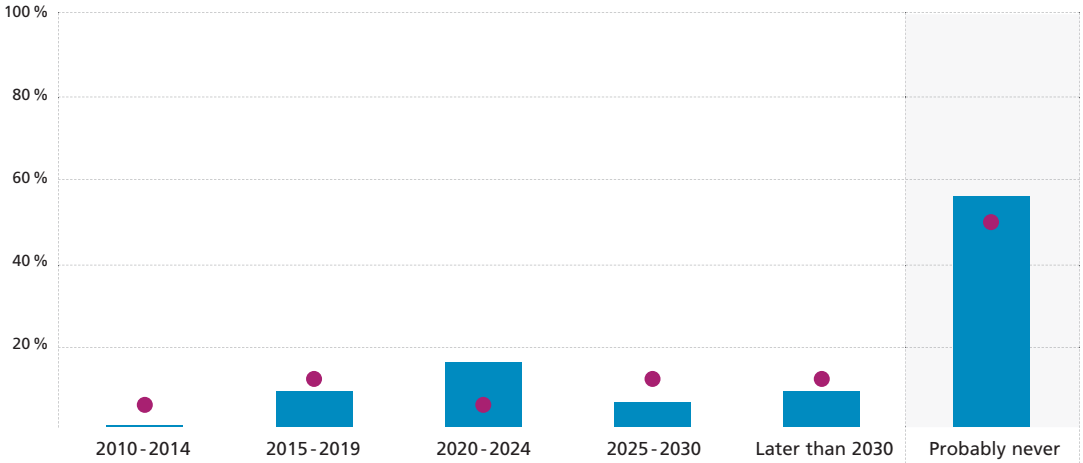
Summary

The statements on the individual theses are somewhat contradictory only upon cursory examination. The experts clearly postulate that Europe and Germany will have a hard time with regard to the future of their "local" research and development, both in the ICT industry and as a whole. Nonetheless, positive trends are expected in selected sectors. Europe is not expected to remain an absolutely dominant player, but can still play an important – if not leading – role, provided massive efforts are undertaken, particularly in R&D. In comparison, the experts for Germany are more optimistic than the others.

Theses on "The future strongholds of ICT" in detail

Fig. II.1: Thesis 40 Europe on a par with the U.S.

Through targeted investments in research and development as well as software competency, Europe has closed in on the USA's lead in the ICT sector.

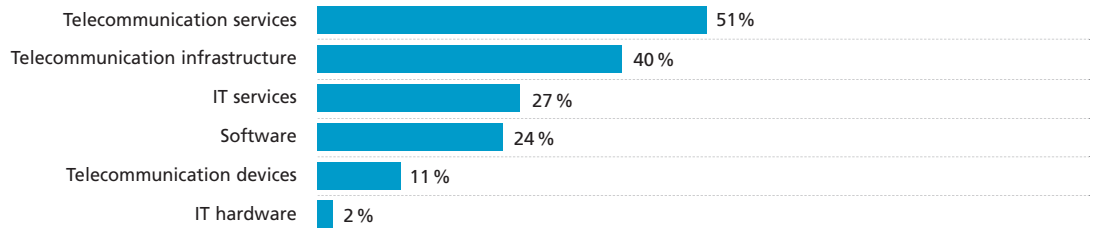


	2010-2014	2015-2019	2020-2024	2025-2030	Later than 2030	Probably never
GER experts (n=73)	1 %	10 %	16 %	7 %	10 %	56 %
EU experts (n=16) [1]*	6 %	13 %	6 %	13 %	13 %	50 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. II.2: Thesis 40 Europe on a par with the U.S. – segments

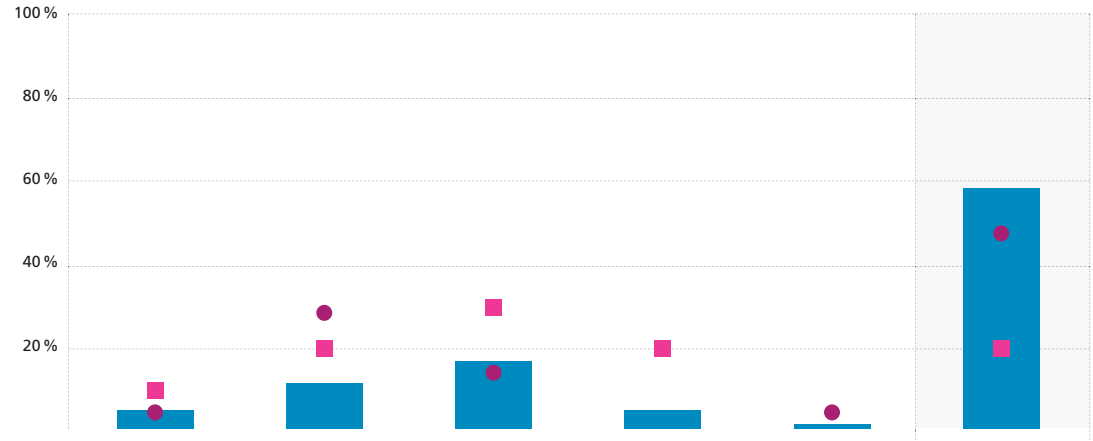
In which of the areas listed below will Europe take a leading position worldwide in the next five to ten years?



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n = 45; Mehrfachnennung

Fig. II.3: Thesis 41 Research and development

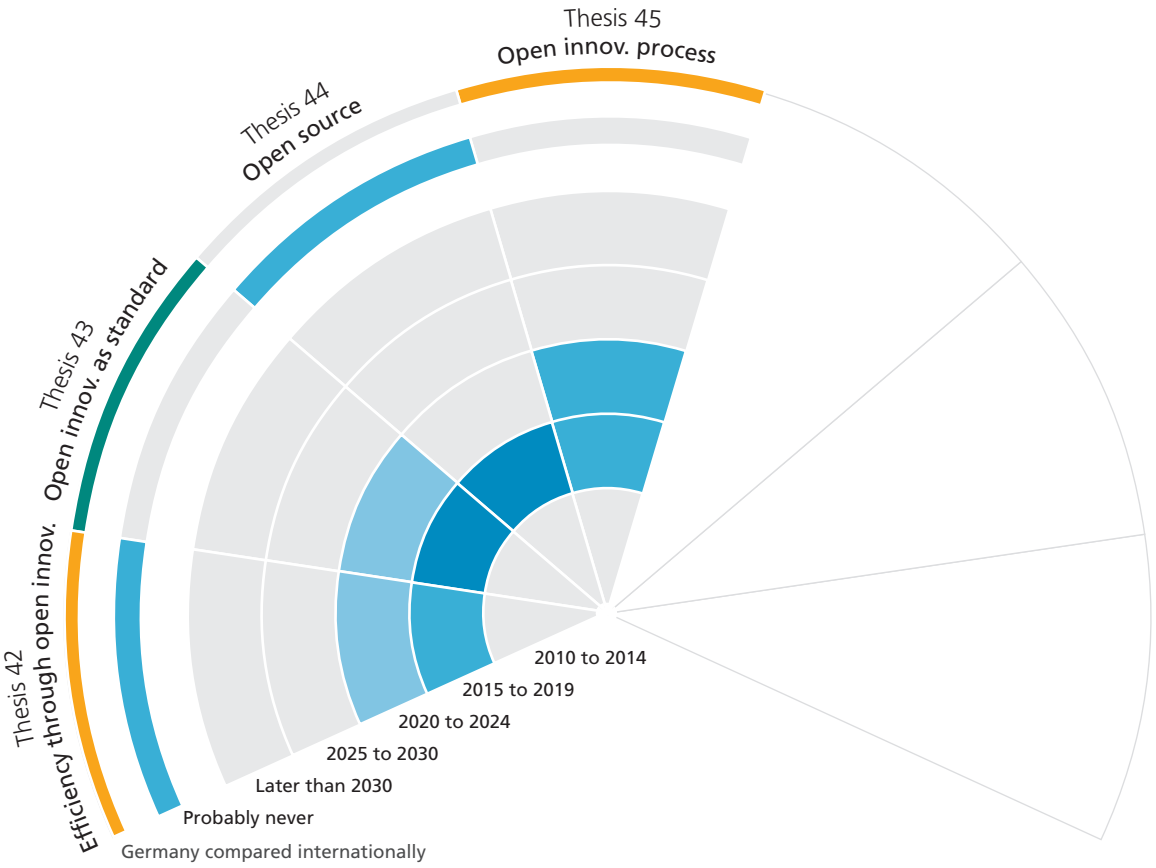
The majority of research and development in the ICT industry (manufacturers and network operators) takes place in Asia.



	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 94)	5 %	12 %	17 %	5 %	2 %	59 %
EU experts (n = 21) [1]	5 %	29 %	14 %	0 %	5 %	48 %
Other intern. experts (n = 10) [2]*	10 %	20 %	30 %	20 %	0 %	20 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, except Germany, Europe and the U.S.; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

II.1.2 Novel innovation processes and development methodology
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 42: Efficiency through open innovation

The concept of "open innovation" is extensively employed by more than 50 percent of businesses in Germany and has led to a substantial increase in the efficiency of innovation processes.

Thesis 43: Open innovation as standard

The inclusion of the outside world in the innovation process and collaborative innovation networks with heterogeneous participants (open innovation) have become established as the standard in leading companies in Germany.

Thesis 44: Open source

Open-source processes and principles are standard for commercial software development in Germany.

Thesis 45: Open innovation processes

Cross-disciplinary collaboration beyond the limits of engineering (e. g., social scientists, designers, artists) is the prevailing method for innovation processes used by german companies.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

The trend toward open innovation and open source

Globalization and technical progress are also changing value chains. The number of process participants is increasing – value chains are becoming value networks – and, at the same time, competition is forcing companies away from "walled gardens" in favor of open systems. Last but not least, customers and users are becoming much more involved in the innovation process.

The key term is open innovation (OI). Nor does innovation refer solely to conventional R&D innovation; it also involves marketing and sales processes, customer retention strategies and product tests. The opening of the traditionally largely hidden innovation process results in the use of intellectual property jointly with third parties, or even with competitors. The open innovation method has an impact on business models and corporate culture, as well as on communication between vendors and users (see Picot&Doeblin 2009). As such, open innovation affects nearly the entire value network. Of course, close, creative collaboration between manufacturers and their suppliers has long been customary in many industries, such as the automotive sector. Still, developments in the ICT and media industries in recent years go far beyond this familiar collaboration pattern. The more open these methods become, however, the more critical questions are asked: Who gets the intellectual property rights (IPR)? Can you do away with your in-house R&D? Does "the" customer who can give us innovation advice exist? And if so, how can we address them? In the age of web communities, many new prospects arise, but they have to remain manageable.

One facet of "openness" (which should not be confused with open innovation) is the open-source movement. Open source (OS) means revealing the source code of software in the hope of promoting further development. The OS principle is tied to certain rules. Open source software is subject to the licensing conditions defined by the Open Source Initiative. The primary characteristics of open-source software are:

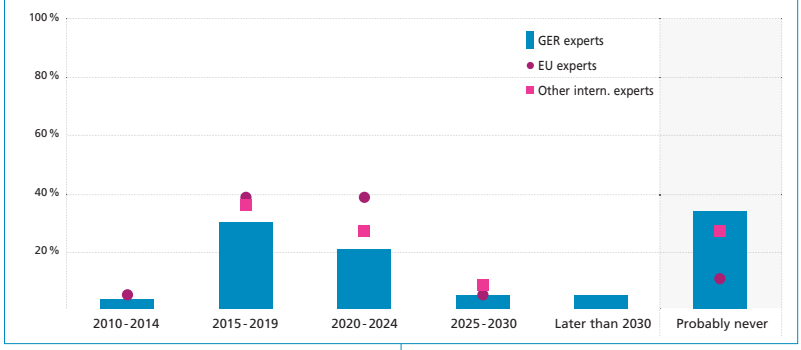
- The software (i.e. the source text) is available in a human-readable, comprehensible format.
- The software can be copied, disseminated and used as often as desired.
- The software may be modified and distributed in the modified form.

This revolutionary approach has proven to be quite successful, as many examples show – and not only from Internet projects. The experts' projections on this topic area from the Delphi survey are described and commented on below.

Open innovation will prevail – but there is still much work to do

The majority of the experts surveyed believe that open innovation will become a dominant R&D paradigm by 2024 at the latest, increasing the efficiency of innovation processes (see Fig. II.4). However, around a third of the experts for Germany and a tenth of the experts for Europe are still skeptical and doubt that this principle can actually improve efficiency; nor do they believe that more than half of the companies in their respective countries will utilize this new form of collaboration. Although the ex-perts for Germany are less optimistic about open innovation than their colleagues from other countries, many of those who foresee open innovation having a positive impact believe that this will occur within the next ten years (34 percent). Many experts for European (45 percent) and other countries (36 percent) confirm this early forecast.

Thesis 42: The concept of "open innovation" is extensively employed by more than 50 percent of businesses in <country> and has led to a substantial increase in the efficiency of innovation processes.



86 percent of the experts for Germany believe open innovation will have a positive to very positive impact on business overall, while 75 percent foresee a positive influence on society (see Fig. II.5). Nearly half of the experts surveyed believe open innovation will have a positive impact on the environment, while 77 percent see a positive to very positive impact for the ICT industry.

Still, 60 percent of the experts for Germany believe that the inclusion of outside collaborators in the innovation process will have established itself as the standard at leading companies by 2019 at the latest (see Fig. II.6). International competition is believed to be the most important driver for this trend (55 percent), followed by promotion of research and development (37 percent). Other relevant drivers are lower costs (27 percent) and, almost equally important, market demand (25 percent), promotion of education, basic and advanced training (24 percent) and investments by business enterprises (23 percent; see Fig. II.7).

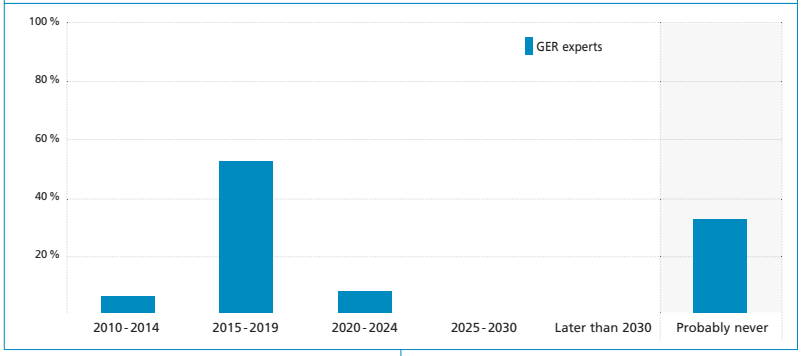
According to the experts for Germany, the most critical obstacle along the way toward the broad implementation of open innovation is the lack of innovation culture – that is, the willingness to try, adopt and maintain such novel, unusual forms of innovation (52 percent; see Fig. II.8). Not unexpectedly, reservations involving privacy issues are also prominent (34 percent); after all, critical entrepreneurial tasks are shifted "outside." The experts also see impediments in a lack of social acceptance (29 percent); at the very least, this factor will likely slow down the necessary changeover from the traditional innovation process to open innovation methods.

Also high in the rankings of potential barriers are "lack of interdisciplinarity" with 22 percent and "insufficient education, basic and advanced training" (16 percent). Accordingly, the result for this thesis on opening the innovation process, which 66 percent of GER experts and 63 percent of EU experts expect, is that closer collaboration with non-technical disciplines – e.g., social scientists, designers and artists – will be a widespread method in the innovation process in the years 2015 to 2024 (see Fig. II.12).

Open source is unstoppable

The importance of the open-source movement for the development of commercial software is seen controversially (see Fig. II.9). As many as 33 percent of experts for Germany do not believe open source will become the standard procedure. Nonetheless, the clear majority (59 percent) agrees that this innovative development methodology will already have become a widespread procedure by 2019.

Thesis 44: Open-source processes and principles are standard for commercial software development in <country>.



Of the drivers for this development, three are clearly in the lead (see Fig. II.10): lower costs (48 percent), market demand (39 percent) and international competition (38 percent). Other leading reasons include the availability of international standards (25 percent) and investments by business enterprises (21 percent). The reasoning that open source will prevail because a wider developer community enables more advanced results is shared by only 14 percent of those surveyed, much less than the other reasons given.

The greatest barrier (31 percent) is estimated to be the potential lack of standards (see Fig. II.11). It can be assumed that above all standardized distributed development procedures and interface standards are seen as critical factors for the efficient, trouble-free substitution and combination of software components. Particularly where highly complex business software is involved, these issues have a decisive impact on quality. Complementary to estimations of the drivers, the lack of an "open source-friendly innovation culture" is seen as a barrier by 27 percent of the experts for Germany. Another obstacle on the way to broad implementation is expected to be the lack of expert staff (24 percent). Somewhat surprising, however, is that only ten percent of the experts surveyed see insufficient education and training as an impediment. Also worthy of mention are potential technical problems (22 percent) and – as with the topic of open innovation above – a lack of acceptance for this new development methodology (20 percent).

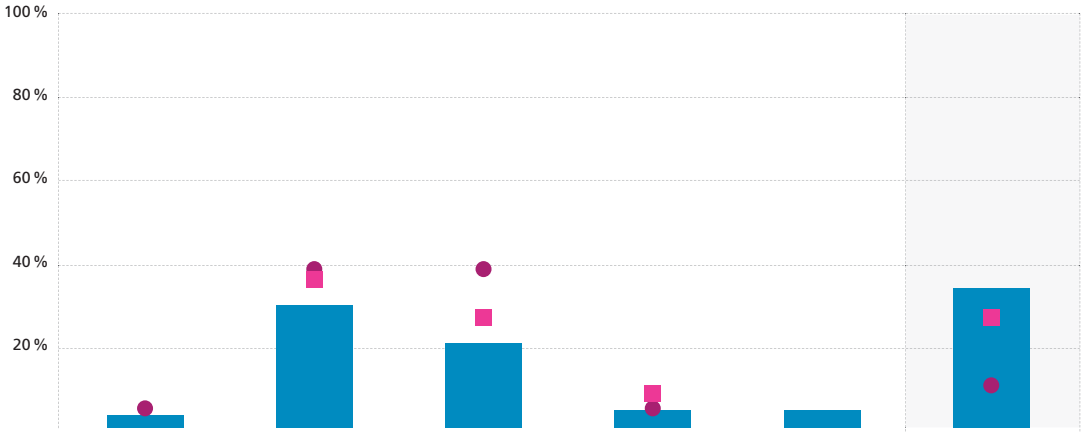
Summary

In the experts' opinion, open innovation and open Source will take a firm hold in the coming decades. Nonetheless, action is clearly needed to reduce existing barriers, especially through measures for educating developers, users and decision-makers in the methods of open innovation and open source, as well as in the active dissemination and use of OI/OS at all levels – from training programs to the broader economy – to facilitate wide acceptance. Another highly important strategic factor is support for developing and deploying international standards, which will also help reduce technical problems (interworking, multi-vendor technologies).

Theses on "Novel innovation processes and development methodology" in detail

Fig. II.4: Thesis 42 Efficiency through open innovation

The concept of "open innovation" is extensively employed by more than 50 percent of businesses in <country> and has led to a substantial increase in the efficiency of innovation processes.

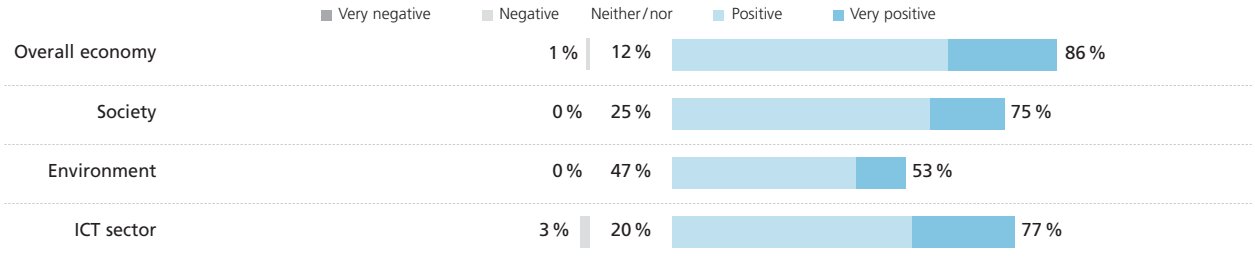


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 76)	4 %	30 %	21 %	5 %	5 %	34 %
EU experts (n = 18) 1*	6 %	39 %	39 %	6 %	0 %	11 %
Other intern. experts (n = 11) 2*	0 %	36 %	27 %	9 %	0 %	27 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, except Germany, Europe and the U.S.; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. II.5: Thesis 42 Efficiency through open innovation – relevance

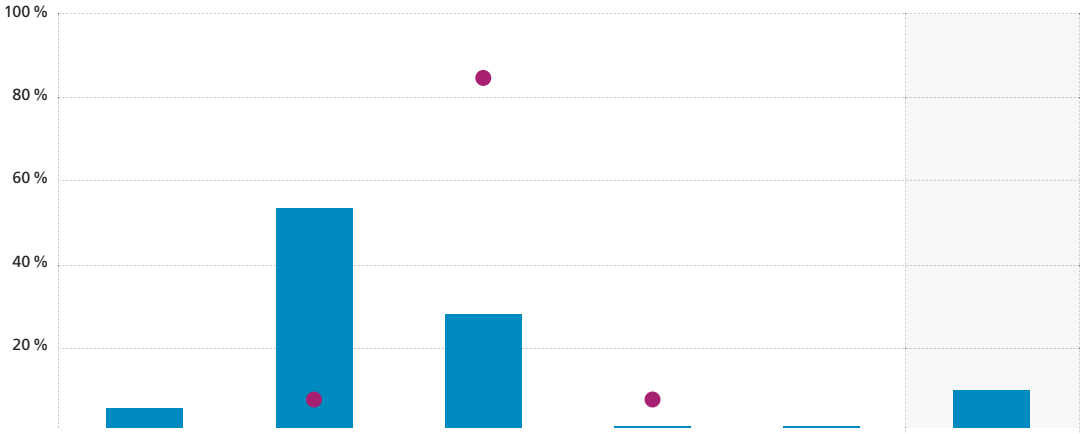
What impact will the validity of Thesis 42 above have on the areas listed below?



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, at least n = 72

Fig. II.6: Thesis 43 Open innovation as standard

The inclusion of the outside world in the innovation process and collaborative innovation networks with heterogeneous participants (open innovation) have become established as the standard in leading companies in <country>.

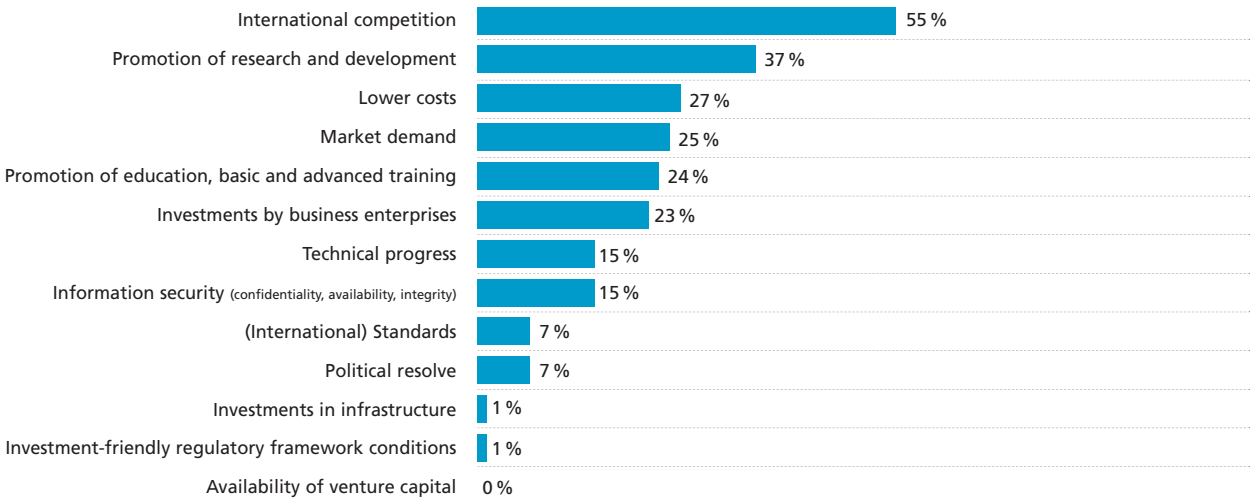


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 71)	6 %	54 %	28 %	1 %	1 %	10 %
EU experts (n = 13) [1]*	0 %	8 %	85 %	8 %	0 %	0 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. II.7: Thesis 43 Open innovation as standard – drivers

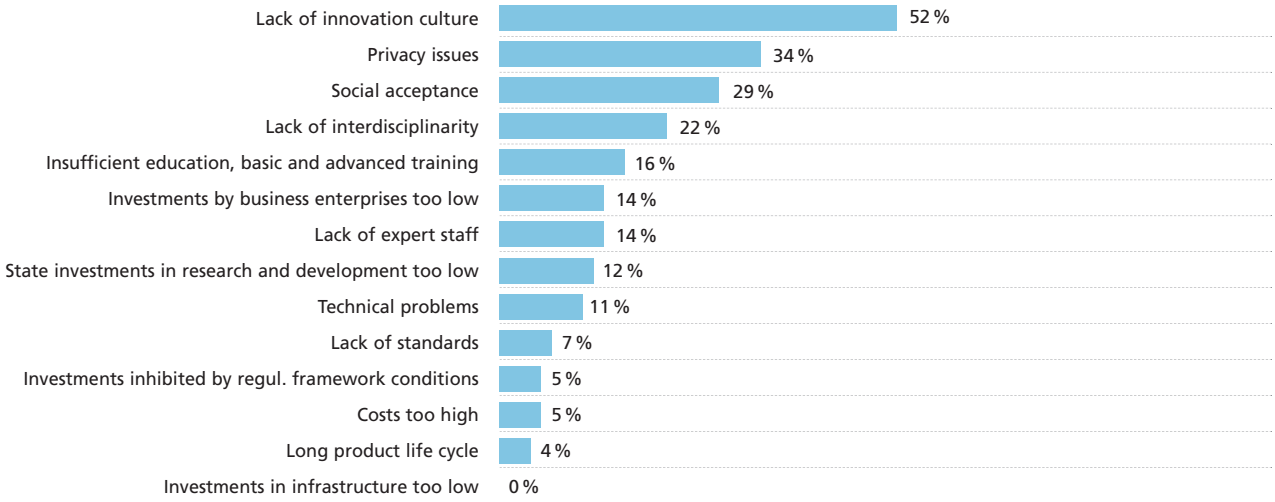
Select up to three drivers from the following list that you consider to be most important for realization of Thesis 43 above.



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n = 71

Fig. II.8: Thesis 43 Open innovation as standard – barriers

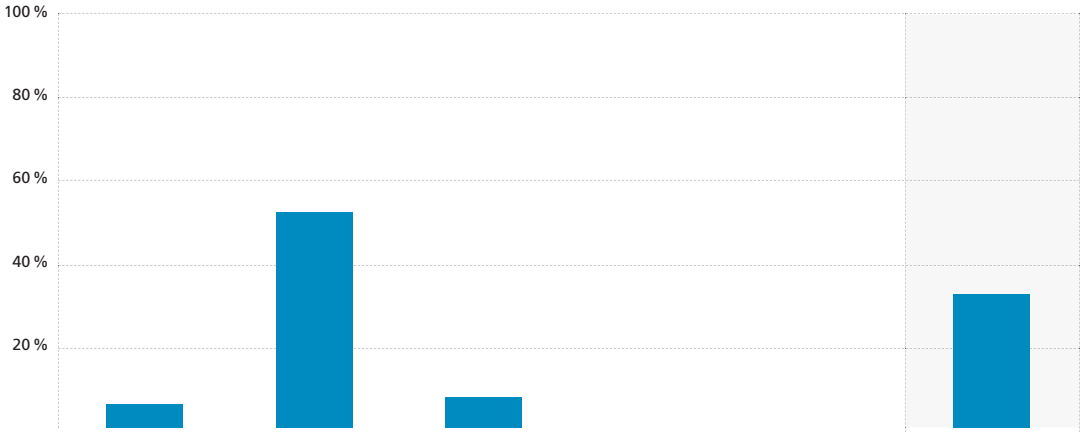
Select up to three barriers from the following list that you consider to be most important for realization of Thesis 43 above.



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n = 73

Fig. II.9: Thesis 44 Open source

Open-source processes and principles are standard for commercial software development in <country>.

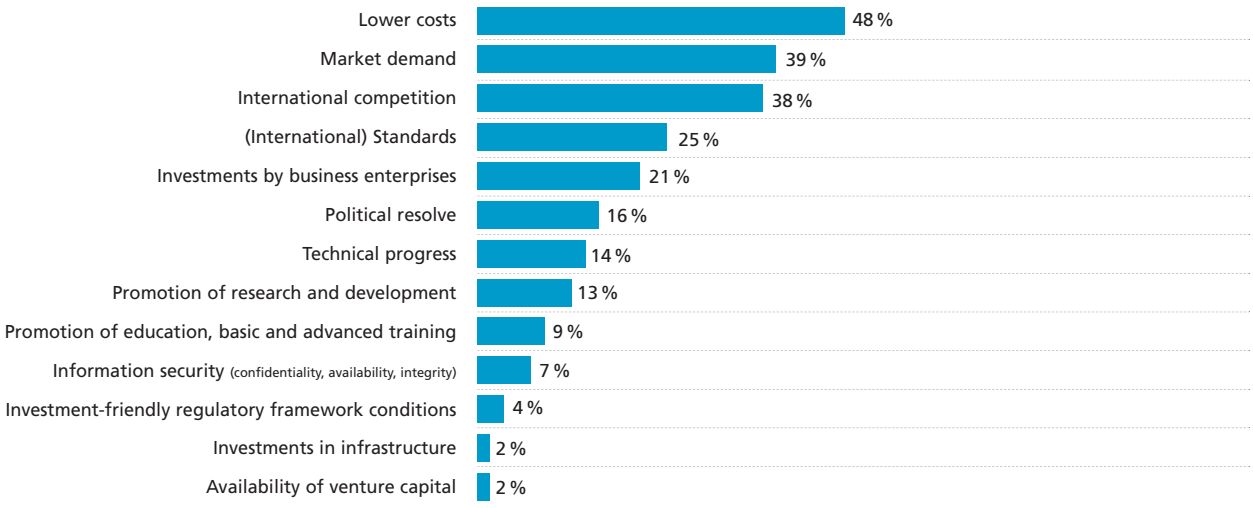


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n=61)	7 %	52 %	8 %	0 %	0 %	33 %

Basis: All people surveyed with special expertise in the topic area

Fig. II.10: Thesis 44 Open source – drivers

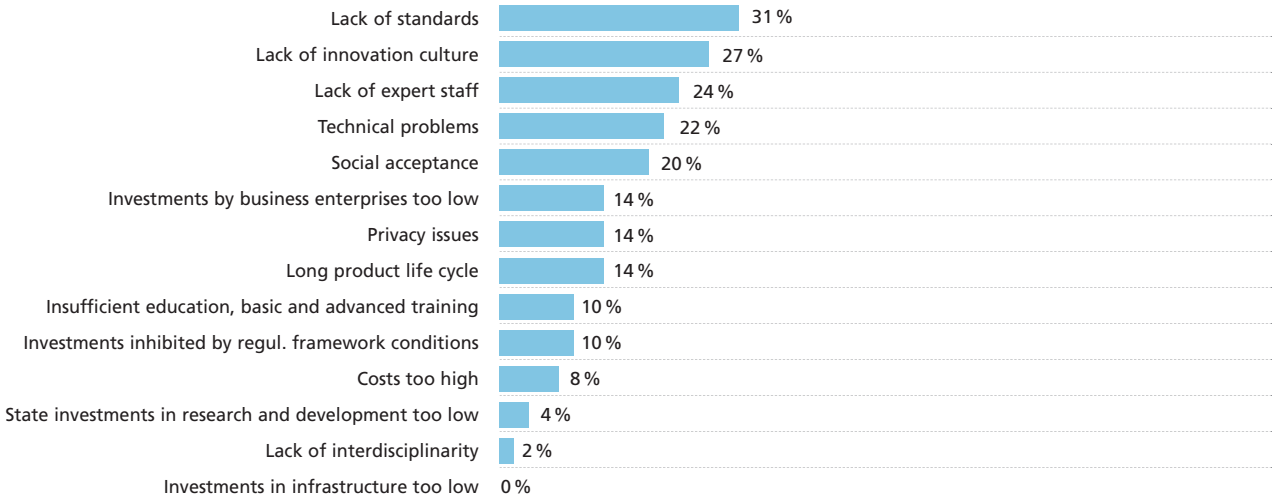
Select up to three drivers from the following list that you consider to be most important for realization of Thesis 44 above.



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n = 56

Fig. II.11: Thesis 44 Open source – barriers

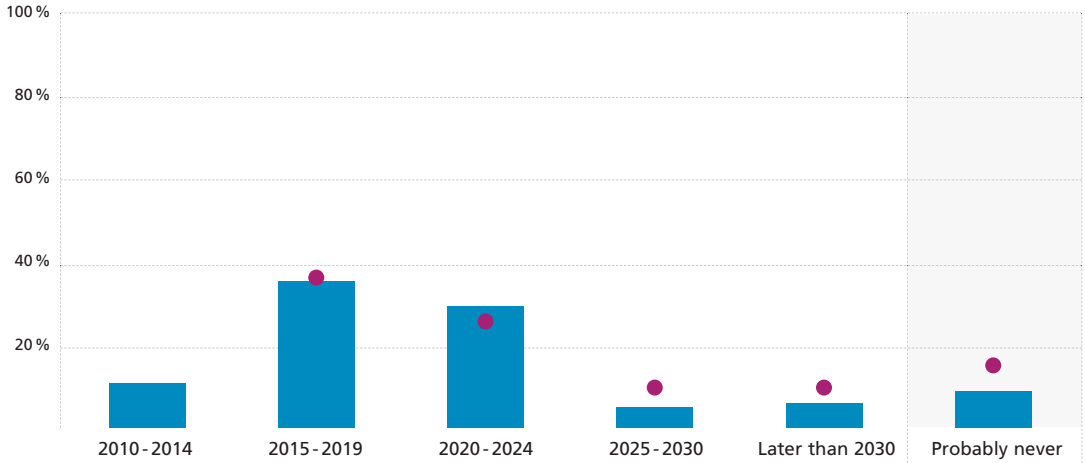
Select up to three barriers from the following list that you consider to be most important for realization of Thesis 44 above.



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n = 51

Fig. II.12: Thesis 45 Open innovation processes

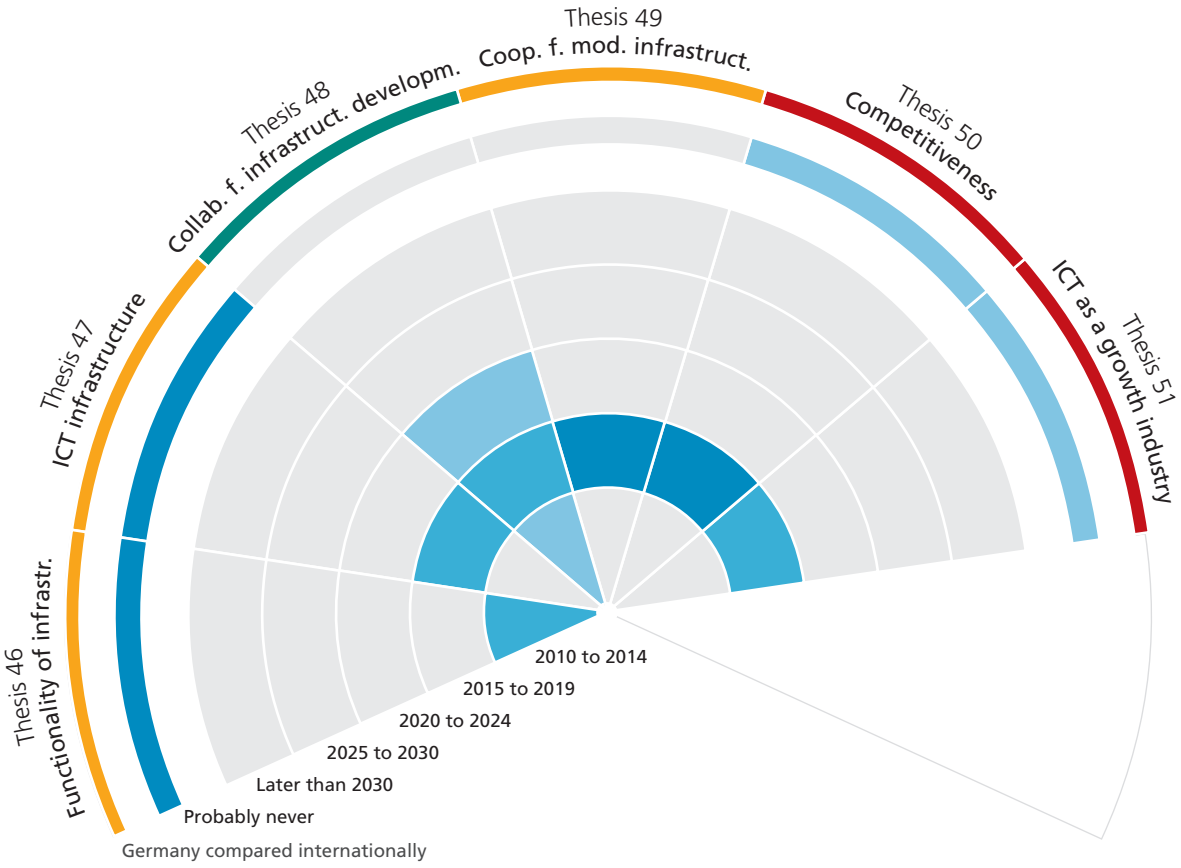
Cross-disciplinary collaboration beyond the limits of engineering (e. g., social scientists, designers, artists) is the prevailing method for innovation processes used by <national> companies.



	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 103)	12 %	36 %	30 %	6 %	7 %	10 %
EU experts (n = 19) [1]*	0 %	37 %	26 %	11 %	11 %	16 %

[1] Experts for European countries, except Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

II.2 Infrastructure policy
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts

Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 46: Functionality of infrastructure

The integrity and functionality of critical ICT infrastructures in Germany are compromised due to dependence on international system suppliers.

Thesis 47: ICT infrastructure

Thanks to political decisions, the telecommunication / ICT infrastructure in Germany has risen to become one of the best in the world.

Thesis 48: Collaboration for infrastructure development

In Germany, models for collaboration between private industry and the public sector are common practice in the development of capital-intensive telecommunication / ICT infrastructure for hitherto underserved areas.

Thesis 49: Cooperation for modern ICT infrastructure

Collaborations within private industry to expand the telecommunication / ICT infrastructure are common practice in Germany to cover the constantly high investment costs for modernization.

Thesis 50: Competitiveness through ICT

Intensive expansion and continuous modernization of the telecommunication / ICT infrastructure have made Germany internationally more competitive and crisis-proof.

Thesis 51: ICT as a growth industry

Germany has overcome the financial and economic crisis as well as regulatory barriers to investment, such that the telecommunication / ICT sector is one of the most profitable industries in the capital market.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

ICT: Infrastructure modernization with a domino effect

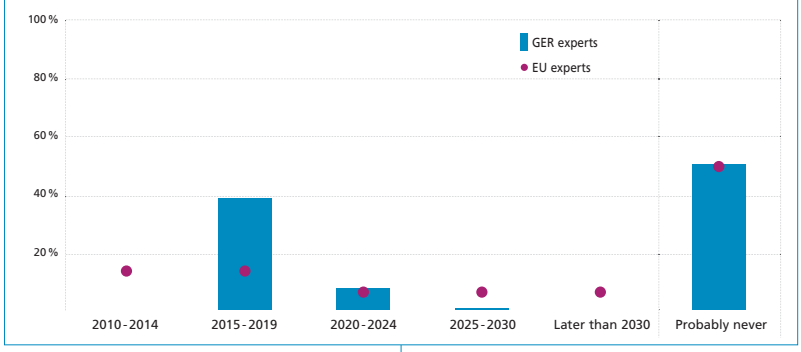
Investments in the expansion of ICT infrastructure have a particularly lasting effect because their impact goes far beyond the industry itself. A modern communication infrastructure boosts Germany's overall economic competitiveness by having a positive effect on participation in society, productivity, innovative patterns and business growth. A powerful ICT infrastructure, now more than ever, is an integral component of modern, democratic societies and a prerequisite for the efficient organization of companies, markets and government. At the same time, it is the foundation for securing a leading role for Germany among the international competition as an attractive place to do business.

Collaboration wanted – high potential for cost-intensive infrastructure expansion

The necessity of an investment-friendly economic framework for the expansion of modern infrastructure has been largely recognized and was established by experts in the previous study.

The German government's broadband strategy, recent collaborations in the private sector and novel PPP (public-private partnership) initiatives are sending the right signals for meeting the vast investments required for new network infrastructure. Accordingly, half of the experts for Germany are convinced that political decisions can help Germany to leap to the front of the pack in infrastructure development. Some 40 percent of the Germany experts surveyed assume that Germany will have one of the most powerful ICT infrastructures in the world by 2015 to 2019 (see Fig. II.15). Still, this target period, which has also been defined by the government, is not unusual in international comparison: 14 percent of the experts for other European countries believe their countries will meet this goal within the next five years. Moreover, 51 percent of the experts for Germany suspect that Germany will "probably never" achieve a top ranking in infrastructure; this skeptical estimate should be taken as an impetus to continue to promote infrastructure expansion, quickly, deliberately and enduringly.

Thesis 47: Thanks to political decisions, the telecommunication / ICT infrastructure in <country> has risen to become one of the best in the world.



Nearly all the experts agree that the high investment costs needed to expand and modernize domestic ICT infrastructures demand joint efforts. Accordingly, collaboration models within private industry and public-private partnerships are both seen as having excellent potential for directing investments at areas that are currently underserved, or not at all. Around one-fifth of the experts for Germany and Europe expect public-private partnerships to be set up within the next five years to drive infrastructure expansion in underserved areas (see Fig. II.16).

A majority of the experts for Germany predict that strictly private, cross-company collaboration to upgrade and modernize the infrastructure will take longer to become established – six to ten years – but they are convinced that it will happen: 59 percent of those surveyed believe that private collaborations will become widespread practice in Germany by 2019.

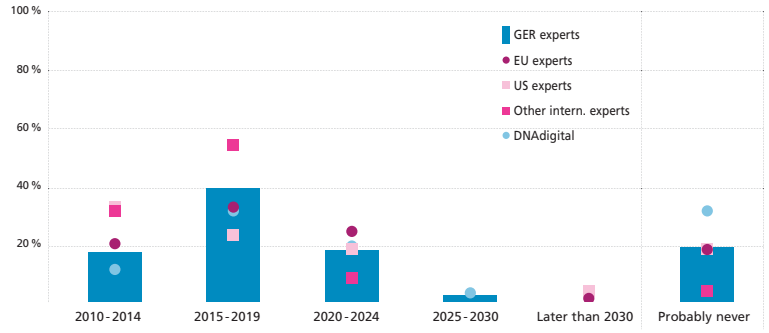
Leap of faith and high expectations of government

Most of the experts for Germany have high expectations of short-term policy decisions. The results of the study, together with many other findings, show that Germany and its knowledge-based economy simply have no alternative. Should Germany not succeed in upgrading its ICT infrastructure to a high international standard in the coming years, this will have a major negative impact on innovation, jobs, economic potential and the country's attractiveness for business in general. Germany's ICT experts see public-private partnerships as a short-term option for connecting remote – and therefore very investment-intensive – regions. Anticipated tight government budgets are only one reason why the experts believe that further upgrade and modernization of Germany's ICT infrastructure will largely be left up to private investors (see Fig. II.17). As the survey shows, the experts see an opportunity for government to create the suitable framework for investments. In the opinion of 40 percent of the experts surveyed, an intensive upgrade and modernization of the ICT infrastructure will not only make Germany more competitive by 2015 to 2019, but also more crisis-proof (see Fig. II.18).

Motivational boost from the U.S.?

The global financial and economic crisis, which had its roots in the U.S., has also impacted consumption and investment trends in the ICT industries, albeit less strongly. SME companies are currently the most affected. Nonetheless, a third of the U.S. experts expect the expansion and modernization of the telecommunication infrastructure in the U.S. between 2010 and 2014 to make a major contribution to resolving the crisis, placing particular trust in the Obama administration (see Fig. II.18). While a large portion of GER and EU experts foresee this trend for Europe and Germany as well, they expect it to occur later. For Europe, some 33 percent of the experts believe the expansion and improvement of the ICT infrastructure will not result in notable effects until 2015-2019; the figure for Germany is 40 percent. While these assessments may reflect the familiar American optimism, reinforced even more by recent initiatives from the Obama administration, it also seems to fit with the widespread belief that Europe is not pursuing the potential of its ICT industry for business development as quickly and as resolutely as it should.

Thesis 50: Intensive expansion and continuous modernization of the telecommunication / ICT infrastructure have made <country> internationally more competitive and crisis-proof.



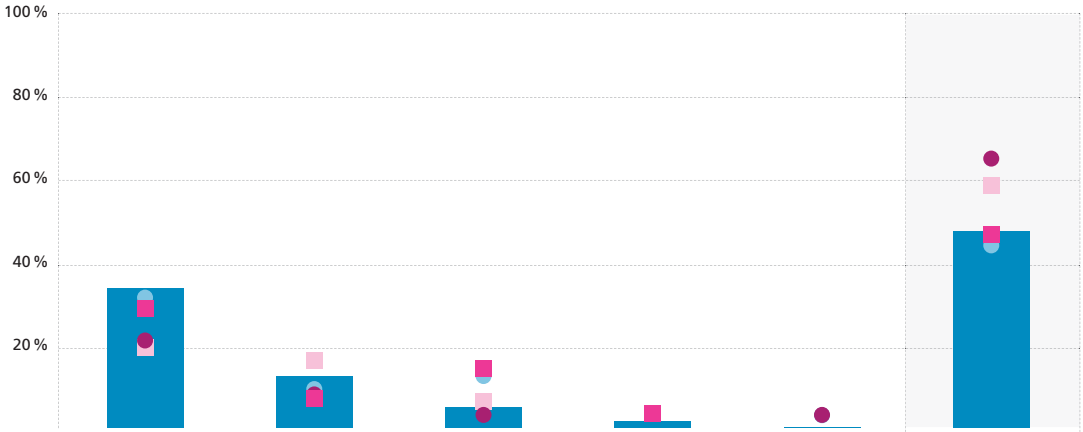
Emphasis on private investment and collaboration potential – government subsidies as a complement

By expanding and modernizing its infrastructure, the ICT industry makes a significant contribution to the economy by helping break through new technologies, as well as create social and business contacts. With a clear commitment and an improved business framework, many experts feel that government can and must contribute to the establishment and operation of a powerful communication infrastructure in Germany. Public-private partnerships (PPPs) are one possible option for equipping remote regions with expensive ICT infrastructure in the near term. In general, however, private-sector market- and collaboration-based solutions are given much more faith in their ability to achieve universal access, as emphasized in Fig. II.17. The antitrust aspects of such collaborations will have to be dealt with. At the same time, state funding must be considered in areas where the private sector is unable to provide the necessary investments. Delays in implementing a binding legal European ICT framework still pose an obstacle to more private investment, however. The EU and its member nations, as well as the private suppliers, must quickly establish the necessary prerequisites to make a sustained contribution to economic and social development and toward beating the current crisis.

Theses on "Infrastructure policy" in detail

Fig. II.13: Thesis 46 Functionality of infrastructure

The integrity and functionality of critical ICT infrastructures in <country> are compromised due to dependence on international system suppliers.

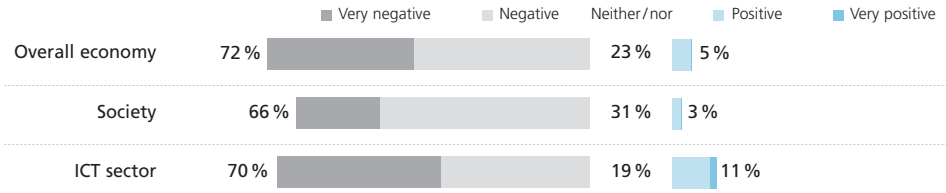


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 314)	33 %	12 %	5 %	2 %	0 %	47 %
EU experts (n = 62) [1]	21 %	8 %	3 %	0 %	3 %	65 %
U.S. experts (n = 31)	19 %	16 %	6 %	0 %	0 %	58 %
Other intern. experts (n = 28) [2]	29 %	7 %	14 %	4 %	0 %	46 %
DNAdigital (n = 32)	31 %	9 %	13 %	0 %	3 %	44 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. II.14: Thesis 46 Functionality of infrastructure – relevance

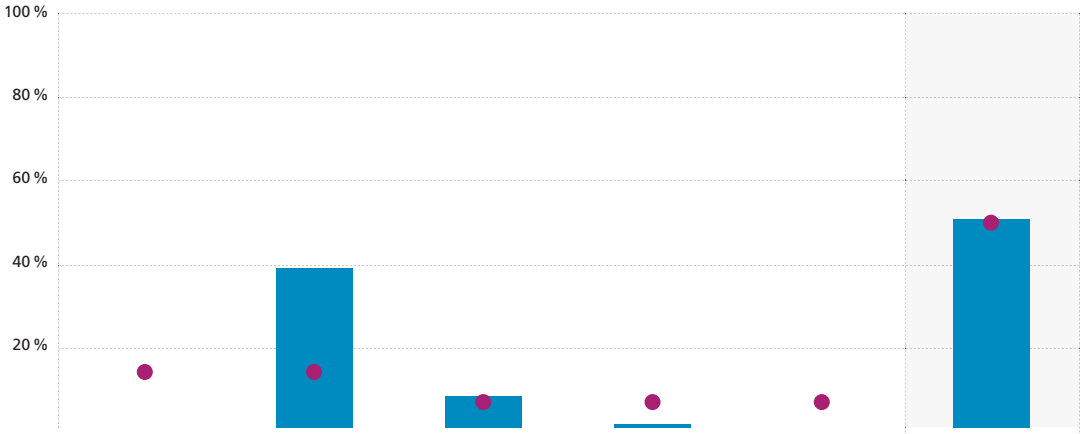
What impact will the validity of Thesis 46 above have on the areas listed below?



Basis: All people surveyed; Sub-group: GER experts, at least n = 313

Fig. II.15: Thesis 47 ICT infrastructure

Thanks to political decisions, the telecommunication / ICT infrastructure in <country> has risen to become one of the best in the world.

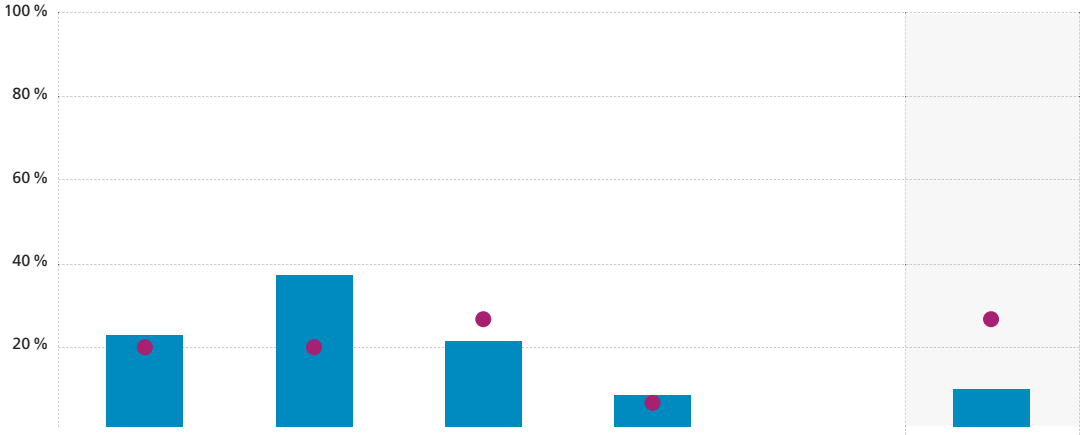


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 59)	0 %	39 %	8 %	2 %	0 %	51 %
EU experts (n = 14) [1]*	14 %	14 %	7 %	7 %	7 %	50 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. II.16: Thesis 48 Collaboration for infrastructure development

In <country>, models for collaboration between private industry and the public sector are common practice in the development of capital-intensive telecommunication / ICT infrastructure for hitherto underserved areas.

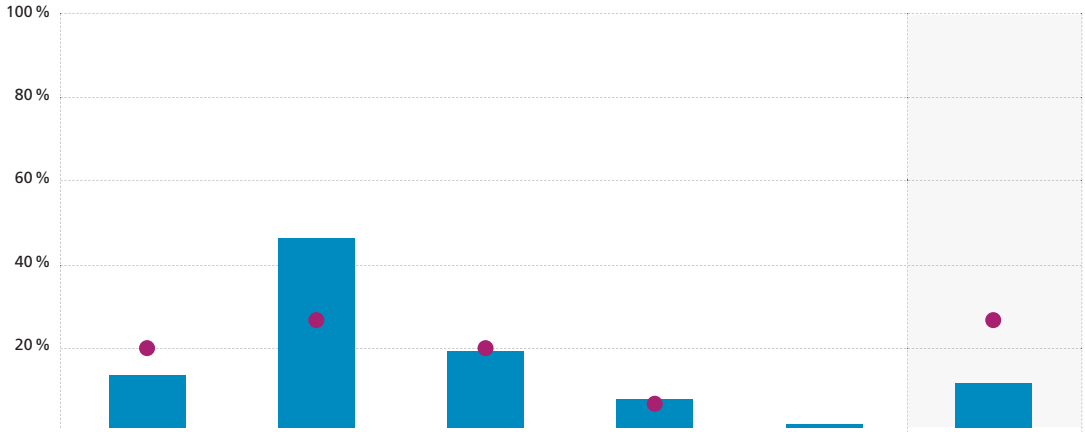


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 70)	23 %	37 %	21 %	9 %	0 %	10 %
EU experts (n = 15) [1]*	20 %	20 %	27 %	7 %	0 %	27 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. II.17: Thesis 49 Cooperation for modern ICT infrastructure

Collaborations within private industry to expand the telecommunication / ICT infrastructure are common practice in <country> to cover the constantly high investment costs for modernization.

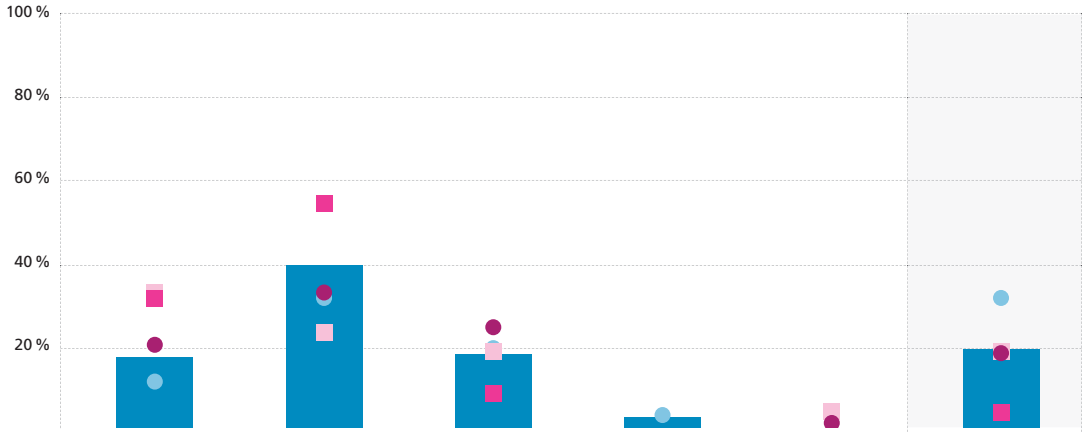


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 52)	13 %	46 %	19 %	8 %	2 %	12 %
EU experts (n = 15) [1]*	20 %	27 %	20 %	7 %	0 %	27 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. II.18: Thesis 50 Competitiveness through ICT

Intensive expansion and continuous modernization of the telecommunication / ICT infrastructure have made <country> internationally more competitive and crisis-proof.

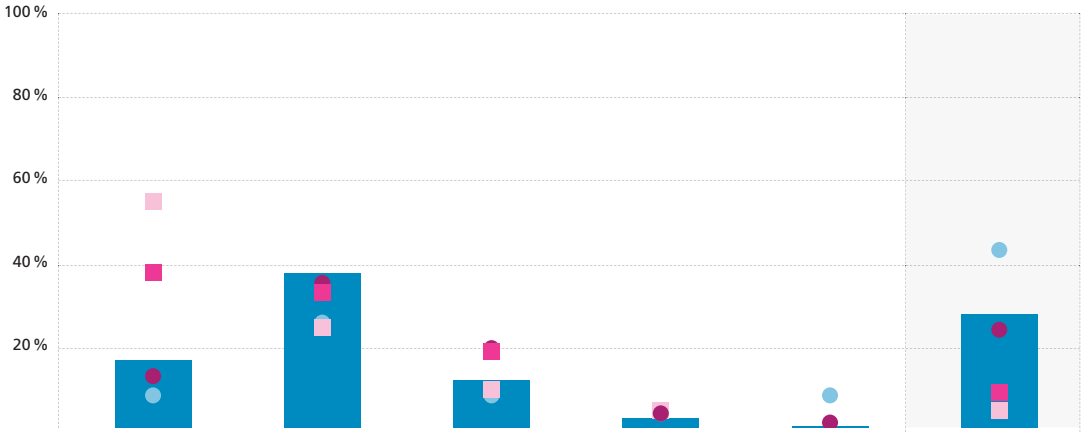


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 263)	18 %	40 %	19 %	3 %	0 %	20 %
EU experts (n = 48) [1]	21 %	33 %	25 %	0 %	2 %	19 %
U.S. experts (n = 21)	33 %	24 %	19 %	0 %	5 %	19 %
Other intern. experts (n = 22) [2]	32 %	55 %	9 %	0 %	0 %	5 %
DNAdigital (n = 25)	12 %	32 %	20 %	4 %	0 %	32 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. II.19: Thesis 51 ICT as a growth industry

<Country> has overcome the financial and economic crisis as well as regulatory barriers to investment, such that the telecommunication / ICT sector is one of the most profitable industries in the capital market.



	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 245)	17 %	38 %	12 %	3 %	1 %	28 %
EU experts (n = 45) [1]	13 %	36 %	20 %	4 %	2 %	24 %
U.S. experts (n = 20)	55 %	25 %	10 %	5 %	0 %	5 %
Other intern. experts (n = 21) [2]	38 %	33 %	19 %	0 %	0 %	10 %
DNAdigital (n = 23)	9 %	26 %	9 %	4 %	9 %	43 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

III Infrastructure development and key technologies

German industry has traditionally been a driver of new technologies. The ever-faster pace of innovation poses an enormous challenge, but also gives businesses and their customers new chances and opportunities. This section, "Infrastructure development and key technologies," examines which future developments can be expected in infrastructure and new technologies.

Infrastructure development

One of the challenges is – and will remain in the near future – the availability of broadband, along with setting up the corresponding infrastructure (see section II.2). The availability of stationary broadband not only has a positive impact on the ICT and media sector, but far beyond this, on the economy as a whole and on society.

Even so, the availability of ICT infrastructure is not the only measure of a country's future capabilities; its utilization is just as important. After all, large bandwidths are not only a prerequisite for new services, but also form the foundation for connected life and work (see section III.1).

In addition to the necessary infrastructure expansion and utilization of stationary broadband, mobile Internet use will also continue to gain importance in personal and business dealings in future (see section III.2). Although technical advances make full coverage in Germany for mobile services with even higher data transmission speeds possible, there are still deficits in implementation. The availability of additional frequencies and the creation of an investment-friendly environment are critically important. It is up to the state and its institutions to make mobile broadband available to everyone; in addition, infrastructure expansion through private companies must be supported.

A decisive prerequisite for this is that use of mobile high-speed networks must increase in coming years in line with their development.

One trend that is paralleling the growth of mobile broadband networks and their use is the development of location-based services (see section III.3): once again, a prerequisite for this is a powerful infrastructure solution that is open to the future, since the technical foundation has largely been established.

Many business sectors, such as logistics and fleet management, already use localization technology. The increased spread of localization options and the development of new services in this sector are also expected to foment change in many other areas.

Key future technologies

In addition to the necessary infrastructure development, other key technologies will be implemented in future that will have a lasting impact on business, government, and society.

One of these key technologies, whose use in a wide range of applications could have a lasting impact on business, is embedded systems (see section III.9). To exploit this potential, business and government have to be strong advocates of research and development in this area and must provide the necessary funding. The specific impact of this technology on the various areas is examined in more detail later in this study.

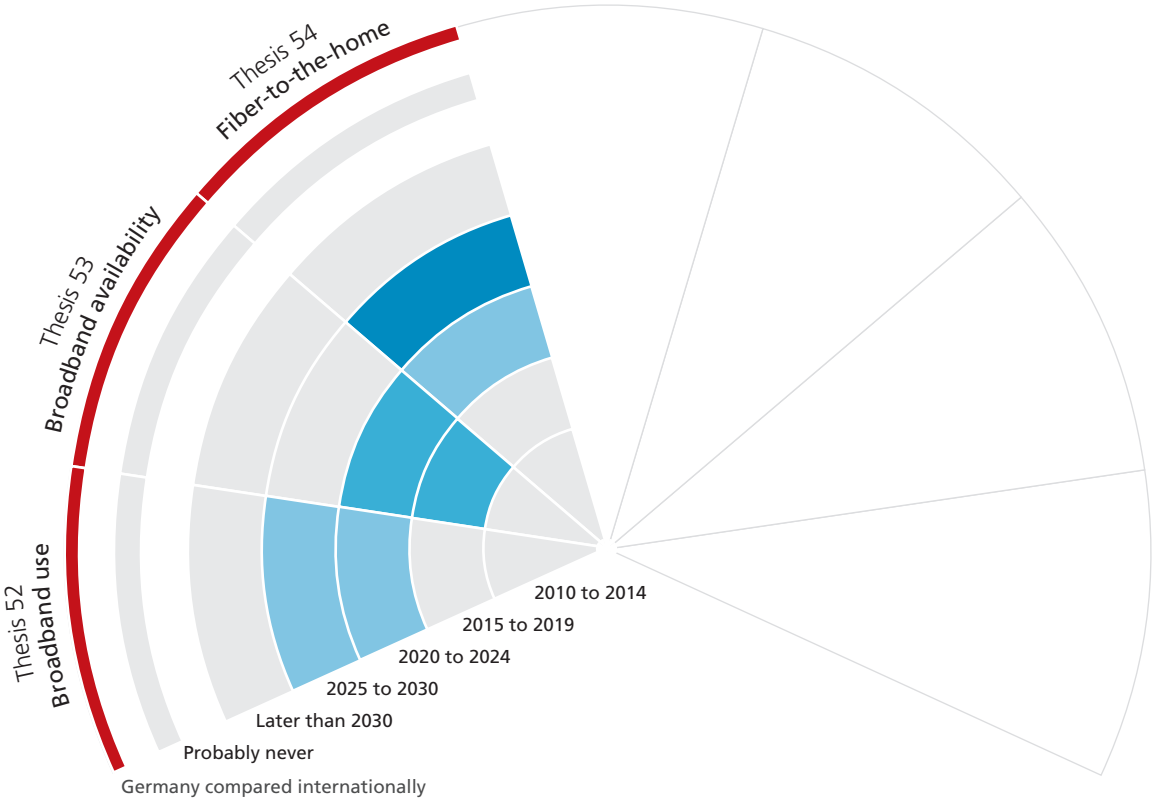
Another highly anticipated future trend that is described here is Cloud computing. Although the basic technical principles of Cloud computing have been established for some time, current technological developments have only now made it possible to implement these network-centric concepts economically from an IT perspective (see section III.5).

The study also examines the extent to which Cloud computing will result in changes in the coming years in both personal and business applications.

In addition to the changes mentioned above, the Study also examined the extent to which the basic structures of the Internet will be modernized – that is, whether a general replacement of the existing Internet Protocol is expected and/or whether a new standard (IPv6) will replace the existing standard (IPv4) in the near term (see section III.7). In this context, changes to how the Internet is used are also relevant: a major development is the transition from the traditional Internet to a semantic web, as well as in utilization and quality for users (see section III.8).

The changes in mobile and stationary infrastructures, the mutating and expanding areas of application for ICT and the new forms of using the Internet and its services will also bring with them constant developments in hardware and in particular in memory and chip technologies. The specific changes that are expected in this area are described in more detail in section III.10.

III.1 Stationary broadband of the future
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 52: Broadband use

In Germany, 95 percent of Internet users use stationary broadband with a connection speed of at least 100 MBit/s (i. e., equally for uploads and downloads).

Thesis 53: Broadband availability

In Germany, 100 MBit/s are available nationwide for stationary Internet use (i. e., equally for uploads and downloads).

Thesis 54: Fiber-to-the-home

Access networks based on optical fibers (fiber-to-the-home) are used nationwide in Germany.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

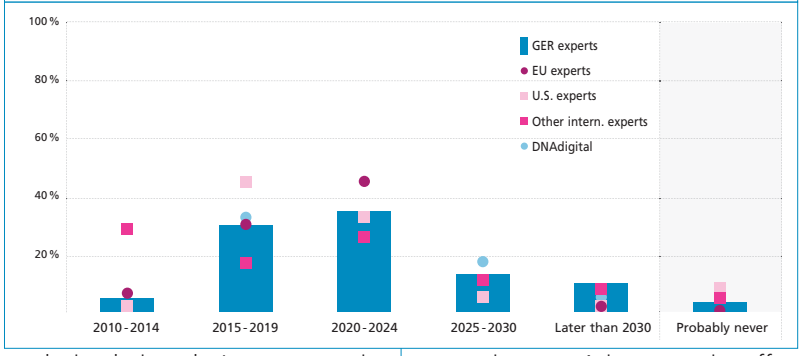
Core results

The potential of stationary broadband must be harnessed

The availability of stationary broadband not only has a positive impact on the ICT and media sector, but far beyond this, on the economy as a whole, on media usage in particular, and on society in general.

Whether or not this potential can be captured will depend on how the corresponding framework is designed. Investments in infrastructure, technical progress and business investments – based on demand for services and favorable framework conditions – can help promote the expansion of high-performance broadband and the associated positive effects. In contrast, a lack of willingness to invest, high cost factors, and a regulatory framework inhibiting investments are currently reining in broadband expansion.

Thesis 53: In <country>, 100 MBit/s are available nationwide for stationary Internet use (i. e., equally for uploads and downloads).



Positive impact of stationary broadband availability on the overall economy and society

The experts surveyed in the Delphi Study agree: the availability of stationary broadband (100 MBit/s upload and download) will have a vast positive impact - not only on the ICT and media industries, but also on the overall economy. The impact of high-speed stationary broadband on media use and on society overall are also thought to be positive by a huge measure. 92 percent of those surveyed expect a positive to very positive impact on the overall economy, and 70 percent on society as a whole; a positive impact is also widely expected for the ICT industry, the media industry and media use – at 96, 88 and 81 percent, respectively. Very few of the surveyed experts expect a negative impact on the listed areas (see Fig. III.4). In this context, the nationwide expansion of a high-performance broadband access network must be classified as a "must" for society.

Nationwide availability in Germany remains in the distant future

Only 31 percent of the experts for Germany expect nationwide availability of stationary broadband (100 MBit/s) in Germany by 2015 to 2019; 35 percent expect it as late as 2020 to 2024. Accordingly, there is a long way to go before the positive impact on business and society can be reaped. Expectations of reaching universal coverage in the rest of Europe are largely similar to those for Germany. In comparison, the forecast for the U.S. is much more optimistic: 45 percent of the U.S. experts expect universal availability by 2015 to 2019. Of the experts for other countries (particularly Asia), 29 percent expect universal coverage by the years 2010 to 2014 – significantly earlier than Europe and the U.S. (see Fig. III.3). The survey was not able to clarify the extent to which the special, state-funded expansion programs in some Asian countries affect this assessment.

Aside from availability, actual use is also critical

An interesting discrepancy appears when we compare the results for the impact of availability of 100 MBit/s stationary Internet with the impact of its actual use. The experts for Germany expect a greater impact on business and society solely from availability than from actual use, which will by definition follow with some delay (see Fig. III.2).

Ergo, to capture the full potential, the initial focus must lie on creating suitable framework conditions and supporting initiatives (such as public-private partnerships for regions in which strictly private investments would be unprofitable) to promote the network upgrade. Once this is achieved, further positive effects can be gained through the proper usage incentives.

Enormous importance of fiber-based access solutions on the demand side – will Germany be a laggard?

43 percent of the experts surveyed expect that stationary broadband with 100 MBit/s will be used in Germany by 95 percent of Internet users by 2024 at the latest (see Fig. III.1). At the same time, 39 percent of the experts predict that fiber-to-the-home access will be available nationwide in Germany by 2024 at the latest (see Fig. III.7). This access type will therefore have a much larger significance on the demand side than other kinds of access. At the same time, however, it is once again striking that the experts for the U.S. are in much greater agreement (60 percent) in assuming that stationary broadband (100 MBit/s) will be used in nearly the entire country by 2024 at the latest. Expectations for fiber-optic usage in Europe are also much more optimistic: 72 percent of the experts for European

countries expect universal use of fiber-to-the-home (FttH) by 2024. This raises questions as to the cause of Germany's much more cautious forecasts.

Private business infrastructure investments are the prime lever – but costs and regulatory framework drag

According to the experts, investments in infrastructure, technical progress, and investments by private businesses are the most important drivers for universal availability of high-performance broadband and the resulting impact on business and society. At the same time, insufficient infrastructure investments, excessive costs, and a regulatory framework inhibiting investments are currently the greatest obstacles in Germany (see Fig. III.5 and III.6).

Summary

Nearly all the experts surveyed agree that the major positive boost that high-speed broadband (> 100 MBit/s) will give to business and society must be utilized. At the same time, the opinions of the international experts paint a picture of Germany as a future "laggard" in broadband expansion and usage – especially fiber-to-the-home. This image must be countered quickly and decisively, to increase Germany's competitiveness and attraction as a place to do business and to benefit from the positive impetus of broadband development as outlined in the EU strategy. This requires fast, sustained measures to support the described drivers and combat the barriers (see Fig. III.5 and III.6).

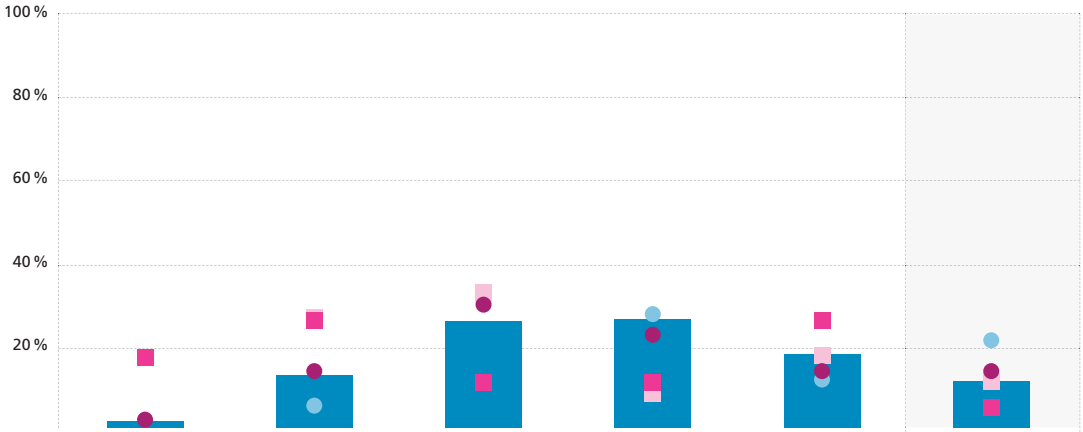
First and foremost, this means creating an investment-friendly framework to enable private businesses to collaborate in their expansion activities. In addition, targeted public investments in infrastructure (particularly as public-private partnerships) or passive infrastructure (such as conduits) could help trigger change in areas where strictly private investment would not be profitable.

Bold, forward-looking capital spending plans by private network operators and investors are the major drivers of broadband expansion by far; these must be supplemented by targeted public initiatives. These ambitious investment projects must be supported and promoted quickly by a suitable regulatory framework at both the EU and national level.

Theses on "Stationary broadband of the future" in detail

Fig. III.1: Thesis 52 Broadband use

In <country>, 95 percent of Internet users use stationary broadband with a connection speed of at least 100 MBit/s (i.e., equally for uploads and downloads).

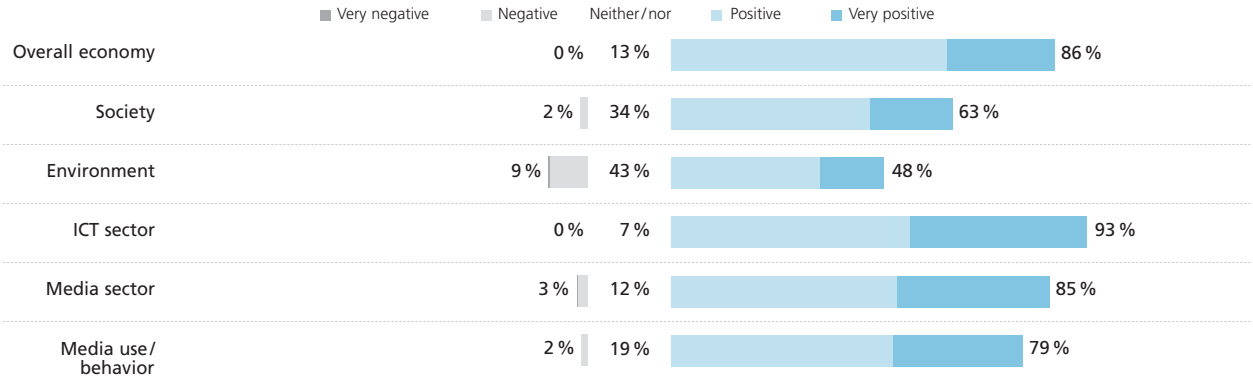


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 355)	3 %	14 %	26 %	27 %	19 %	12 %
EU experts (n = 69) [1]	3 %	14 %	30 %	23 %	14 %	14 %
U.S. experts (n = 33)	0 %	27 %	33 %	9 %	18 %	12 %
Other intern. experts (n = 34) [2]	18 %	26 %	12 %	12 %	26 %	6 %
DNAdigital (n = 32)	0 %	6 %	31 %	28 %	13 %	22 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. III.2: Thesis 52 Broadband use – relevance

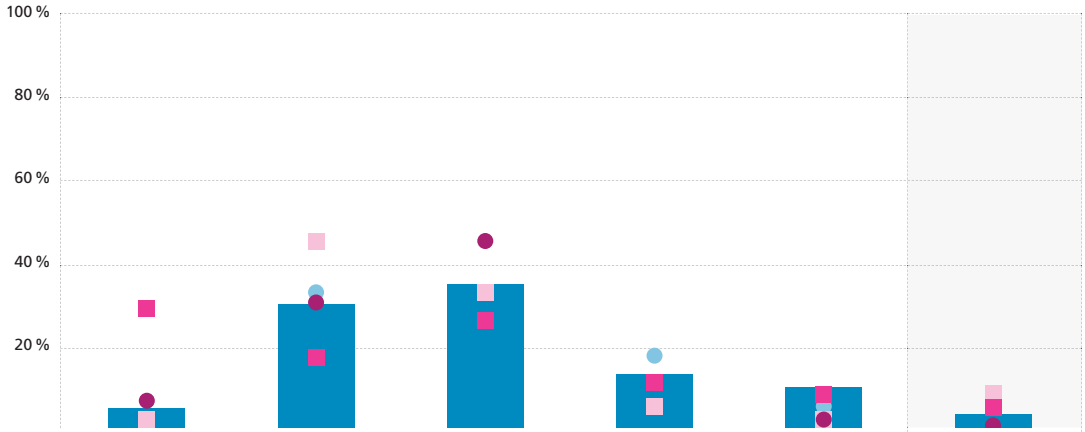
What impact will the validity of Thesis 52 above have on the areas listed below?



Basis: All people surveyed; Sub-group: GER experts, at least n = 331

Fig. III.3: Thesis 53 Broadband availability

In <country>, 100 MBit/s are available nationwide for stationary Internet use (i. e., equally for uploads and downloads).

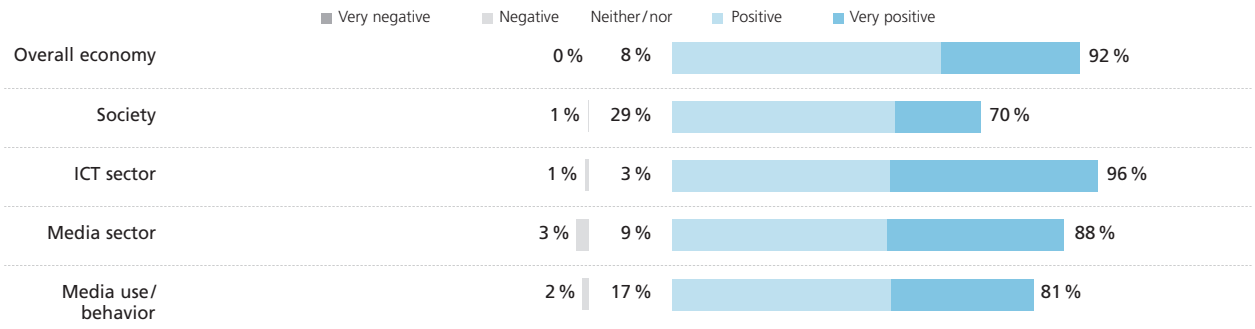


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 357)	6 %	31 %	35 %	14 %	11 %	4 %
EU experts (n = 68) [1]	7 %	31 %	46 %	12 %	3 %	1 %
U.S. experts (n = 33)	3 %	45 %	33 %	6 %	3 %	9 %
Other intern. experts (n = 34) [2]	29 %	18 %	26 %	12 %	9 %	6 %
DNAdigital (n = 33)	3 %	33 %	33 %	18 %	6 %	6 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. III.4: Thesis 53 Broadband availability – relevance

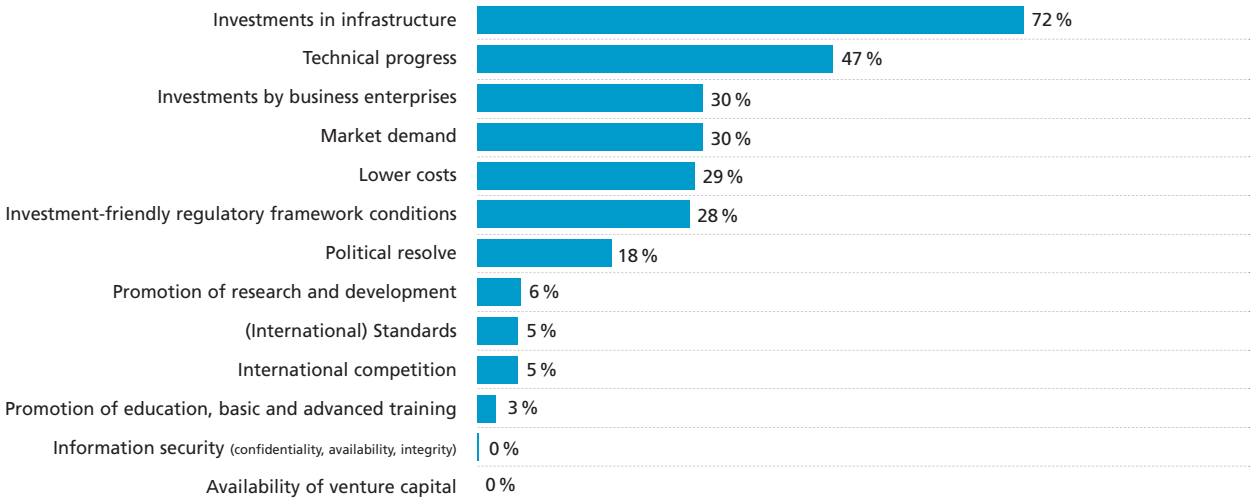
What impact will the validity of Thesis 53 above have on the areas listed below?



Basis: All people surveyed; Sub-group: GER experts, at least n = 348

Fig. III.5: Thesis 53 Broadband availability – drivers

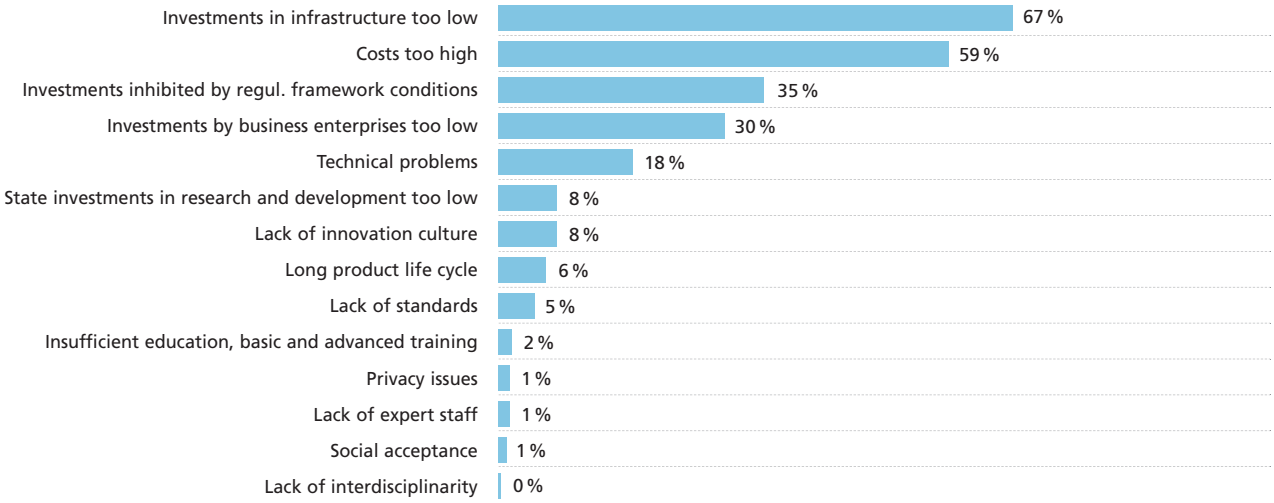
Select up to three drivers from the following list that you consider to be most important for realization of Thesis 53 above.



Basis: All people surveyed; Sub-group: GER experts, n = 276

Fig. III.6: Thesis 53 Broadband availability – barriers

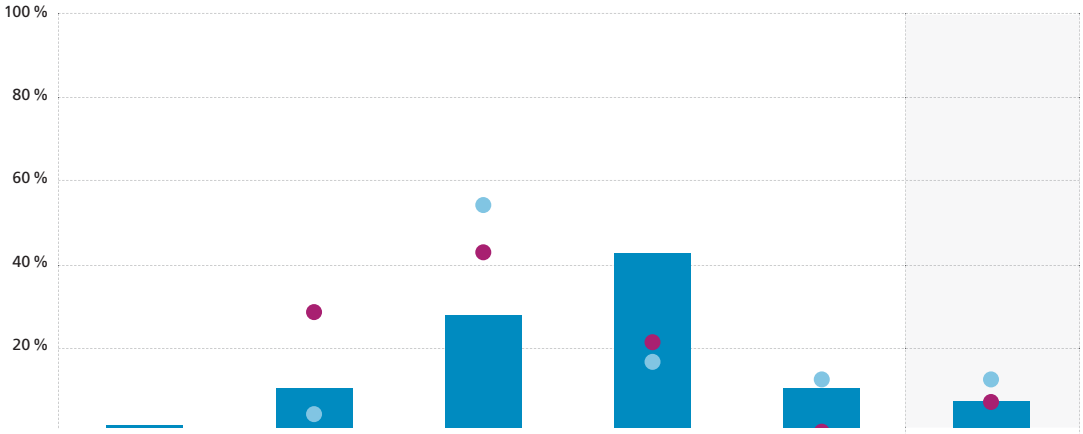
Select up to three barriers from the following list that you consider to be most important for realization of Thesis 53 above.



Basis: All people surveyed; Sub-group: GER experts, n = 273

Fig. III.7: Thesis 54 Fiber-to-the-home

Access networks based on optical fibers (fiber-to-the-home) are used nationwide in <country>.

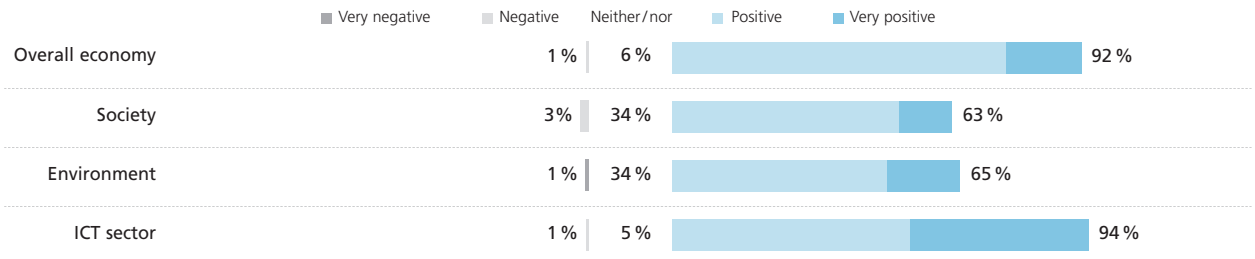


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 68)	1 %	10 %	28 %	43 %	10 %	7 %
EU experts (n = 14) [1]*	0 %	29 %	43 %	21 %	0 %	7 %
DNAdigital (n = 24)	0 %	4 %	54 %	17 %	13 %	13 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. III.8: Thesis 54 Fiber-to-the-home – relevance

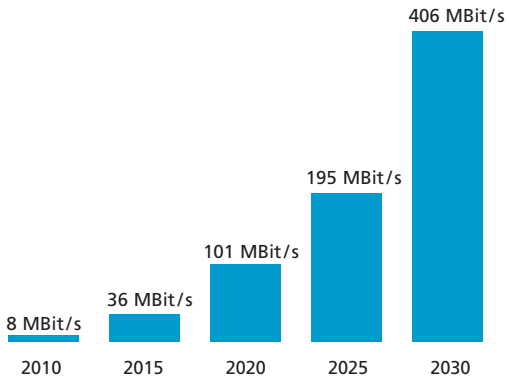
What impact will the validity of Thesis 54 above have on the areas listed below?



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, at least n = 74

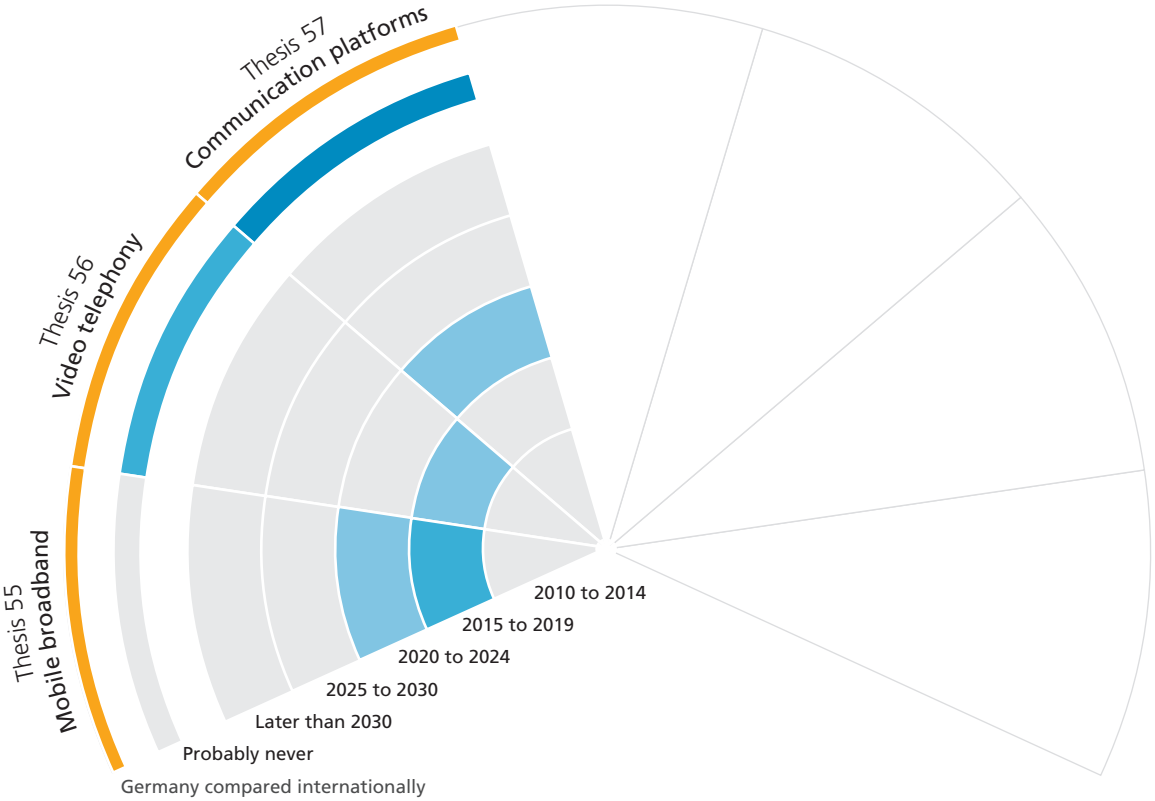
Fig. III.9: Future stationary bandwidth

What average bandwidth will be used for stationary Internet access in Germany at the times quoted:



The mean value is shown
Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, at least n=51

III.2 Mobile broadband and mobile communication
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 55: Mobile broadband

In Germany, 50 MBit/s are available nationwide for mobile Internet use (i. e., equally for uploads and downloads).

Thesis 56: Video telephony

In Germany, 75 percent of cell phone users use video telephony on their mobile device.

Thesis 57: Communication platforms

Open architecture solutions have replaced proprietary and closed communication platforms (e. g., cellular technology, machine-to-machine communication) in Germany.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

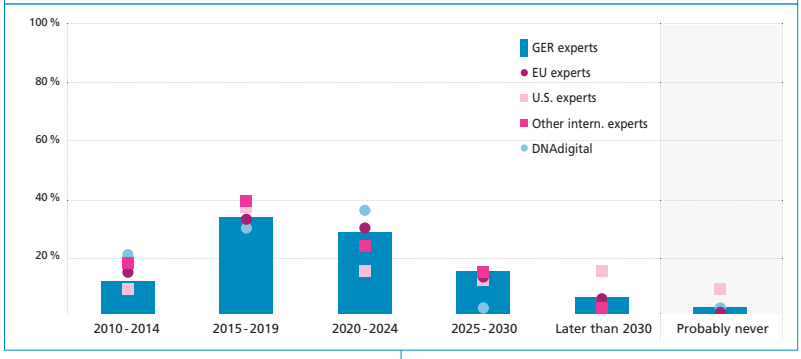
Core results

It is technically possible to provide nationwide mobile broadband coverage with even higher data transmission speeds for all of Germany, but this requires additional frequencies below 1,000 MHz to be made available and an environment to be created that provides incentives for investments. It is up to the state and its institutions to support this expansion of the infrastructure through private companies.

Bold regulatory decisions needed to promote universal mobile broadband coverage

The majority of the experts for Germany surveyed as part of the Delphi Study believe that universal mobile broadband coverage with 50 MBit/s will be possible in Germany in six to fifteen years (see Fig. III.10). This is especially necessary given that stationary broadband technologies will continue to increase data rates significantly in the next two decades. This will result in market and customer expectations for a further boost in data rates in mobile networks. In urban environments, rates of up to 1 GBit/s are theoretically possible – this fact will further widen the digital divide between city and countryside if fiber connections are not extended to rural regions. But demand for powerful mobile data transmission will continue to increase even if we can achieve an almost even distribution of high-performance stationary broadband accesses, since the population will want to access sophisticated data services through ever more attractive mobile devices.

Thesis 55: In <country>, 50 MBit/s are available nationwide for mobile Internet use (i. e., equally for uploads and downloads).



In contrast to today's mobile networks, universal, high-speed, broadband mobile offerings will demand the availability of additional spectrum below 1,000 MHz. Data rates of up to 6 MBit/s with broad coverage will be possible in Germany and Europe once the appropriate frequencies are assigned and the Next Generation Mobile Networks are implemented in the frequency range 790–862 MHz. In contrast, universal mobile offerings of up to 50 MBit/s will not be possible until a subsequent mobile phone generation (such as LTE – Long Term Evolution – advanced technology).

In all of this, we must consider that mobile broadband networks are by definition a shared medium, which means high bit rates can only be utilized simultaneously by relatively few users. For this reason, the mobile broadband network will never be a sustainable alternative to expansion of the stationary broadband network, although it will remain an important complement.

An enhanced mobile broadband network will only be possible through use of the combined frequency resources from the "digital dividend" (790–862 MHz range), the established 900 MHz frequencies and additional broadcasting frequencies below 790 MHz. To enable this, additional regulatory prerequisites still have to be created. In particular, this includes the rapid auction of frequencies from the "digital dividend," which are becoming available as a result of the digitization of broadcasting (planned in early 2010), as well as the medium to long-term reservation of other frequencies from this spectrum range.

The ongoing development of universal mobile broadband will stimulate all areas of the economy

Nearly all the surveyed experts for Germany agree that the impetus from the further expansion of mobile broadband throughout the country will have a positive to very positive impact on society (66 percent) and the economy (90 percent) as a whole (see Fig. III.11). The figures from international studies clearly confirm this. As one would expect, the expansion is deemed to have an especially positive impact on further development of the ICT industry (95 percent). This is also important because the initial emphasis of mobile broadband does not lie in urban areas or areas with high population density, but instead will provide a positive impetus for developments in the countryside, to help bridge the digital divide.

Willingness to invest and favorable regulatory framework are critical

The surveyed experts primarily see investments in infrastructure as a major driver for this development (66 percent), followed by technical progress (47 percent), lower costs (39 percent) and companies' willingness to invest (31 percent) based on market demand for services (29 percent). Not surprisingly (because mobile communication is subject to comparatively less regulation), the necessity of investment-friendly regulatory framework conditions is given a lower – though still noteworthy – weight (20 percent), as is the government's political resolve (13 percent); the other factors are largely negligible (see Fig. III.12).

The figures for barriers give a nearly identical picture: the major obstacles are seen to be too low investments in infrastructure (67 percent), excessive costs (60 percent), a lack of willingness for companies to invest (32 percent), regulatory framework conditions that inhibit investments (25 percent) and technical problems (21 percent; see Fig. III.13). In the context of regulatory framework conditions, the issues of frequency allocation and planning addressed above play a major role.

Customer usage pattern

In the survey, video telephony, an especially data-intensive mobile service, was used as an example to try to estimate future use of novel offerings (see Fig. III.15). Despite the availability of mobile bandwidth, some of the experts do not expect market penetration for this specific service until a very late date, if at all. This is in agreement with previous experience with video telephony in the landline network (such as Internet-based video telephony), which continues to be a niche product although it has been available for years.

Apparently, much less sustained mobile demand is expected for this service than for other mobile applications, such as Internet surfing, games, navigation, small videos and various innovative, data-intensive apps, etc., some of which have already attracted amazing numbers of users and immense data volume.

Global mobile communication standards and harmonized frequency ranges are essential

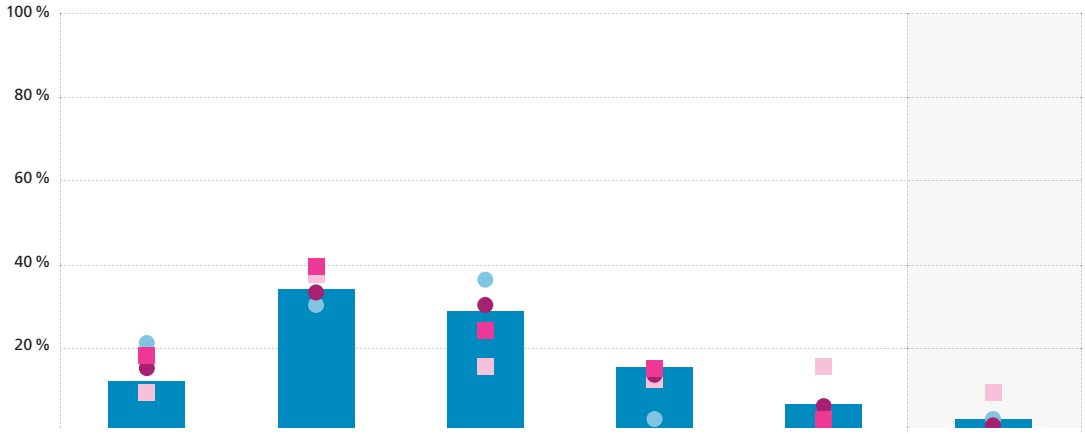
The experts for Germany (62 percent) and Europe (47 percent) agree that proprietary, closed platform solutions will not be widely replaced by open solution approaches in the development of future mobile communication systems, meaning completely open solutions will play a minuscule role (see Fig. III.16).

This confirms the belief of manufacturers and network operators that global mobile communication standards will continue to be essential. Only such standards, together with frequency ranges harmonized throughout Europe – or even better, throughout the world – will allow the economies of scale that will benefit operators and customers alike.

Theses on "Mobile broadband and mobile communication" in detail

Fig. III.10: Thesis 55 Mobile broadband

In <country>, 50 MBit/s are available nationwide for mobile Internet use (i. e., equally for uploads and downloads).

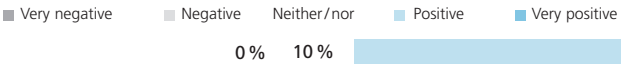


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 355)	12 %	34 %	29 %	15 %	6 %	3 %
EU experts (n = 66) [1]	15 %	33 %	30 %	14 %	6 %	2 %
U.S. experts (n = 32)	9 %	38 %	16 %	13 %	16 %	9 %
Other intern. experts (n = 33) [2]	18 %	39 %	24 %	15 %	3 %	0 %
DNAdigital (n = 33)	21 %	30 %	36 %	3 %	6 %	3 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. III.11: Thesis 55 Mobile broadband – relevance

What impact will the validity of Thesis 55 above have on the areas listed below?

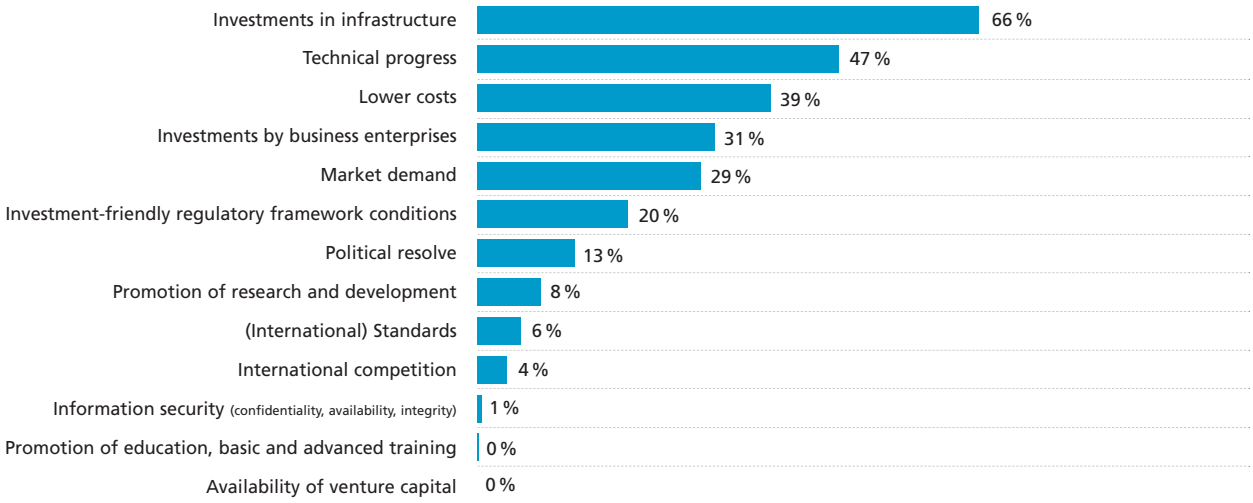


Overall economy	0 %	10 %		90 %
Society	1 %	33 %		66 %
ICT sector	0 %	4 %		95 %
Media sector	3 %	9 %		88 %
Media use/ behavior	2 %	17 %		80 %

Basis: All people surveyed; Sub-group: GER experts, at least n = 339

Fig. III.12: Thesis 55 Mobile broadband – drivers

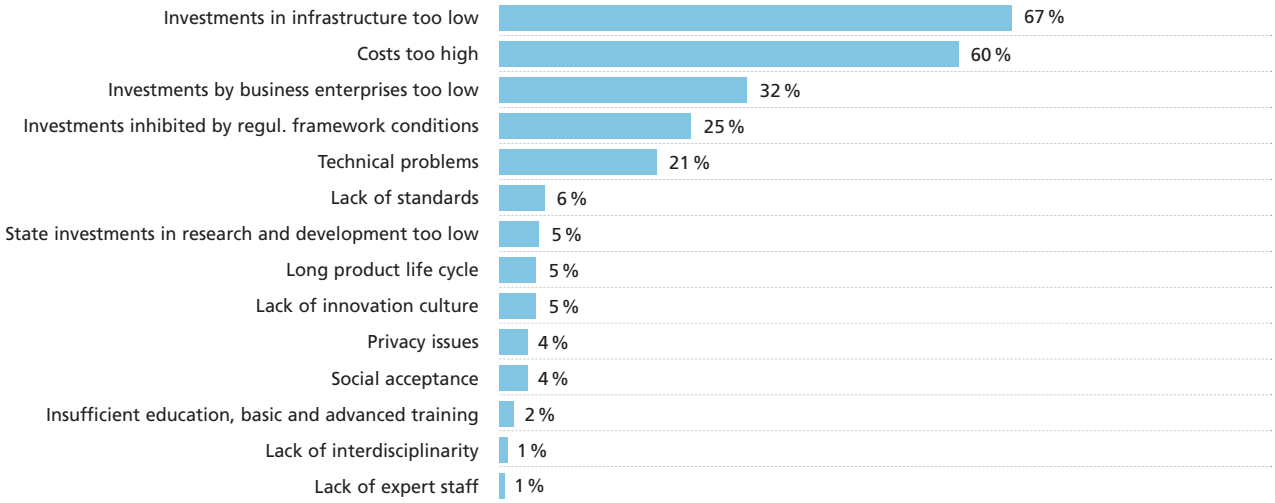
Select up to three drivers from the following list that you consider to be most important for realization of Thesis 55 above.



Basis: All people surveyed; Sub-group: GER experts, n = 272

Fig. III.13: Thesis 55 Mobile broadband – barriers

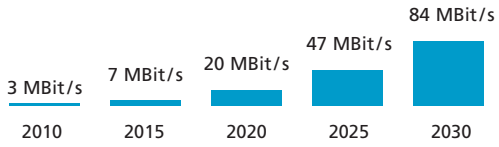
Select up to three barriers from the following list that you consider to be most important for realization of Thesis 55 above.



Basis: All people surveyed; Sub-group: GER experts, n = 271

Fig. III.14: Future mobile bandwidth

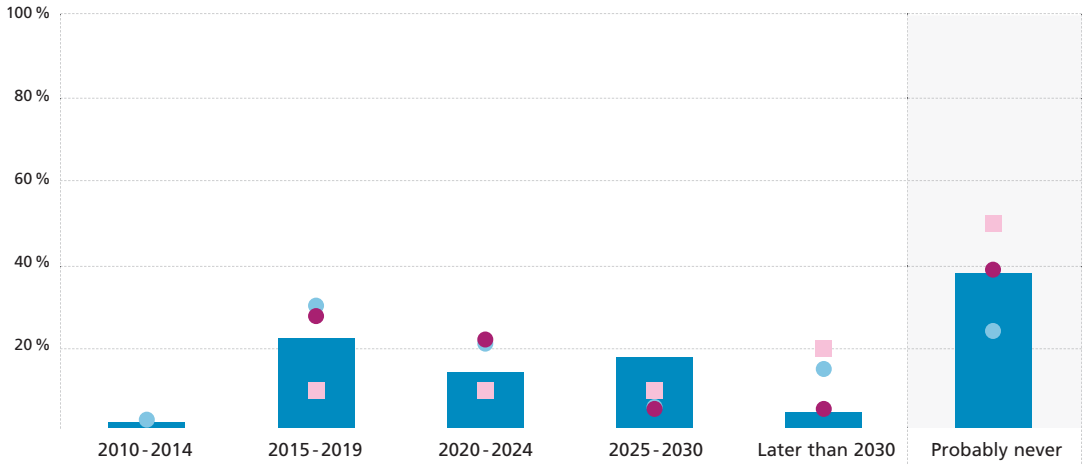
What average bandwidth will be used for mobile Internet access in Germany at the times quoted:



The mean value is shown
Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, at least n=41

Fig. III.15: Thesis 56 Video telephony

In <country>, 75 percent of cell phone users use video telephony on their mobile device.

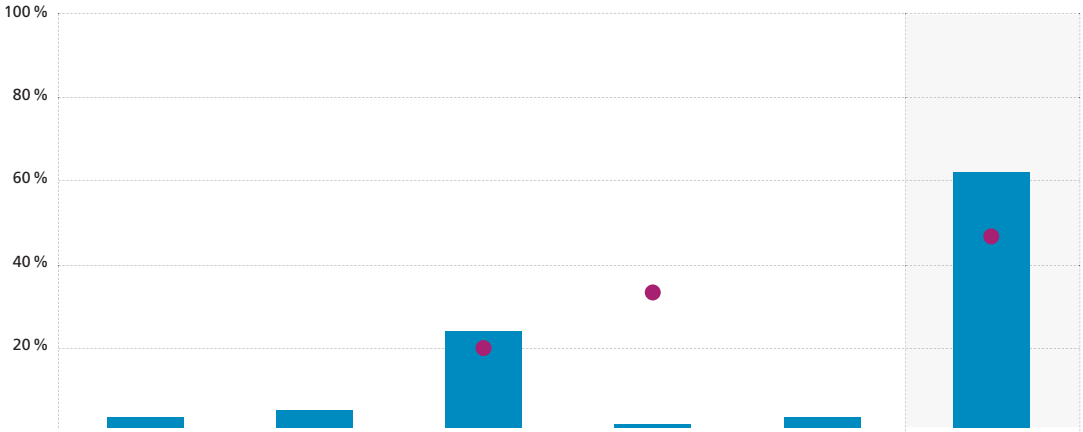


	2010-2014	2015-2019	2020-2024	2025-2030	Later than 2030	Probably never
GER experts (n=84)	2 %	23 %	14 %	18 %	5 %	38 %
EU experts (n=18) 1*	0 %	28 %	22 %	6 %	6 %	39 %
U.S. experts (n=10) *	0 %	10 %	10 %	10 %	20 %	50 %
DNAdigital (n=33)	3 %	30 %	21 %	6 %	15 %	24 %

1 Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. III.16: Thesis 57 Communication platforms

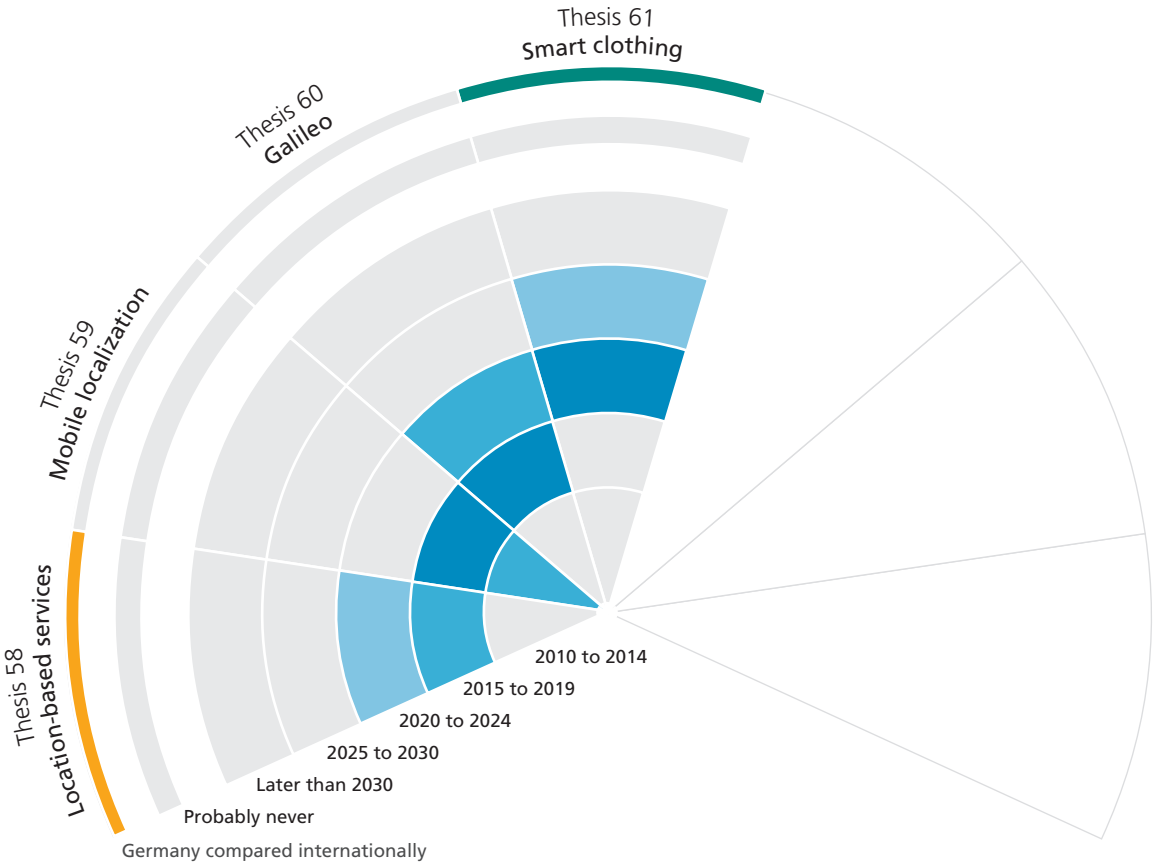
Open architecture solutions have replaced proprietary and closed communication platforms (e. g., cellular technology, machine-to-machine communication) in <country>.



	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 58)	3 %	5 %	24 %	2 %	3 %	62 %
EU experts (n = 15) [1]*	0 %	0 %	20 %	33 %	0 %	47 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

III.3 Navigation and localization
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts

Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 58: Location-based services

In Germany, 75 percent of cell phone users access location-based services on a daily basis through their mobile device.

Thesis 59: Mobile localization

Navigation, positioning and localization systems (e. g., Galileo, GPS) are standard components of all mobile devices (e. g., cell phones, cameras).

Thesis 60: Galileo

Galileo has established itself as the standard for positioning and localization services in Europe.

Thesis 61: Smart clothing

Operating devices, sensors as well as positioning and navigation modules for communication with a mobile device are integrated in work clothes, athletic gear and daily wear and widely disseminated in Germany.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

Navigation and localization will become standard in more and more business sectors

For a long time, only a very few specialized, tech-friendly experts used navigation and location-based services. Today, navigation systems are standard equipment in motor vehicles and many upscale mobile phones are also equipped with exact positioning and navigation functions. Many business sectors – such as logistics, fleet management, sales and personal security – already make intensive use of localization technologies. Through the increasing spread of localization and communication options and the development of new technologies and services in this area, changes will also occur in many other sectors. New possibilities for filtering, controlling and monitoring information, as well as creating profiles, will arise. They promise a great deal of positive potential for the makers of localization and navigation systems, as well as for the users of these systems and services. However, experts are also discussing the negative aspects, such as the dangers posed by the loss of privacy.

Technical foundation first, then the services – Delphi experts see vast growth potential in navigation and localization

A majority of the experts for Germany (74 percent) expects navigation, positioning and localization systems (e. g., Galileo, GPS) to become available in every mobile device (e. g., mobile phones, cameras) in a time frame from 2010 to 2019 – that is, in the relatively short term (see Fig. III.18).

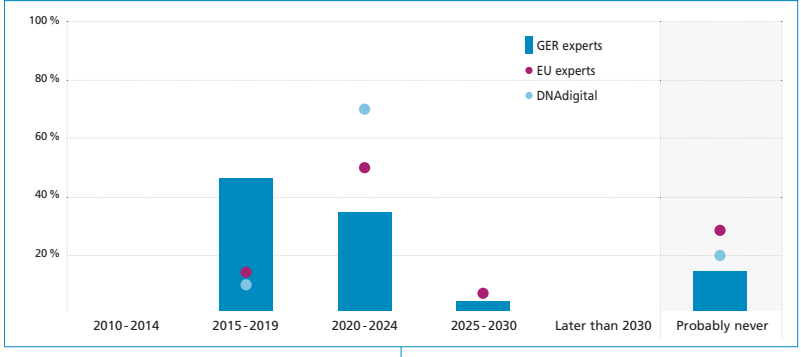
However, the widespread use of services that utilize this information is not expected until a later time (see Fig. III.17). According to 59 percent of the experts for Germany, 75 percent of mobile phone users will use location-based services on their mobile devices daily by 2015 to 2024. The predictions by the experts for Europe are similar (71 percent). The experts surveyed in the DNAdigital group are particularly optimistic about the daily use of location-based services.

We must assume that the expectations for these two theses include the effect that the technological foundation must become available first before the corresponding services can be developed and spread among users. In addition, issues involving the user-friendliness – and thus the practicality – of these services on user devices will not be finally resolved before their use has become widespread.

While only a small share of those surveyed believe that the thesis regarding the broad availability of localization systems in mobile devices will never occur, the share of skeptics is much higher when it comes to the integration of controls and localization/navigation modules in smart clothing (see Fig. III.21). 33 percent of the experts for the European region believe this thesis will never occur; the remaining majority does not expect it to occur until a later time (2020 to 2030).

A majority of experts for Germany expects the establishment of Galileo as the standard for navigation and location-based services in Europe to occur in the time frame from 2015 to 2024. However, 29 percent of the surveyed experts for Europe do not expect this thesis to occur at all (see Fig. III.19). Although the opinion that Galileo will never establish itself as the European standard is shared by 20 percent of the DNAdigital group, the vast majority of them (80 percent), as well as the Germany experts, believe that Galileo will have become the standard by 2024 at the latest (see Fig. III.19). The experts for Germany foresee Galileo having a positive impact on both the overall economy (73 percent) and on the ICT industry in particular (80 percent). When asked about the reasons why Galileo is expected to become the standard in Europe, a majority of the surveyed experts cited the system's technical superiority and Europe's ambitions for independence from an American provider. The most important drivers for Europe-wide standardization are deemed to be political resolve and support by the European Union.

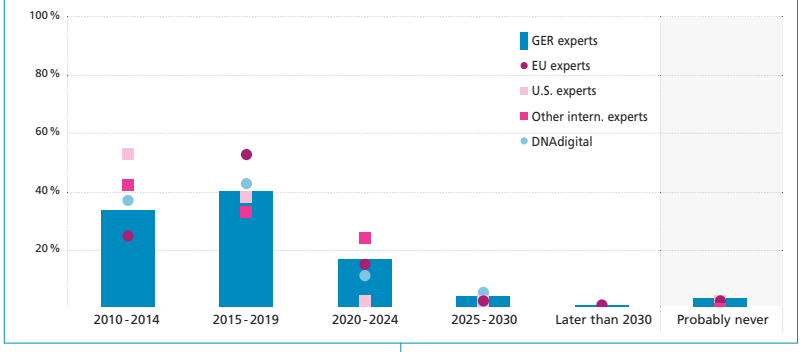
Thesis 60: Galileo has established itself as the standard for positioning and localization services in Europe.



Experts for Europe and the U.S. have vastly different estimations of the potential of location-based services

The differing assessment of the theses on location-based services and mobile localization between the different groups of experts is quite interesting. 53 percent of the experts for the U.S. predict the availability of positioning modules in mobile devices in the time frame from 2010 to 2014, while only 25 percent of the experts for Europe believe this will occur so quickly (see Fig. III.18).

Thesis 59: Navigation, positioning and localization systems (e. g., Galileo, GPS) are standard components of all mobile devices (e. g., cell phones, cameras).



The results for expected use of location-based services is almost exactly the opposite: 59 percent of the experts for Europe expect broad use of location-based services by 2019; this estimation is shared by only 40 percent of the U.S. experts, who believe a later occurrence of this thesis is more likely (see Fig. III.17).

Summary

The results of the study are clear: navigation and localization will become increasingly important and will spread to many different life situations in future. This presents huge opportunities for the German industry in a growing market in which most of the basic technological prerequisites have already been created. The establishment of navigation and localization applications shows parallels to the development of the Internet. It took the availability of a universal infrastructure for transferring data to enable the rapid development of the new applications that have greatly changed today's society.

In the context of localization technology, this means an infrastructure for inexpensive mobile access to location data must be created first to enable the free development of applications.

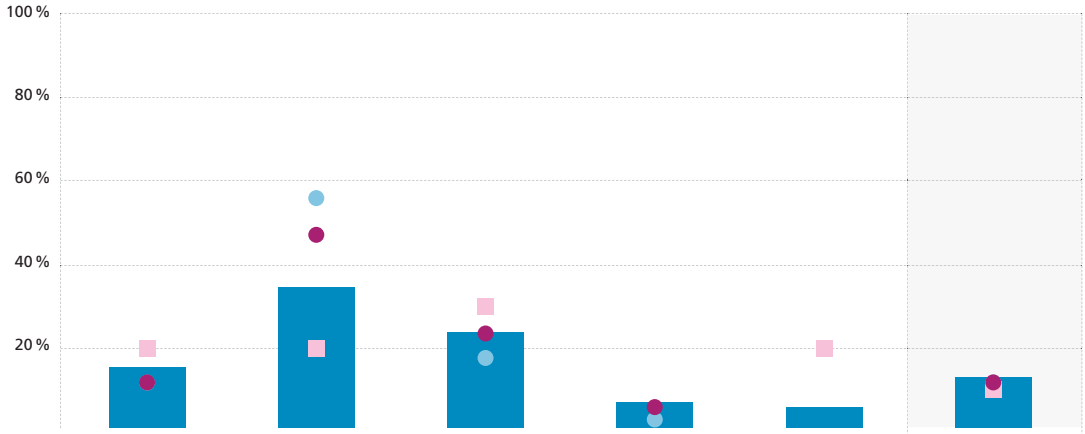
Another important aspect in the development of these technologies is adequate regulation and control of access to personal location data, so users do not have to fear unauthorized monitoring of or spying on their personal lives.

Another related issue for the future, which is particularly gaining importance in the industrial area, is locating within buildings. This is not supported by either GPS or Galileo in a practical form. Developments toward seamless technologies are expected – that is, services that work both outside and inside of buildings, but with the same user interface. This will be made possible by merging measurement data from multiple technologies, using suitable information processing methods.

Theses on "Navigation and localization" in detail

Fig. III.17: Thesis 58 Location-based services

In <country>, 75 percent of cell phone users access location-based services on a daily basis through their mobile device.

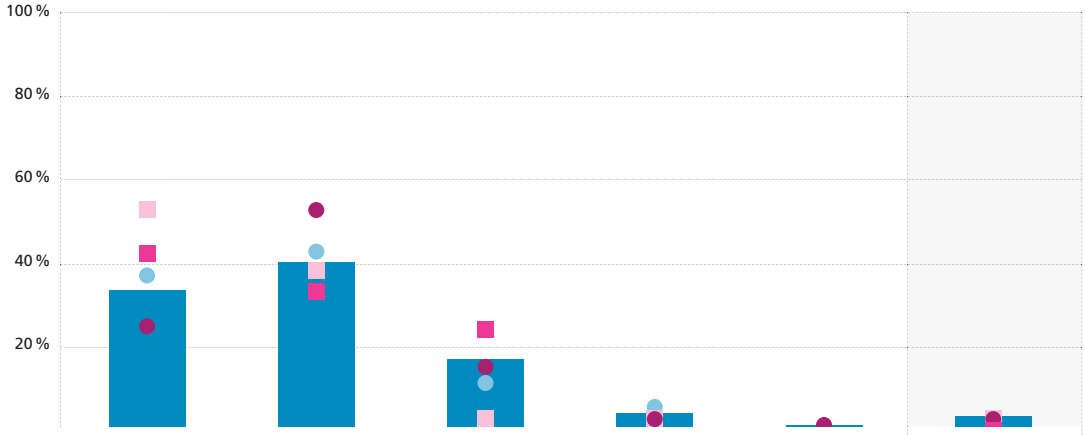


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 84)	15 %	35 %	24 %	7 %	6 %	13 %
EU experts (n = 17) [1]*	12 %	47 %	24 %	6 %	0 %	12 %
U.S. experts (n = 10) *	20 %	20 %	30 %	0 %	20 %	10 %
DNAdigital (n = 34)	12 %	56 %	18 %	3 %	0 %	12 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. III.18: Thesis 59 Mobile localization

Navigation, positioning and localization systems (e. g., Galileo, GPS) are standard components of all mobile devices (e. g., cell phones, cameras).

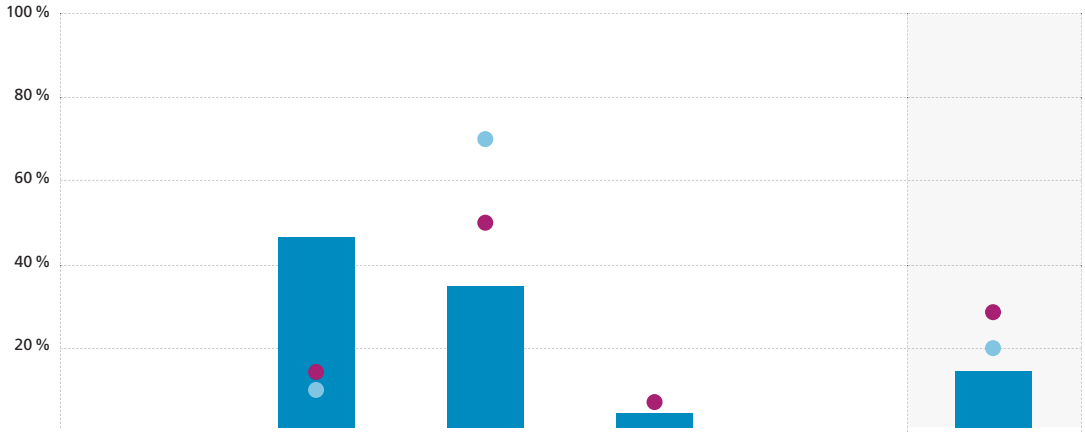


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 371)	34 %	40 %	17 %	4 %	1 %	4 %
EU experts (n = 72) [1]	25 %	53 %	15 %	3 %	1 %	3 %
U.S. experts (n = 34)	53 %	38 %	3 %	3 %	0 %	3 %
Other intern. experts (n = 33) [2]	42 %	33 %	24 %	0 %	0 %	0 %
DNAdigital (n = 35)	37 %	43 %	11 %	6 %	0 %	3 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. III.19: Thesis 60 Galileo

Galileo has established itself as the standard for positioning and localization services in Europe.

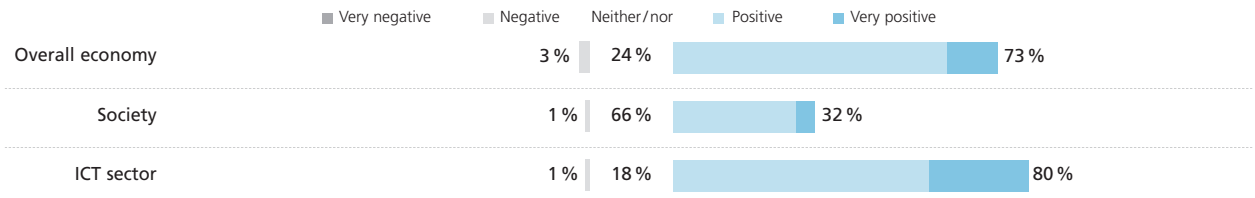


	2010-2014	2015-2019	2020-2024	2025-2030	Later than 2030	Probably never
GER experts (n=69)	0 %	46 %	35 %	4 %	0 %	14 %
EU experts (n=14) [1*]	0 %	14 %	50 %	7 %	0 %	29 %
DNAdigital (n=20)	0 %	10 %	70 %	0 %	0 %	20 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. III.20: Thesis 60 Galileo – relevance

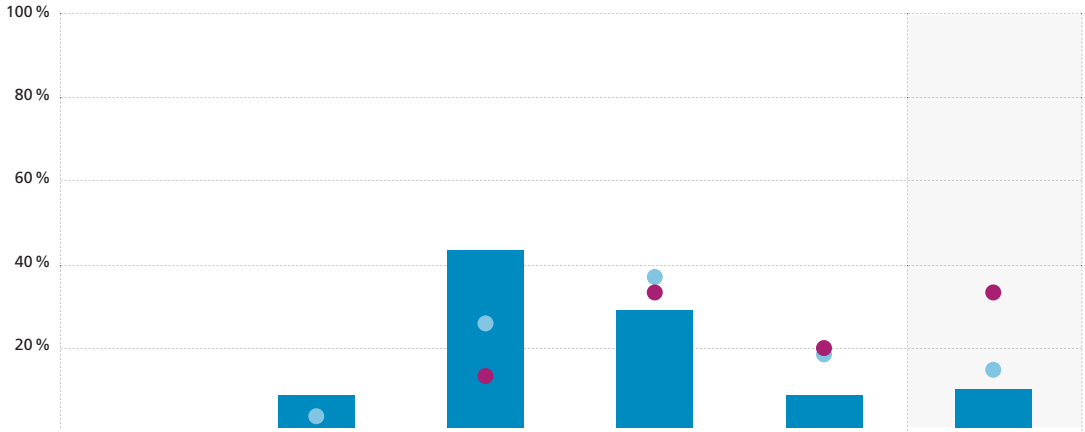
What impact will the validity of Thesis 60 above have on the areas listed below?



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, at least n=71

Fig. III.21: Thesis 61 Smart clothing

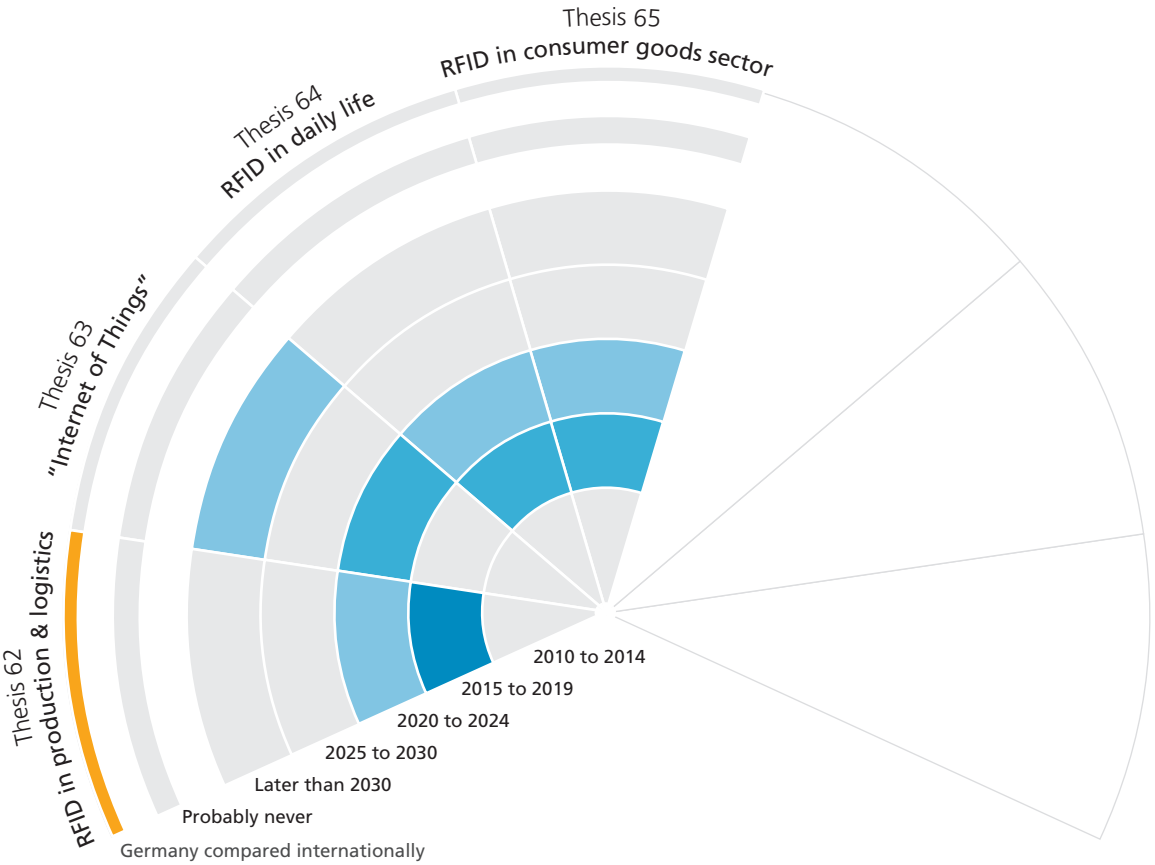
Operating devices, sensors as well as positioning and navigation modules for communication with a mobile device are integrated in work clothes, athletic gear and daily wear and widely disseminated in <country>.



	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 69)	0 %	9 %	43 %	29 %	9 %	10 %
EU experts (n = 15) [1]*	0 %	0 %	13 %	33 %	20 %	33 %
DNAdigital (n = 27)	0 %	4 %	26 %	37 %	19 %	15 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

III.4 RFID
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 62: RFID in production and logistics
RFID has established itself nationwide in Germany as the standard technology in the area of production and logistics.

Thesis 63: "Internet of Things"
The information exchange between everyday objects has led to the Internet of Things in Germany.

Thesis 64: RFID in daily life
RFID is used as standard in Germany in products for daily life.

Thesis 65: RFID in the consumer goods sector
RFID has replaced the barcode in the consumer goods sector in Germany.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

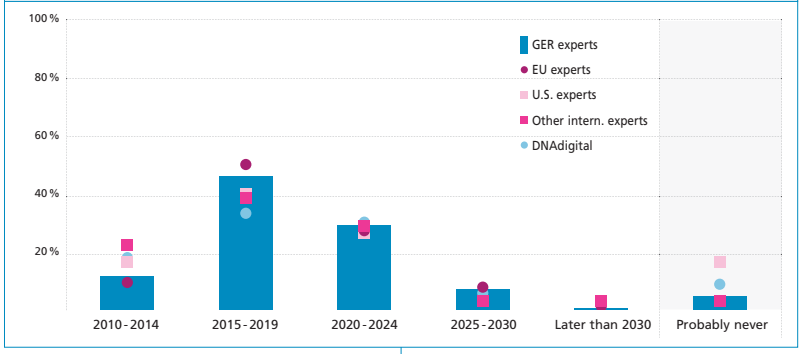
Core results

In future, RFID tags will appear in many different areas of everyday life: on food packaging, letters and even money. While the use of RFID tags continues to spread, especially in transportation and production logistics, "identity managers" have also recognized their benefits and hope that RFID will offer greater security in dealing with digital identities. Nonetheless, not everyone feels that RFID is a beneficial invention: privacy advocates are still very distrustful. If we examine the studies published by respected market research institutes to date, however, as well as analysts' forecasts, it is clear that the basic trend in this Delphi Study is more positive than the assessments of previous studies.

RFID – standard for production, logistics, and consumer goods within ten years

For the production and logistics area, 46 percent of the experts for Germany believe that RFID will establish itself as the standard technology across the board in the next six to ten years. The experts for other countries have similar expectations (see Fig. III.22). 94 percent of the experts for Germany assume that comprehensive RFID standard technology will have a (very) positive impact on the ICT industry. In addition, nearly as many experts see positive effects for the overall economy (91 percent; see Fig. III.23). Some 60 percent of the surveyed experts also expect the environment to benefit from the use of RFID, whereas only around one third expect positive effects on society.

Thesis 62: RFID has established itself nationwide in <country> as the standard technology in the area of production and logistics.



The expectation of a positive impact for the environment by RFID is somewhat surprising, since a study ordered by Germany's Federal Environment Agency covered the specific consequences that these small transmitter chips and their disposal systems will have for the environment in future. After all, they contain substances such as acrylate ester (adhesive), silicon (IC), copper, aluminum and silver (antennae), epoxy resins, PET (polyethylenterephthalat) and nickel (see Federal Environment Agency 2009).

In the context of RFID, privacy experts in particular have repeatedly expressed reservations about the hazards and potential for abuse, which must be taken seriously. This caution, which is prevalent in Germany, is clearly reflected in the named barriers to using RFID in Germany (see Fig. III.25). 37 percent of the experts expect data protection problems to occur in Germany that will prevent the rapid implementation of RFID. Other barriers named by the experts include high costs (44 percent) and a lack of willingness to invest (30 percent). In parallel to the barriers, the most important drivers toward using the technology are lower costs (61 percent), the companies' willingness to invest (42 percent) and technical progress (38 percent; see Fig. III.24).

In addition to the breakthrough in production and logistics, a large portion of the experts for Germany expect a breakthrough of RFID in the consumer goods industry (see Fig. III.28) and its use in everyday products (see Fig. III.27): Around 50 percent of the experts for Germany expect breakthroughs in both areas by 2019 at the latest.

Later market penetration, in the years 2020 to 2024, is expected by 28 percent of the surveyed experts for everyday products and by 26 percent for consumer goods.

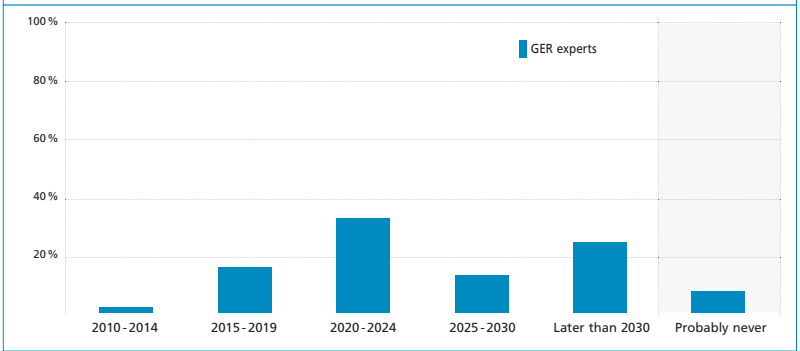
Delphi Study experts have an optimistic opinion of RFID

Examining the experts' estimations from the Delphi Study on the spread of RFID in the areas of production and logistics, consumer goods and everyday products, expectations for a breakthrough in the years 2015 to 2019 are clear. In contrast, other studies show a slower gain in market share up to the year 2012 that does not seem to indicate a breakthrough by 2019 (see BMWi 2007 and Wildeman & Connaughton 2008, among others).

Furthermore, it can be said that the breakthrough of RFID is a prerequisite for the "Internet of Things," but does not represent the "Internet of Things" in and of itself. 53 percent of the experts for Germany assume that the potential to exchange information between everyday objects will create an "Internet of Things" by 2024 at the latest, while 33 percent believe this will become reality by 2020–2024 (see Fig. III.26).

Differences compared to other studies can be found for the individual segments. Estimates of RFID penetration for everyday products and consumer goods are nearly identical: in the broad sense, "everyday products" also includes complex, high-value products; whereas a large proportion of consumer goods is summarized under the term "fast moving consumer goods" (FMCG). The latter includes products that only cost a few euros (or even a few cents), particularly in the foods sector.

Thesis 63: The information exchange between everyday objects has led to the Internet of Things in <country>.



The use of RFID instead of barcodes for these low-price products will initially result in higher costs, even if the cost of the RFID tags themselves continues to fall dramatically, and it will not be possible to pass these costs onto retail partners and consumers in all cases. For this reason, analysts expect that RFID will first establish itself in closed cycles and multi-stage processes within a supply chain, where additional positive effects (such as lower logistics costs) can be realized.

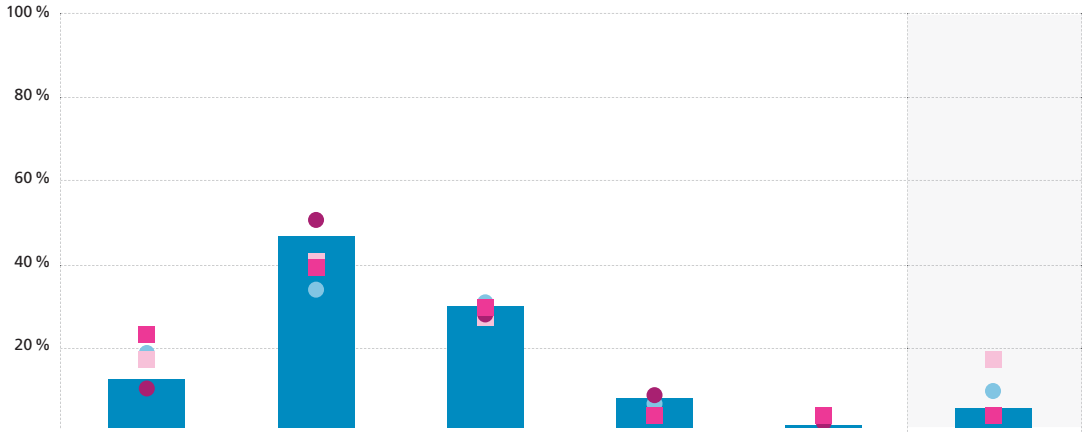
Once a critical mass is reached, this could extend to other areas, ultimately resulting in the broad deployment of RFID. In contrast, the experts surveyed here focus more on the inexpensive technology already available and the companies' basic willingness to invest. As such, only 15 percent of the experts believe that lack of infrastructure investment will be a barrier.

Whether this is more of a technology-centric perspective that tends to neglect economic process analyses, or whether the technical possibilities are granted their due significance, is not entirely clear. As such, we will have to take both positions into account in following further developments.

Theses on "RFID" in detail

Fig. III.22: Thesis 62 RFID in production and logistics

RFID has established itself nationwide in <country> as the standard technology in the area of production and logistics.

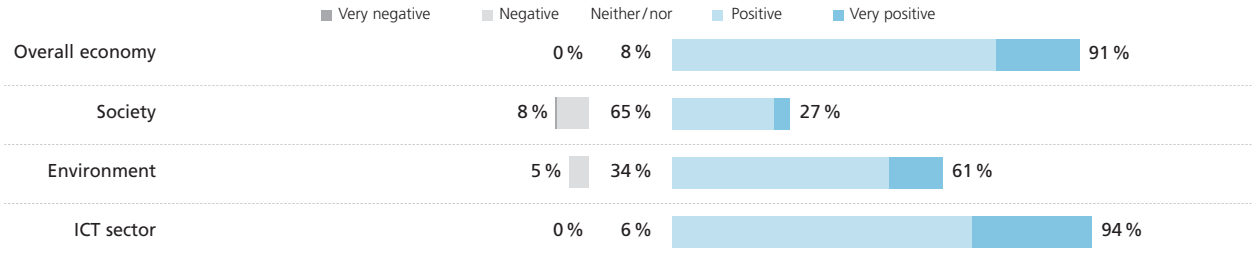


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 335)	12 %	46 %	29 %	7 %	1 %	5 %
EU experts (n = 62) [1]	10 %	50 %	27 %	8 %	2 %	3 %
U.S. experts (n = 30)	17 %	40 %	27 %	0 %	0 %	17 %
Other intern. experts (n = 31) [2]	23 %	39 %	29 %	3 %	3 %	3 %
DNAdigital (n = 33)	18 %	33 %	30 %	6 %	3 %	9 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. III.23: Thesis 62 RFID in production and logistics – relevance

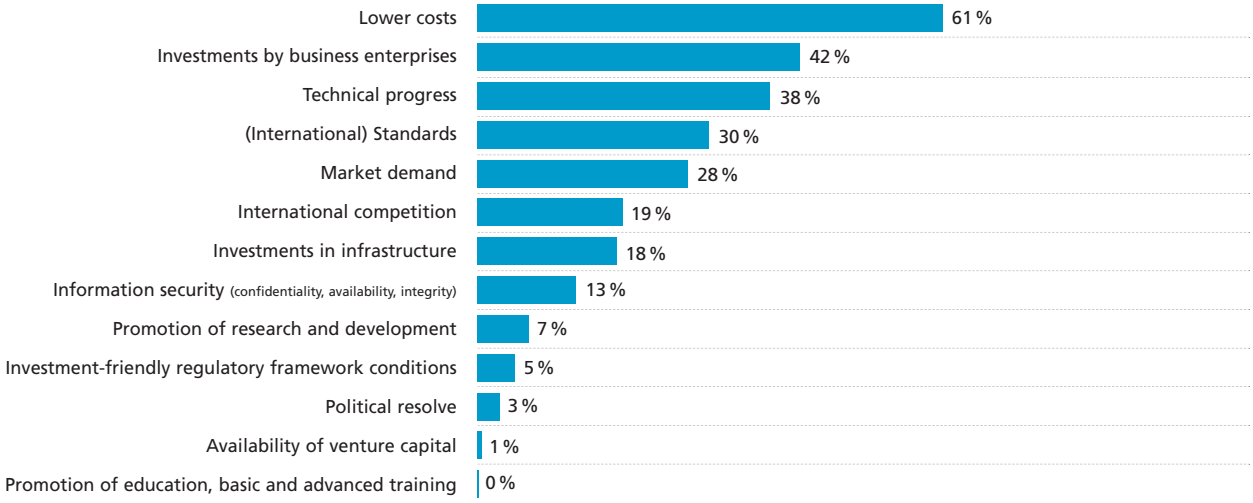
What impact will the validity of Thesis 62 above have on the areas listed below?



Basis: All people surveyed; Sub-group: GER experts, at least n = 324

Fig. III.24: Thesis 62 RFID in production and logistics – drivers

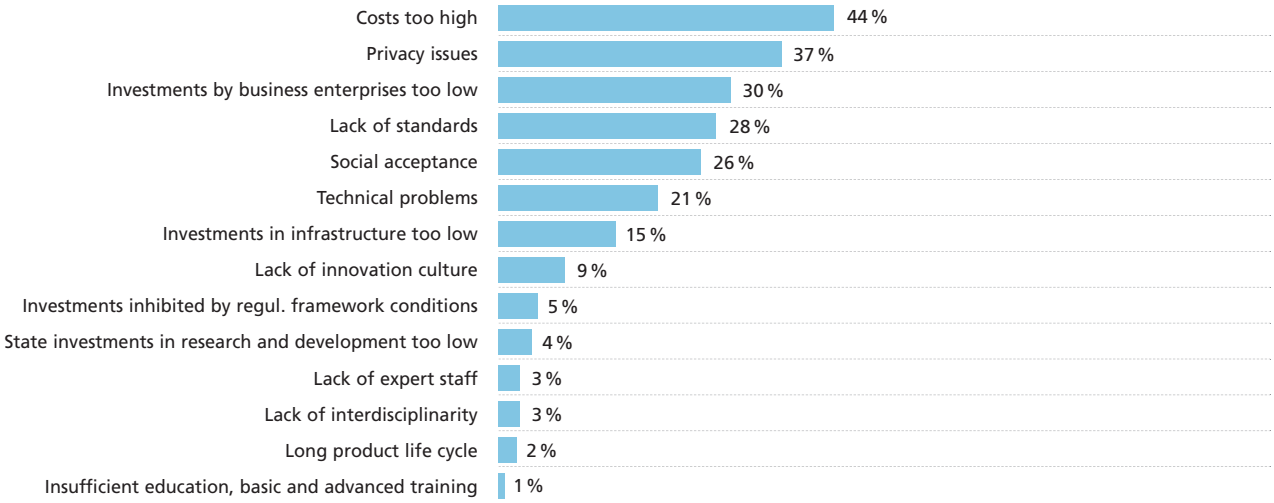
Select up to three drivers from the following list that you consider to be most important for realization of Thesis 62 above.



Basis: All people surveyed; Sub-group: GER experts, n = 260

Fig. III.25: Thesis 62 RFID in production and logistics – barriers

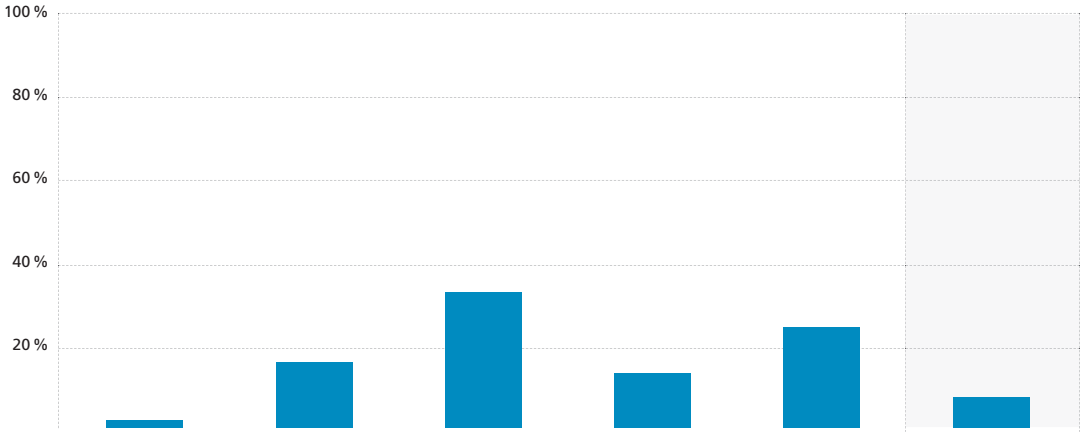
Select up to three barriers from the following list that you consider to be most important for realization of Thesis 62 above.



Basis: All people surveyed; Sub-group: GER experts, n = 253

Fig. III.26: Thesis 63 “Internet of Things”

The information exchange between everyday objects has led to the Internet of Things in <country>.

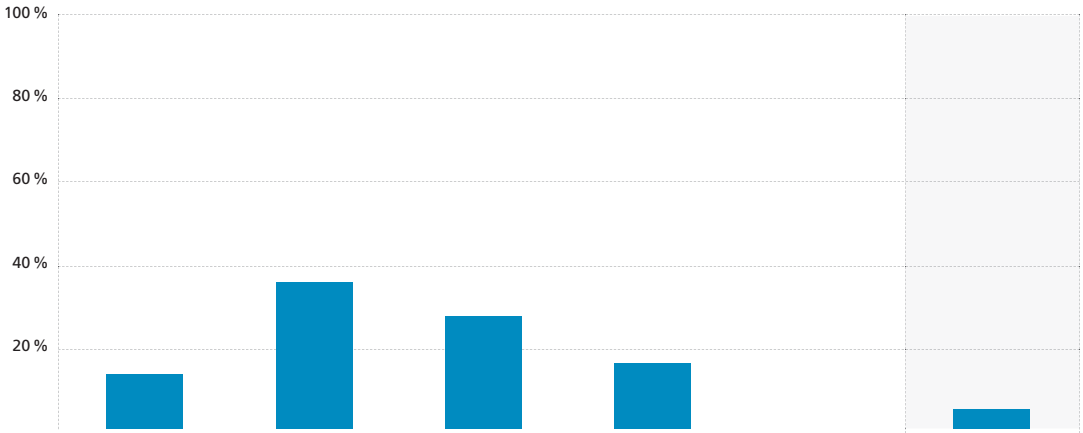


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n=36)	3 %	17 %	33 %	14 %	25 %	8 %

Basis: All people surveyed with special expertise in the topic area

Fig. III.27: Thesis 64 RFID in daily life

RFID is used as standard in <country> in products for daily life.

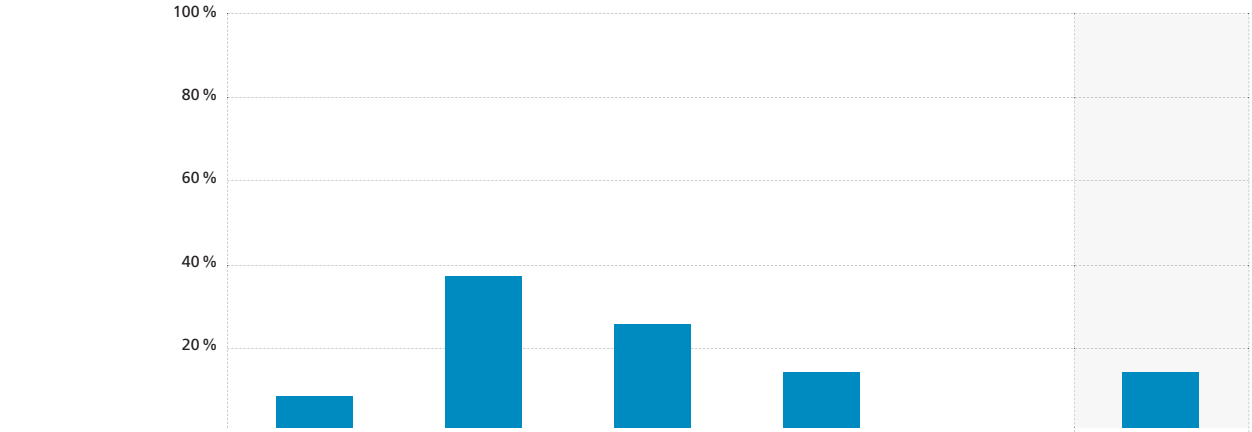


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n=36)	14 %	36 %	28 %	17 %	0 %	6 %

Basis: All people surveyed with special expertise in the topic area

Fig. III.28: Thesis 65 RFID in the consumer goods sector

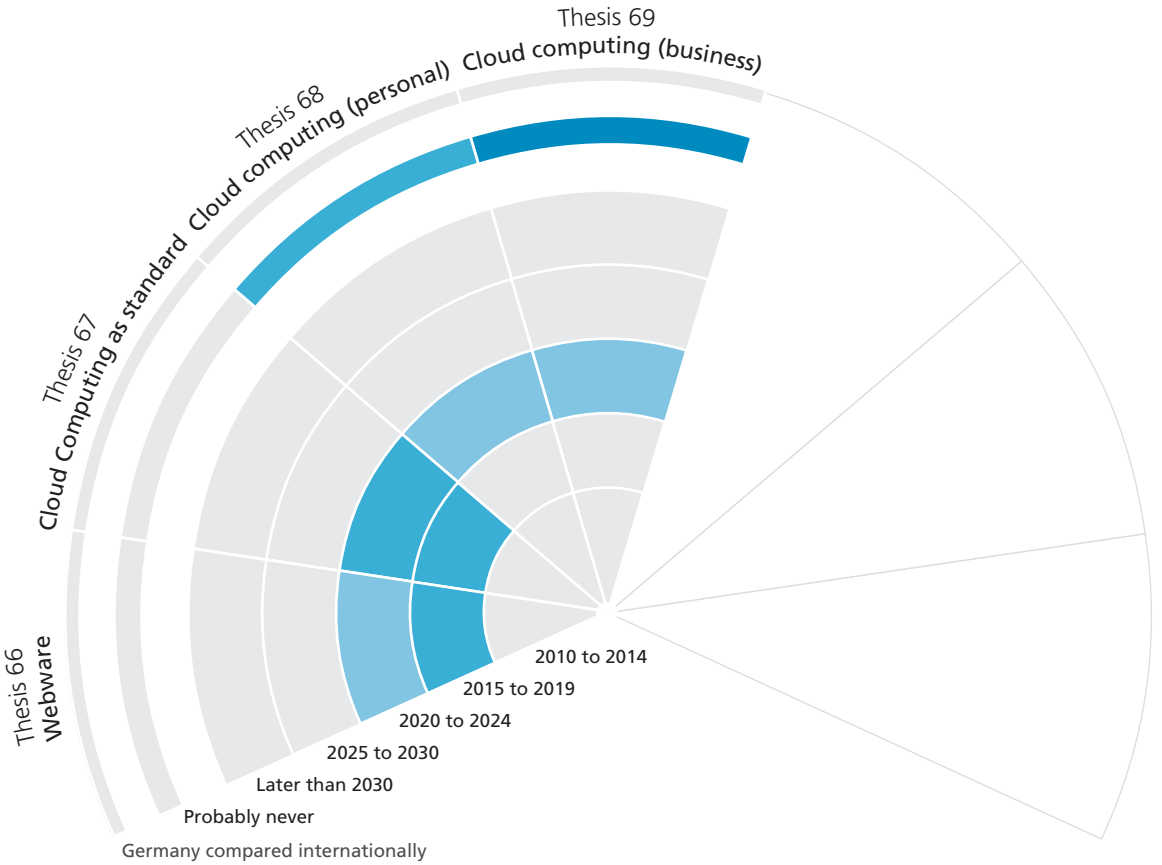
RFID has replaced the barcode in the consumer goods sector in <country>.



	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 35)	9 %	37 %	26 %	14 %	0 %	14 %

Basis: All people surveyed with special expertise in the topic area

III.5 Cloud computing
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 66: Webware

Software is no longer used on an isolated basis on local computers or mobile end devices, but rather on an "on-demand" basis as "webware" on and over the Internet.

Thesis 67: Cloud computing as standard

It is the standard in Germany for stationary computers and mobile end devices to permanently link to decentralized computer capacities through an Internet connection ("Cloud computing").

Thesis 68: Cloud computing in personal life

More than 75 percent of private data (e. g., documents, pictures, music) in Germany is located on the Internet (net-centric approach).

Thesis 69: Cloud computing in business life

More than 75 percent of business data (e. g., documents, company databases) in Germany is located on the Internet (net-centric approach).

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

Cloud computing – structural change in IT architectures

Cloud computing was surely one of the most-often used terms in the IT world in 2009. While the basic technical principles of cloud computing have been known for some time, current technological developments have only now made it possible to implement these new network-centric IT concepts economically.

This concept revolves around the industrialization of IT operation and the on-demand utilization of application resources via the Internet. A pool of globally distributed resources is created in the Internet, consisting of computing power, storage space, programs and network bandwidth that customers can use on demand. This basic principle enables flexible, on-demand payment of services based on economies of scale in large, automated data centers. Its expansion is supported in particular by the development of communication networks (coverage, bandwidth and speed), the standardization of web service protocols and the virtualization of hardware.

The term "cloud computing" can refer to any of the following three basic concepts:

- Infrastructure-as-a-service (IaaS) provides users directly with individual virtual resource instances – such as servers, storage and network elements – in the Internet.

- Platform-as-a-service (PaaS) performs basic resource management and provides additional basic services, such as directory services and access control services for cloud applications, similar to an operating system for conventional computers.

- Software-as-a-service (SaaS) describes cloud applications that can be used by users or other services.

The approach of software-as-a-service harbors particularly far-reaching potential for fundamental changes in the IT industry. Applications no longer reside locally, but instead are used on-demand with local browsers via the Internet, as "webware." The data can either be local or stored in the Internet.

The importance of software compatibility with operating systems, as well as the local configuration of the device (PC, laptop, mobile device) and the data management appear in a new light. This may also result in changes for both stationary and mobile fields of use. In general, browsers and Web 2.0 technologies will continue to gain in importance and new licensing and distribution models for program use will arise.

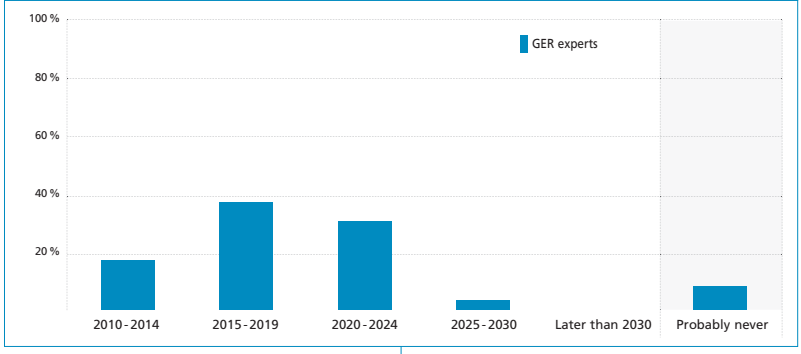
As use of the Internet increases on mobile devices and embedded systems, the desire for simplified device management through network-centric management of programs and data can be fulfilled. New device configurations also become possible, since centralized program and data resources are available in the Internet: new mobile devices with powerful mobile Internet connections link at high bandwidth to the local infrastructure, such as available displays and keyboards, and can become competitors to current PC architectures in many areas of use.

This development will result in new technical and business challenges – particularly those that affect the way applications are used, data security, long-term archiving and backup functions (see section III.6) and privacy protection.

Accessing the cloud will become commonplace

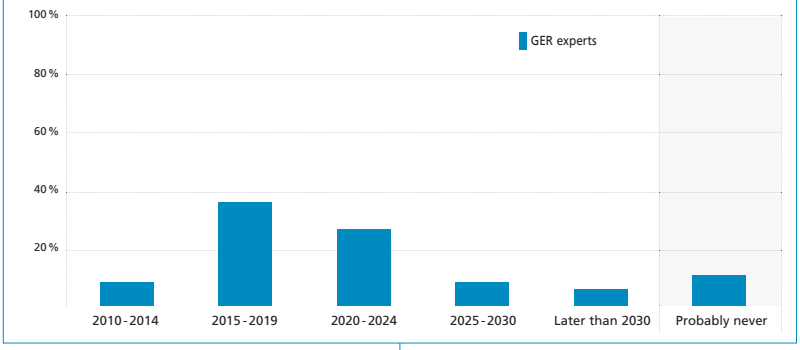
The majority of experts agree on this trend. 69 percent of the surveyed Germany experts believe that accessing computing power and storage in the cloud will become commonplace by the 2015–2024 time frame. Another 18 percent of the surveyed experts assume that access to applications and/or data will become commonplace as soon as 2010–2014, as the Internet is accessed from mobile and stationary devices. Only 9 percent of the surveyed experts do not believe cloud computing will become prevalent in future (see Fig. III.30). The results on the use of webware show a similar picture.

Thesis 67: It is the standard in <country> for stationary computers and mobile end devices to permanently link to decentralized computer capacities through an Internet connection ("Cloud computing").



63 percent of the Germany experts surveyed in the study believe that we will complete the transition of no longer having software on a specific computer by the 2015–2024 time frame, but instead activate and use it on demand as webware via the Internet. Another nine percent feel this thesis will occur by 2010–2014, which clearly shows that we are on the verge of this major change. Nearly 90 percent of those surveyed assume that the future of IT applications lies in software-as-a-service with a network-centric approach (see Fig. III.29). This will mean a permanent change in the IT world, which will affect both the IT infrastructure and software development and its sales models.

Thesis 66: Software is no longer used on an isolated basis on local computers or mobile end devices, but rather on an "on-demand" basis as "webware" on and over the Internet.

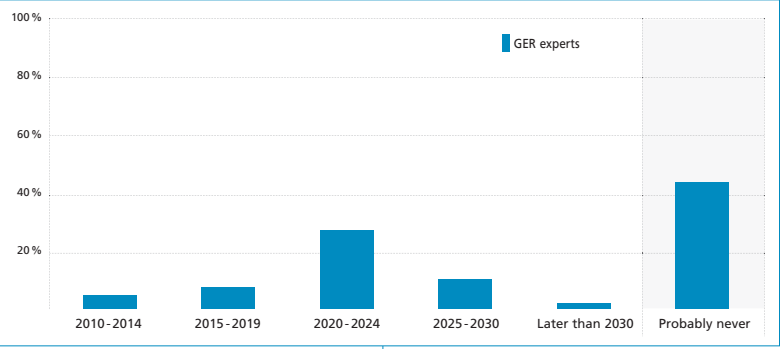


Solutions for IT security are a key prerequisite for future cloud computing services

A clear picture has been painted for potential applications and programs: the future belongs to the network-centric view. In this process, however, the way in which the data is handled becomes particularly important in light of the shift of business and personal data to the network.

75 percent of the experts for Germany have a similar assessment of the shift of the webware data to the network. For private data, 46 percent of the experts surveyed foresee occurrence by 2024. For business data, 42 percent of the experts believe a major share of business data will shift to the Internet (see Figs. III.31 and III.34).

Thesis 69: More than 75 percent of business data (e. g., documents, company databases) in <country> is located on the Internet (net-centric approach).



The most important driver for private use is seen as low costs, by three-quarters of those surveyed, followed by information security and technical progress. The experts rank the same drivers for the use and storage of business data in the Internet in the top spots (see Figs. III.32 and III.35).

The experts named the following barriers that could obstruct the realization of this thesis: The main barrier for both personal and business life is thought to be privacy issues, by a significant margin: 85 percent (personal) and 91 percent (business) of the experts surveyed placed this item among their top three choices (see Figs. III.33 and III.36). This is followed by social acceptance, which is surely also related directly to data protection and is seen as a critical point for personal life.

The experts' appraisal for personal and business use are very similar. With the other reservations – lack of standards, high costs and technical problems – the appraisals of the five greatest barriers are similar in both cases. The German ICT industry has the opportunity to unify these demands if it recognizes the international requirements and future customer needs with regard to digital data and applications in the Internet at an early stage and actively shapes the market with regard to standards and openness.

How we deal with data on the Internet demands broad-based discussion

As we can see from the appraisal of the three most important drivers and/or greatest barriers, a broad-based discussion on how data and webware are handled is needed. Special attention must be paid to the end user and their needs.

It is certain that the three basic cloud concepts (IaaS, PaaS and SaaS) will capture the IT landscape at different paces. With regard to data distribution, a large portion of the experts feels that both in the private and business area, the critical data will be stored in the Internet by 2030. But the greatest obstacles

to IT security are seen in data handling (see section III.3.4). Politics and research in particular will have to create a framework that recognizes data privacy as part of people's personal rights. To achieve this, broad-based discussion is needed on the potential offered by this new way of dealing with data, media and the corresponding applications in the Internet.

Summary

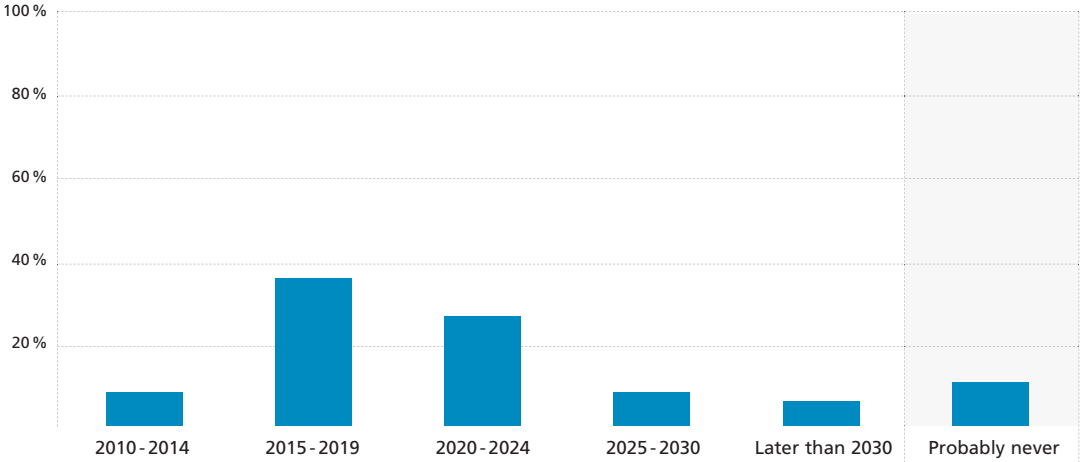
The results of the survey paint a clear picture for the network-centric approach of cloud computing. Almost unanimously, the experts agree that in future, software-as-a-service and webware will gain in significance, changing how software is used. Most applications will no longer be installed or used locally, but instead used on demand via the Internet. When the corresponding data also resides in the Internet, however, the surveyed experts are more critical. In their opinion, data protection issues represent the greatest barrier.

Technologies for information security and data distribution are needed to make cloud computing a secure solution. The experts also see the low costs – resulting from the economies of scale that the major cloud providers can achieve – as another driver for cloud computing.

Theses on "Cloud computing" in detail

Fig. III.29: Thesis 66 Webware

Software is no longer used on an isolated basis on local computers or mobile end devices, but rather on an "on-demand" basis as "webware" on and over the Internet.

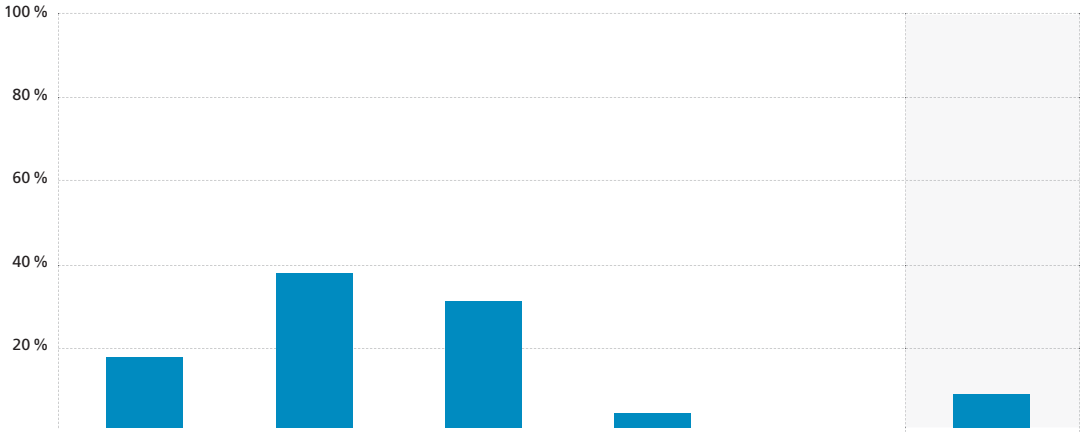


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 44)	9 %	36 %	27 %	9 %	7 %	11 %

Basis: All people surveyed with special expertise in the topic area

Fig. III.30: Thesis 67 Cloud computing as standard

It is the standard in <country> for stationary computers and mobile end devices to permanently link to decentralized computer capacities through an Internet connection ("Cloud computing").

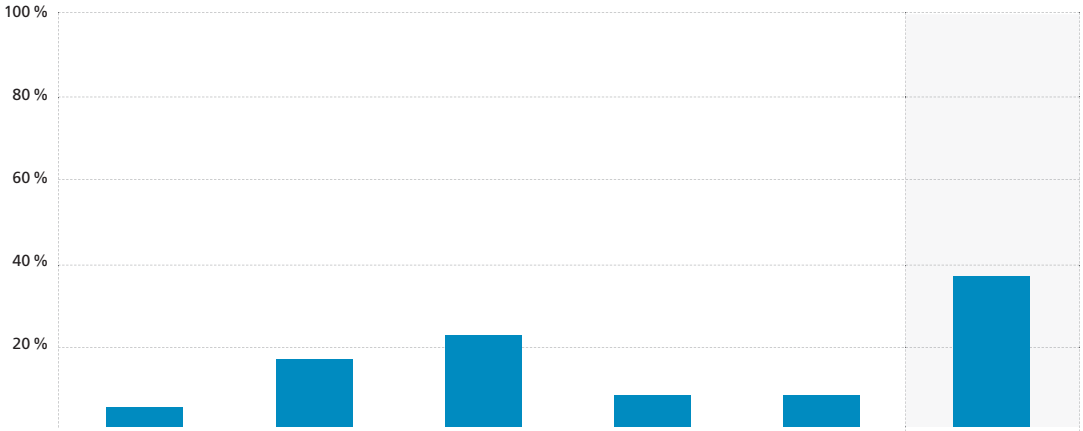


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n=45)	18 %	38 %	31 %	4 %	0 %	9 %

Basis: All people surveyed with special expertise in the topic area

Fig. III.31: Thesis 68 Cloud computing in personal life

More than 75 percent of private data (e.g., documents, pictures, music) in <country> is located on the Internet (net-centric approach).

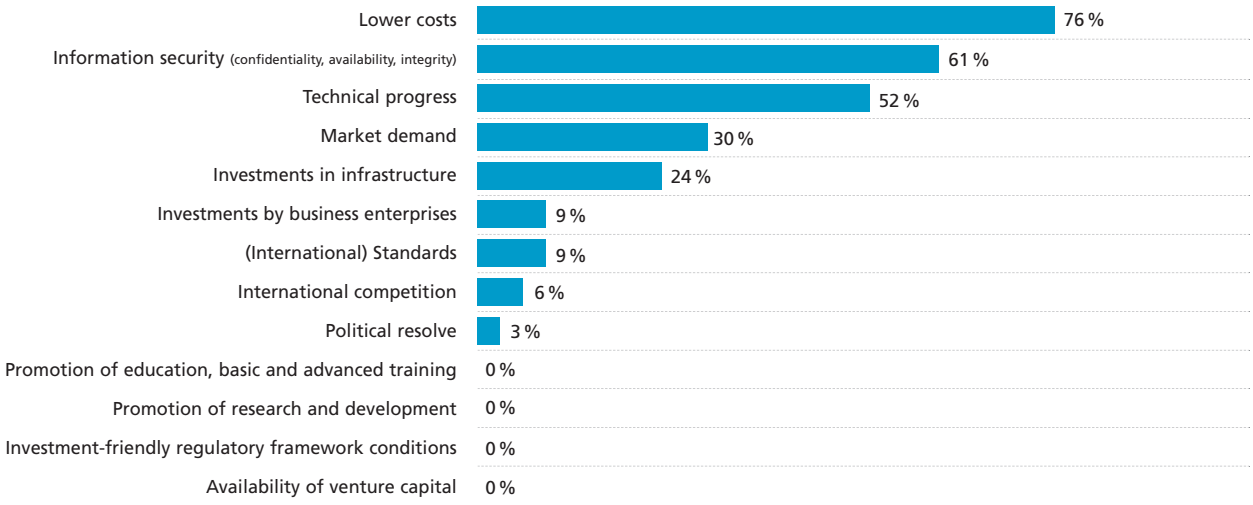


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n=35)	6 %	17 %	23 %	9 %	9 %	37 %

Basis: All people surveyed with special expertise in the topic area

Fig. III.32: Thesis 68 Cloud computing in personal life – drivers

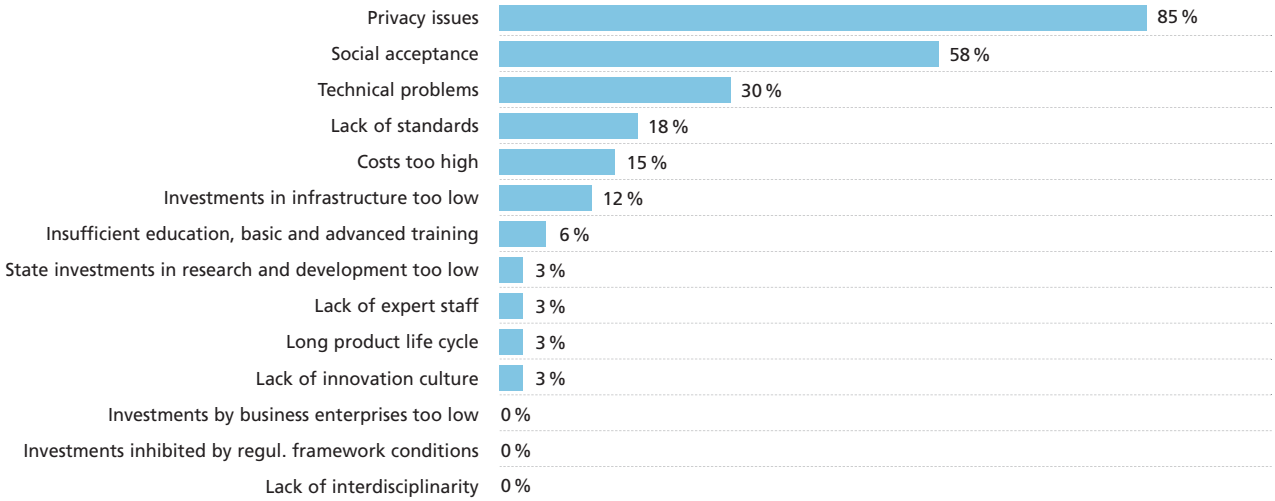
Select up to three drivers from the following list that you consider to be most important for realization of Thesis 68 above.



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n = 33

Fig. III.33: Thesis 68 Cloud computing in personal life – barriers

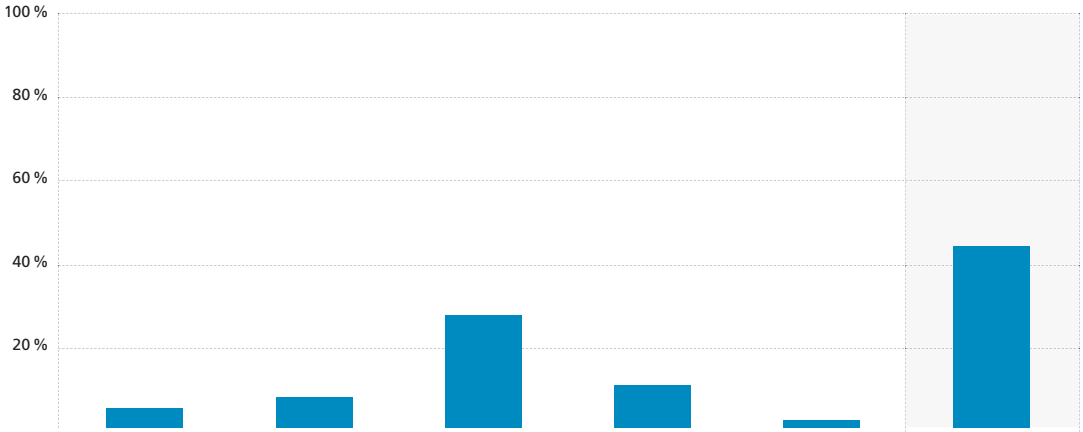
Select up to three barriers from the following list that you consider to be most important for realization of Thesis 68 above.



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n = 33

Fig. III.34: Thesis 69 Cloud computing in business life

More than 75 percent of business data (e. g., documents, company databases) in <country> is located on the Internet (net-centric approach).

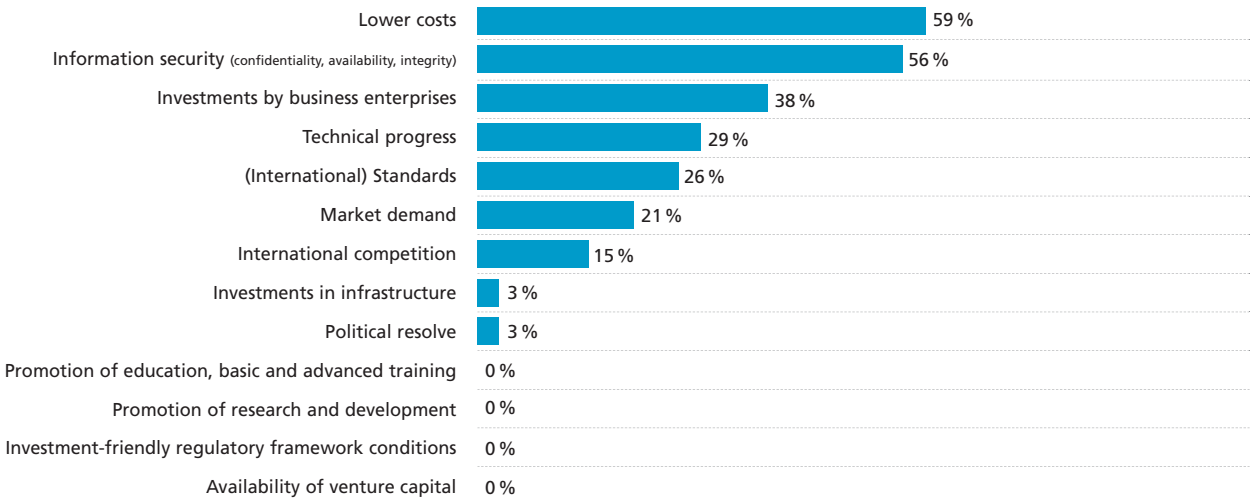


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 36)	6 %	8 %	28 %	11 %	3 %	44 %

Basis: All people surveyed with special expertise in the topic area

Fig. III.35: Thesis 69 Cloud computing in business life – drivers

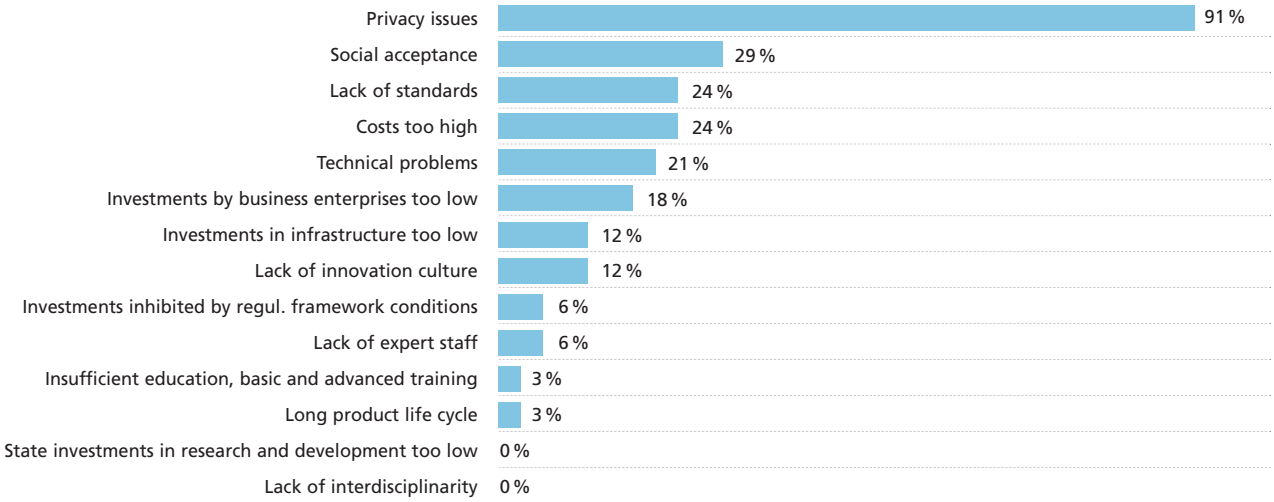
Select up to three drivers from the following list that you consider to be most important for realization of Thesis 69 above.



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n = 34

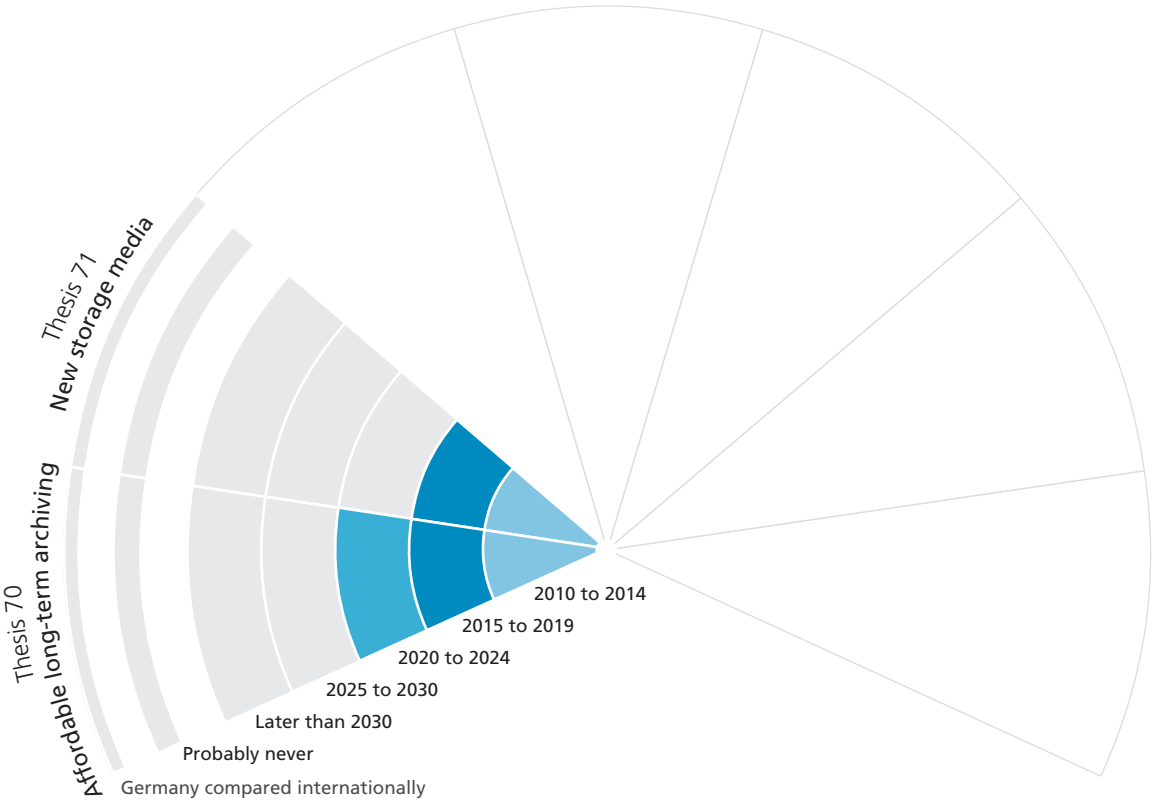
Fig. III.36: Thesis 69 Cloud computing in business life – barriers

Select up to three barriers from the following list that you consider to be most important for realization of Thesis 69 above.



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n = 34

III.6 Digital archiving
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 70: Affordable long-term archiving

Affordable digital solutions are available for the reliable long-term archiving of documents, e. g., the automatic copying of databases from one storage medium to another before any technical problems arise.

Thesis 71: New storage media

New storage media are available on the market for the reliable long-term archiving of documents.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

Digital long-term archiving on the path to everyday use and toward virtual memory spaces

Archives aren't only an important element of our business and legal framework, but also a fundamental component of our society in the cultural, scientific, political, and personal areas. Since vast numbers of business, personal, medial, cultural, political, and legal artifacts are created and replicated in digital – and therefore non-physical – form, questions arise as to adequate archiving that is appropriate for the respective situations.

Estimations indicate that data volumes will increase to 988 billion gigabytes by 2010; around 70 percent of this information is created by private citizens (see EMC 2007). As such, the ever-deeper penetration into our everyday lives by genuinely electronic information will affect nearly everyone to an increasing extent.

• For personal electronic transactions, such as orders, invoices, payment transactions, contracts, official documents, taxes, certificates, correspondence with public authorities and for job applications.

• For personal digital data, such as pictures, music, videos, books, correspondence and contact information.

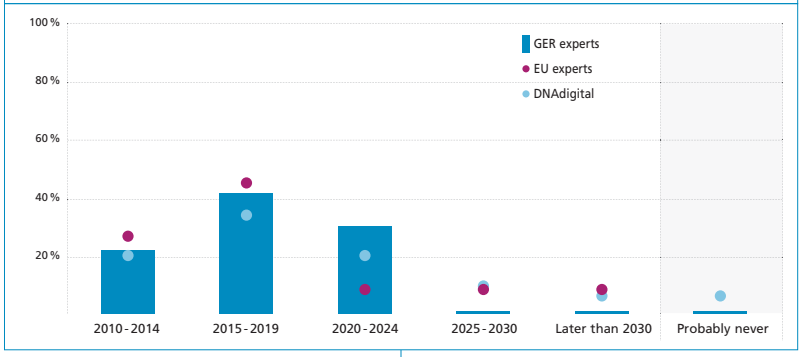
At the same time, we also face the challenge of digitizing and archive information that was previously paper-based. The digital scanning of books merely represents the tip of the iceberg on this subject, but is an excellent example of the myriad problems posed: books are being digitized with the goal of improved global accessibility, but this is causing disputes under existing copyright law. It is already clear that electronic archiving and its associated problems will continue to increase in importance.

Two major topic areas have arisen:

1. Technical issues involving the long-term storage media and their operation and use.

2. Discussion about the suitable handling of the stored objects.

Thesis 70: Affordable digital solutions are available for the reliable long-term archiving of documents, e.g., the automatic copying of databases from one storage medium to another before any technical problems arise.



Digital long-term storage media will become more affordable in the coming decade

Experts believe compliant solutions for the reliable long-term archiving of documents will become available within the next ten years. They deem the timely copying of datasets to more modern media before one of the links in the archiving chain breaks to be the solution to the long-term safeguarding of digital archiving (see Fig. III.37): 65 percent of the GER experts and 72 percent of the Europe experts expect inexpensive digital solutions for long-term archiving to become available by 2019 at the latest. Moreover, one-fifth of both the GER experts and Europe experts surveyed expect this to become reality as soon as 2014.

During the process of copying the datasets to modern media, a transfer to each of the four levels described below (the logical level of the file formats and/or source code, the logical level of the file systems, the technical level of the readers and the technical/physical level of the storage media) may be necessary. Currently, this is associated with inestimable costs. These costs are part of the reason why some of our cultural artifacts have already disappeared. One example of this is the Deutsche Filmarchiv (German film archive), which has lost many films stored on nitrocellulose due to decomposition.

A comparatively optimistic picture is painted regarding the question of availability of new storage media with inherently longer storage capabilities for long-term archiving. Still, the experts for Germany are somewhat less optimistic than the experts for Europe: 20 percent of the surveyed GER experts believe that these media will not become available until after 2024, or not at all (see Fig. III.38). Nonetheless, two-third of the Germany experts expect these storage media to become available within the next ten years. The Europe experts are even more optimistic: they are completely convinced these new storage media will become available – not a single one chose "Probably never." At the same time, the Europe experts have differing opinions with regard to the specific realization period. One-quarter each believe general availability will occur in the time frames 2010–2014, 2015–2019, 2020–2024 and 2025–2030.

Lack of consensus on methodical foundation and standards for broad-based long-term archiving use

To date, there is a lack of consensus regarding the methodical foundations for the myriad archiving applications combined with a lack of trust in the security of the underlying storage technology. Both of these factors prevent the transition of individual projects and standalone solutions – with their file structures, location services, resistance to tampering, long-term storage and backup management – to widely applicable product functionality. Accordingly, at the closing event for nestor 2009, the attendees concluded that the "long-term storage of information is an unsolved problem" at the present time (Sietmann 2009).

For successful long-term archiving, at least four functional levels must work together. Digital bit rotting can occur at any single level or through interaction of several levels, resulting in the loss of the object:

• The logical level of file formats and/or source code: future archive users will need tools to interpret the data. These are either programs that make the content visible or, at minimum, a specification of the formats necessary to develop such tools. This cannot be taken for granted for the proprietary formats that are widely used in business and administration. Vendors will cease support for these legacy formats sooner or later due on economic grounds. We can hardly expect that the vendors of the most widely-used word processing programs in business and administration will continue to support the storage formats from earlier versions forever. Moreover, these formats are proprietary, not publicly documented and enjoy intellectual property protection, which means older documents will be lost at some point.

• The logical level of the file systems: tools and the relevant specifications are also needed to interpret the file and metadata organization on the data media. The same factors described for the file formats above apply.

• The technical level of the readers: technical devices for retrieval on modern, digital data processing devices and their maintenance must be available.

• The technical/physical level of storage media: the archive media themselves must be protected against aging – that is, environmental factors such as temperature, moisture, oxidation, sunlight and other harmful rays – to remain physically readable at all.

In general, archive users require open, non-discriminatory access to these tools, or at least to the corresponding specifications. Specifically, the interpretation and read rules must also be archived permanently, in the same manner as the data, and in a form that is accessible without requiring further utilities.

Need for an all-encompassing solution approach

Digital archiving solutions that are based on timely, largely automatic copying or on the intrinsic ability of long-term storage media solve the issues of the lower storage media level.

The functional levels of the source code, file and metadata organization, and readability of the storage media still require a massive effort to enable long-term access to the ever-growing amounts of data. In addition, new approaches must be created for searching in digital archives, since the effort for organizing and classifying the data when checking it into the archives is becoming more and more expensive as the number of digital artifacts increases. Moreover, it is difficult to anticipate the criteria that future archive users will use for their search and retrieval. Accordingly, new search and access methods that are open for future enhancements must be developed. Likewise, there are very few approaches for non-discriminatory access to data in the public interest.

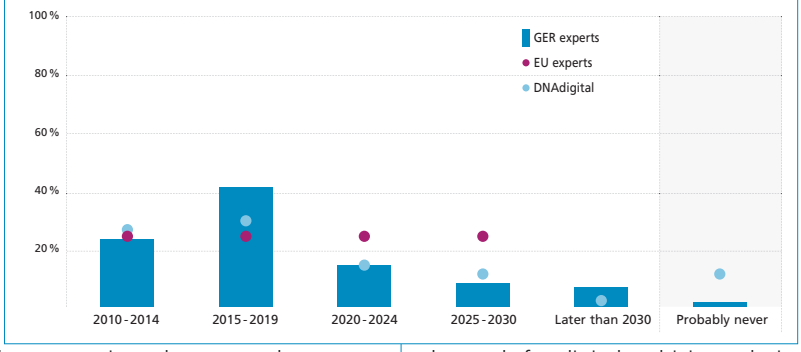
Last but not least, the role of the archivist – who stands between day-to-day storage and the long-term archive and transfers documents between the two – must be automated. The shift between day-to-day storage and the archive will become blurred: documents that are automatically assigned archive status at some point must be just as easy for users to find as those in day-to-day work.

Opportunities through focus on R & D

Germany has a chance to assume a leadership role in the area of long-term archiving solutions. The experts for other European countries are divided as to whether the problem can be solved in the second or third decade of this century, while the experts for Germany expect solutions to become available more quickly – namely, within the next ten years (see Fig. III.38).

This represents a major opportunity for the German ICT industry: if the German domestic economy begins deploying digital archiving solutions sooner, as the GER experts forecast, manufacturers and users can assume a leadership role. At the same time, however, the export markets must also be prepared for these archiving solutions. It is up to the German companies to drive the harmonization of the European legal framework and systems standardization.

Thesis 71: New storage media are available on the market for the reliable long-term archiving of documents.



Summary

As the quantity and type of digital objects grow dramatically, it is becoming necessary to coordinate the various efforts for long-term archiving domestically and internationally – and in particular across the many manifold areas of use.

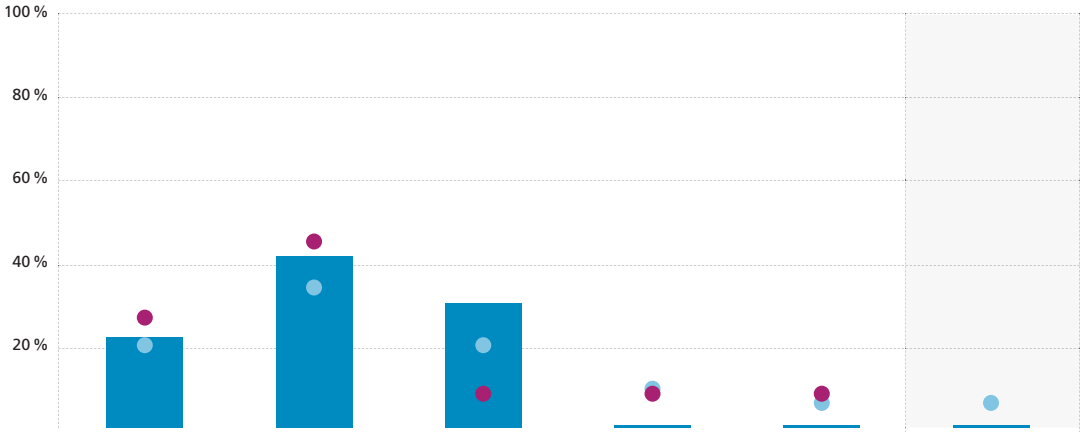
In this process, the requirements of private citizens with regard to the long-term handling of their personal documents must be a particular focus.

Ultimately, this area poses a tremendous opportunity for the German ICT industry if it can recognize the future international demands for digital archiving solutions at an early juncture and actively shapes the market with regard to standards and openness. The German ICT industry will have to play an active role in designing the future social and economic framework.

Theses on “Digital archiving“ in detail

Fig. III.37: Thesis 70 Affordable long-term archiving

Affordable digital solutions are available for the reliable long-term archiving of documents, e. g., the automatic copying of databases from one storage medium to another before any technical problems arise.

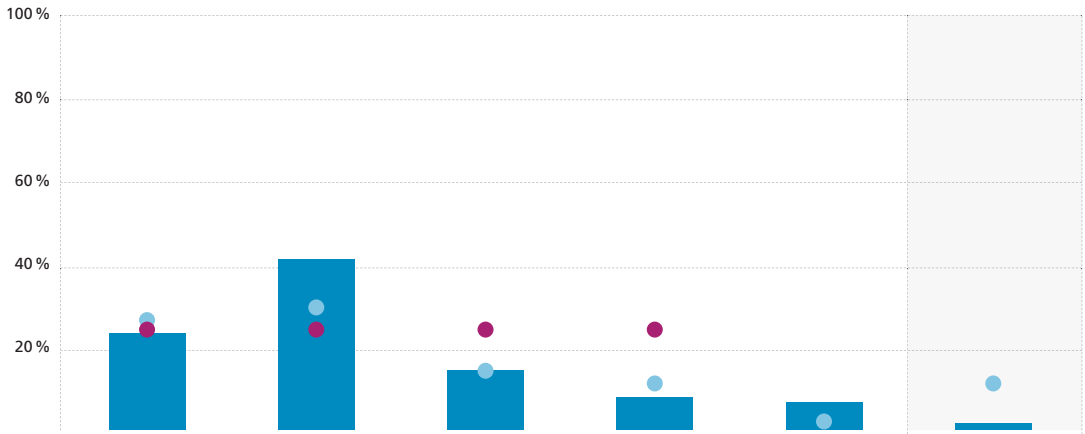


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 62)	23 %	42 %	31 %	2 %	2 %	2 %
EU experts (n = 11) [1]*	27 %	45 %	9 %	9 %	9 %	0 %
DNAdigital (n = 29)	21 %	34 %	21 %	10 %	7 %	7 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. III.38: Thesis 71 New storage media

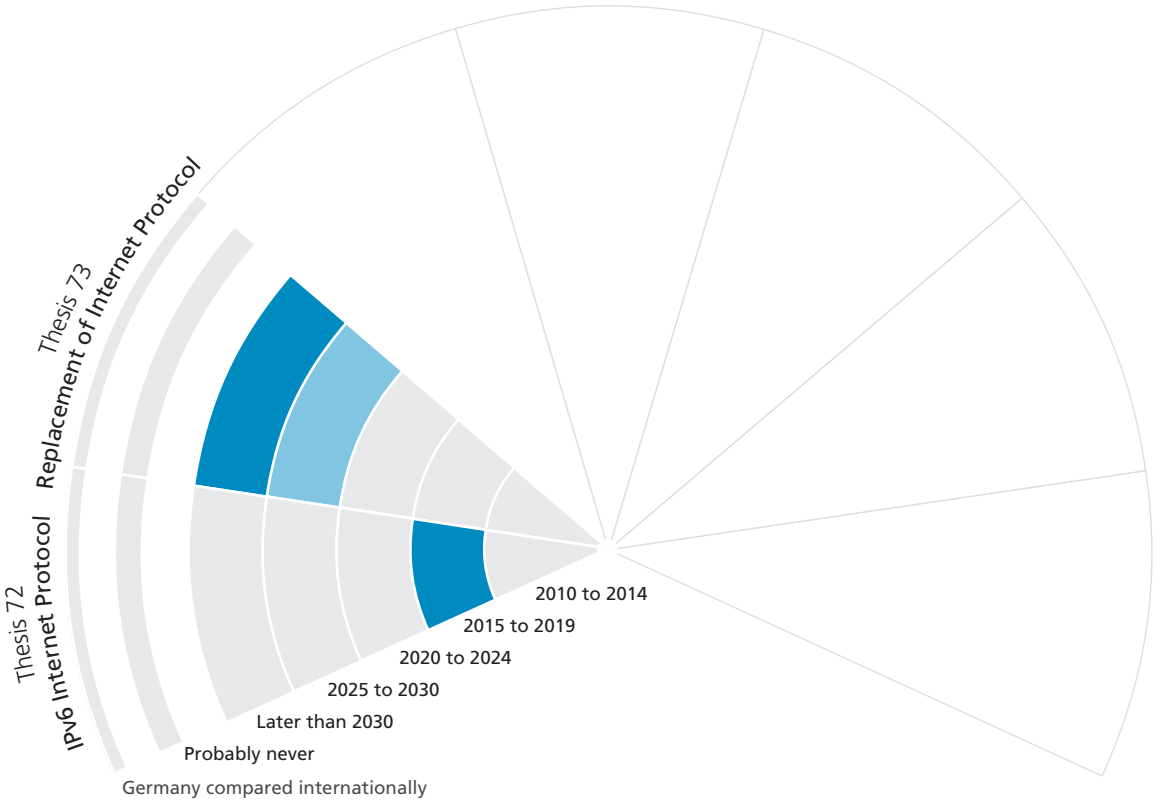
New storage media are available on the market for the reliable long-term archiving of documents.



	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 79)	24 %	42 %	15 %	9 %	8 %	3 %
EU experts (n = 12) [1]*	25 %	25 %	25 %	25 %	0 %	0 %
DNAdigital (n = 33)	27 %	30 %	15 %	12 %	3 %	12 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

III.7 Technological development of the Internet
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 72: IPv6 Internet Protocol

IPv6 has replaced the former IPv4 standard and is the current established standard.

Thesis 73: Replacement of Internet Protocol

IP (Internet protocol) has been replaced as the base technology of the Internet.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

From Arpanet to the global Internet

The roots of today's Internet extend back to the year 1969, to ARPANET, which in its early days connected four American research facilities. This network grew as the years passed and a series of communication protocols was developed, including the Internet Protocol (IP). Version 4 of this protocol was the first to be deployed worldwide. It was standardized by the IETF in RFC 791 in the year 1981. It quickly became clear that the 32-bit addressing defined in IPv4 would be insufficient and work on a successor, IPv6, began in 1995. The corresponding IETF standard, RFC 2460 from 1998, laid the foundation for the new Internet Protocol.

The shortage of available addresses under IPv4 is solved using 128-bit address lengths in IPv6, which allow the addressing of over $3x10^{38}$ devices; IPv4 is limited to around $4x10^{9}$ devices. In addition to scalability issues, IPv6 also provides much better support in the areas of quality of service (QoS), security and mobility compared to IPv4.

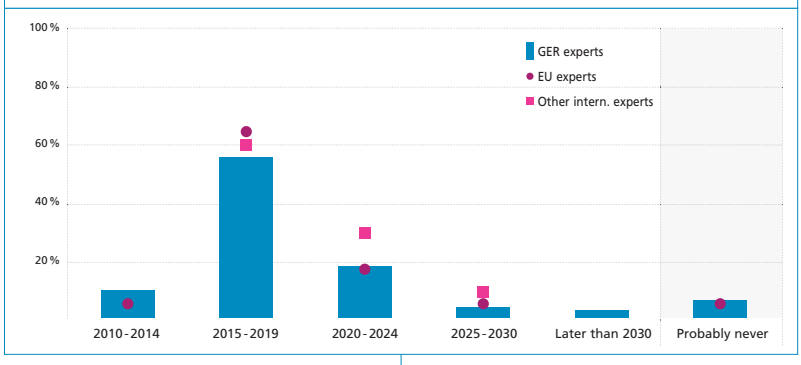
All in all, IPv6 is an evolutionary development of the Internet Protocol, one that is still waiting for broad-based deployment. A few fundamental issues of the Internet, such as mobility management, remain unsolved under IPv6; other problems, such as the size of the routing tables, would even be exacerbated. As a result, researchers are already examining revolutionary clean-slate approaches, meaning a complete restart of the Internet that does not require compatibility with currently used technologies. A variety of activities in national and international research programs are pursuing this goal. They are focusing on more comprehensive solution approaches to the scalability issues (particularly with regard to mobile applications), the flexible composition of new services and applications, the virtualization of functions and, of course, network security.

Experts expect implementation of IPv6 in the next six to ten years

Despite the ongoing difficulties with IPv4, it was not replaced by its successor in the past decade. Instead, IPv4 has been expanded with a number of protocol enhancements, each aimed at limiting a specific, acute bottleneck. One example of this is the implementation of NAT (network address translation), which improves the scalability of IPv4 by concealing entire networks behind a single IP address, but has also resulted in many new problems.

One of the most decisive reasons for delaying general migration from IPv4 to IPv6 is surely the massive cost and effort required to do so, combined with the difficulty of achieving a sufficient short-term ROI (return on investment). As this study shows, the experts do not believe the slow pace of implementation of IPv6 will change much in coming years (see Fig. III.39): merely ten percent of the GER experts and six percent of the Europe experts expect IPv6 to replace IPv4 within the next five years. More than half the experts surveyed believe this will take six to ten years. On the other hand, only seven percent of the Germany experts and six percent of the Europe experts believe that IPv6 will fail to be implemented at all.

Thesis 72: IPv6 has replaced the former IPv4 standard and is the current established standard.



The comprehensive use of completely new Internet technologies that are no longer based on the current Internet Protocol will not occur until 2025 at the soonest, according to the experts.

The experts for Germany expect deployment of these "beyond IP" technologies much later than their European colleagues (see Fig. III.40). One reason for this might be the relatively generous supply of German and European Internet service providers with IPv4 addresses, which has its roots in the history of Internet development and which generally lessens pressure to replace the existing protocol.

The Internet of the future – a precursor for many new applications

The importance and role of the Internet have changed significantly. Used primarily for the simple exchange of data via e-mail in its early days, the Internet now plays an enormously important role for countless applications – implementing efficient business processes, for example – and as a sheer infinite store of data and information.

More than ever, future industrial applications will need a well-functioning Internet that, in particular, enables communication with an immense number of microdevices in the form of embedded systems and RFID tags. This will open up new opportunities in many areas, such as automation, logistics systems, transportation, building management, healthcare and the energy sector.

As a result, the early availability of new, suitable Internet technologies is needed to ensure that no barriers to implementing new applications pop up, to strengthen national, European and international industry. For this very reason, EU commissar Viviane Reding called on the EU member states in May 2008 "[...] to make sure that public authorities and industry have IPv6 widely sown up by 2010." (European Commission 2008). There are also believable forecasts that the world will run out of IPv4 addresses in the first half of the next decade (see IPv4 Address Report 2009). From this perspective, the experts' prediction that comprehensive use of new technologies such as IPv6 will not occur for at least six years seems relatively late.

Germany experts see clean-slate Internet as a far-off prospect

Experts' estimations of the time frame in which IPv6 will replace IPv4 are largely consistent between the various regions (see Fig. III.39). The experts for Germany are a bit more pessimistic, which could be due to the fact that IPv6 currently only plays a miniscule role in Germany, whereas there is already some commercial use in other European countries and even more in countries outside Europe.

Much more significant is the difference in expectations of establishing a completely new Internet technology that is independent of IP. Around two-thirds of the surveyed experts for Germany do not expect Internet Protocol to be replaced until after 2030, if at all, whereas more than half the Europe experts think this could occur by 2030 (see Fig. III.40).

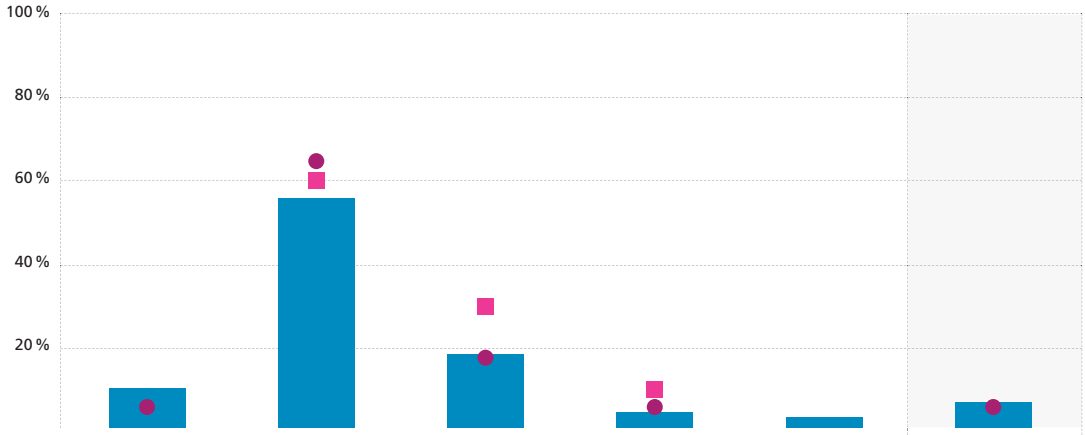
Summary

The surveyed Delphi experts agree that IP technology will continue to define the Internet for a long time to come. In particular, the sluggish transition from IPv4 to IPv6 shows that even numerous technical benefits of a new technology do not guarantee its rapid deployment. Its commercial potential – taken in relation to the effort and expense of its implementation – is much more important, particularly since the implementation process is far from spontaneous in most cases, instead requiring a planned, step-by-step migration concept. In particular, we must ensure that the commercial implementation of future (industrial) applications is not blocked through restricted technical capabilities of the future Internet. At the same time, the implementation of new technologies in the Internet must not be delayed unduly based on a perceived lack of available new applications.

Theses on "Technological development of the Internet" in detail

Fig. III.39: Thesis 72 IPv6 Internet Protocol

IPv6 has replaced the former IPv4 standard and is the current established standard.

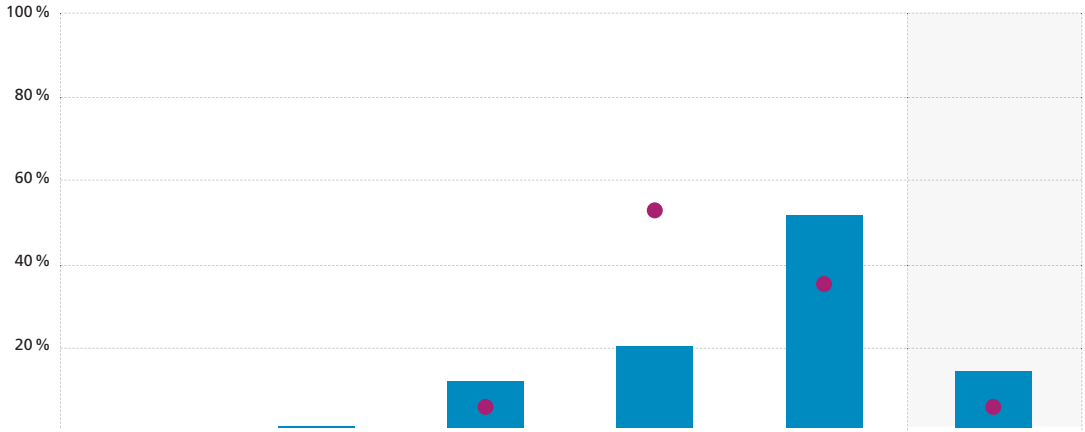


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 86)	10 %	56 %	19 %	5 %	3 %	7 %
EU experts (n = 17) [1]*	6 %	65 %	18 %	6 %	0 %	6 %
Other intern. experts (n = 10) [2]*	0 %	60 %	30 %	10 %	0 %	0 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, except Germany, Europe and the U.S.; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. III.40: Thesis 73 Replacement of Internet Protocol

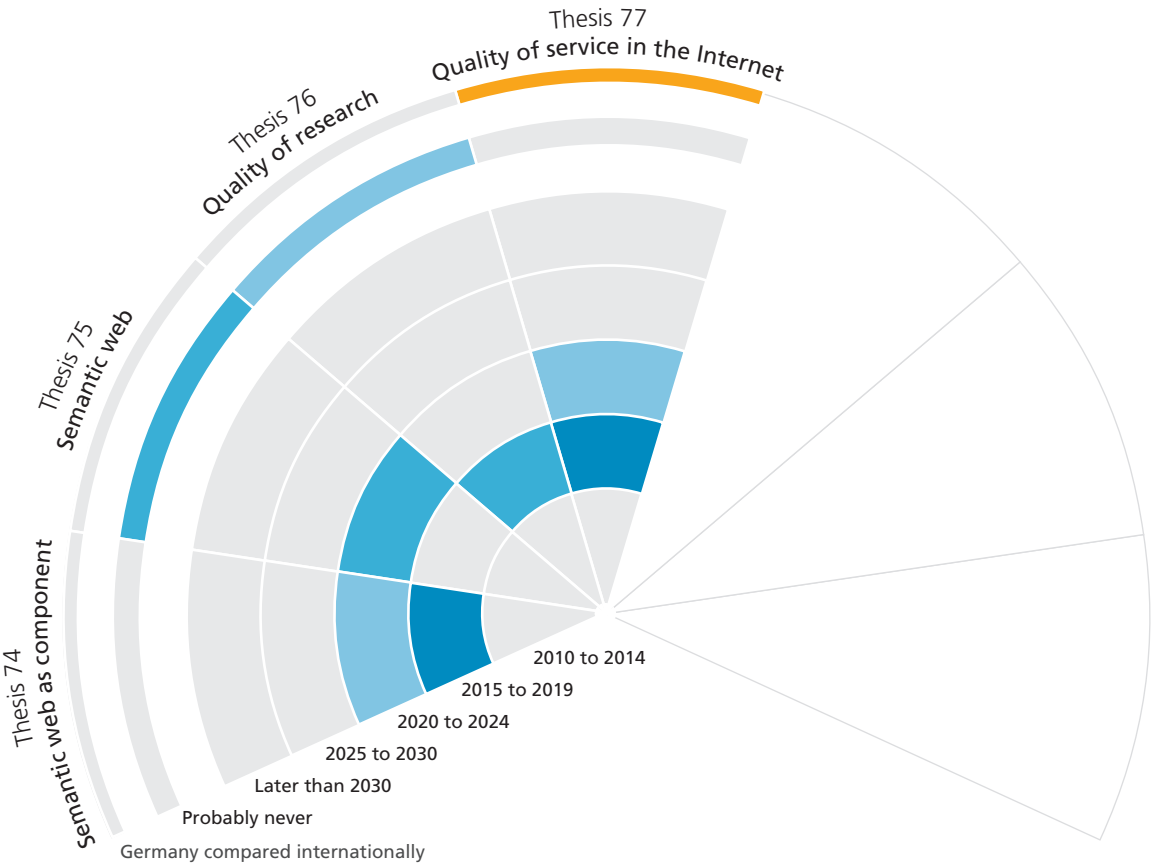
IP (Internet protocol) has been replaced as the base technology of the Internet.



	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 83)	0 %	1 %	12 %	20 %	52 %	14 %
EU experts (n = 17) [1]*	0 %	0 %	6 %	53 %	35 %	6 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

III.8 Semantic web
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 74: Semantic web as Internet component

Technologies of the semantic web are integral system components of the Internet.

Thesis 75: Semantic web

Suppliers of semantic technologies have led to a shift in Internet markets since they have replaced conventional offers and suppliers.

Thesis 76: Quality of Internet research

Credible quality indicators for information found on the Internet are available to users conducting Internet research and search requests.

Thesis 77: Quality of service in the Internet

Quality of service guarantees are standard for Internet services in Germany.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

From information collection to understanding knowledge

The Internet has evolved at a rapid pace in the last 15 years – so much so that it is now hard to imagine life without it. Alongside the major benefits, however – such as timeliness and availability of information – the deficits of the World Wide Web approach are apparent. The immense flood of information in the WWW threatens to overwhelm conventional search engines, which no longer deliver accurate results. The search engines base their searches on keywords in network content, but do not "understand" it – for example, a search for "Jaguar" returns hits for both the car brand and the big cat.

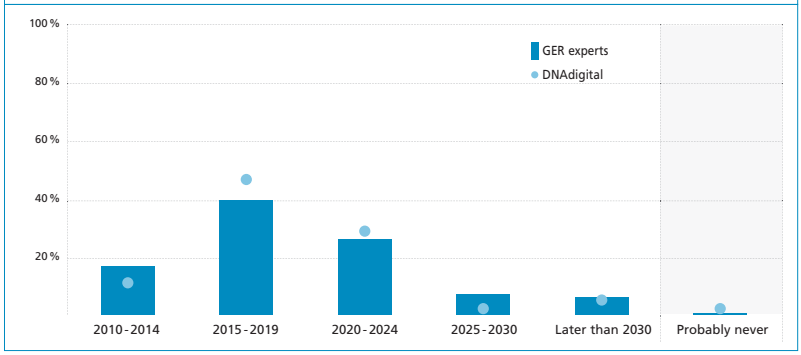
In contrast, the semantic web approach involves relating different bits of information. This will allow the search engines to prepare, filter and process the information in a completely new way. To implement the idea of the semantic web, uniform, open standards for the exchange of information between applications and platforms must be devised and agreed upon.

This would allow computers to work their way through the sheer infinite amount of information in the web and find new connections and conclusions that human experts have been unable to discover due to their lack of breadth. This foundation could be used to create new applications or improve existing ones, creating significant added value for Internet users.

Experts have great expectations of the benefits of a semantic web

The Delphi survey shows a clearly positive mood among the surveyed GER experts with regard to the economic relevance of a semantic web and the extent to which such technologies are spread around the Internet: 84 percent of those surveyed believe that semantic web technology will become an integral component of the Internet by the year 2024 at the latest (see Fig. III.41). Half the experts believe this will occur even earlier, by the year 2019. Aside from a small minority, nearly all of those surveyed believe the semantic web will be implemented in some form. The benefit of a semantic web for economic development in general is considered to be extremely positive. In particular, they believe a semantic web will be particularly significant in identifying the QoS (quality of service) of electronic services. Technological progress is seen as the most important contributing factor, but also as the greatest barrier. As yet, it is unclear whether the semantic web will result in a shift of power in Internet markets.

Thesis 74: Technologies of the semantic web are integral system components of the Internet.



Positive trend through standards

The role of the Internet is changing: formerly only a platform for providing information, it is now the foundation for a wide variety of applications and services. Future industrial applications will need an intelligent Internet more than ever, one that supports the semantic description of information and their automatic machine-based processing and interpretation.

The surveyed experts for Germany expect the ongoing development and implementation of the semantic web to have a largely positive to highly positive impact on the overall economy, on society and on the ICT and media industries (see Fig. III.42). Only nine percent of the surveyed experts expect negative effects on the media industry. The early definition of uniform standards is considered to be a primary factor to minimizing barriers to introduction of new applications, to strengthen national, European and international industry.

How is the quality of Internet services?

While a clear majority of those surveyed believes that implementation of the semantic web is only a question of time (see Fig. III.41), when it comes to the more general question of when the Internet-based services (particularly the services of the semantic web) will become available, the experts' opinions diverge: 53 percent of the surveyed GER experts and 54 percent of the Europe experts assume that credible information will be available on the quality of the results of Internet research and search requests within the next ten years.

In contrast, most of the experts for non-European countries (50 percent) do not expect this quality boost in the Internet until after 2020. When asked whether it will be possible to provide credible content in the

Internet at all, the Germany experts are much more critical: 24 percent assume this will never be possible; only five percent of the Europe experts and eight percent of the experts for non-European countries share this opinion (see Fig. III.46).

When asked about a potential shift in power in Internet markets, the assessment by the Germany experts differs widely from those surveyed in the DNAdigital group: Three-quarters of those surveyed at DNAdigital assume that conventional offerings and suppliers will be replaced in the next 15 years; only half of the surveyed experts for Germany share this opinion (see Fig. III.45).

Research funding and investment needed

The surveyed experts for Germany see technological progress (71 percent) and investments in research and development (44 percent) as the most important drivers for realizing a semantic web (see Fig. III.43). This corresponds with the assessment that technical problems pose the greatest obstacle for developing and implementing these new technologies (46 percent). Other possible hindrances to the development of a semantic web include a lack of standards (35 percent) and insufficient investment by companies (31 percent).

Summary

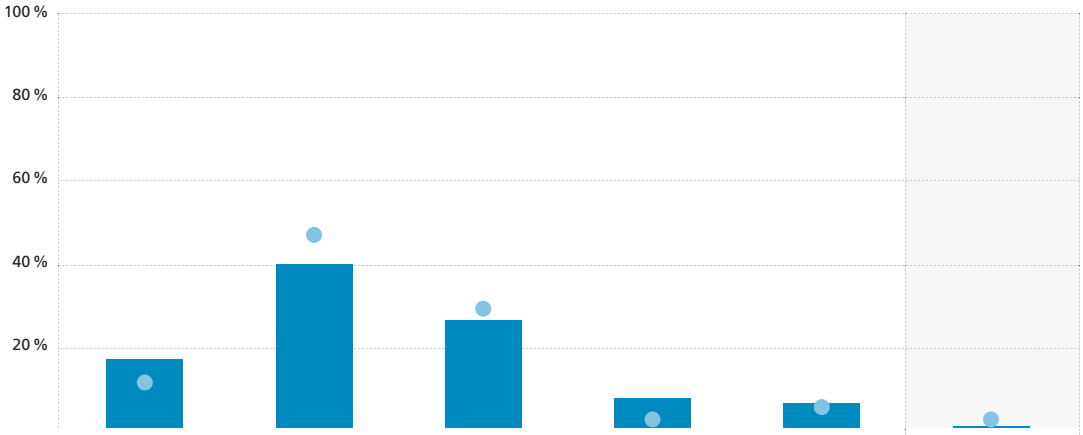
The results clearly show that the evolution of the World Wide Web to a semantic web is seen to be both positive and likely by those surveyed.

Technical progress, support for research and development and agreement on standards are considered to be an essential foundation to the semantic web. At the same time, the results also indicate that targeted investment in technological development is needed to reap the major commercial opportunities posed by the semantic web.

Theses on “Semantic web“ in detail

Fig. III.41: Thesis 74 Semantic web as Internet component

Technologies of the semantic web are integral system components of the Internet.

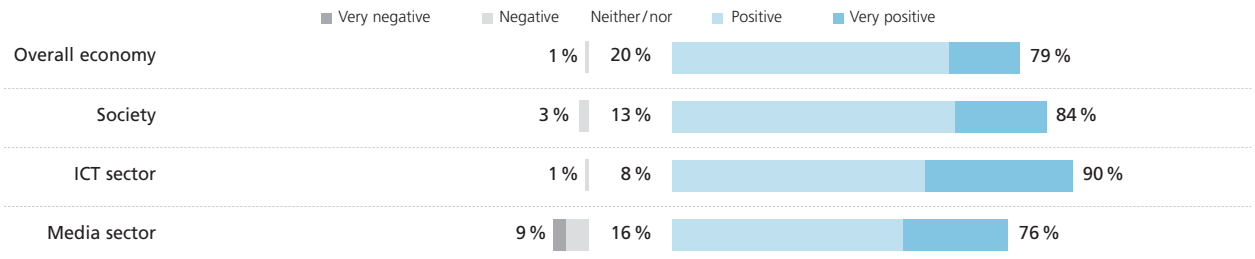


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 75)	17 %	40 %	27 %	8 %	7 %	1 %
DNAdigital (n = 34)	12 %	47 %	29 %	3 %	6 %	3 %

Basis: All people surveyed with special expertise in the topic area

Fig. III.42: Thesis 74 Semantic web as Internet component – relevance

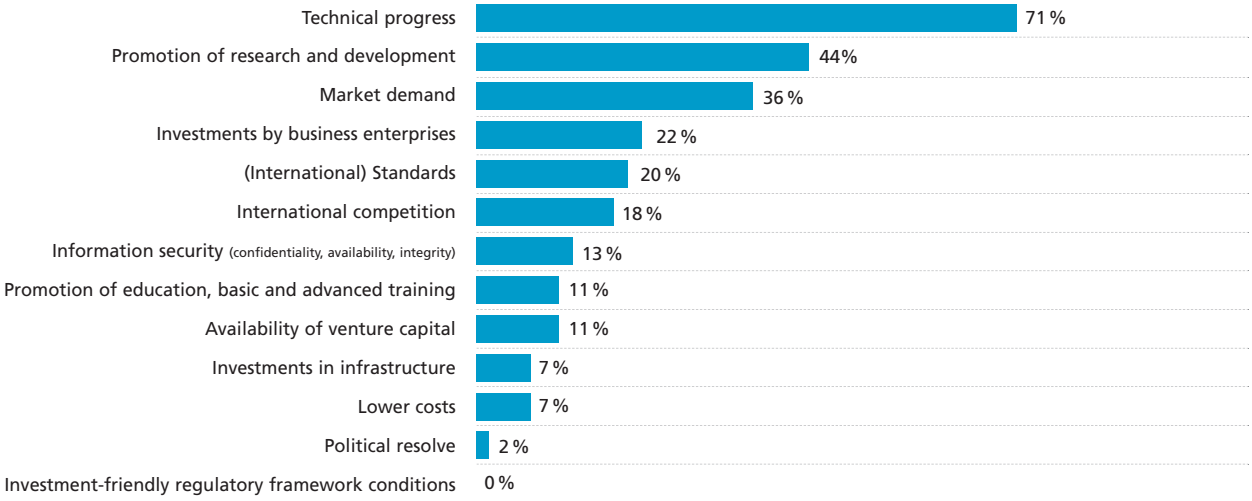
What impact will the validity of Thesis 74 above have on the areas listed below?



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, at least n = 70

Fig. III.43: Thesis 74 Semantic web as Internet component – drivers

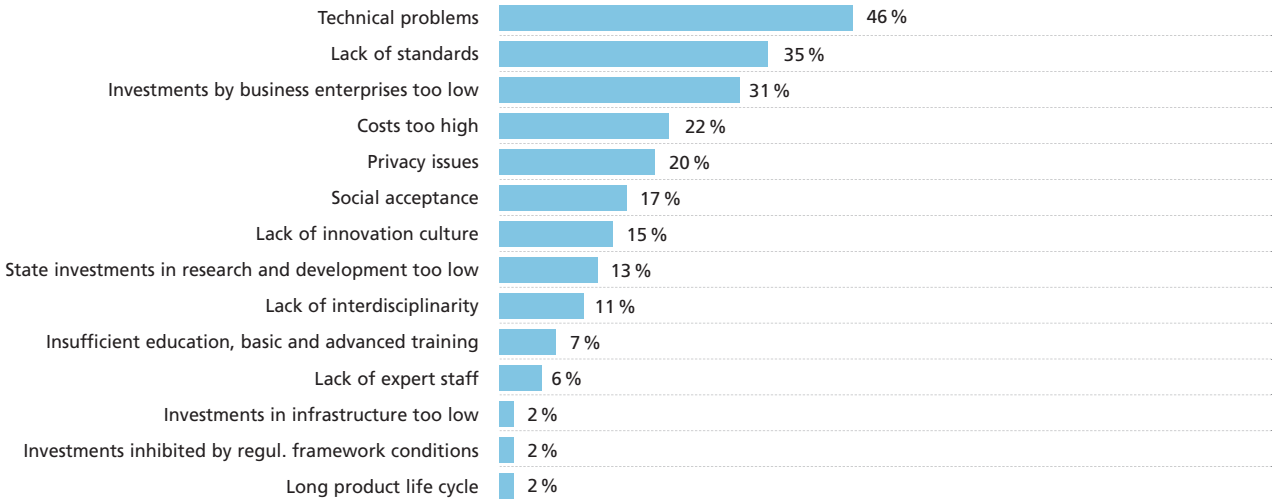
Select up to three drivers from the following list that you consider to be most important for realization of Thesis 74 above.



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n=55

Fig. III.44: Thesis 74 Semantic web as Internet component – barriers

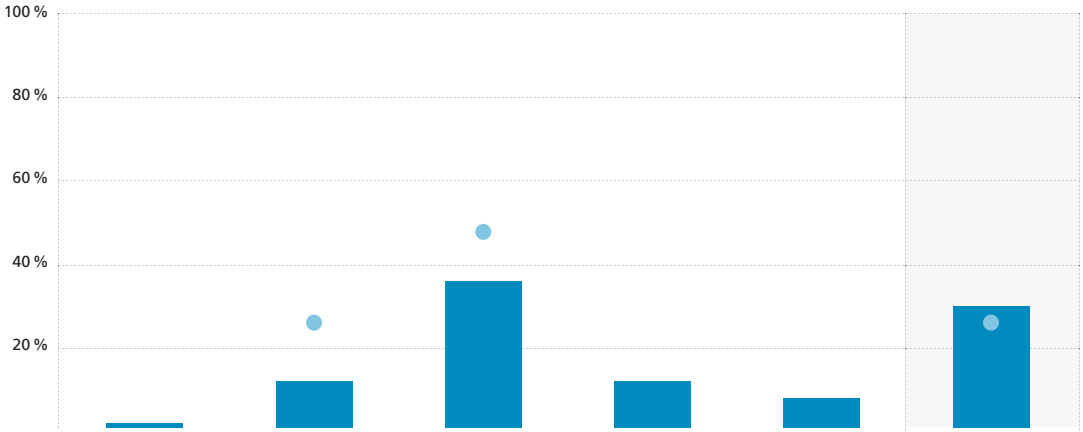
Select up to three barriers from the following list that you consider to be most important for realization of Thesis 74 above.



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n=54

Fig. III.45: Thesis 75 Semantic web

Suppliers of semantic technologies have led to a shift in Internet markets since they have replaced conventional offers and suppliers.

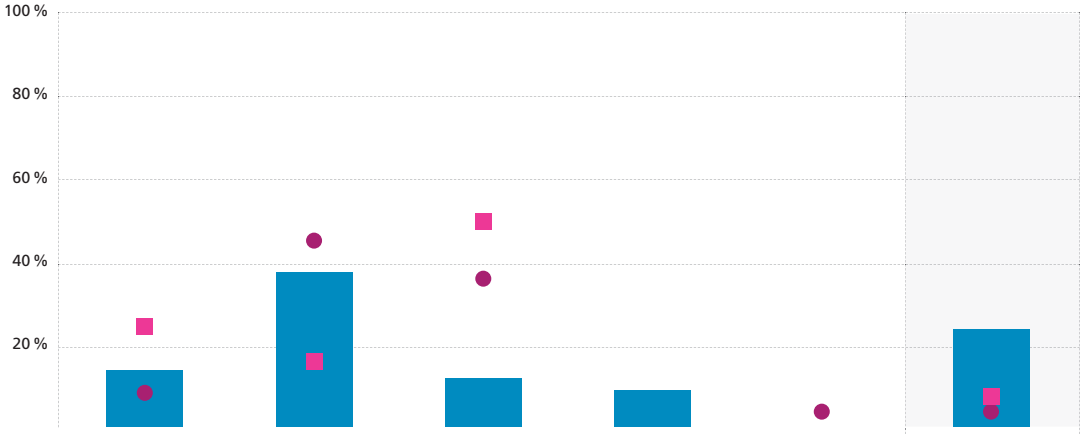


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 50)	2 %	12 %	36 %	12 %	8 %	30 %
DNAdigital (n = 23)	0 %	26 %	48 %	0 %	0 %	26 %

Basis: All people surveyed with special expertise in the topic area

Fig. III.46: Thesis 76 Quality of Internet research

Credible quality indicators for information found on the Internet are available to users conducting Internet research and search requests.



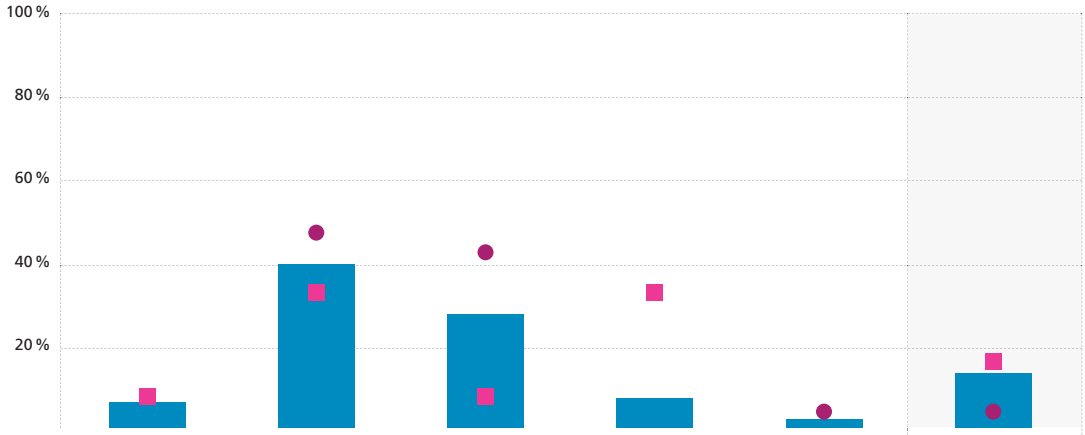
	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 103)	15 %	38 %	13 %	10 %	1 %	24 %
EU experts (n = 22) [1]	9 %	45 %	36 %	0 %	5 %	5 %
Other intern. experts (n = 12) [2*]	25 %	17 %	50 %	0 %	0 %	8 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, except Germany, Europe and the U.S.; *Fewer than 20 cases!

Basis: All people surveyed with special expertise in the topic area

Fig. III.47: Thesis 77 Quality of service in the Internet

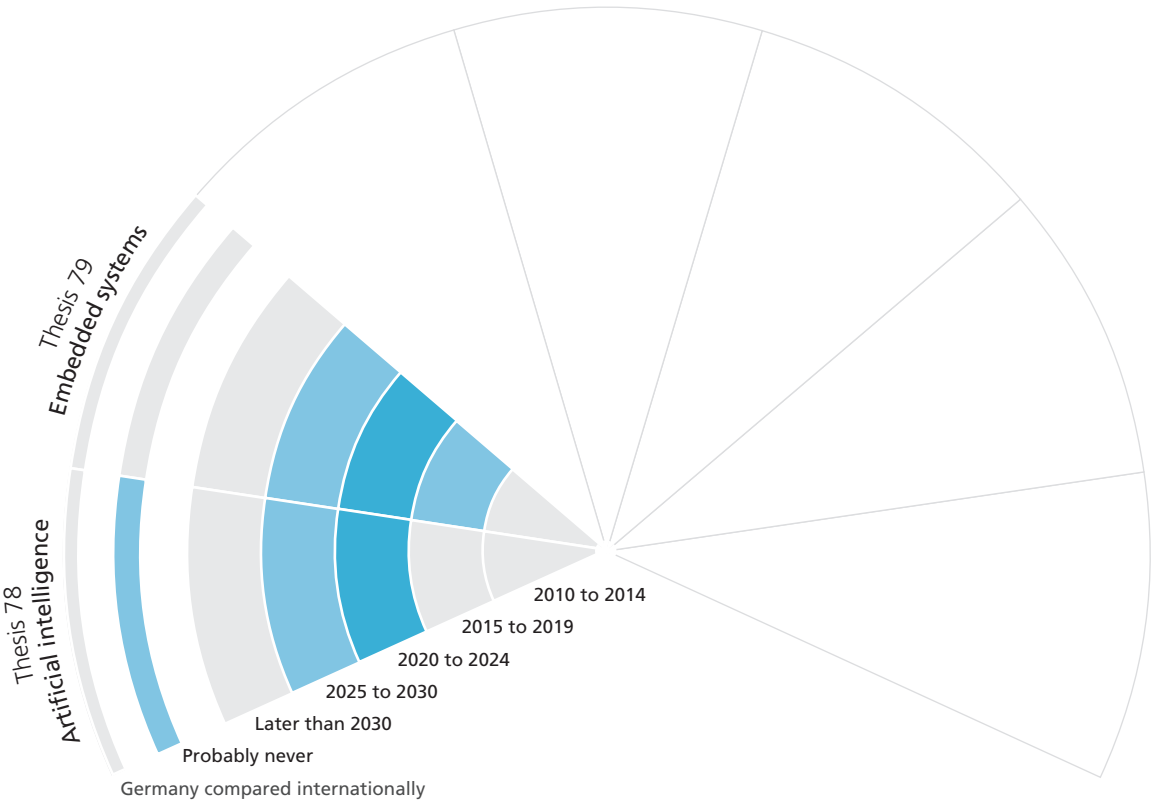
Quality of service guarantees are standard for Internet services in Germany.



	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 100)	7 %	40 %	28 %	8 %	3 %	14 %
EU experts (n = 21) [1]	0 %	48 %	43 %	0 %	5 %	5 %
Other intern. experts (n = 12) [2]*	8 %	33 %	8 %	33 %	0 %	17 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, except Germany, Europe and the U.S.; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

III.9 Embedded systems
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 78: Artificial intelligence

The application of "artificial intelligence" (self-learning embedded systems) has revolutionized the product, service and process world.

Thesis 79: Embedded systems

"Autonomous intelligent embedded systems" that learn from other intelligent systems and communicate with them on an automated and completely independent basis are standard for a wide range of applications and products.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

Current developments in information technology that are producing inexpensive, powerful and embedded systems – such as ubiquitous and pervasive computing – as well as new forms of mobile communication and advanced software technologies that manage and use complex systems and growing data volumes are paving the way for tomorrow's autonomous, intelligent embedded systems: systems that learn from other intelligent systems and communicate with them automatically and completely independently. However, complex systems that are affected by the environment create demand for the best respective form of operation, which usually involves resource conservation and energy efficiency.

Autonomous learning and methods for artificial intelligence are creating broad potential for embedded systems.

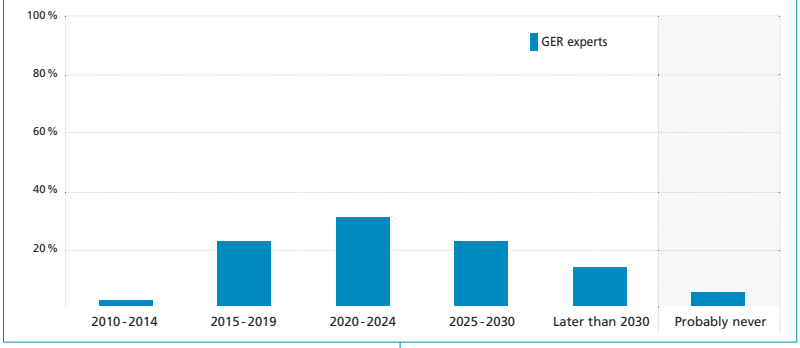
The sections below introduce the subject of autonomous, intelligent embedded systems based on the opinions of the surveyed experts for Germany, providing insight to future developments in this area.

Significant market share for autonomous, intelligent embedded systems from 2020

The majority of the experts for Germany (57 percent) believe autonomous, intelligent embedded systems – which learn from other systems and communicate with them completely independently – will become the standard for myriad applications and products by 2024. Two-thirds of the experts surveyed expect broad market penetration by this technology by 2030 (see Fig. III.49).

The experts believe this technology will have a positive impact on the overall economy, and particularly on the ICT industry (see Fig. III.50), where there is tremendous business potential from the improvement of existing applications and the creation of new applications that also affect other business sectors – such as manufacturing and the energy sector. The results will be systems, technical processes and workflows that are continuously optimized from both an ecological and economic perspective. Accordingly, the experts paint a largely positive picture for society in general, despite potential reservations.

Thesis 79: "Autonomous intelligent embedded systems" that learn from other intelligent systems and communicate with them on an automated and completely independent basis are standard for a wide range of applications and products.



These reservations might have their roots in the expected negative impact of increasing automation on job availability. The perceived opacity of automated decision-making by the system, taking many dimensions into account, is also considered negative. Still, the positive aspects dominate, for example, optimized operation in a variety of different situations, lower costs and greater stability and scalability – that are expected from the improved flexibility and the expected higher degree of automation in complex applications.

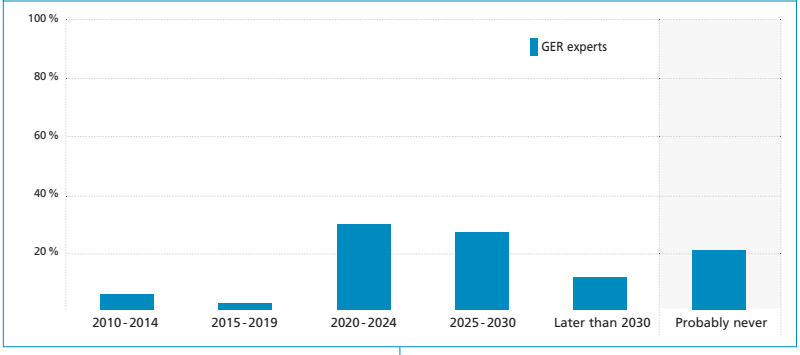
Examining the drivers of this technology, technical progress (66 percent) and the promotion of research and development (48 percent) get the most mentions. The GER experts also believe that the technology can get a major boost through market demand, (international) standards and investments by companies. Interestingly, none of the experts surveyed named political resolve or an innovation-friendly regulatory framework as one of the three most important drivers. Apparently, politicians have not yet recognized the importance of this technology for achieving climate targets (see Fig. III.51).

Experts believe the greatest barriers to realizing the technology are a lack of standards (48 percent) and technical problems with implementation (38 percent). In contrast, only 28 percent of the experts see data protection issues as an obstacle. Other problems with implementation are perceived to be excessively high costs and a lack of a culture of innovation: one-fifth of the surveyed experts for Germany believe investments in research and development in this area by companies and the state are too low. This seems to have its roots in the longer-term horizon of the subject, although it is also perceived to be highly relevant (77 percent) to the overall economy (see Fig. III.52).

79 percent of the surveyed experts agree with the thesis that the "artificial intelligence" application (self-learning, embedded systems) will revolutionize the product, service and process world.

Six percent of the surveyed Germany experts believe this will be achieved by 2010. However, the majority (57 percent) believes implementation will be accomplished in the 2020–2030 time frame. Only 21 percent of the surveyed experts do not expect "artificial intelligence" to cause a revolution in the areas named above (see Fig. III.48).

Thesis 78: The application of "artificial intelligence" (self-learning embedded systems) has revolutionized the product, service and process world.



Further development can bring the technology to market maturity

According to experts' appraisal, "artificial intelligence" can attain high market significance from 2020. The time frame of more then ten years until the technology achieves market significance can be traced to the following aspects: individual solutions, technologies and procedures in the communication of embedded systems, as well as autonomous optimization through "artificial intelligence" procedures already exist. To achieve a significant market position, however, these existing solutions must be merged and expanded to new, more generalized applications. Examples of the independent communication standards used for specific applications include UMTS, ZigBee, Bluetooth and WLAN – some of which also incur high communication expenses.

Autonomous systems have been used in information technology for some time now. The implementation of these systems on limited-resource embedded systems is much more recent. Computing power and storage capacity, in particular, were too limited for a long time. When autonomous and mobile devices are involved, energy efficiency and supply are also important factors.

The software must guarantee robustness and reliability. More complex algorithms, such as those utilized in "artificial intelligence," require dataefficient learning to develop energy-efficient, resource-efficient action strategies. Other important issues include the secure exploration of the systems in their environment and consideration of the changed statistics for the obtained information.

A shared data model, which standardizes the exchange of information, is useful for intelligent, autonomous systems. Such models must contain semantic descriptions as well as simulation/domain models to enable automated processing in interacting systems.

The greatest impact on the ICT industry is expected in this area, as it must create the semantic technologies, algorithms and new energy-efficient communication methods, standardize them as necessary and bring them to market. These developments will continue to increase their influence on the manufacturing, energy and medical technology sectors and enable new applications. This new, complex, autonomous software must prove its effectiveness in various applications, to ensure trust in the technology continues to grow. In particular, high-profile applications that demonstrate the capabilities and reliability of such systems are needed. The described prerequisites and the successive further development and integration of such systems will help boost acceptance, which in turn is required for market maturity.

Support and standardization are important drivers

Business and politics have to become more ardent supporters of research and development in this area, as well as provide funding, to help counteract an insufficiently developed culture of innovation. Furthermore, international standards must be demanded and developed to ensure the sustainability of the technology. This also entails data protection, since proper consideration of privacy issues in highly networked, distributed information processing will help foster greater acceptance among business and society.

Summary

Experts believe that technology involving autonomous, intelligent systems that learn from other systems and communicate with them automatically and fully independently will be an important component for a variety of applications and products. It will have a clearly positive impact on business and society.

We will begin seeing the strong effects and rapid market penetration of this technology in products, services and processes as soon as the year 2020. The main drivers are technical progress and the promotion for research and development of the technology.

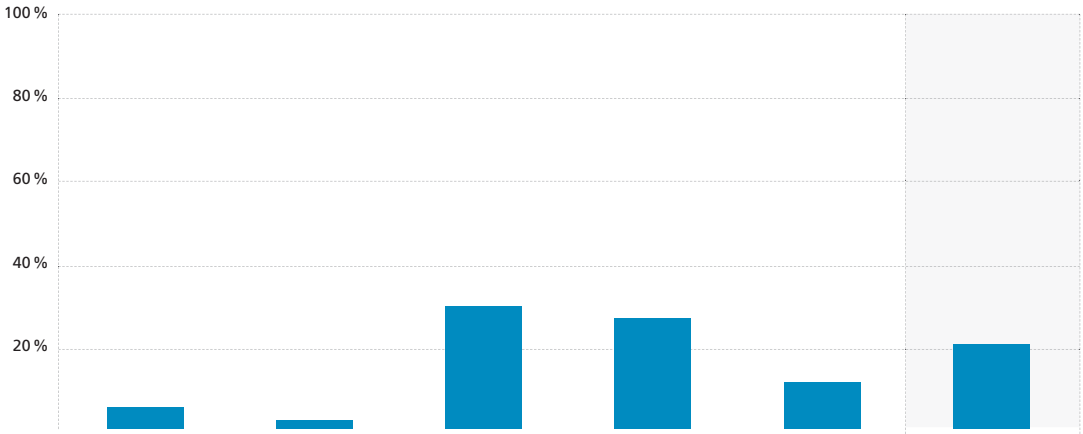
Standards are seen to be an important precursor. In contrast, a lack of political will or regulatory framework, as well as low state and company investments paired with high costs, currently inhibits development.

It is up to science and industry to intensify their research and development – and formulate the necessary standards – to set this technology on the path to a wide market presence.

Theses on "Embedded systems" in detail

Fig. III.48: Thesis 78 Artificial intelligence

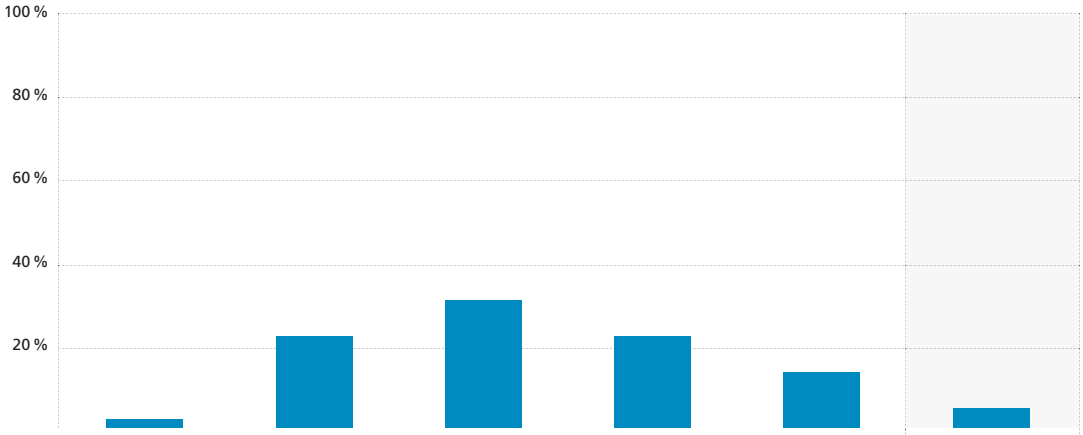
The application of "artificial intelligence" (self-learning embedded systems) has revolutionized the product, service and process world.



Basis: All people surveyed with special expertise in the topic area

Fig. III.49: Thesis 79 Embedded systems

"Autonomous intelligent embedded systems" that learn from other intelligent systems and communicate with them on an automated and completely independent basis are standard for a wide range of applications and products.

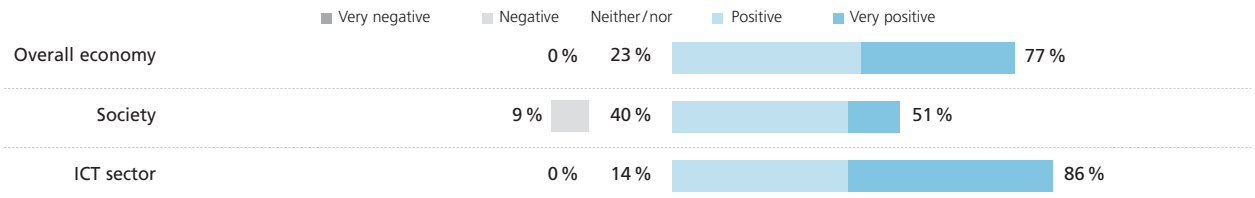


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 35)	3 %	23 %	31 %	23 %	14 %	6 %

Basis: All people surveyed with special expertise in the topic area

Fig. III.50: Thesis 79 Embedded systems – relevance

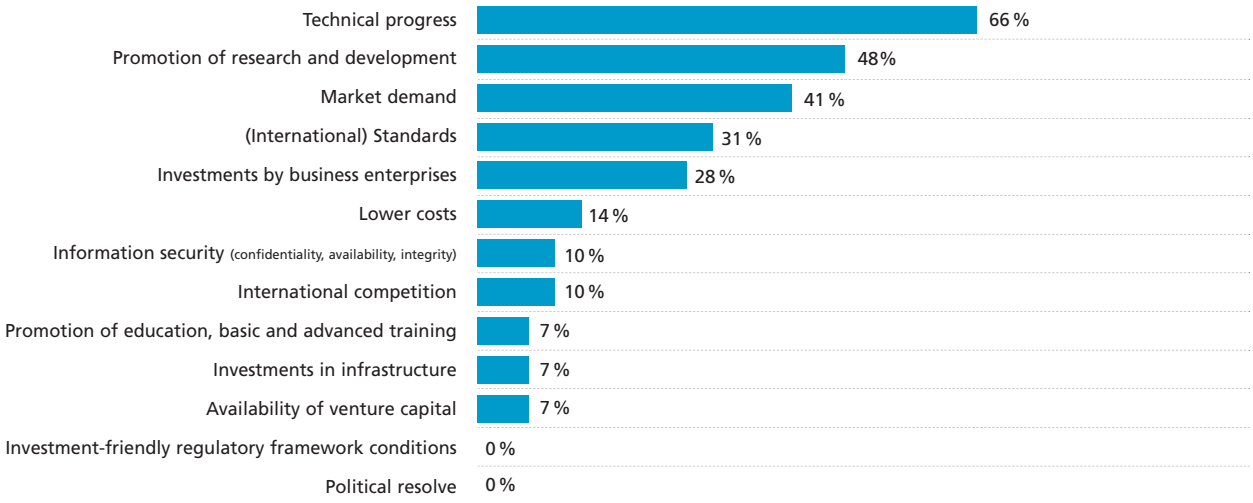
What impact will the validity of Thesis 79 above have on the areas listed below?



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, at least n = 35

Fig. III.51: Thesis 79 Embedded systems – drivers

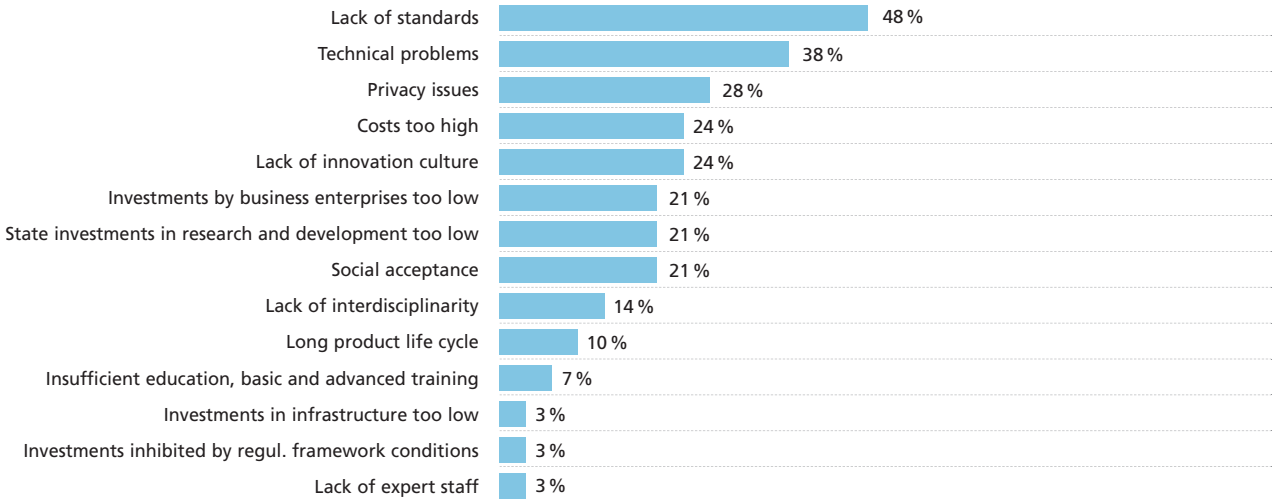
Select up to three drivers from the following list that you consider to be most important for realization of Thesis 79 above.



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n = 29

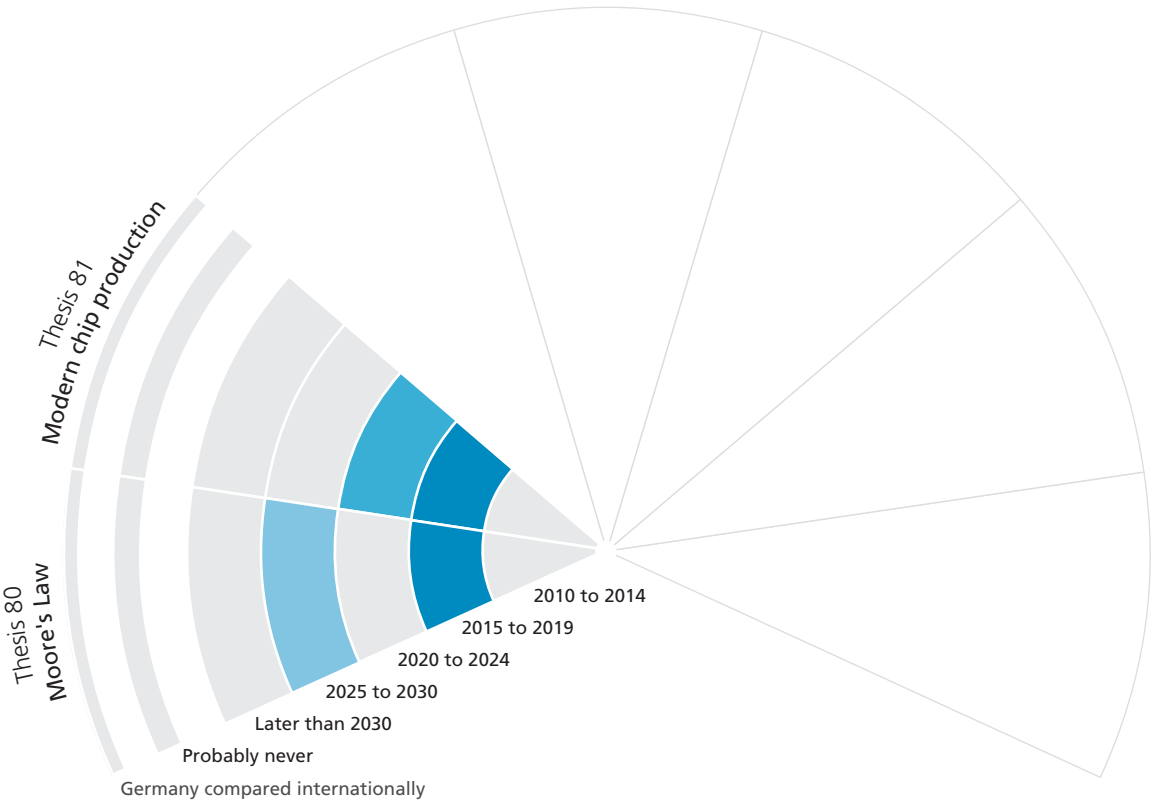
Fig. III.52: Thesis 79 Embedded systems – barriers

Select up to three barriers from the following list that you consider to be most important for realization of Thesis 79 above.



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n = 29

III.10 Semiconductor technology
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 80: Moore's Law

Traditional silicon-based chips (memories and processors) have been pushed to their performance limits due to increasing miniaturization.

Thesis 81: Modern chip production

Conventional photolithographic technology has been replaced as the standard technology for the production of chips (memories and processors), e. g., by technologies such as nanoimprint or maskless lithography.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

Moore's law and its significance for ICT

The triumphant advance of ICT and media technology is due largely to the constant increase in capacity of the hardware modules in the systems in past decades. The rapid, sustained growth of the number of transistor functions per area on a silicon chip (integrated switch) has enabled enduring growth of memory size and computing capacity of microprocessors. One beneficial side effect: the prices for the same performance sink drastically and permanently.

The growth of microelectronics is described using the famous "Moore's Law," an empirically based forecast of the future development of microelectronics made by Gordon Moore, co-founder of Intel, more than 40 years ago, which has remained accurate ever since. It states that the number of transistors that can be fit on a silicon chip doubles every 12–24 months – exponential growth! Without these ever more powerful, innovative chips, there would be no computers, mobile phones, or other new functions in hardware and software. And since this technology can also be used to build communication systems, the components can be networked with one another inexpensively. To put it another way, if there were no silicon semiconductors and no Moore's Law, there would be no Internet and no mobile telephony.

Although not an actual "law," decades of research and development efforts by the best engineers and physicists around the world have proven it true. The fact that this prediction has held true to today – and, as experts predict, will continue to do so for at least another decade – has surprised some experts; repeated forecasts of the "end of the silicon age" have proven to be wrong.

Limits in sight

Nonetheless, natural limits are now in sight, from a variety of perspectives. First of all, the laws of physics are a barrier to further miniaturization. As the individual transistors and memory cells become more and more miniaturized, they become more susceptible to errors, particularly while thin layers and dimensions result in unwanted, yet unavoidable effects through electrical interference. Despite numerous successes through new technological procedures, such as continuing to lower the utilized voltage, the physical limits are slowly being reached. The same applies to energy consumption: the electrical capacity density of a modern high integration chip exceeds that of a stovetop burner by magnitudes! But even if these problems can be solved, we still have to deal with the design gap, which continues to expand: the complexity (number of transistors) of producible chips has been growing more quickly than chip developers can actually implement over the years. Without (partial) compensation by improved drafting software, it will be possible to manufacture more complex chips, but not design them.

Another, more fuzzy limit is the ability to produce such chips in the required numbers (billions per year) economically, thus reducing costs further. The German Federal Ministry of Education and Research, BMBF, confirmed this: "In the meantime, transistor densities have increased to the extent that millions of transistors now fit on the tip of a ball-point pen. Several billion transistors are active in advanced processors, and they have to be linked with one another in such a way that the chip works as designed – an adventurous undertaking that makes extreme demands of the design and manufacturing process" (BMBF 2005).

Last but not least, costs for chip factories – or "fabs" – have increased nearly as exponentially as the performance of the chips they produce. Here, as well, there have been many breakthroughs with innovative manufacturing technologies without which Moore's Law would have lost its validity long ago. Against this backdrop, the experts in the Delphi Study were presented with two theses: one regarding the future of Moore's Law and the other on the future of chip manufacturing techniques.

Limits of silicon technology reached in ten years

59 percent of the experts for Germany suspect that conventional silicon technology will run into its fixed physical limits, and thus maximum capability, by the year 2019 at the latest (see Fig. III.53). Nine percent believe this could occur as soon as 2014, while another 28 percent believe

this "zero hour" will not occur until later (in the time frame to 2030). Another 14 percent do not believe this limit will be reached until even later than that – which isn't that outrageous in light of the "magic" performed by the technologists over the last 50 years.

Still, new things are on the horizon. The confidence of many Germany experts seems to be based on the fact that completely new technologies will be used for chip manufacturing in coming years, replacing conventional photolithographic methods with new ones that are currently in the experimental stage, such as e-beam direct write and nanoimprint procedures. This will help to avoid certain steps in the extremely complex conventional manufacturing process. After all, the fewer process steps are involved, the less susceptible the procedure is to mistakes. 53 percent of the experts for Germany believe that traditional photolithographic methods will be replaced in the 2015–2019 time frame (see Fig. III.54). They see technical progress as the major driver for achieving further gains (79 percent). Investments play a central role in their considerations: "investments by business enterprises" takes second place on the list of the most important drivers (64 percent), followed by "promotion of research and development" (57 percent). Other drivers, such as lower costs or international competition (both 21 percent), are nearly negligible in comparison (see Fig. III.55).

The vision of the "chip of the future" could remain a mere vision, however, unless certain barriers can be overcome. If the significant technical problems cannot be solved (71 percent), company investments remain too low or costs remain disproportionately high (57 percent each), then the end of the silicon age will come sooner than hoped.

Summary

The results clearly show that the silicon technology will be pushed toward its limits with massive effort and expense in the next 10 to 20 years, despite the fact that many experts see the silicon age coming to its end. The most important drivers in this direction are technical progress – i. e., efforts by science and industry in research and development, particularly in manufacturing techniques. At the same time, the assessment of the technical problems, the most important barrier, indicates the associated risk. Accordingly, high costs – and the associated risk of willingness to invest – appear in second place for both drivers and barriers.

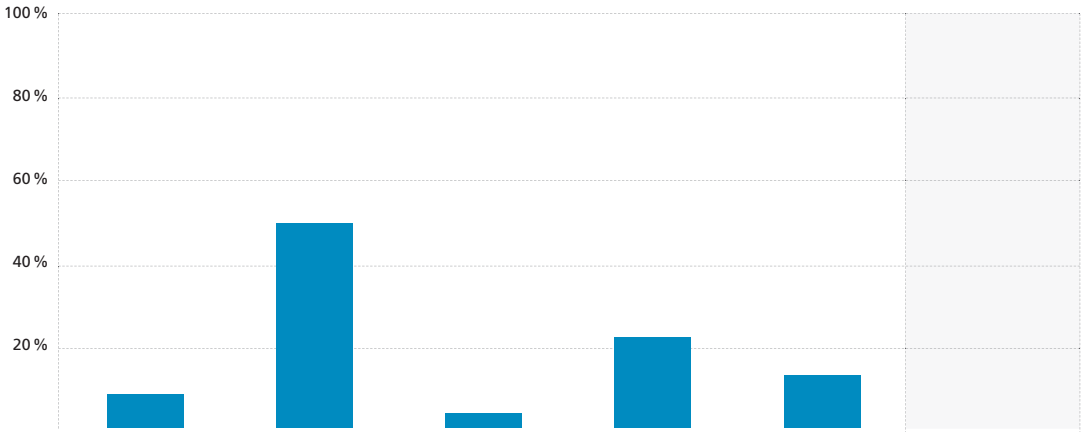
The solution to the myriad technical problems – both in switching technology and in manufacturing procedures – is the key to a successful continuation of the silicon age. Against this backdrop, it is urgent to promote research for technologies beyond silicon and to search for efficient, more cost-effective manufacturing technologies.

The cost factor, in particular, should not be underestimated. The research and development infrastructure in Germany is in an excellent position to make major contributions to this topic.

Theses on "Semiconductor technology" in detail

Fig. III.53: Thesis 80 Moore's Law

Traditional silicon-based chips (memories and processors) have been pushed to their performance limits due to increasing miniaturization.

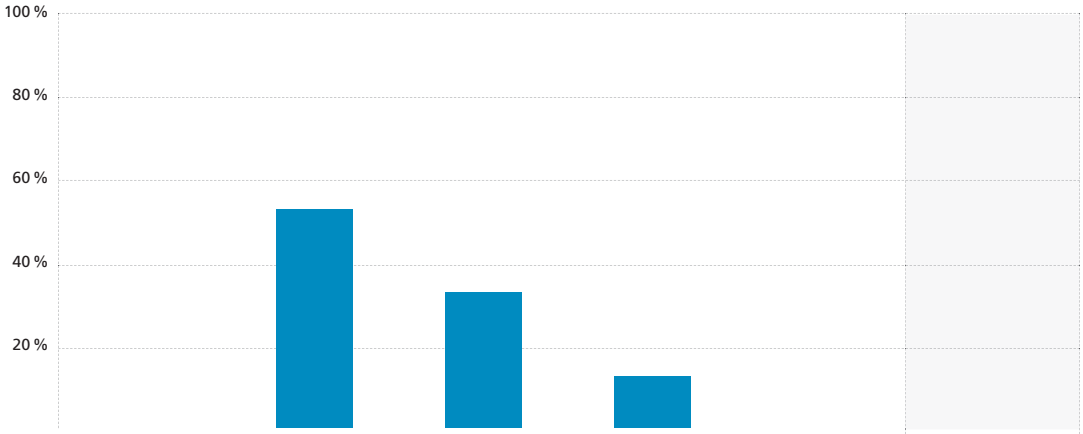


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 22)	9 %	50 %	5 %	23 %	14 %	0 %

Basis: All people surveyed with special expertise in the topic area

Fig. III.54: Thesis 81 Modern chip production

Conventional photolithographic technology has been replaced as the standard technology for the production of chips (memories and processors), e. g., by technologies such as nanoimprint or maskless lithography.

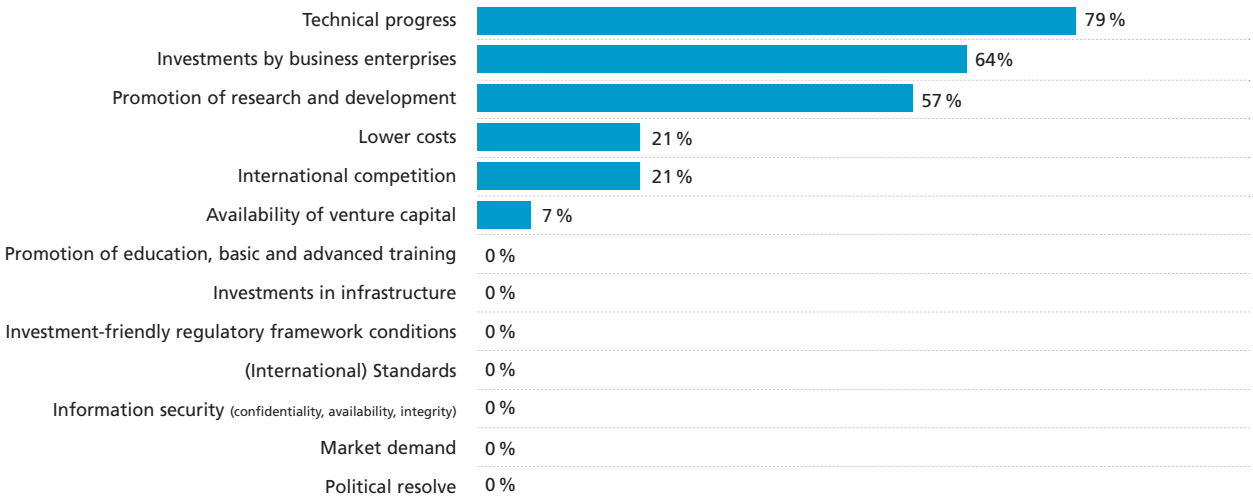


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 15) *	0 %	53 %	33 %	13 %	0 %	0 %

*Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. III.55: Thesis 81 Modern chip production – drivers

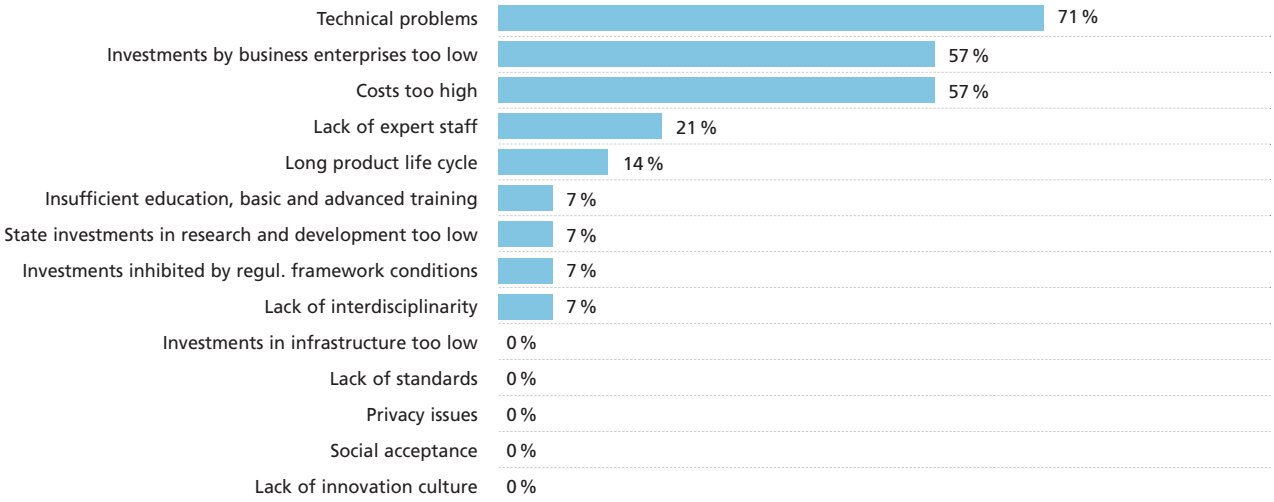
Select up to three drivers from the following list that you consider to be most important for realization of Thesis 81 above.



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n = 14*
*Fewer than 20 cases!

Fig. III.56: Thesis 81 Modern chip production – barriers

Select up to three barriers from the following list that you consider to be most important for realization of Thesis 81 above.



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n = 14*
*Fewer than 20 cases!

IV ICT as innovation driver in central application sectors

The future sustainability of the German economy depends largely on its capacity to innovate and to compete in the international arena. Information and communication technologies (ICT) already represent crucial interdisciplinary technologies for many key sectors of industry today. In the coming years, ICT is set to play the role of growth accelerator and innovation driver especially in four key industries: the media sector, the energy industry, healthcare and the automotive industry. Before looking at this, the study analyzed the impact of ICT penetration in people's home environments.

ICT and the media sector

Technical developments in the fields of ICT and the media will trigger change processes for users and their usage habits. Technical innovations in the world of communication frequently have a direct impact on recipients' communication and media usage habits. The Delphi Study analyzed in depth the influence exerted by communication technologies on recipients' habits, and the resulting chances and risks for media providers.

One of the aspects analyzed was the much discussed decline in the importance of the traditional media (see section IV.2): Internet affinity among the younger generation is seen to be the trigger for the decreasing significance of traditional media. The internet affinity of the digital natives is considered to be the driving force that will prompt subsequent generations to abandon the traditional media. Section IV.2.2 discusses the media changes that can be expected in the future, the extent this will cover, and whether and when we can expect them to completely oust our traditional media. Alongside the change in media usage, the study also addresses such topics as the future significance of electronic media (section IV.2.3) and the changes taking place in television (section IV.2.4).

ICT in the energy sector

Climate change, the increasing global demand for energy and rising energy costs are raising public awareness for issues such as efficient energy usage and reliable energy supplies.

Under the issues known as e-energy and green IT concepts are being discussed which are based on information and communication technologies and which help to promote the efficient, resource-saving and environmentally friendly use of energy.

In contrast to other industries, the energy sector has made little use of innovative ICT concepts and technologies to date. However, ICT will be indispensable in effectively integrating renewable and sustainable energy sources (e. g., wind, sun, combined heat and power), which will be far more widely used than at present, in the energy system in future. The extent to which ICT can help to reach the fundamental energy goals of cost-effectiveness, reliable supplies and climate friendliness is discussed in section IV.4.1.

Alongside the endeavor to deploy intelligent energy systems as a means of protecting the environment, ICT has another contribution to make toward climate protection. These efforts are subsumed under the term green IT and analyzed more closely in section IV.4.2.

ICT in the health sector

As a consequence of the present demographic change in Germany, attention is turning to the question of how care for the older generation will be organized. Despite the fact that a 70-year-old today is as healthy as a 65-year-old in the previous generation, the risk of infirmity and the need for care increases with age, so that the number of people needing care will increase dramatically in the coming decades. One of the challenges facing society in future will be how to support a maximum of independence, mobility and safety, and to maintain good health in order to increase people's autonomy and their quality of life in old age. The extent to which information and communication technologies can have an alleviating impact in this field is discussed in detail in section IV.5. The study also differentiates between beneficial and obstructive aspects of ICT deployment in the healthcare sector.

ICT and the automotive sector

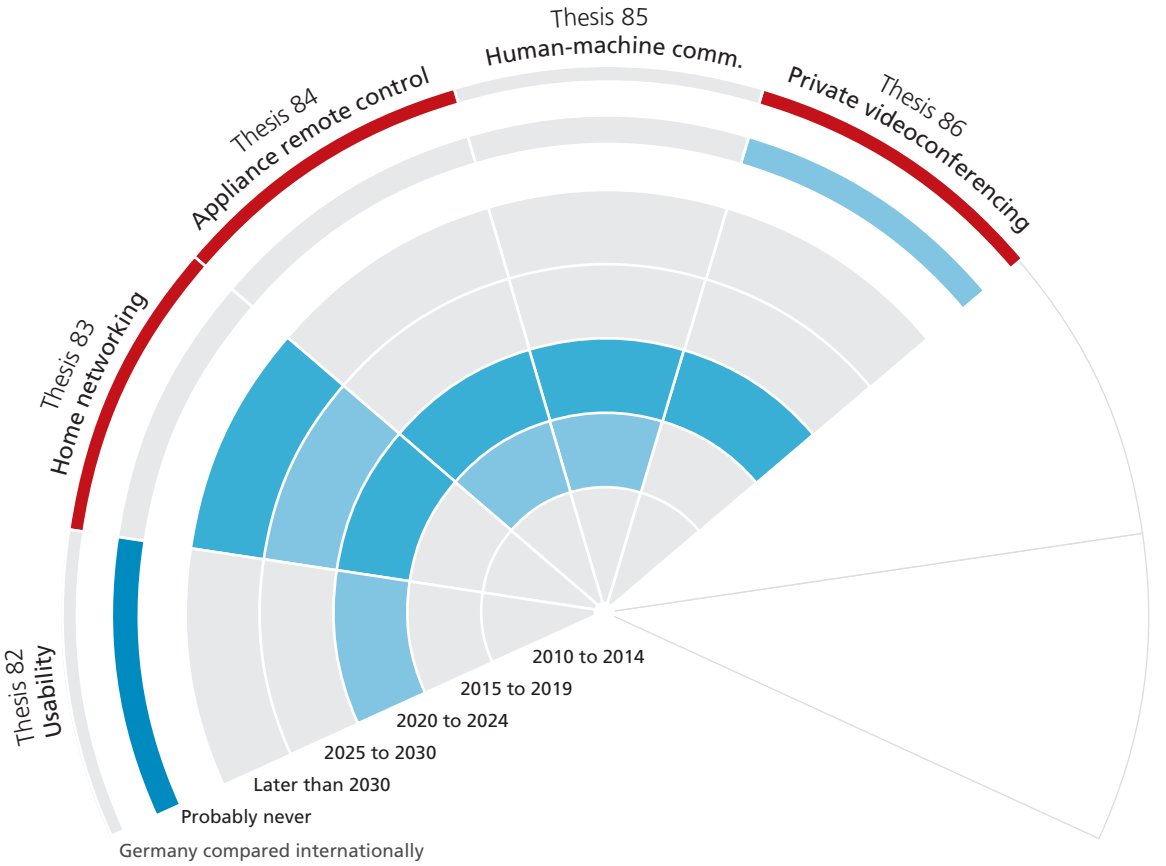
ICT innovations are also set to have a long-term impact in another important business segment: the automotive sector.

An analysis of current technology trends in the automotive sector shows it to be yet another area in which ICT is already making progress. Predominant topics include intelligent active assistance and communication systems as well as emission-reducing drive technologies. Along with these trends, ICT also plays a key role in central areas of today's automotive industry. This affects manufacturing and development processes, as well as products themselves. This development has given rise to new forms of cooperation between manufacturers and their suppliers, and has added numerous services in and around automobiles to their portfolios.

This development is characterized by extension of the traditional value chain into the service and information sectors, and by a continuing trend toward a "hybrid product," combining ICT-based services with traditional products.

The far-reaching influence exerted by ICT makes it clear that the future of ICT in the automotive industry must be analyzed from different sides. This study therefore looked not only at the general significance of ICT for the automotive industry (section IV.6.1) but also at ICT in the vehicles themselves (section IV.6.2). Alongside these two aspects, the study also addressed innovative future visions and discussed them in detail in section IV.6.3.

IV.1 The connected smart home
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 82: Usability

Every user is capable of intuitively operating electronic devices used in their daily private lives without a user manual.

Thesis 83: Home networking

In Germany, 75 percent of all consumer electronics in the house (brown and white goods, such as televisions, stereo systems, washing machines, espresso machines, etc.) and building technology components (lights, air conditioning, heating, etc.) are connected with each other and via the Internet.

Thesis 84: Appliance remote control

In Germany, electronic household appliances are connected to the Internet and thus can be operated from any location.

Thesis 85: Human-machine communication

Everyday objects are equipped with high-capacity close-range communication, making it possible to interact with and operate them through proximity, movement or gesticulation.

Thesis 86: Private videoconferencing

More than 75 percent of the population in Germany regularly uses video conferences in their personal life.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

Networked digital home – soon commonplace or science fiction for a long time to come?

The intelligent home, which recognizes and automatically responds to the wishes and needs of the people who live in it, has been a topic of discussion for many years. The Delphi Study experts submitted a prognosis on whether the topic would remain science fiction or whether interaction between networked household devices, utility services, telecommunication network links and sophisticated sensor systems will soon be taken for granted by consumers in their home environments.

Long-term change most likely

Virtually half (48 percent) of the GER experts doubt whether technology will ever be so perfectly tuned to human needs that it can be operated intuitively, another eight percent consign this scenario to the distant future (after the year 2030). Whereas, for example, U.S. experts consider it probable that end-users will be enjoying the user-friendliness of these technologies on a considerably earlier date, the DNAdigital group follows the example of the GER experts with a 47-percent rejection rate (see Fig. IV.1).

For the GER experts, the networking of appliances and building services lies in the more distant future for three quarters of all households – and will definitely not materialize before 2020 (31 percent) - while 53 percent quote a date later than 2024 or never at all (13 percent) (see Fig. IV.2). This is completely at odds with the appraisal of the experts for European countries: The majority (77 percent) expect full home networking to be implemented by 2024 at the latest.

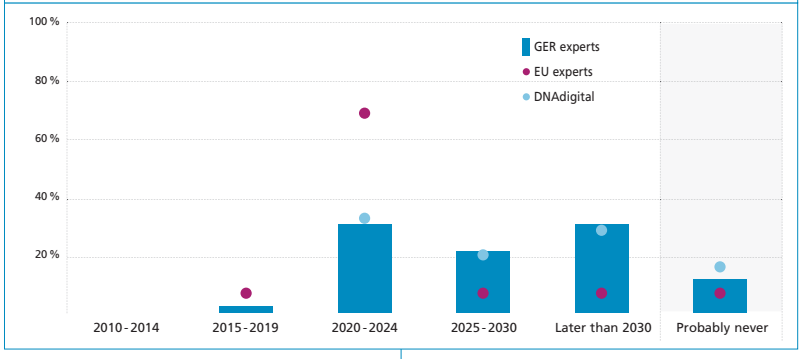
The experts' forecast for smart operation of individual appliances in Germany is slightly more optimistic but still relatively late: The majority (59 or 60 percent) believe that remote control of household appliances over the Internet (see Fig. IV.5) or sensor-based contactless interaction with appliances and other objects (see Fig. IV.6) will be standard practice in six to 15 years' time.

When it comes to a live "presence" at home or elsewhere through regular use of videoconferencing in private environments, experts' opinions are divided: 36 percent of the GER experts estimate that the large majority of the population will not use videoconferencing on a regular basis for another eleven years, while 29 percent of them do not believe that this will ever be the case (see Fig. IV.7). The U.S. experts are highly positive on this count: Almost one third (29 percent) think it probable that private videoconferences will have gained the upper hand within a maximum period of ten years from today.

Standalone solutions instead of fully networked systems

Buying a house is a step that most well-off German citizens take only once in their lives. The forecast by the GER experts, namely that the fully networked digital home will not become reality for some time to come, reflects this situation, which is related to procurement cycles in the home property market. Standalone solutions such as household appliances that are connected to the Internet (see Fig. IV.5) mean lower costs for consumers and can prompt the earlier purchase of a new product, as can simplified control with smart sensors. The period of six to 15 years they quote for market penetration in Germany would therefore appear realistic. Complete upgrades to networked building services in existing homes and installation in new houses are likely to remain an extremely long-term process (even if the Europe experts see it differently), primarily due to the major work and costs involved, which would bear no relation to their actual benefit for many consumers. In addition to this, the lack of technical standards inhibits change (see Fig. IV.4).

Thesis 83: In <country>, 75 percent of all consumer electronics in the house (brown and white goods, such as televisions, stereo systems, washing machines, espresso machines, etc.) and building technology components (lights, air conditioning, heating, etc.) are connected with each other and via the Internet.



Experts for Germany highly skeptical

The experts for Germany are slightly more reticent in their optimism than the experts for other countries when it comes to the intuitive operation of appliances in daily use; however, the DNAdigital group is equally skeptical.

The Europe experts set the period for full home networking at a significantly earlier date than the GER experts.

Whereas the GER experts cautiously quote the period between 2020 and 2024, most of the Europe experts are unanimous (see Fig. IV.2). These reactions reflect aspects such as the different international approaches to home ownership and the usually lower prices for living space.

Most of the experts for the U.S. expect to see household appliances being controlled via the Internet five years earlier than the other expert groups (see Fig. IV.5). The U.S. traditionally plays a pioneering role in Internet services so that this estimate comes as no real surprise.

Subsidizing the networked home helps to promote greater energy efficiency

High costs are one of the main inhibitors to comprehensive home networking in Germany, and thus stand in the way of full market penetration. If home networking is seen as one element of an energy efficiency concept – with smart networked sensors controlling light, power, heat, etc., for all devices and rooms – then state subsidies for new buildings and building upgrades are meaningful (comparable to the current subsidies for heating systems) and would have a positive impact on development in this branch of industry, above all with regard to international markets. Furthermore, such a step could serve to raise awareness and openness for this topic among the population. Another issue involves the enhanced skills required by people working on house construction and renovation or on the integration of the individual components. Concepts will need to be drawn up and qualification certificates issued for appropriate additional training in cooperation with the ITC industry, trades and public bodies.

The assessments supplied by the experts for countries outside Germany show that these are already one step ahead. In view and on account of this scenario, an increased German presence is required on international standardization committees.

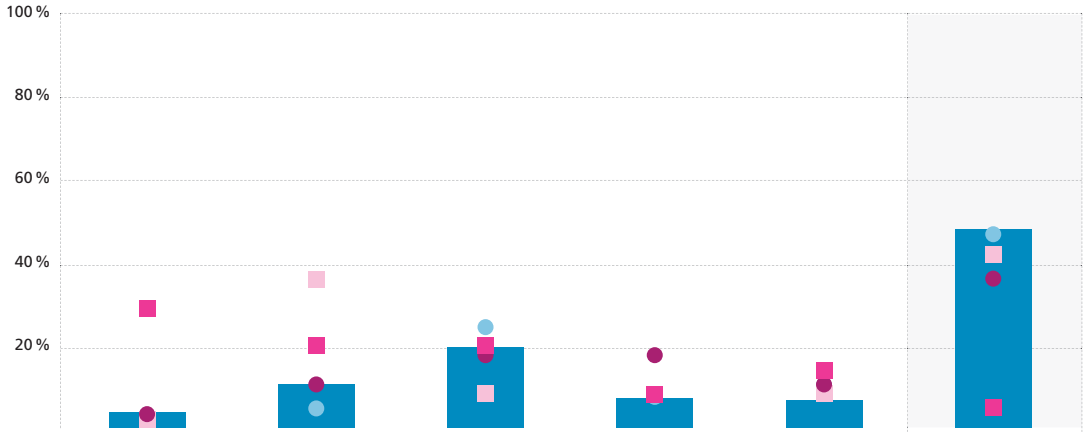
Networked homes are also a public issue

The digitally networked home is not just a private privilege for Germany's consumers. Alongside the anticipated extra convenience and comfort, aspects relating to energy and resources consumption also play a key role. State subsidies for consumer home networking, support for qualification measures in the building sector and a stronger presence on standardization committees are therefore not only meaningful but also desirable.

Theses on "The connected smart home" in detail

Fig. IV.1: Thesis 82 Usability

Every user is capable of intuitively operating electronic devices used in their daily private lives without a user manual.

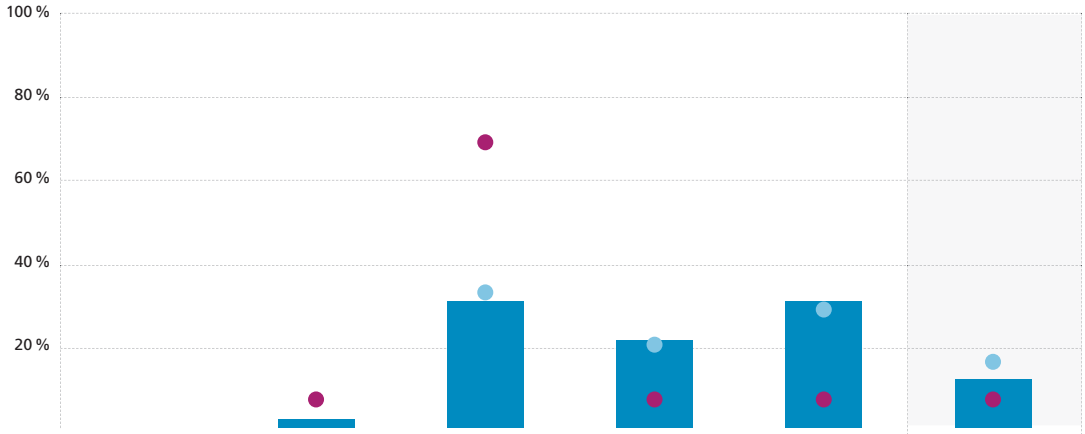


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 372)	5 %	11 %	20 %	8 %	8 %	48 %
EU experts (n = 71) [1]	4 %	11 %	18 %	18 %	11 %	37 %
U.S. experts (n = 33)	3 %	36 %	9 %	0 %	9 %	42 %
Other intern. experts (n = 34) [2]	29 %	21 %	21 %	9 %	15 %	6 %
DNAdigital (n = 36)	3 %	6 %	25 %	8 %	11 %	47 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. IV.2: Thesis 83 Home networking

In <country>, 75 percent of all consumer electronics in the house (brown and white goods, such as televisions, stereo systems, washing machines, espresso machines, etc.) and building technology components (lights, air conditioning, heating, etc.) are connected with each other and via the Internet.

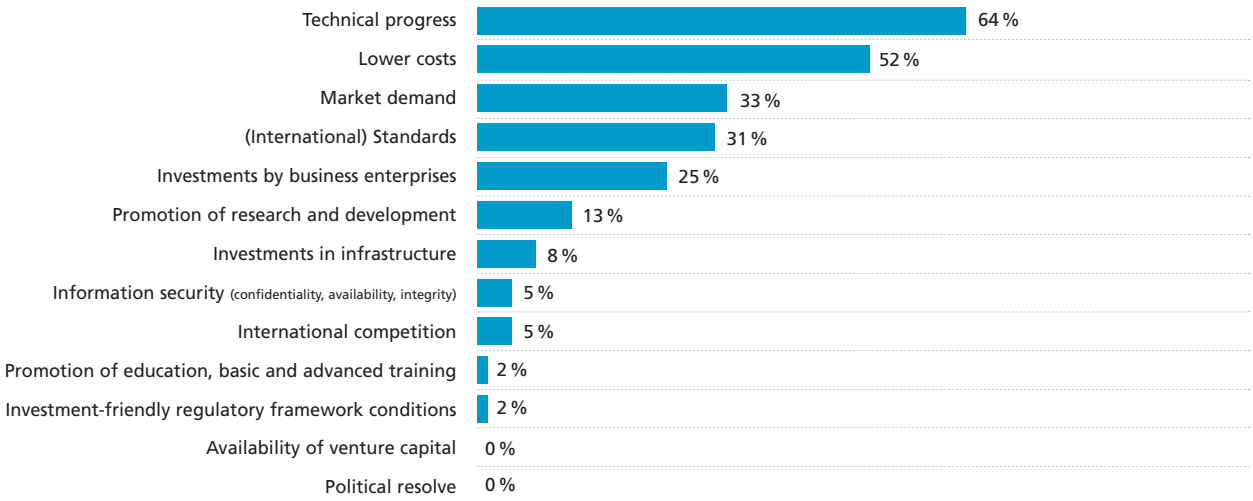


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 64)	0 %	3 %	31 %	22 %	31 %	13 %
EU experts (n = 13) [1]*	0 %	8 %	69 %	8 %	8 %	8 %
DNAdigital (n = 24)	0 %	0 %	33 %	21 %	29 %	17 %

[1] Experts for European countries, excluding Germany; * Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.3: Thesis 83 Home networking – drivers

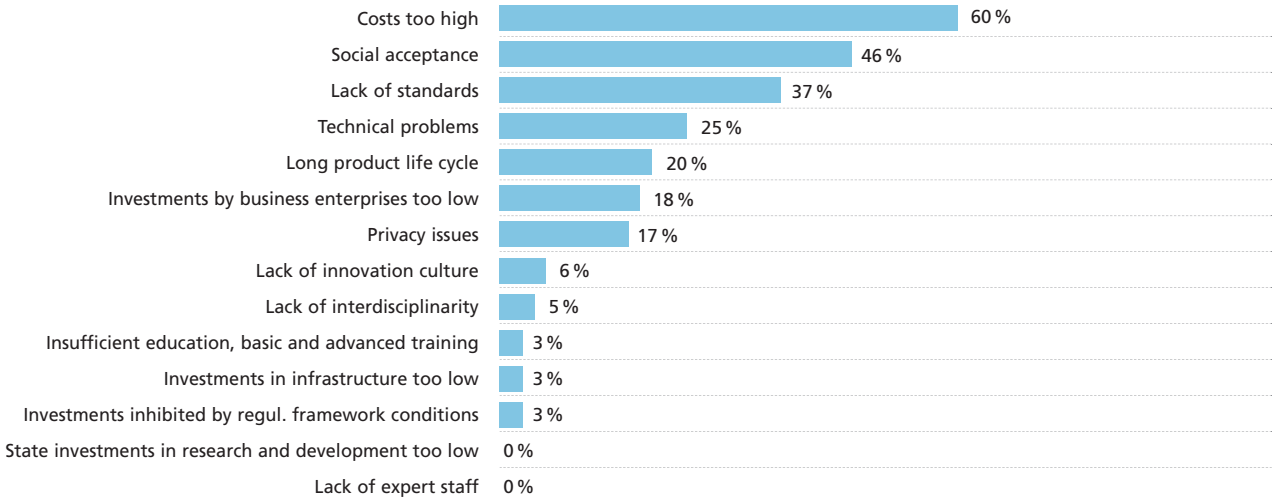
Select up to three drivers from the following list that you consider to be most important for realization of Thesis 83 above.



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n = 64

Fig. IV.4: Thesis 83 Home networking – barriers

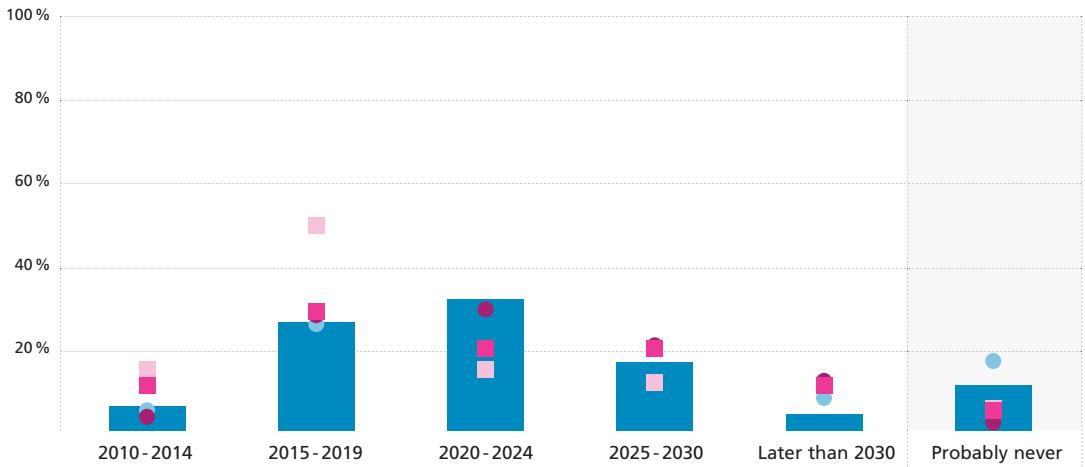
Select up to three barriers from the following list that you consider to be most important for realization of Thesis 83 above.



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n = 65

Fig. IV.5: Thesis 84 Appliance remote control

In <country>, electronic household appliances are connected to the Internet and thus can be operated from any location.

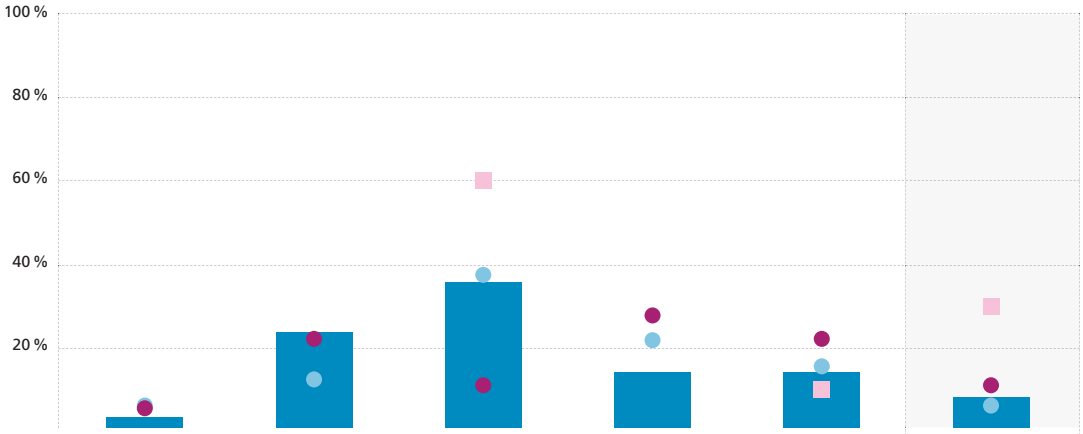


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 365)	7 %	27 %	32 %	17 %	5 %	12 %
EU experts (n = 70) [1]	4 %	29 %	30 %	21 %	13 %	3 %
U.S. experts (n = 32)	16 %	50 %	16 %	13 %	0 %	6 %
Other intern. experts (n = 34) [2]	12 %	29 %	21 %	21 %	12 %	6 %
DNAdigital (n = 34)	6 %	26 %	21 %	21 %	9 %	18 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. IV.6: Thesis 85 Human-machine communication

Everyday objects are equipped with high-capacity close-range communication, making it possible to interact with and operate them through proximity, movement or gesticulation.

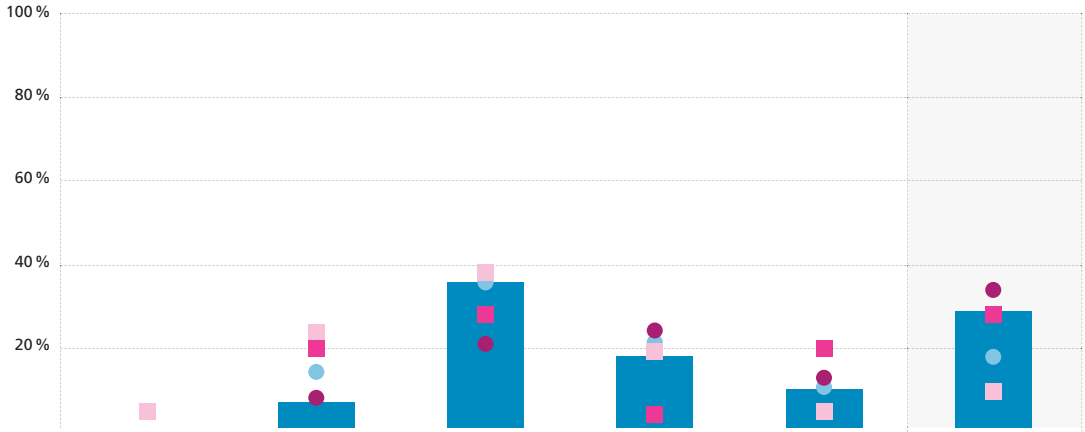


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 84)	4 %	24 %	36 %	14 %	14 %	8 %
EU experts (n = 18) [1]*	6 %	22 %	11 %	28 %	22 %	11 %
U.S. experts (n = 10) *	0 %	0 %	60 %	0 %	10 %	30 %
DNAdigital (n = 32)	6 %	13 %	38 %	22 %	16 %	6 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.7: Thesis 86 Private videoconferencing

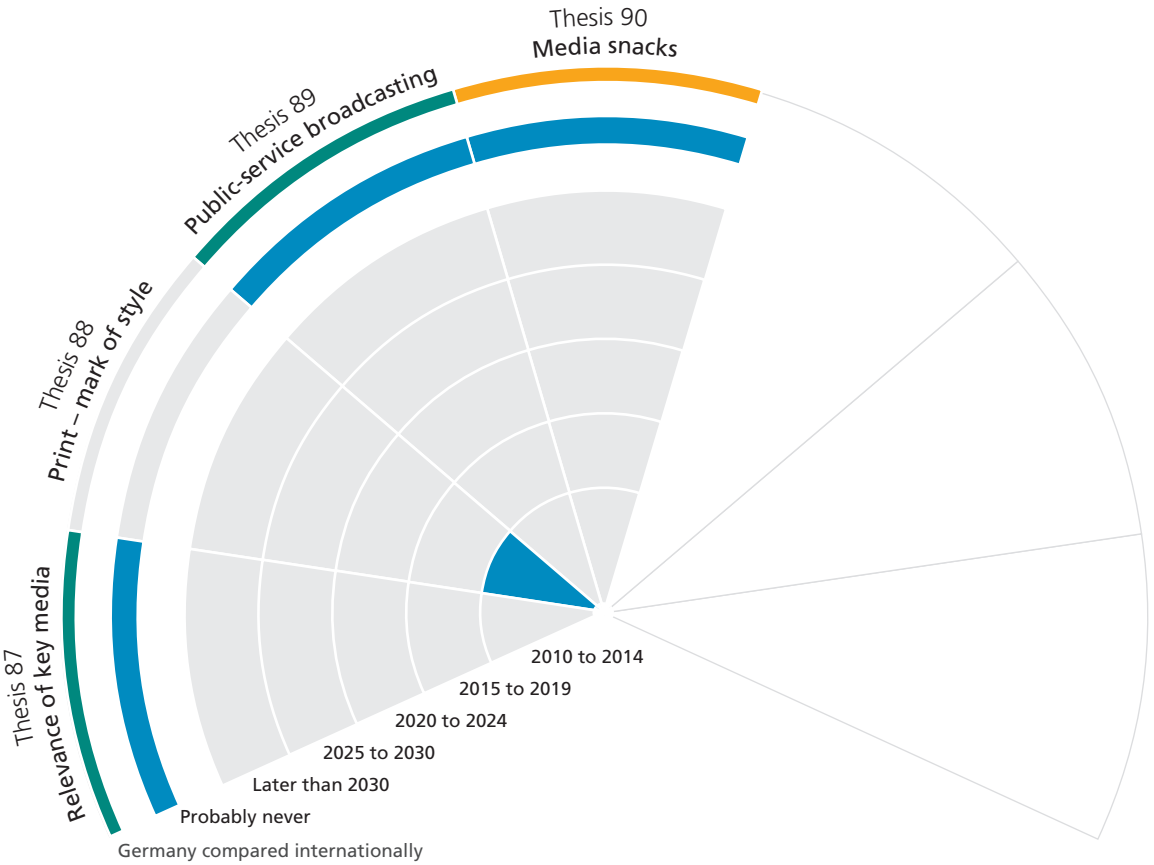
More than 75 percent of the population in <country> regularly uses video conferences in their personal life.



	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 294)	0 %	7 %	36 %	18 %	10 %	29 %
EU experts (n = 62) [1]	0 %	8 %	21 %	24 %	13 %	34 %
U.S. experts (n = 21)	5 %	24 %	38 %	19 %	5 %	10 %
Other intern. experts (n = 25) [2]	0 %	20 %	28 %	4 %	20 %	28 %
DNAdigital (n = 28)	0 %	14 %	36 %	21 %	11 %	18 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

IV.2.1 The future of media
Future radar*: Forecast occurrences



Sub-group of GER experts: ■ ≥ 40 % of experts ■ 30 % – 39 % of experts ■ 20 % – 29 % of experts ■ < 20 % of experts
Germany in comparison: ■ pioneering role ■ on a par with global developments ■ lagging behind ■ not possible to say

Thesis 87: Relevance of key media

Conventional media like television, newspapers and magazines have lost their social significance and their function as the prevailing media in Germany.

Thesis 88: Print media as a mark of style

For opinion leaders in Germany, reading printed newspapers and magazines is back in vogue (mark of style).

Thesis 89: Public-service broadcasting

Public-service broadcasting is no longer relevant for the functioning of public democratic opinion-making in Germany, due to the broad diversity of readily available information and its high quality.

Thesis 90: Media snacks

For media consumers in Germany, short-format products ("media snacks") have largely supplanted original media formats: 3-minute clips instead of feature films, short stories instead of books.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

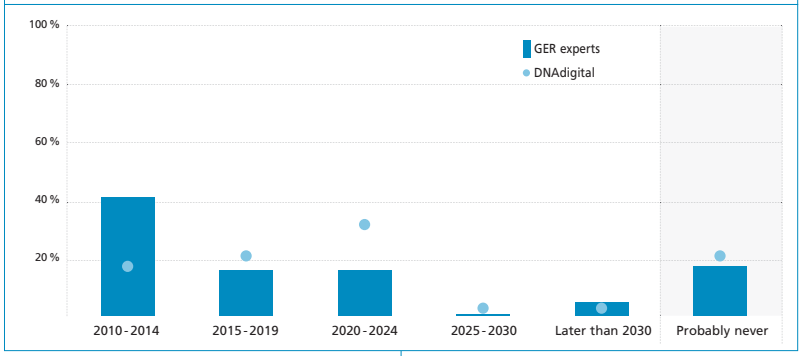
Technical developments in the fields of ICT and the media will trigger change processes for users and their usage habits. Technical innovations in the world of communication frequently have a direct impact on recipients' communication and media usage habits. The following analyses therefore focus on the impact that communication technologies have on recipients' habits, and the resulting chances and risks for media providers.

Functions of media usage

Traditional media will retain their position as the key media in Germany in the mid- and long-term. This is the conclusion drawn by the present Delphi survey: 51 percent of the GER experts do not believe that traditional media like television, newspapers and magazines will lose their social significance and their function as the prevailing media in Germany in the future. Another 26 percent assume that this – if it transpires at all – will not occur until 2025 or later (see Fig. IV.8). This also indicates that the GER experts do not believe traditional media will lose their importance. It is interesting to compare the people interviewed in the DNAdigital group with the experts for the U.S. Almost half the DNAdigital people do not expect traditional media to lose their significance for another eleven to 21 years. Another third of them who are "socialized in the new media" expect traditional media to retain their key function for ever. At a weaker level, they therefore corroborate the result supplied by the GER experts. Nonetheless, almost half the U.S. experts reckon that traditional media will be replaced as agenda setters within the next ten years at the latest.

Two other theses confirm the status of the traditional media. 42 percent of the GER experts estimate that reading printed newspapers and magazines will regain its popularity among opinion leaders within the next five years (or that it never actually lost its former status). The majority of the people surveyed in the DNAdigital group expect this to occur in the next 15 years (see Fig. IV.9).

Thesis 88: For opinion leaders in <country>, reading printed newspapers and magazines is back in vogue (mark of style).



At the same time, they take a clear stance on the availability of public broadcasting services. Almost three quarters of the GER experts are of the opinion that the importance of this institution will not wane in the future. Almost the same percentage of people surveyed in the DNAdigital group share this opinion (see Fig. IV.11).

The main reason for the assessment that the traditional media will not lose their social importance and their function as key media in the future, say the experts for Germany, is the possible co-existence of the different media genres. So far, Riepl's Law of the complementarity of media, now well over 100 years old, has not been refuted. According to this law, "new" media have so far not ousted the "old" media but simply assigned them new functions. One important reason for the decline in the importance of the traditional media is the Internet affinity of the younger generation. This Internet affinity among those who grew up with the "new" media is seen to be the driving force for future generations to abandon the traditional media. However, the degree to which media usage habits actually change with age cannot yet be forecast for the current generation. The key benefit provided by newspapers and magazines is not altered by the fact that new technical access options are now available. They still provide an orientation, no matter what carrier medium is used to transport them to recipients, and may well play a more important role again in the future media mix for this very reason.

Traditional media order the chaos

How should we interpret this commitment to traditional media? It shows that free access to information, however good, is not sufficient in itself to shape public opinion. Information must be structured to suit the media and put in a meaningful context. Access to a broad base of information does not necessarily mean that the accessing individual is well-informed. Reports have to be prioritized, a classic agenda-setting function, in order to turn information into relevant news. At the same time, information must be examined not only for relevance but above all for its reliability. The gatekeeper function played by traditional media is all the more important since the technical prerequisites make it easier for practically everyone to access information and for practically everyone to disseminate it. It would appear that these professional qualities give the traditional media an indispensable status, especially among opinion leaders.

From an expert standpoint, another vital factor is that traditional media still present far lower barriers to access than the new communication technologies. This encourages users' "old" reception habits. According to the experts, technical progress tends to be merely a secondary reason for users to turn their backs on the traditional media. New technologies do not automatically lead to a complete change in users' habits, especially if the benefit they offer proves limited. Reading lengthy texts on computer screens, for example, is still an arduous undertaking. A printed page in a magazine or newspaper consists of various text, image and graphics elements, which lead readers through an article, emphasizing the core statements and thus facilitating the reception process. This functionality is virtually lost on today's state-of-the-art screens, even more so the smaller the screen diagonal becomes. Although it is easier for users to pack up a daily newspaper and take it with them on a handheld than the original paper version, it is not likely to be reader-friendly enough for reading anything more than short snippets of news.

Segregation of functions between "old" and "new" media

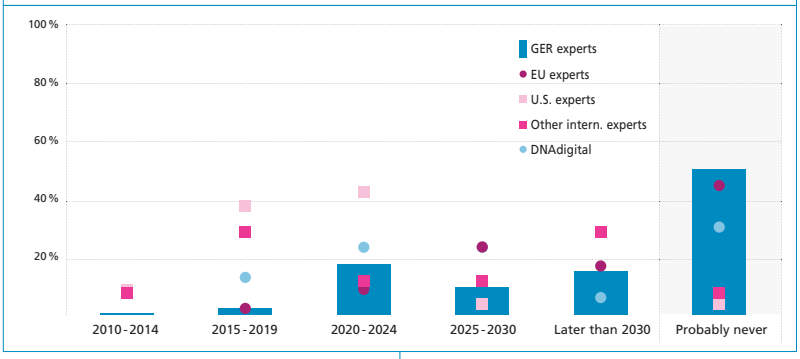
The current state of technology in Germany points to a "segregation of functions" at different levels between the "new" and the "old" media. One level involves the purely technical options that the "new" media offer for the production environments of the "old" media. The "new" media provide individual, quick, up-to-date, permanently available information on the surface, while the so-called "old" media are used to interpret and network the individual news items.

Given this right of interpretation, the key function of the traditional media would be maintained under the current circumstances.

Future technical developments could serve to further consolidate the key role played by the traditional media. The development of "electronic paper" could make it possible to produce newspapers and magazines whose layout and readability come very close to their paper-based relations, i. e., reader friendliness would be greatly improved in comparison with the electronic readers available at present. Content is downloaded from the Internet to the carrier medium, which can be executed on a docking station at the newsagents, at a home computer or even via a special e reader with an Internet-enabled connectivity function. Another level affects the options for recipient interaction that are created by the "new" media. Examples of this are social communities, blogs, wikis and personalization options. In the age of new communication technologies, traditional media will still be characterized by passive usage and by the fact that they are compiled by professional journalists.

Media usage in the U.S. shows a differentiated picture

Thesis 87: Conventional media like television, newspapers and magazines have lost their social significance and their function as the prevailing media in <country>.



The U.S. experts assess developments differently than their colleagues with expertise for Germany. Almost half of them reckon that traditional media will be replaced as agenda setters at the latest within the next ten years. A similarly high group among the U.S. experts expects this to occur in the decade following it (see Fig. IV.8). What is the reason for this difference? The answer is clear if we look at circulation figures for the biggest daily newspapers in the U.S. and Germany. USAToday sells around 2.2 million copies, Bild in Germany about 3.2 million copies. Obviously, importance cannot be gauged by quantity alone, but if we consider that around 307 million people live in the U.S., but only 82 million in Germany, it would appear that newspapers have a different status in the two societies. Basically this can be attributed to the sheer size of the United States.

A country of this size that stretches across six time zones faces huge logistics problems if it wants to offer a medium with the same level of topicality across the entire country. This applies to print media to a greater extent than to the traditional electronic media, but news breaking at prime time on the east coast is likely to differ from that broadcast in the west. The size of the country also gives rise to a degree of social heterogeneity that should not be underestimated. All this contributes to the fact that loyalty to one or a handful of big media is not as pronounced as it is in Germany, or even Europe as a whole. In addition to this, traditional media in the U.S. face the need to combat a growing decline in credibility. Reports that subsequently

proved to be pure fiction, including those that pandied excessively to advertising customers and the reporting we experienced during the Bush era, served to worsen their image. In this area, the Internet plays a dual role. It gives users time sovereignty over usage as well as enabling them to communicate directly with like-minded people and thus assume a critical watchdog function for traditional media.

Media's political and social function must be more widely embraced

Media studies is gaining in importance in schools and must be taught across a broad base of fundamental issues: How are the media made and who are the media makers? Who actually decides what is worth reporting and what is not? What about economic framework conditions? What about legal framework conditions? How have the media changed? What functions do the different media genres have?

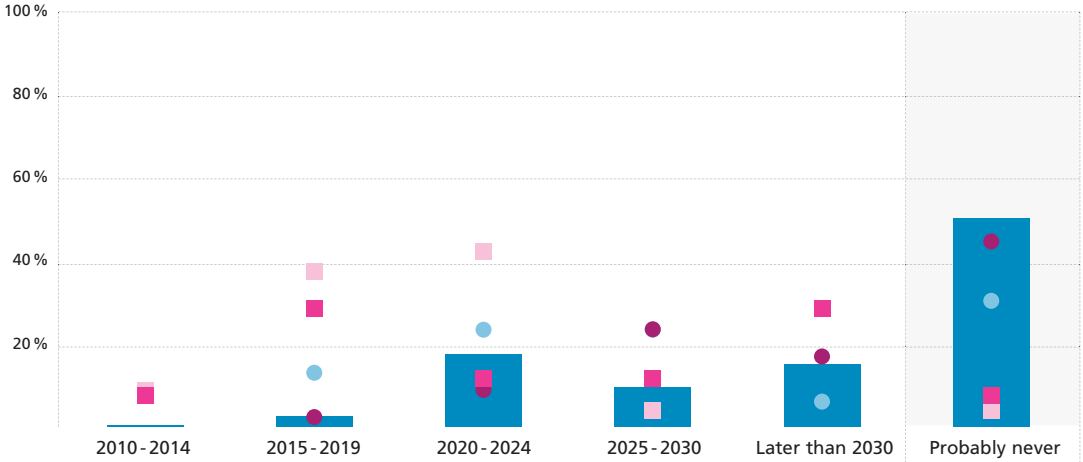
The object is to learn how to judge information sources by their credibility. This is independent of whether the information comes from "new" or "old" media. This need increases in urgency as the possibilities for gaining information grow. However, it is equally important to convey the fact that knowledge is not generated by accumulating as much information as possible but that it only occurs when information is meaningfully networked.

Skills in communicating with other people must be trained so that knowledge can be constantly further developed. Nonetheless, such measures remain ineffective unless knowledge is conveyed on a broad basis. The traditional learning of facts is the basis for assessing the relevance and credibility of information and its sources.

Theses on „The future of media" in detail

Fig. IV.8: Thesis 87 Relevance of key media

Conventional media like television, newspapers and magazines have lost their social significance and their function as the prevailing media in <country>.

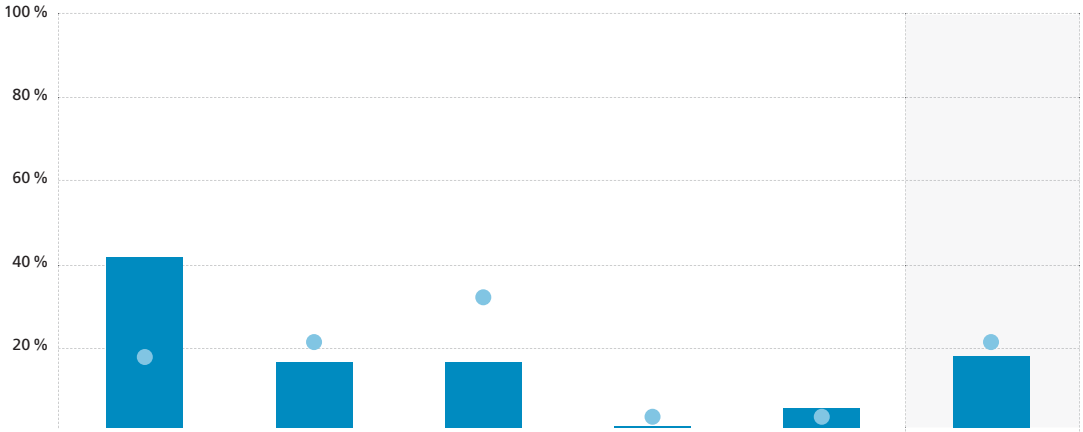


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 291)	1 %	3 %	18 %	10 %	16 %	51 %
EU experts (n = 62) [1]	0 %	3 %	10 %	24 %	18 %	45 %
U.S. experts (n = 21)	10 %	38 %	43 %	5 %	0 %	5 %
Other intern. experts (n = 24) [2]	8 %	29 %	13 %	13 %	29 %	8 %
DNAdigital (n = 29)	0 %	14 %	24 %	24 %	7 %	31 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. IV.9: Thesis 88 Print media as a mark of style

For opinion leaders in <country>, reading printed newspapers and magazines is back in vogue (mark of style).

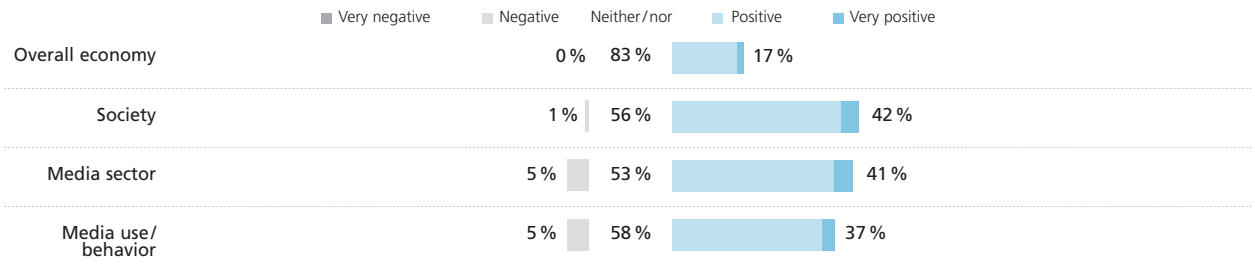


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 72)	42 %	17 %	17 %	1 %	6 %	18 %
DNAdigital (n = 28)	18 %	21 %	32 %	4 %	4 %	21 %

Basis: All people surveyed with special expertise in the topic area

Fig. IV.10: Thesis 88 Print media as a mark of style – relevance

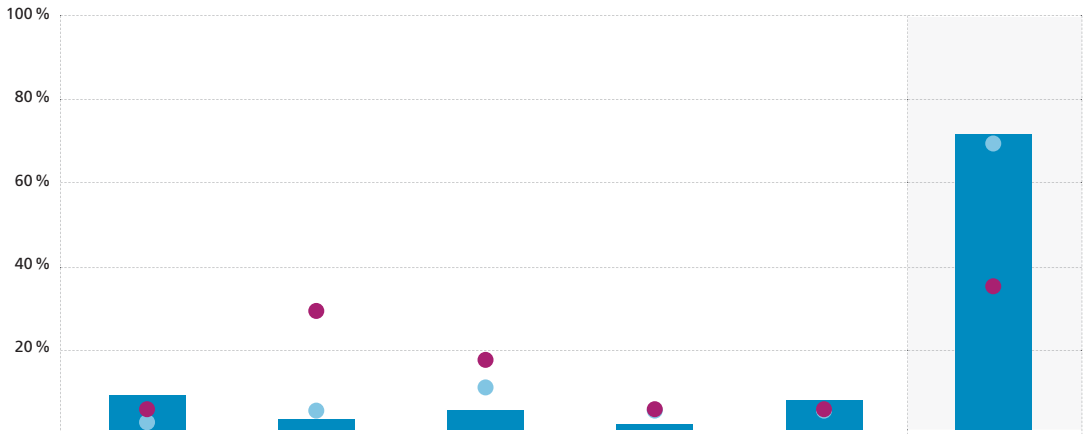
What impact will the validity of Thesis 88 above have on the areas listed below?



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, at least n = 72

Fig. IV.11: Thesis 89 Public-service broadcasting

Public-service broadcasting is no longer relevant for the functioning of public democratic opinion-making in <country>, due to the broad diversity of readily available information and its high quality.

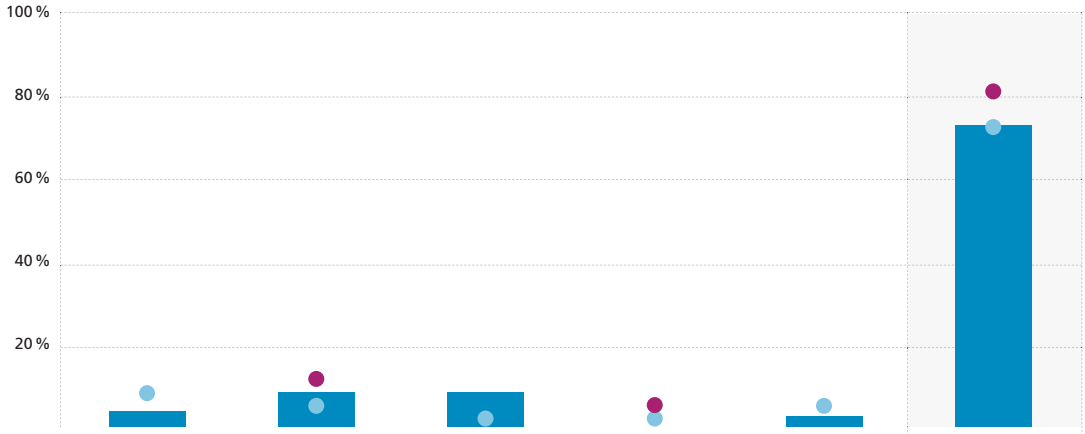


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 88)	9 %	3 %	6 %	2 %	8 %	72 %
EU experts (n = 17) [1]*	6 %	29 %	18 %	6 %	6 %	35 %
DNAdigital (n = 36)	3 %	6 %	11 %	6 %	6 %	69 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.12: Thesis 90 Media snacks

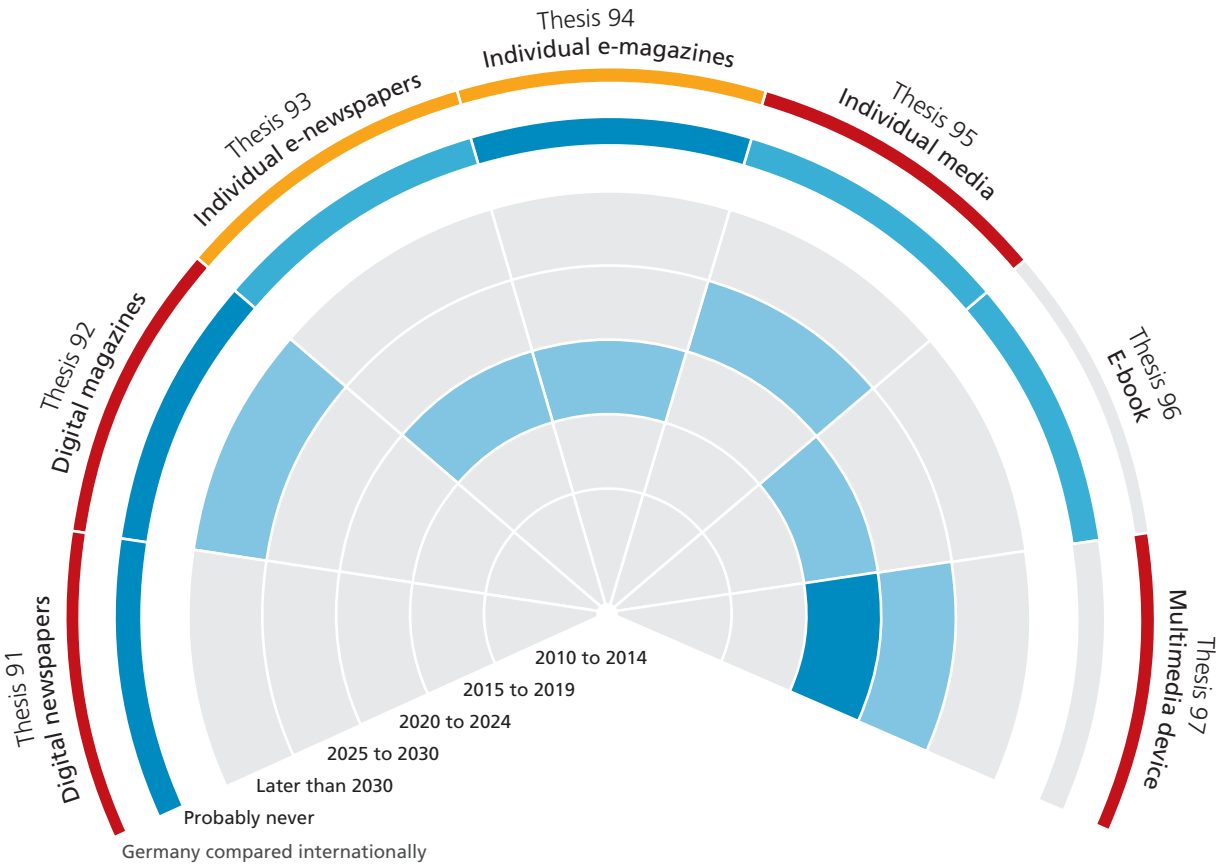
For media consumers in <country>, short-format products ("media snacks") have largely supplanted original media formats: 3-minute clips instead of feature films, short stories instead of books.



	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 86)	5 %	9 %	9 %	0 %	3 %	73 %
EU experts (n = 16) [1]*	0 %	13 %	0 %	6 %	0 %	81 %
DNAdigital (n = 33)	9 %	6 %	3 %	3 %	6 %	73 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

IV.2.2 Print: New technologies and "old" reception habits
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 91: Digital newspapers
Newspapers in Germany only exist in digital format on the Internet.

Thesis 92: Digital magazines
Magazines in Germany only exist in digital format on the Internet.

Thesis 93: Individual e-newspapers
More than 75 percent of the population in Germany use daily e-newspapers with customized content.

Thesis 94: Individual e-magazines
More than 75 percent of the population in Germany use e-magazines with customized content.

Thesis 95: Individual media
More than 75 percent of the population in Germany use e-newspapers / e-magazines with customized content.

Thesis 96: E-book
The electronic book (e-book) has established itself as the standard "book" format.

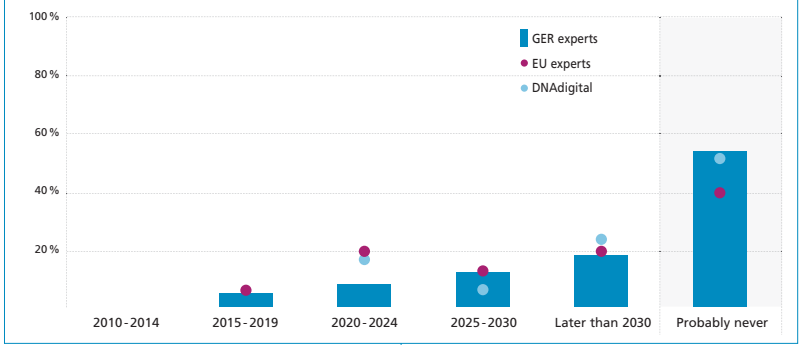
Thesis 97: Multimedia device
More than 75 percent of the population in Germany use a multimedia mobile end device as the unifying element for conventional media (books, newspapers, magazines, television and Internet) for displaying text, images, music and videos.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

The experts do not envisage newspapers or, far less, magazines as purely digital versions on the Internet in future (see Fig. IV. 13 and Fig. IV. 14). It is striking that the DNAdigital group largely follows this assessment. Reading longer articles on screen is tedious – which is one of the reasons why average usage figures for consecutive Internet pages with editorial content are far lower than for newspapers or magazines. Of course, it is possible to print out the interesting parts of the newspaper or magazine from the Internet. However, one aspect that should not be ignored is the feel of the printed medium. It is physical, intransient and thus conveys a sense of reliability. It can be used several times without any problems and presents users with a wealth of information they can readily comprehend and use. The recipient can, in the true sense of the word, "come to grips" with the topics it presents.

Thesis 91: Newspapers in <country> only exist in digital format on the Internet.



Alongside the largely technical limitations of current on-screen reading scenarios, it is increasingly the subjective and esthetic expectations of demanding readers that safeguard the future of printed newspapers, magazines and books. Complex layout and design, production and features of the printed media are conducive to understanding and enjoyment of the content in many fields of interest. Their visibility can convey status and personality to users, to a far greater extent than a neutral digital carrier can.

Printed media on "electronic paper" are sure to have greater chances of acceptance among readers, because they continue to rely on learned usage patterns coupled with innovative functions. Should it actually be possible to roll up, crease or fold this "electronic paper" like normal paper, then we would still have a traditional print medium with the usual optical format but on different carrier material. This electronic carrier material would, in turn, offer new possibilities for the "old" print medium such as incorporation of audio material and/or moving images.

The individual daily newspaper or magazine - probably never

The GER experts tend to be skeptical in their assessment of the prospects for e-newspapers and e-magazines that are individually compiled by users (see Fig. IV.15 and Fig. IV.16).

Over 50 percent of the experts expect this development to occur for daily newspapers after 2030, or never at all, and the figure for magazines is even higher at 60 percent. However, there is a "revolutionary" fraction in Germany: No less than a quarter of the GER experts anticipate that this trend will become reality for daily newspapers as well as for magazines in eleven to 15 years from now.

Today, German citizens read an average of eleven magazines, two of them on a regular basis. Almost 90 percent of these people read at least one daily newspaper now and again, and 59 percent of the German population still read newspapers on a regular basis (see MA 2009/II). Papers and magazines are selected according to the individual interests of readers, who do nothing more or less than compile their own individual reading material. This could be given added support by the technical options offered by the Internet. Readers could filter out content that does not interest them even more efficiently than before. So why are the experts so skeptical?

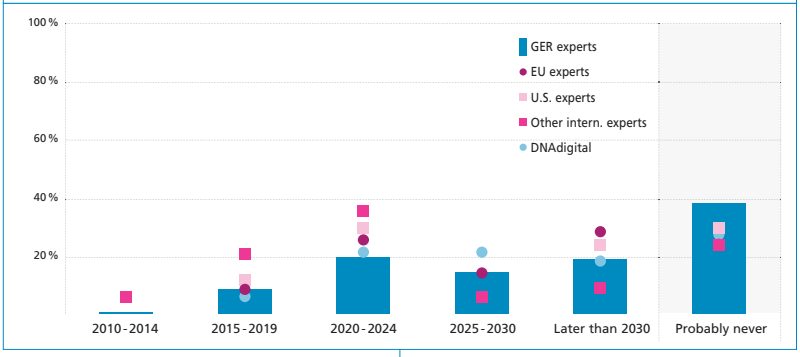
What attracts readers to a particular article? Subject matter, obviously, that is of special interest to a reader, but probably also topics that have, or will have, certain social relevance now or in the future. These could include topics that are not of immediate interest to them or that they have no knowledge about as yet. However, with individual preselection, these topics would probably be excluded by readers' personal preferences and, thus, users deprived of know-how they require to discuss the topics. One function of media is to inform, but equally important is their potential for social orientation and integration. These functions would be weakened in the case of individualized content.

Another factor in favor of the traditional use of newspapers and magazines is that the medium does more than provide objective information only. Readers have certain expectations of a newspaper or magazine that they want to be fulfilled. This need may vary greatly depending on readers' individual situations, in other words the choice they make may not always be the most suitable. Of course, readers have the option of re-selecting at any time. But who, and how many, people actually make the effort to do this on a constant basis?

Books – State library in a one-room apartment

A good third of the GER experts reckon that the e book will be the standard book format at the latest by the year 2024. An equally large group disagrees, and forecasts that this application will never gain a dominant position in the book market. Here again, it is striking that the DNAdigital group tends to follow this assessment (see Fig. IV. 19).

Thesis 96: The electronic book (e-book) has established itself as the standard "book" format.



Books without major visual elements can already be used effectively on e-book hardware. With the exception of photo collections, reference books containing graphics, charts and tables, virtually all segments of the book market are available on this carrier. Sony is currently trying to position its new Touch Edition PRS-600 reader in the market alongside the Kindle. This model, which was launched in the German market at the beginning of 2009, has not generated significant sales. Similarly, the e-book boom that was triggered by the Kindle launch in the U.S. two years ago has not yet left the ground in Germany. The range of books that is available in electronic format in North America, however, is far broader than that in Germany.

Amazon offers over 350,000 digital books in the U.S., while its competitor Barnes & Noble plans to top this with a portfolio of a million electronic titles by 2010. In Germany, the Libreka platform currently has 14,000 e-books on sale. Sony cooperation partner Libri offers 7,000 books for download (see Focus 2009). Nonetheless, it is astounding that almost 50 percent of U.S. experts do not expect to see the electronic book as the standard book format until 2030, or possibly never at all (see Fig. IV.19).

Lower prices, touchscreen technology, minimal battery consumption, greatly improved readability based on e-ink technology and interaction options for readers are all designed to make e-books a success. Standards that enable cross-device usage (e. g., EPUB standard) and mobile device connectivity of the type offered by the Kindle in the U.S. but not yet an element of the portfolio in Germany enhance the e-book's attraction and universality.

Generally speaking, the e-book has good chances of catching on, since it offers readers many novel advantages. It means that readers are no longer faced with agonizing decisions as to which book to take on holiday with them because storage capacities are virtually unlimited. Reader can also say goodbye to overloaded bookshelves and one-room apartments can actually house book collections approaching the size of a state library. The font size is scalable; failing eyesight therefore no longer presents users with a problem. Bookmark functions enable them to resume reading exactly where they left off. The book of choice is available anytime - for download from the Internet. This gives publishing houses the chance to establish new business models through various billing channels.

However, it will probably be difficult to get the same price for electronic books as for the printed version. On the other hand, since publishers no longer incur costs for printing and sales, they should be able to produce their electronic books at lower prices than the printed ones.

Electronic books have a good chance of asserting themselves in the market, but they will co-exist with other formats in the same way as we have hard cover and paperback formats today. Printed books will continue to exist but the paperback may not survive, since electronic books offer benefits over and beyond their similar characteristics (weight, price), e. g., the possibility to interact with other readers, on-demand access, integration options for the audio version, etc., and this new technology could also give new momentum to traditional book printing. Printed books for conventional readers will have a broader range of functions and be more sophisticated.

As a result, higher prices can be asked for these book-lovers' copies. Children's books, in particular, will have a special status. The e-book will not be able to reproduce the tactile features that children love in the foreseeable future, e.g., popups and stencils, nor will it be washable or slaver-proof.

Rights to the written word

The new technical possibilities do, however, pose new questions relating to publishing rights, which have culminated in the recent discussions about the Google Books project.

Google has been digitizing library books that are out of print or whose copyright owners cannot be ascertained for many years in the U.S. Last year, the Internet company reached a mutual agreement with U.S. writers' associations. These can have their works entered in a register, which entitles them to almost two thirds of the money that Google earns with charges for use of their works. However, the agreement has yet to be endorsed by a U.S. court. Google also registers the works of European authors in the U.S.

Basic approval for approaches like the one taken by Google Books has been expressed by the EU Commission. It has plans to reform copyright laws in Europe to enable private firms such as Google to place the contents of whole libraries on the Internet on a grand scale. The reason given by the EU: Public institutions have to rely on support from private firms to digitize their books. The EU needs to establish a legal basis so that a service similar to that offered by the Google library in the U.S. is also available to consumers in Europe. Criticism of Google has been voiced by the German government as well as by rivals such as Amazon, Microsoft and Yahoo. They all share the basic fear that Google could assume a monopoly position in book rights and thus become the sole controller of access to their content.

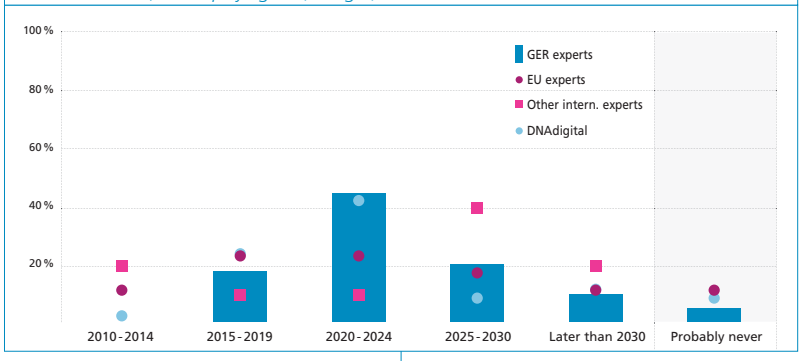
In the meantime, Google's business rivals, Amazon, Yahoo and Microsoft, have joined forces with non-profit organizations to prevent court approval for the agreement between Google and the U.S. writers' associations.

The agreement dating from October 2008 grants Google the right to scan books from universities and libraries and place them on the Internet in return for payment of USD 125 million. Amazon, the online mail-order business, has criticized the plans, claiming they are not conducive to competition and consumer friendliness. Should the agreement between Google and the U.S. authors be approved, Google Books would be in a position to offer millions of books in digital format. Amazon currently has a base of 350,000 digital books.

Devices: One for all?

Can we picture having one mobile device for all media, books, newspapers, television and the Internet? A full two thirds of the GER experts envisage that this development will occur in the period between 2015 and 2024, as do the experts for Europe. Most of the experts for other countries expect the onset of this development at a much later date (see Fig. IV.20). The early date quoted by the GER experts is, at first sight, surprising in view of the time frame for electronic newspapers and books. However, state-of-the-art smartphones can already fulfill these functions. On the other hand, the growing range of potential applications increases device complexity, an acceptance inhibitor for most users that should not be underestimated.

Thesis 97: More than 75 percent of the population in <country> use a multimedia mobile end device as the unifying element for conventional media (books, newspapers, magazines, television and Internet) for displaying text, images, music and videos.



If we look at use of multifunction devices already on the market, the extent to which the available functions are now used is relatively disillusioning. None of the cell-phone owners use more than three of their phone's functions, and even when we look at frequent callers (with more than 2 hours' private usage per day) 40 percent belong to this group (see Communication Networks 2009). One of the reasons for this is, undoubtedly, that individual users cannot keep track of the broad array of available functions or take advantage of them without consulting a user manual. And even if things were simpler: users' interests vary and they all have their own individual requirements for their handsets. This means that functions they do not use are soon felt to be unnecessary ballast.

This could also apply to the notion of an omnipotent device. Cell phones are ideal for reading and sending short text messages. Electronic paper is suitable for reading magazines and newspapers with a complex layout. Books, above all fiction without major visual elements, are already easy to read on the existing e-book platforms. Almost all devices are Internet-enabled. The development of a highly sophisticated solution, a "communication all-rounder," may present a challenge not only on the engineering but also on the marketing side. Young target groups, especially, who are still highly attracted by gaming, will take to the "all-in-one" devices, even though they often lack the necessary budget to pay for the device, a contract or content. Other target groups tend to see multifunctionality as an obstacle to their requirement for ease of use. The solution of choice in this case would be various devices that are networked to build one modular media system.

Supporting and enhancing reading skills

Is electronic paper on its way? Will we ever have an omnipotent device for all types of media usage? Will we always read on screen in the future? Or will traditional printed newspapers, magazines and books experience a new heyday? The success of all these options depends on one main element – namely reading. If this skill is not preserved, or is confined to the consumption of text messages of 160 characters in length, the potential of the new technologies will remain largely unexploited.

Although new technologies and business models may enable easy and low-cost options for virtually everyone to access a broad range of different content, they do not automatically lead to a higher standard of education. Education, and reading in particular, is, alongside parental care, the social responsibility of politics as well as – and in particular – of business and the media, if they want to avoid a scenario in which most of their innovations and services remain technical gimmicks for nerds.

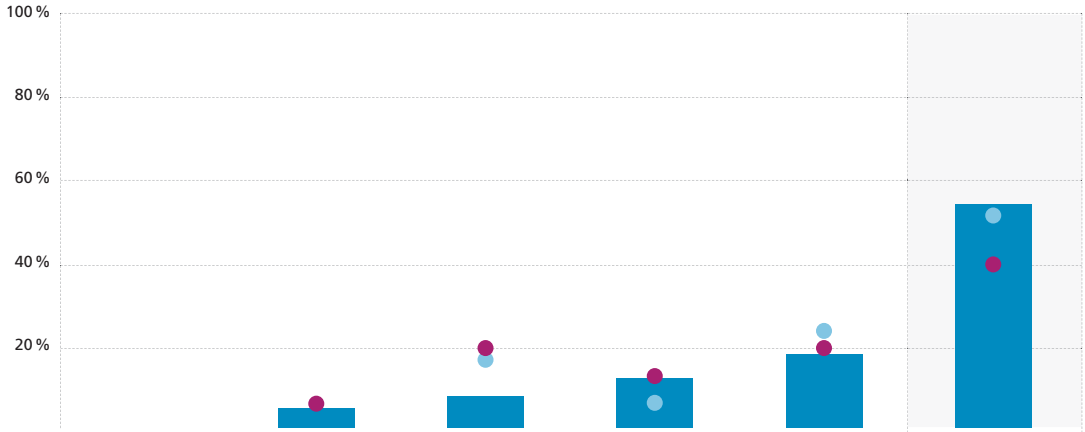
In actual fact, evidence exists that increasing digitization and Internet usage, in particular among the younger population groups, leads to greater willingness to handle texts in their private lives. The diversity of texts in our daily lives is increasing. Printed documents now find an additional and new form of brief expression in text messages, chat rooms and on Twitter, in forum contributions, Amazon recommendations, and writing, reading and commenting on blogs. Much of this is still at the "infant" experimental stage. However, all media search for and find their own language and position in the lives of each and every individual.

This "revival" of text and the written word is also promoted by the continual growth of digital text-based media, and can be seen as an opportunity and the responsibility of new digital reading services and text-makers.

Theses on "Print: New technologies and "old" reception habits" in detail

Fig. IV.13: Thesis 91 Digital newspapers

Newspapers in <country> only exist in digital format on the Internet.

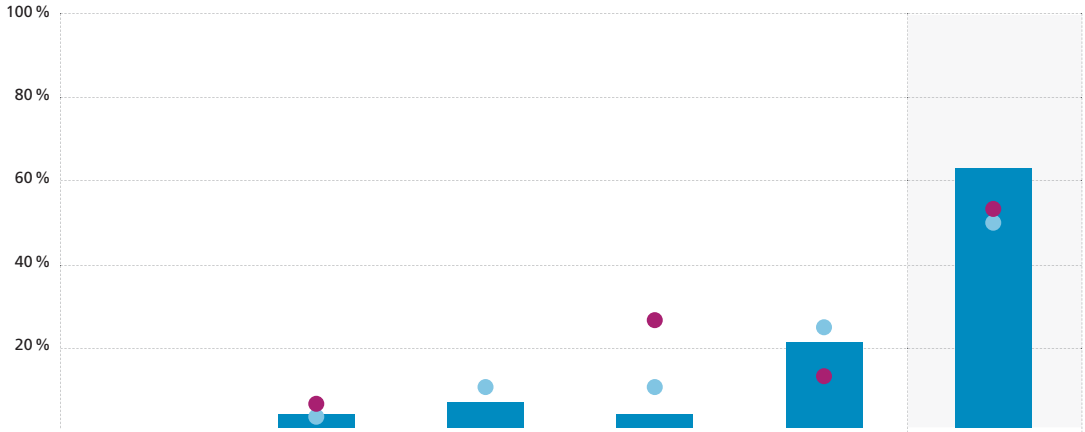


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 70)	0 %	6 %	9 %	13 %	19 %	54 %
EU experts (n = 15) [1]*	0 %	7 %	20 %	13 %	20 %	40 %
DNAdigital (n = 29)	0 %	0 %	17 %	7 %	24 %	52 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.14: Thesis 92 Digital magazines

Magazines in <country> only exist in digital format on the Internet.

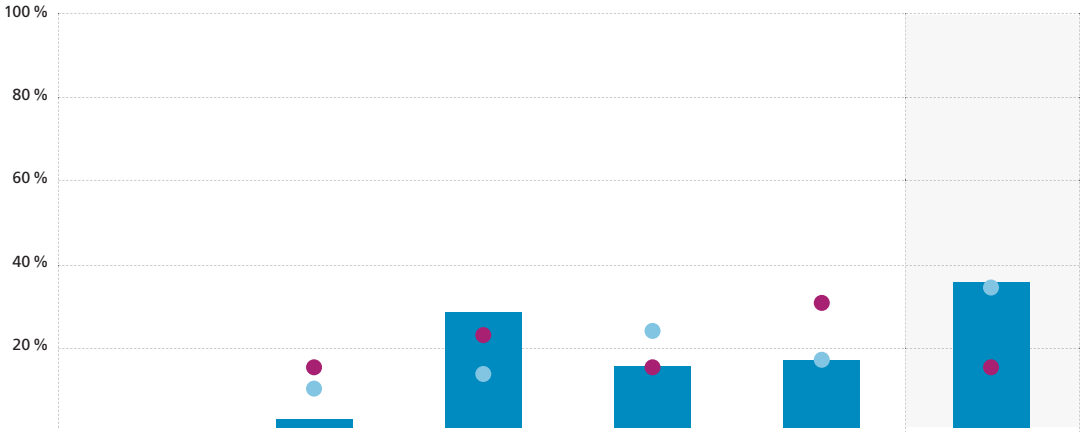


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 70)	0 %	4 %	7 %	4 %	21 %	63 %
EU experts (n = 15) [1]*	0 %	7 %	0 %	27 %	13 %	53 %
DNAdigital (n = 28)	0 %	4 %	11 %	11 %	25 %	50 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.15: Thesis 93 Individual e-newspaper

More than 75 percent of the population in <country> use daily e-newspapers with customized content.

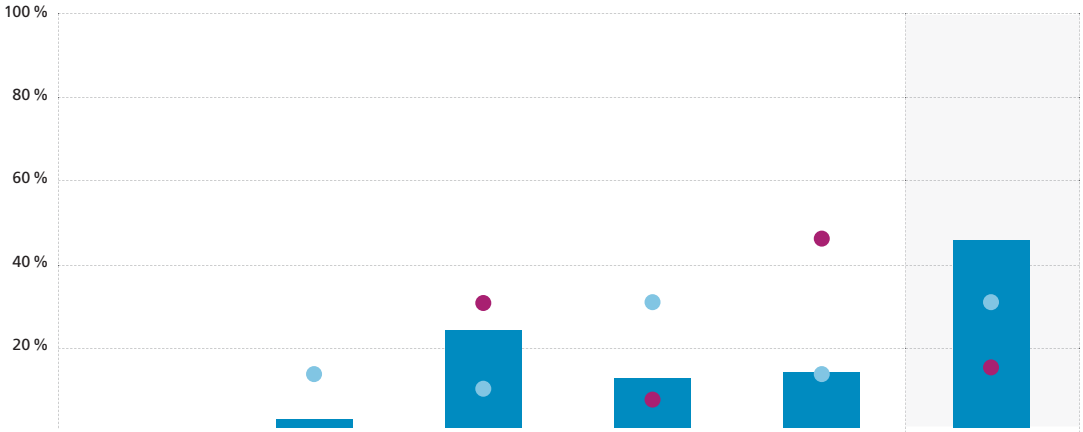


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 70)	0 %	3 %	29 %	16 %	17 %	36 %
EU experts (n = 13) [1*]	0 %	15 %	23 %	15 %	31 %	15 %
DNAdigital (n = 29)	0 %	10 %	14 %	24 %	17 %	34 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.16: Thesis 94 Individual e-magazine

More than 75 percent of the population in <country> use e-magazines with customized content.

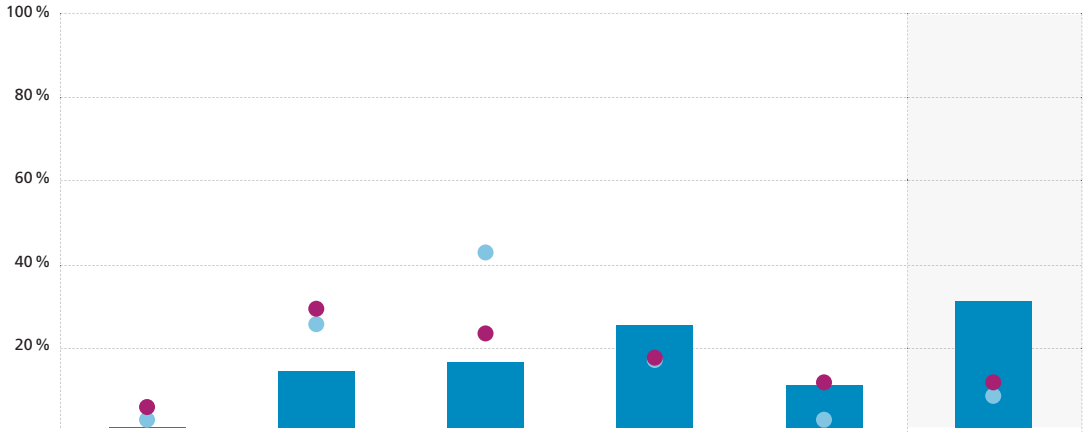


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 70)	0 %	3 %	24 %	13 %	14 %	46 %
EU experts (n = 13) [1*]	0 %	0 %	31 %	8 %	46 %	15 %
DNAdigital (n = 29)	0 %	14 %	10 %	31 %	14 %	31 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.17: Thesis 95 Individual media

More than 75 percent of the population in <country> use e-newspapers/e-magazines with customized content.

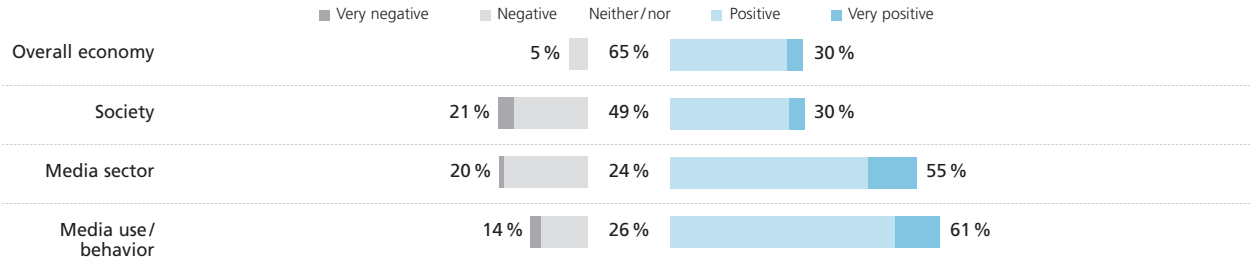


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 90)	1 %	14 %	17 %	26 %	11 %	31 %
EU experts (n = 17) [1]*	6 %	29 %	24 %	18 %	12 %	12 %
DNAdigital (n = 35)	3 %	26 %	43 %	17 %	3 %	9 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.18: Thesis 95 Individual media – relevance

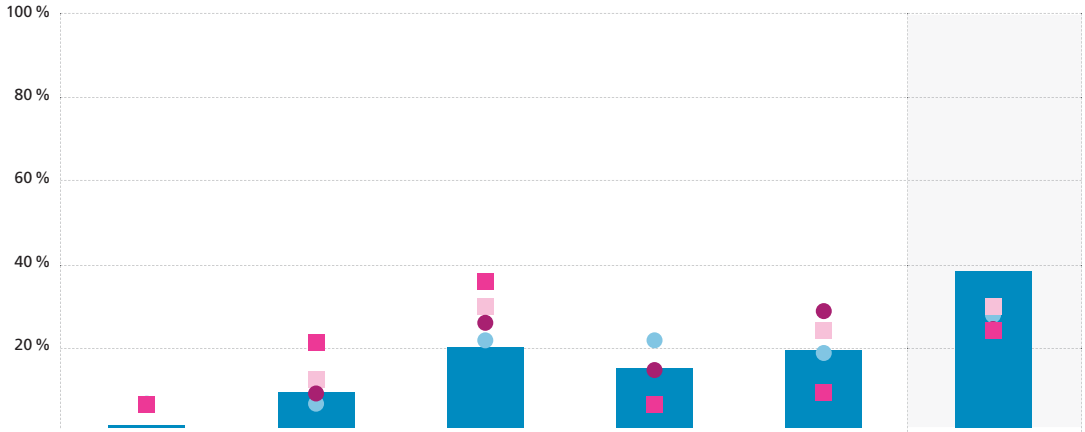
What impact will the validity of Thesis 95 above have on the areas listed below?



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, at least n = 81

Fig. IV.19: Thesis 96 E-book

The electronic book (e-book) has established itself as the standard "book" format.

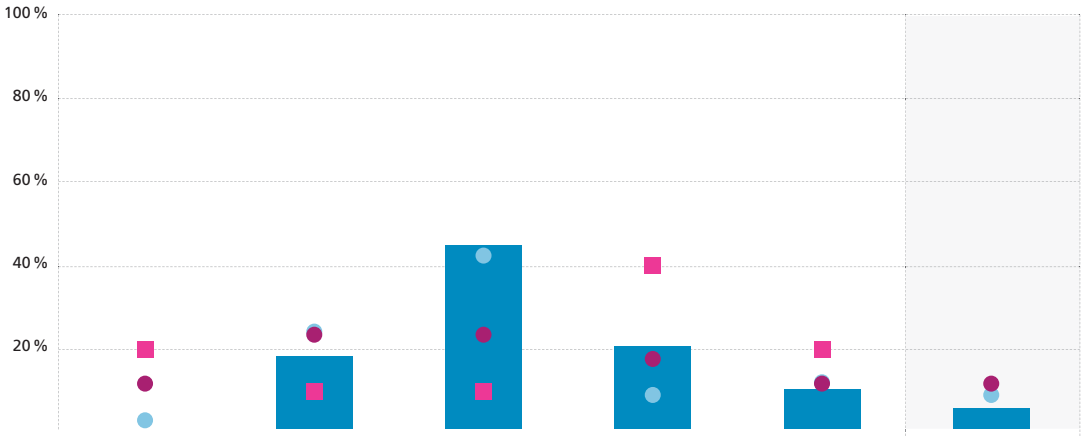


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 368)	1 %	9 %	20 %	14 %	19 %	38 %
EU experts (n = 71) [1]	0 %	8 %	25 %	14 %	28 %	24 %
U.S. experts (n = 34)	0 %	12 %	29 %	6 %	24 %	29 %
Other intern. experts (n = 34) [2]	6 %	21 %	35 %	6 %	9 %	24 %
DNAdigital (n = 33)	6 %	6 %	21 %	21 %	18 %	27 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. IV.20: Thesis 97 Multimedia device

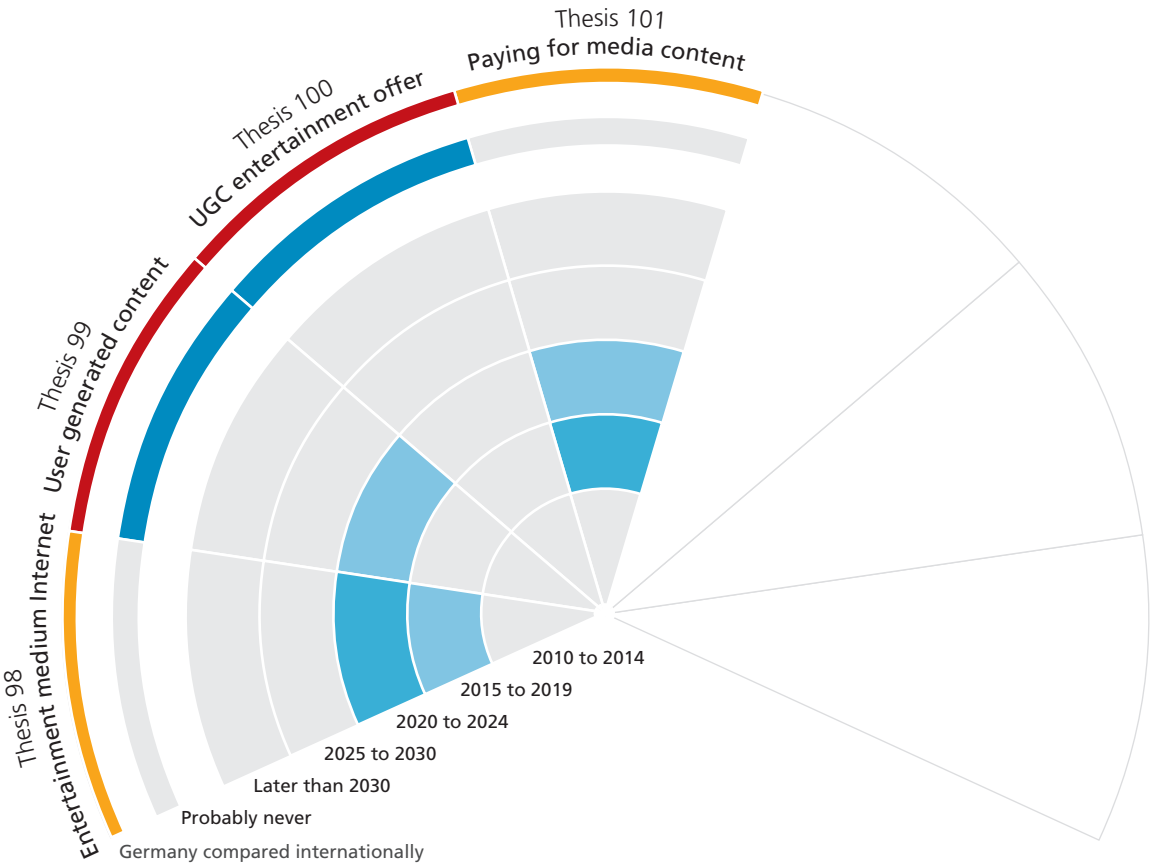
More than 75 percent of the population in <country> use a multimedia mobile end device as the unifying element for conventional media (books, newspapers, magazines, television and Internet) for displaying text, images, music and videos.



	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 87)	0 %	18 %	45 %	21 %	10 %	6 %
EU experts (n = 17) [1]*	12 %	24 %	24 %	18 %	12 %	12 %
Other intern. experts (n = 10) [2]*	20 %	10 %	10 %	40 %	20 %	0 %
DNAdigital (n = 33)	3 %	24 %	42 %	9 %	12 %	9 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, except Germany, Europe and the U.S.; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

IV.2.3 Electronic media
Future radar*: Forecast occurrences



Sub-group of GER experts: ■ ≥ 40 % of experts ■ 30 % – 39 % of experts ■ 20 % – 29 % of experts ■ < 20 % of experts
Germany in comparison: ■ pioneering role ■ on a par with global developments ■ lagging behind ■ not possible to say

Thesis 98: The Internet as an entertainment medium

The Internet is the number one medium for entertainment in Germany.

Thesis 99: User generated content (UGC)

More than half the Internet users in Germany themselves produce content each week, such as images, music, films and text (user generated content) and make these available to other users on the Internet.

Thesis 100: UGC entertainment offer

Entertainment options based on user generated content dominate private media usage in Germany.

Thesis 101: Paying for media content on the Internet

For more than half the Internet users in Germany, it is the norm to pay for retrieving professionally produced media content from the Internet (films, electronic newspapers and magazines, music, etc.).

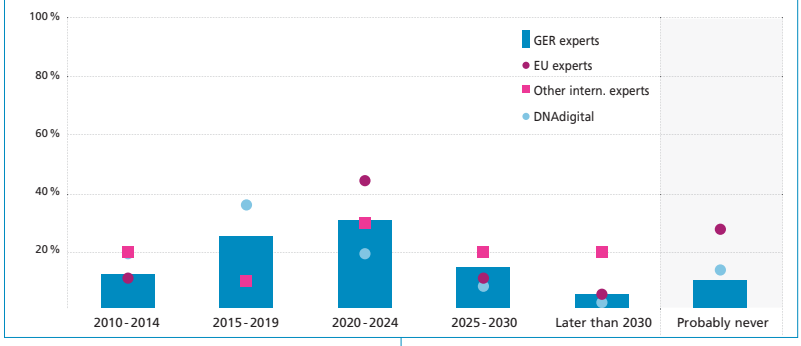
* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

The Internet as an entertainment medium

Around one third of the experts for Germany forecasts that the Internet will already achieve the status of No. 1 entertainment medium in the next ten years. Another third believes that it will occupy this position by the mid 20s of the new century at the latest. The DNAdigital group expects this to occur slightly faster, but the experts for Europe are more skeptical in their assessment than those for Germany: One quarter of them assume that the Internet will never achieve this position in the entertainment sector (see Fig. IV.21).

Thesis 98: The Internet is the number one medium for entertainment in <country>.



"Entertainment programs" like YouTube have already gained a firm foothold on the Internet. If we include services like iTunes and flickr, the worldwide web already offers significant entertainment potential. If the large majority of TV and radio programs are broadcast over the Internet, then the Internet is sure to become the No. 1 entertainment medium. Soon we will no longer be able to distinguish whether entertainment is delivered by TV and radio broadcasters or via the Internet. The hardware in people's homes will be similar to a TV set – or even electronic wallpaper (as showcased at the IFA fair). This requires not only adequate technical transmission capacity but also appliances that guarantee trouble-free access to TV programs. The Internet and TV will be accessible via a single device. The new technical transmission format will enable new viewing options, for example:

- More specialty channels, in other words more programs tuned to individual interests

- Better link between TV content and additional information or bonus material from the Internet (e. g., as in series and casting shows)

- Better download options for audio and video content

- Time-shifted television, which is independent of fixed program schedules.

Being one's own program director is an attractive prospect but requires more activity on the part of the user than fixed conventional program schedules. However, electronic program guides make it possible to list YouTube, for example, as a personal channel and to position this video service so that it is perceived and used at the same level as the standard TV offering. Selecting a video clip requires no more effort than choosing one of the standard TV programs, and the use of playlists generates what is virtually a "linear" television experience. This is the point at which traditional TV and multimedia offers will increasingly merge in the future.

The Internet will ultimately become a technical medium that broadcasts program signals in the same way as antennae, cables and satellite dishes do today. In their own perception, most users will probably still consider themselves to be watching TV but in reality will be consuming content from the Internet. This produces an analogy to the print media, which is another area where technical innovations will make it possible to maintain the status of an "old" medium and, at the same time, provide suitable new options for it.

User generated content – from recipient to producer?

One of the new possibilities offered by technological innovations is something known as user generated content. Experts are divided in their opinions on Internet users' production activities (see Fig. IV.23). 40 percent of the experts for Germany do not believe that the majority of Internet users will place content on the web for the benefit of other users on a weekly basis; almost half the members of the DNAdigital group shares this opinion. All other experts are slightly less skeptical than their colleagues for the German market but are not exactly euphorical about online users' own activities.

Despite the vast range of possibilities offered by the Internet, the majority of online users tend to be passive recipients who use the Internet predominantly as a source of information, for on-demand services and entertainment and not as a forum for disseminating their own creative content.

At present, for example, around 20 percent of visitors to Foto-community.de claim to have actively uploaded photos to the site - which is a top rate among comparable Internet

sites. In Germany, YouTube.com reports that only eleven percent of its visitors play an active role (see Communication Networks 2009).

For private use only!

With its broad variety of technical offers, the Internet undoubtedly offers diverse and above all transparent options for placing one's own content on the Net for others to share.

However, widespread acceptance should be viewed with caution due to the swift fragmentation of individual content. It can be assumed that self-produced content is primarily made available to a specific user group, which is the digital equivalent of an evening spent viewing "holiday slides with friends."

The 65 percent forecast submitted by the experts for Germany must be seen in this context, namely that user generated content will never dominate entertainment offers (see Fig. IV.24). A comparable number of persons surveyed from the DNAdigital group and the Europe and U.S. experts agree with this forecast.

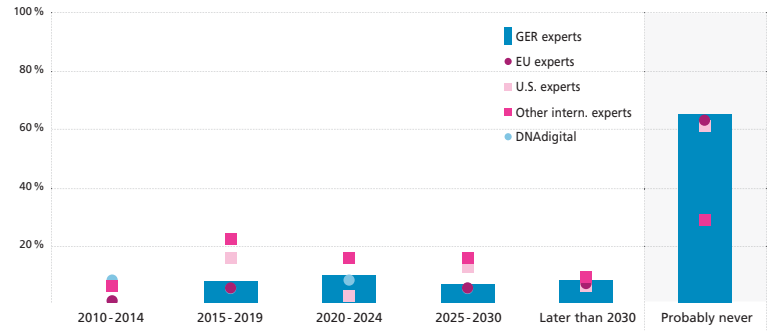
Thanks to simplified production conditions, this field of action may extend to include every user but the significance of publicly and freely accessible entertainment content will by no means grow in proportion to their possibilities.

Summary

Electronic media – first and foremost among them the Internet – have found their role in satisfying users' entertainment and information needs and will continue to expand it with the addition of new offers.

In order to offer consumers a highly diverse portfolio and ensure that no-one is excluded from the possibilities offered, for example, by linking television and the Internet, it is vital to make investments in a nationwide broadband infrastructure.

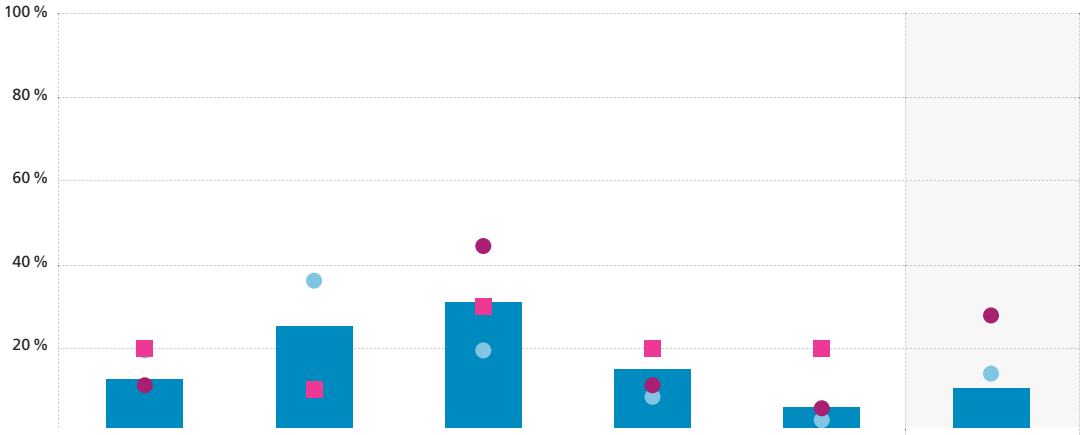
Thesis 100: Entertainment options based on user generated content dominate private media usage in <country>.



Theses on "Electronic media" in detail

Fig. IV.21: Thesis 98 The Internet as an entertainment medium

The Internet is the number one medium for entertainment in <country>.

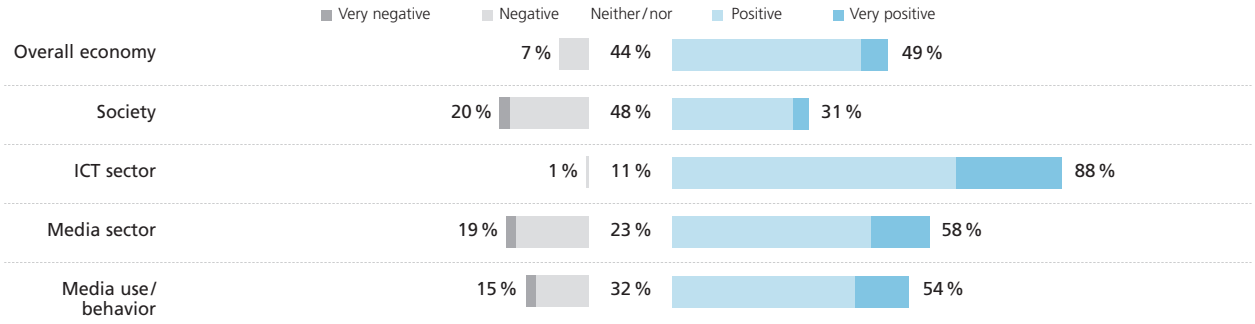


	2010-2014	2015-2019	2020-2024	2025-2030	Later than 2030	Probably never
GER experts (n=87)	13 %	25 %	31 %	15 %	6 %	10 %
EU experts (n=18) [1]*	11 %	0 %	44 %	11 %	6 %	28 %
Other intern. experts (n=10) [2]*	20 %	10 %	30 %	20 %	20 %	0 %
DNAdigital (n=36)	19 %	36 %	19 %	8 %	3 %	14 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, except Germany, Europe and the U.S.; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.22: Thesis 98 The Internet as an entertainment medium – relevance

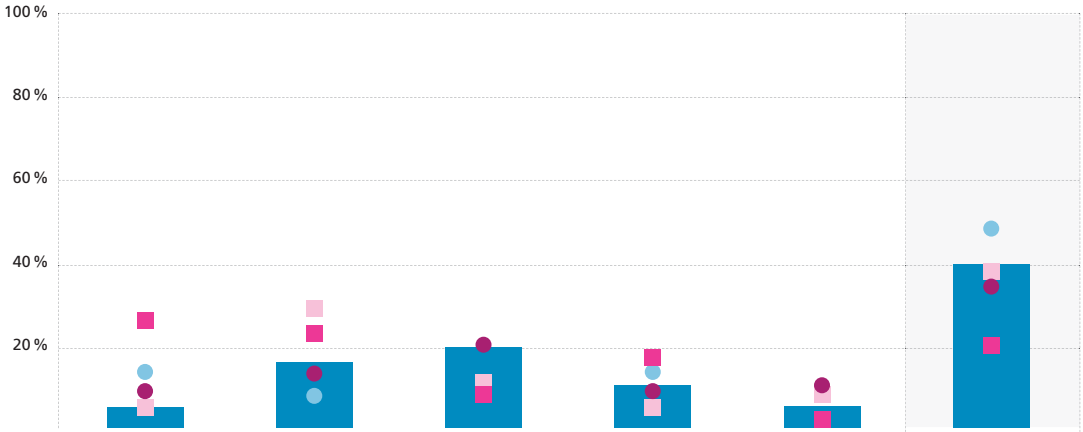
What impact will the validity of Thesis 98 above have on the areas listed below?



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, at least n=81

Fig. IV.23: Thesis 99 User generated content (UGC)

More than half the Internet users in <country> themselves produce content each week, such as images, music, films and text (user generated content) and make these available to other users on the Internet.

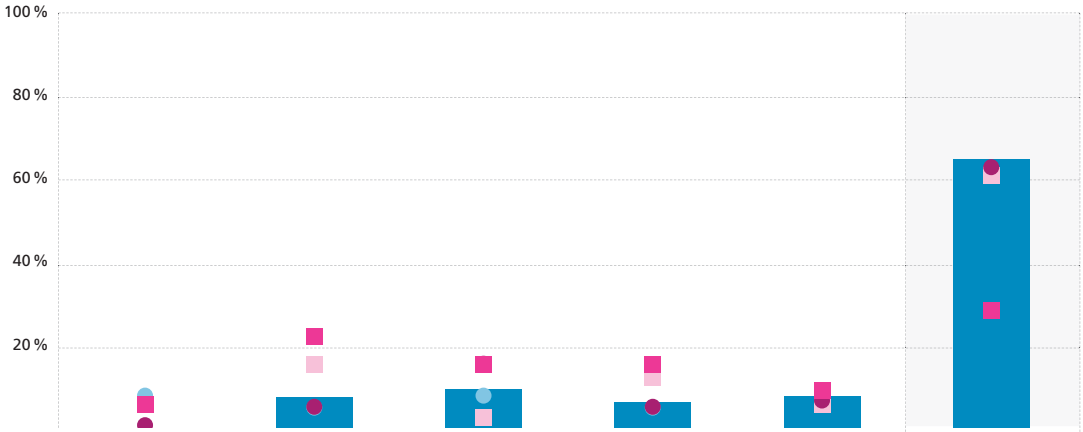


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 360)	6 %	17 %	20 %	11 %	6 %	40 %
EU experts (n = 72) [1]	10 %	14 %	21 %	10 %	11 %	35 %
U.S. experts (n = 34)	6 %	29 %	12 %	6 %	9 %	38 %
Other intern. experts (n = 34) [2]	26 %	24 %	9 %	18 %	3 %	21 %
DNAdigital (n = 35)	14 %	9 %	11 %	14 %	3 %	49 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. IV.24: Thesis 100 UGC entertainment offer

Entertainment options based on user generated content dominate private media usage in <country>.

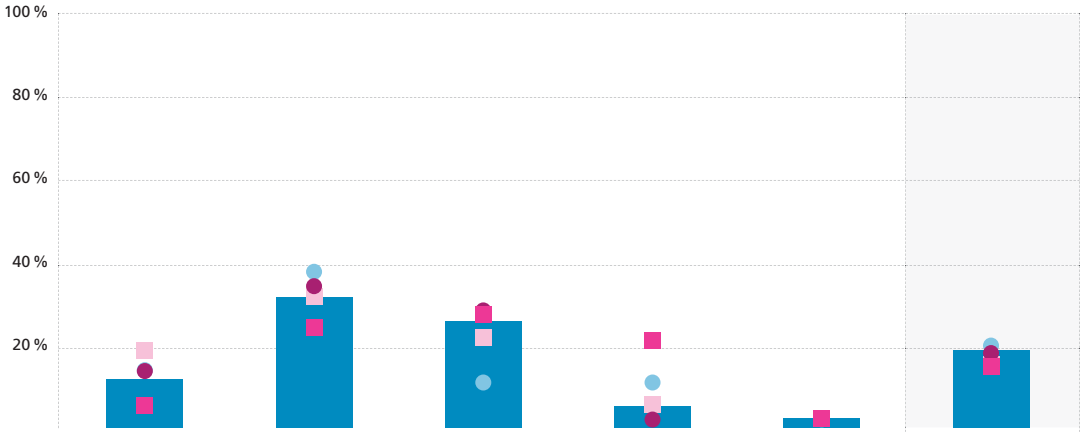


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 353)	1 %	8 %	10 %	7 %	9 %	65 %
EU experts (n = 68) [1]	1 %	6 %	16 %	6 %	7 %	63 %
U.S. experts (n = 31)	0 %	16 %	3 %	13 %	6 %	61 %
Other intern. experts (n = 31) [2]	6 %	23 %	16 %	16 %	10 %	29 %
DNAdigital (n = 35)	9 %	6 %	9 %	6 %	9 %	63 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. IV.25: Thesis 101 Paying for media content on the Internet

For more than half the Internet users in <country>, it is the norm to pay for retrieving professionally produced media content from the Internet (films, electronic newspapers and magazines, music, etc.).

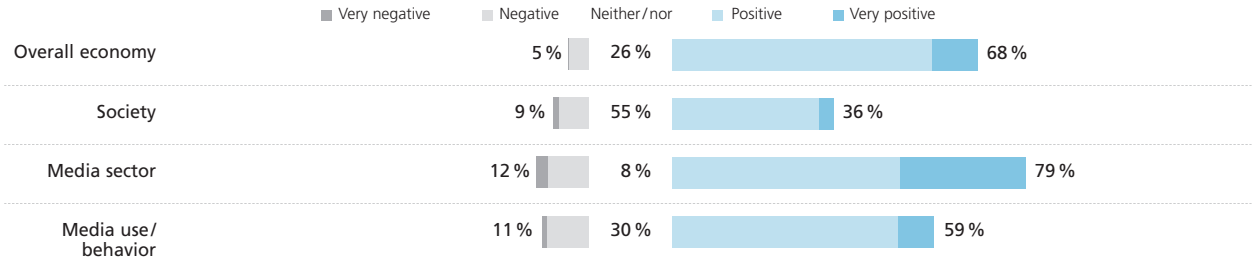


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 366)	13 %	32 %	27 %	6 %	3 %	19 %
EU experts (n = 69) [1]	14 %	35 %	29 %	3 %	0 %	19 %
U.S. experts (n = 31)	19 %	32 %	23 %	6 %	3 %	16 %
Other intern. experts (n = 32) [2]	6 %	25 %	28 %	22 %	3 %	16 %
DNAdigital (n = 34)	15 %	38 %	12 %	12 %	3 %	21 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. IV.26: Thesis 101 Paying for media content on the Internet – relevance

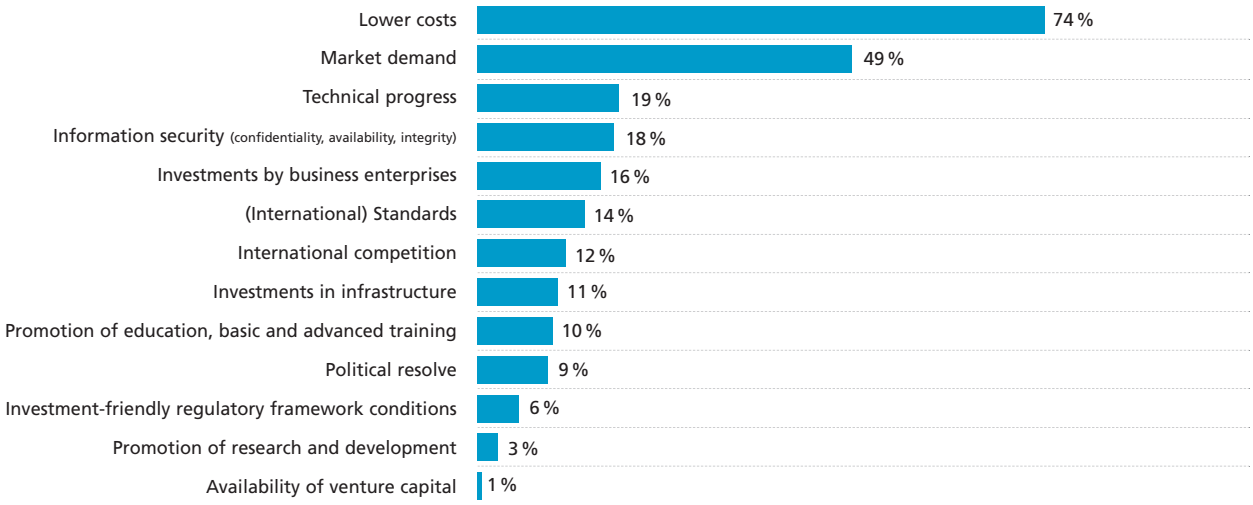
What impact will the validity of Thesis 101 above have on the areas listed below?



Basis: All people surveyed; Sub-group: GER experts, at least n = 358

Fig. IV.27: Thesis 101 Paying for media content on the Internet – drivers

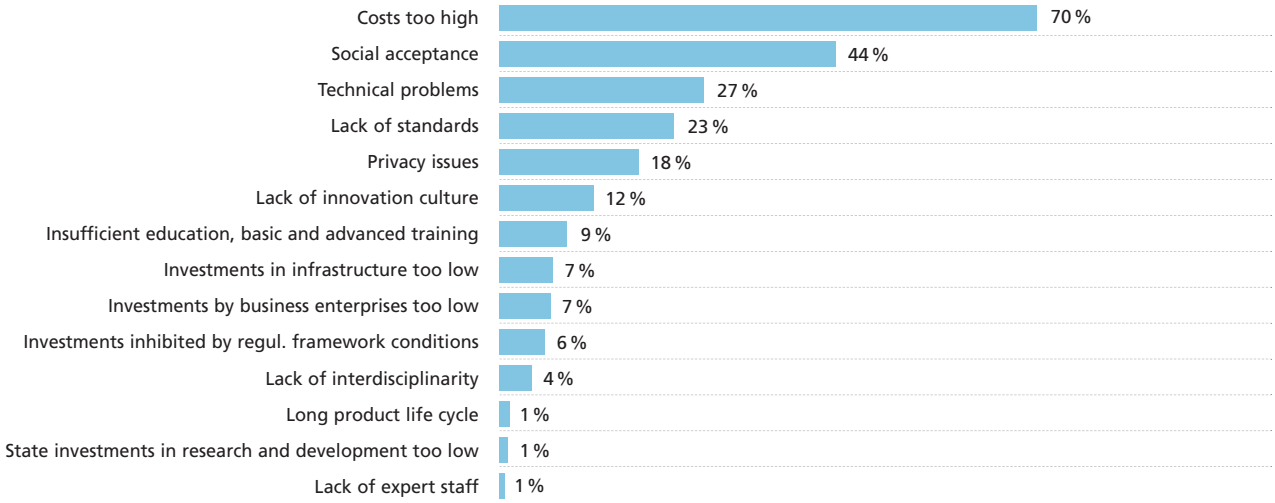
Select up to three drivers from the following list that you consider to be most important for realization of Thesis 101 above.



Basis: All people surveyed; Sub-group: GER experts, n = 289

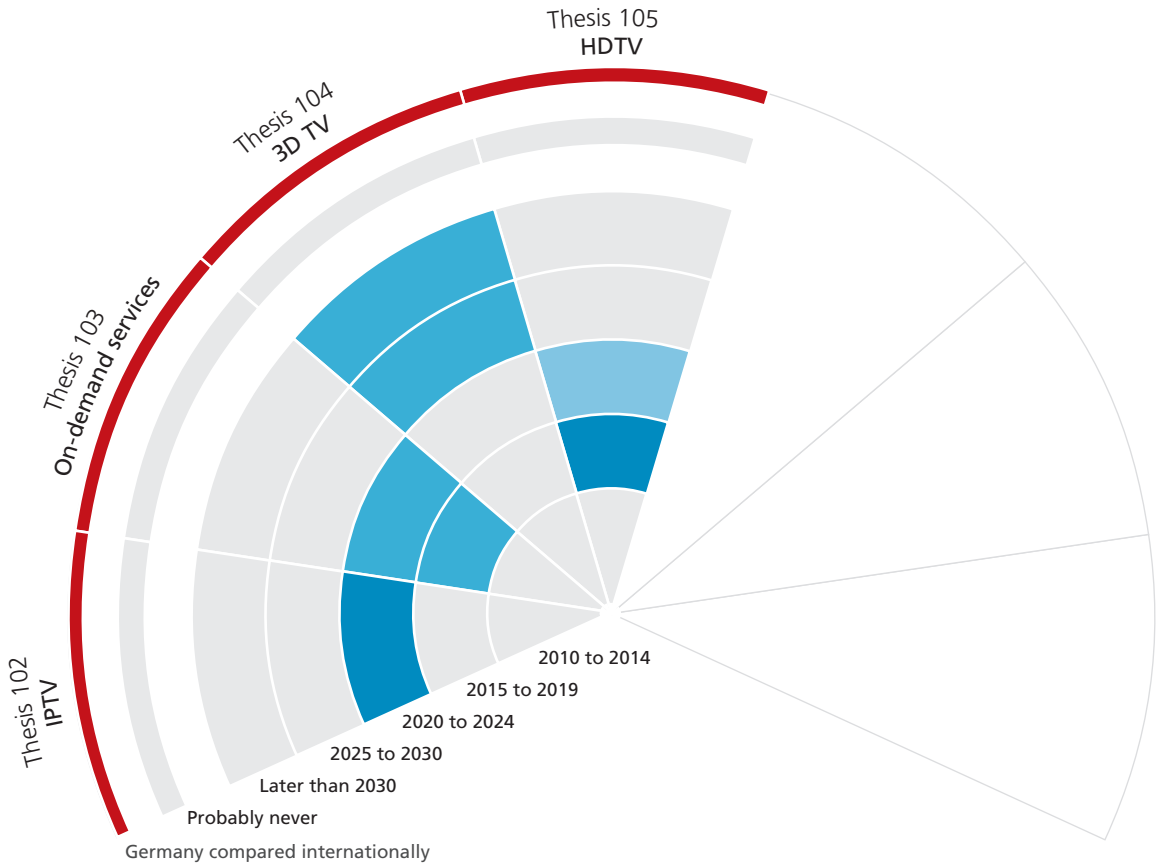
Fig. IV.28: Thesis 101 Paying for media content on the Internet – barriers

Select up to three barriers from the following list that you consider to be most important for realization of Thesis 101 above.



Basis: All people surveyed; Sub-group: GER experts, n = 284

IV.2.4 Television of the future
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 102: IPTV
Television in Germany is transmitted for the most part via IP-based broadband networks.

Thesis 103: On-demand services
More than half the population in Germany use on-demand media and services in their daily media consumption instead of conventional linear television (fixed or scheduled programming).

Thesis 104: 3D TV
3D-television is available nationwide in Germany.

Thesis 105: HDTV
High-definition television (HDTV) is the standard quality of television transmission in Germany.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

The initial phase of the "Prospects and Opportunities of Germany's Information and Communication Technologies" research project quickly revealed that further dynamic growth in the demand for high-speed telecommunication infrastructures can be expected in the coming years. In concrete terms, this means that today's technologies will reach maximum capacity by the year 2010. Specifically, technology convergence and convergent IP-based applications such as IPTV, triple/quadruple play, video on demand and HDTV spawn the need for new networks based on optical fiber (glass fiber) (see Münchner Kreis, Deutsche Telekom AG, TNS Infratest, EICT 2008). Alongside what were initially technology-driven requirements for infrastructure development (see section III.1), the future success and spread of new media offers and services will depend to a large degree on whether they are accepted and assimilated by recipients and users.

According to BITKOM, the number of IPTV subscribers is still steadily increasing in Germany. Whereas 180,000 IPTV subscribers were counted for Germany in 2007, the figure rose swiftly to 536,000 in 2008. Further strong growth is expected for 2009. Deutsche Telekom, the biggest IPTV provider in the German market, aims to have one million subscribers to its T-Entertain IPTV service by the end of 2009 – according to its own figures, Deutsche Telekom already had over 500,000 subscribers at the end of 2008. And this massive growth is set to continue: BITKOM forecasts 1.8 million paying IPTV customers as early as 2010, a figure that represents growth of 50 percent on 2009. The Detecon consulting company forecasts that Germany will have five million IPTV households in the year 2013 (cf. Detecon 2009).

A fast growing market: IPTV

To do justice to this major change in the traditional medium, experts were also asked during the present Delphi study for their assessment of whether, and by when, TV transmission over IP-based broadband networks will dominate the market.

69 percent of the GER experts are convinced that this will be the case by 2024 at the latest (see Fig. IV.29). A fifth of these experts actually assumes that the TV convergence process will be complete within the next ten years, i.e., by the end of 2019. Only eleven percent of the experts contradict this very clear trend in IPTV development; they forecast that this scenario will never materialize in Germany.

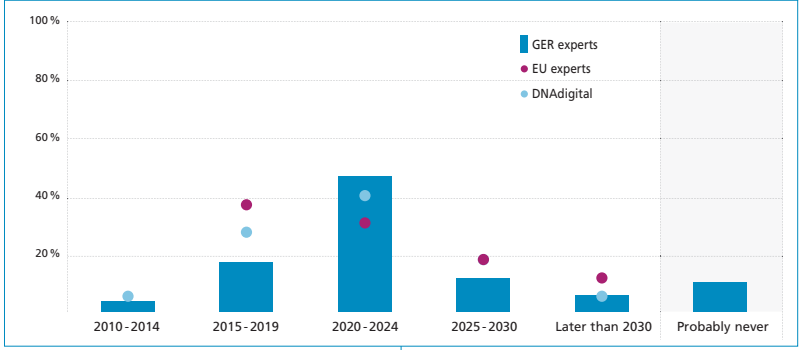
The opinion expressed by the experts for Europe and the members of the DNAdigital group was similar to that of the experts for Germany. 75 percent of the DNAdigital interviewees and 69 percent of the experts for Europe expect most TV programs to be broadcast over IP-based broadband networks by 2024 at the latest. Nonetheless, their assessments are at great variance: almost two fifths of the experts for Europe are more optimistic and reckon that IP-based broadcasting will be implemented in their countries during the period 2015 to 2019 (38 percent).

This optimistic view of TV broadcasting convergence is also shown clearly by another key figure: in contrast to the GER experts, all members of the DNAdigital group and all experts for Europe assume that IP-based TV broadcasts will advance to become the TV broadcasting standard in future – none of the people surveyed thinks it likely that this transmission technology will never assert itself. According to 88 percent of the experts for Germany, developments in all areas ranging from conventional TV signal transmission formats to IP-based IPTV broadcasts will have a positive impact above all on the ICT industry (see Fig. IV.30).

The media industry (73 percent) as well as media consumption and habits in Germany stand to gain from transmission over IP-based networks (57 percent). On the other hand, the respondents expect a lesser impact on society as a whole: 73 percent of the experts surveyed state that they see neither positive nor negative effects in this area.

Estimates of the consequences for the economy as a whole produce a differentiated picture. Opinions vary greatly among the GER experts: Whereas 49 percent of the people surveyed assume that IPTV will not have any impact at all on the overall economy, an equally large proportion (47 percent) forecasts a positive influence.

Thesis 102: Television in <country> is transmitted for the most part via IP-based broadband networks.

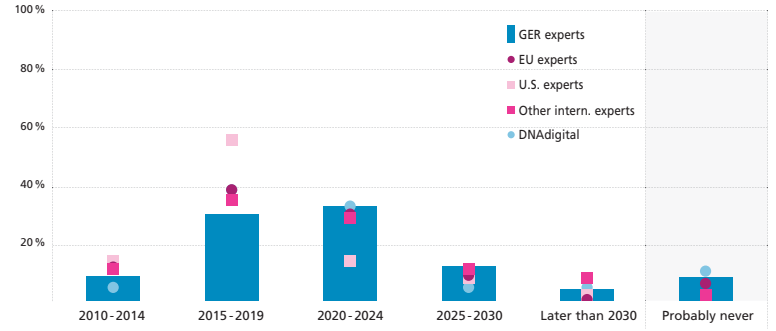


Investments in the relevant infrastructure represent a key driver that, according to the GER experts, will be responsible for materialization of the IPTV trend (59 percent; see Fig. IV.31). Another factor that is seen to be significant is technical progress (57 percent). In addition to

this, 51 percent of the experts expect that low costs for users, in particular, will be instrumental in the success of television over IP-based broadband networks. Consequently, the GER experts currently see excessive costs (48 percent), lack of investments in the requisite infrastructure (45 percent) and technical problems (30 percent) as the primary hurdles to the successful development of IPTV.

In order to provide a more accurate forecast of the transmission types that will be used for TV services in the future development of IP-based TV technologies – satellite, broadband TV cable, terrestrial, mobile and fixed broadband (DSL) – the importance of these transmission channels was another aspect included in the Delphi Study. According to 78 percent of the experts for Germany, the fixed DSL broadband network in particular will be at least very important or possibly even highly important for IP-based TV broadcasting (see Fig. IV.33). High significance for the transmission of IP TV services is also assigned to the mobile broadband network and the TV cable network (57 percent), with 52 percent of the experts expecting them to be at minimum very important. This view completely contradicts the appraisal of the significance of terrestrial services. 70 percent of the GER experts expect that terrestrial broadcasting will cease to play any significant role in this context in Germany in the future but will continue to exist as part of a basic service in individual setups.

Thesis 103: More than half the population in <country> use on-demand media and services in their daily media consumption instead of conventional linear television (fixed or scheduled programming).



On-demand services set to change viewing habits?

The possibility of using on-demand media and services grows hand in hand with the increase in IP-based television coverage. The revenue potential available to businesses that organize direct content provision and immediate payment over bidirectional broadband Internet links has generated euphoria in the media sector for some time, despite the fact that a major breakthrough has yet to materialize in Germany. However, the consequences of these services are already foreseeable: the increase in on-demand services is bound to have a negative impact, first and foremost on the traditional television and DVD markets. Providers in these markets will therefore have to adjust their business models to bring them into line with new developments if they are to stay competitive. In Germany, for example, Deutsche Telekom has already taken a first step in this direction with T-Home Entertain and its online video shop known as videoload, as has SevenSenses (Pro-Sieben/Sat1 network) with the maxdome VoD portal. Providers who originally specialized in providing infrastructure or service packages for content transmission will need to take account of this trend in order to safeguard their own futures. Kabel Deutschland, for instance, has upgraded its networks and is set to play the market with its own web offers. The extent to which on-demand services will change viewing habits in future is shown by the experts' forecasts.

72 percent of the experts for Germany expect that over half the German population will be using on-demand media and services in place of traditional linear viewing (fixed or scheduled programs) in their daily media consumption by the year 2024 at the latest. The majority of them (63 percent) assume that this will not occur in Germany until the period between 2015 and 2024 (see Fig. IV.34).

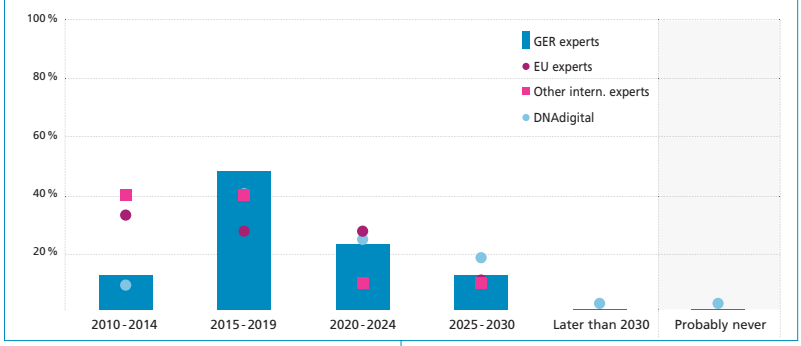
Similarly to the GER experts, the experts for Europe (83 percent) and for the international arena (76 percent) expect this thesis to gain validity by 2024 at the latest. In contrast, the U.S. experts are far more optimistic: 71 percent of them expect that over half the U.S. population will be using on-demand media and services to the exclusion of all others within the next ten years - hence by 2019 at the latest.

HDTV broadcasting - Germany trailing the field

Reports from IFA 2009 state that high definition TV (HDTV) will advance over the next few years to become one of the key trends and drivers in the consumer electronics industry (as hardware supplier) and as a supplier of content in the media sector. Increasingly, both video on demand and "traditional" linear television will be available in HD quality.

Although the advance of this trend has been sluggish to date, the experts surveyed for the Delphi Study believe that it will gain momentum in the coming years. The experts for Germany (61 percent) quote the year 2019 as the latest date for HDTV becoming the standard quality for TV images in television broadcasting in Germany. As many as half the members of the DNAdigital group who were surveyed forecast this rapid development by the year 2019. A large percentage of the experts for Europe (33 percent) and other countries (40 percent), however, anticipate that the trend will materialize in the coming five years up to the end of 2014 (see Fig. IV.36). One of the reasons for this could be that HDTV is already being received in an increasing number of other European countries. Although individual items on the broadcasting schedule have already been viewed in high definition on German television, we have yet to experience a breakthrough, probably as a result of low response on the consumer side. Now that low viewer figures have prompted the first private broadcasters in Germany to take their HD service off the market again, new HD offers are likely to be available on free TV in Germany from the end of 2009 (in addition to the HD channels on pay TV).

Thesis 105: High-definition television (HDTV) is the standard quality of television transmission in <country>.



Some private broadcasters are planning to roll out more TV programs in HD quality during 2009, while the public broadcasters will launch a regular HDTV broadcasting service from 2010, starting with the Vancouver Olympic Games. Individual programs are already scheduled to be broadcast in HD quality before then. The basic prerequisite for reception of these services is that households are equipped with suitable HD-capable TV sets. It is assumed that 19 million German households will have HD-capable TV appliances by the end of 2009. However, the current number of HDTV receivers lies at just below five million. This, coupled with the private broadcasters' plans for technical encryption procedures, tends to spawn doubt among the GER experts as to whether HDTV can actually become the standard quality in TV broadcasting over the next six years.

More than 70 percent of the experts for Germany expect the standard HDTV quality to have a positive impact on the media industry in Germany (see Fig. IV.37). This could be accounted for by the possibilities that the planned encryption procedures offer for private broadcasters' HDTV service: They would mean that restrictions could be imposed on program recording and steps taken to prevent users skipping advertising blocks – a positive note for the advertising industry and thus above all for development of the media sector. Potentially, however, these very plans could upset viewers, causing further delays in the establishment of HDTV. Only 54 percent of the GER experts who were surveyed envisage that HDTV could have a positive impact on the German economy as a whole.

3D technology – from the cinema to the living-room

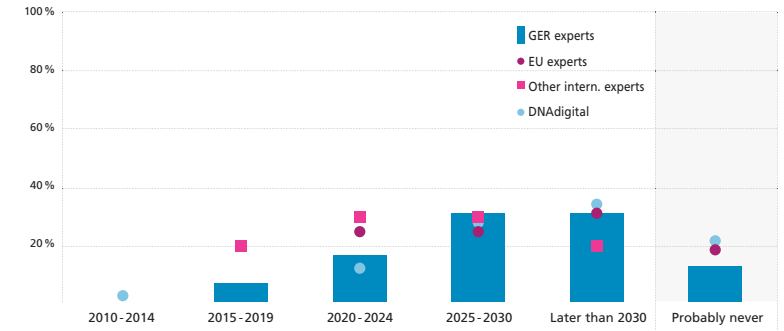
3D technology is being used to attract an increasing number of viewers to cinemas in the foreseeable future – this is, at any rate, the intention of the cinema operators. However, TV manufacturers are another group who have already set their sights on 3D screens. U.K. pay TV provider BSkyB plans to launch a 3D channel as early as 2010. To receive its programs, viewers will require a 3D-ready TV – here again, the first models are expected as early as 2010. 3D TV has been technically feasible for some time – but so far no one system has succeeded in establishing itself for the mass market. In order to provide a 3D television service, costly 3D film productions are also necessary. Additionally, the use of 3D glasses plays a role in the future development of 3D technology, since we can expect yet more development work before 3D TV can be viewed without special 3D goggles.

Possibly for this reason, the majority of GER experts (62 percent) does not expect 3D television to be available throughout Germany until 2025 or even later. The DNAdigital interviewees (62 percent) and the experts for European countries (56 percent) express a similar opinion. However, as many as 22 percent of the members of the DNAdigital group surveyed believe that 3D television will never be available throughout Germany – and 19 percent

of the experts for Europe submit the same assessment for other European countries.

A more optimistic attitude to the dissemination of 3D TV is taken by the experts for other countries: 50 percent believe that 3D TV will be available in all the countries they assessed by the year 2024 (see Fig. IV.35).

Thesis 104: 3D-television is available nationwide in <country>.



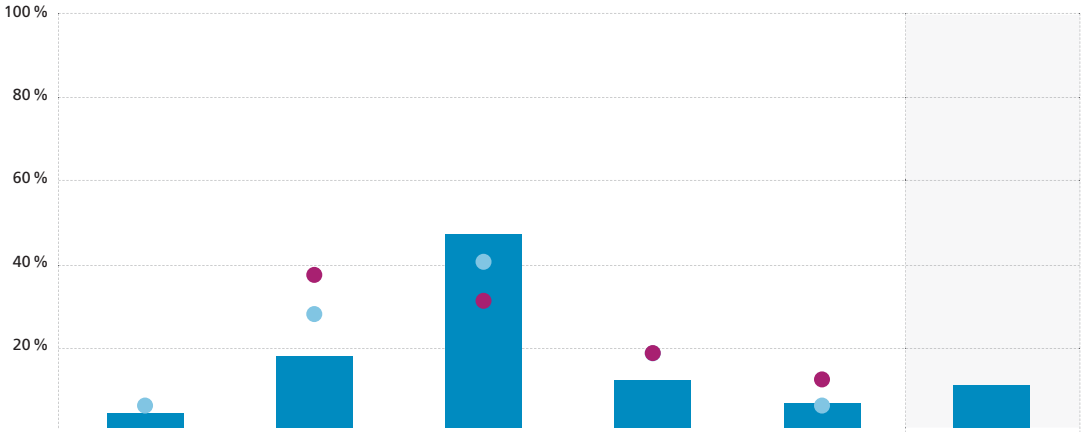
Summary

With IP, HD, on-demand and 3D TV, the outlook for our future television service is highly promising. According to the experts who were interviewed, most German TV programs will be broadcast in HD quality over IP-based DSL broadband networks by 2024 at the latest. The new possibilities offered by DSL broadband networks go hand in hand with the expectation that the majority of the German population will also be using on-demand media and services in place of "traditional" linear viewing in their daily media usage by that date.

Theses on "Television of the future" in detail

Fig. IV.29: Thesis 102 IPTV

Television in <country> is transmitted for the most part via IP-based broadband networks.

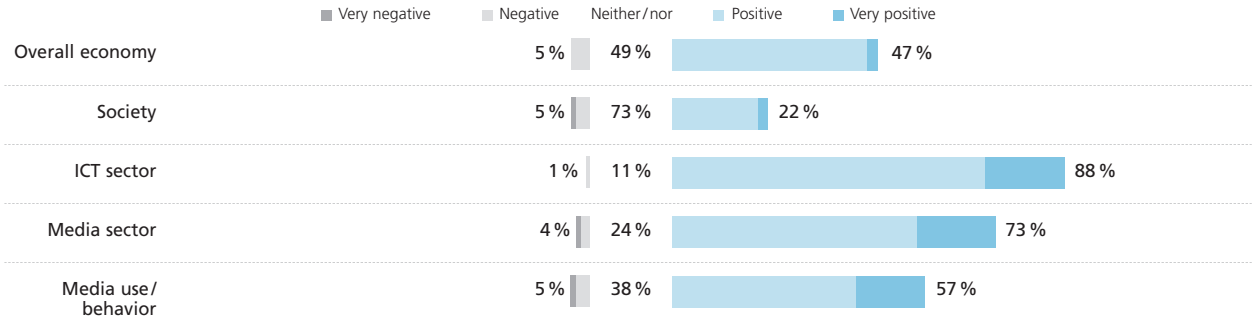


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 89)	4 %	18 %	47 %	12 %	7 %	11 %
EU experts (n = 16) [1]*	0 %	38 %	31 %	19 %	13 %	0 %
DNAdigital (n = 32)	6 %	28 %	41 %	19 %	6 %	0 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.30: Thesis 102 IPTV – relevance

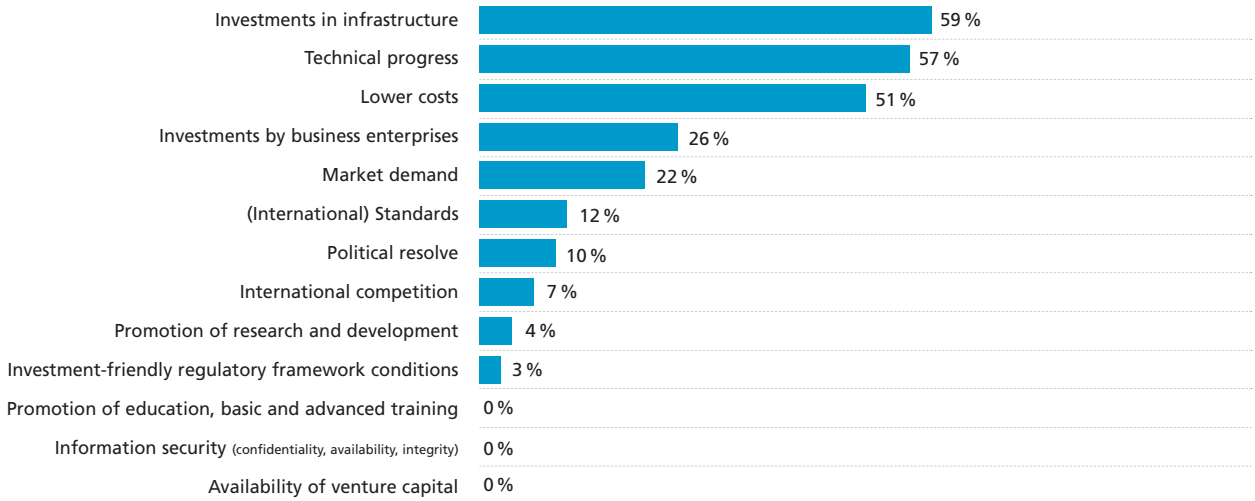
What impact will the validity of Thesis 102 above have on the areas listed below?



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, at least n = 84

Fig. IV.31: Thesis 102 IPTV – drivers

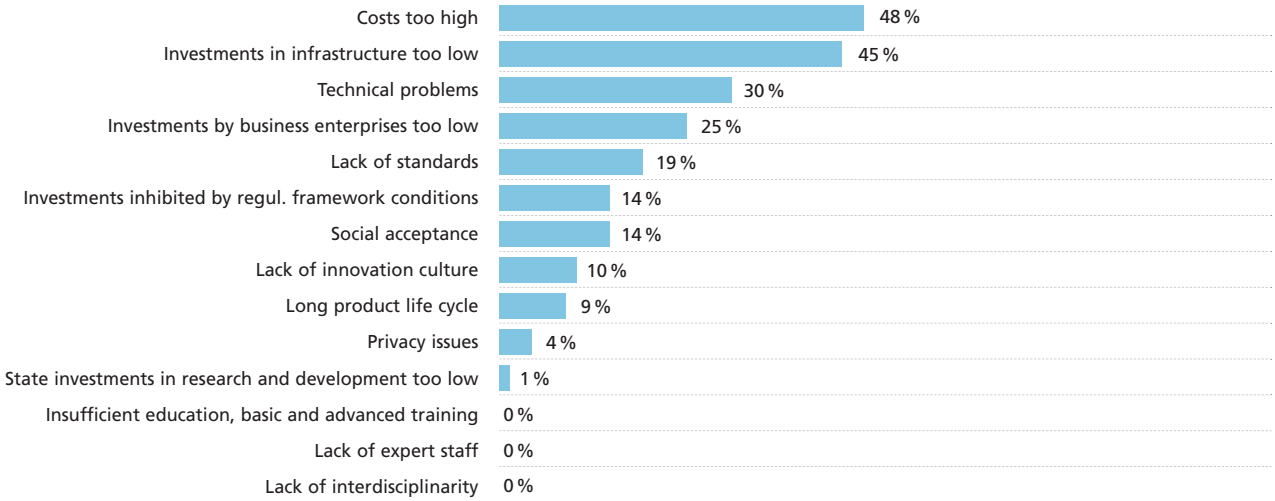
Select up to three drivers from the following list that you consider to be the greatest impediments to realization of Thesis 102 above.



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n = 69

Fig. IV.32: Thesis 102 IPTV – barriers

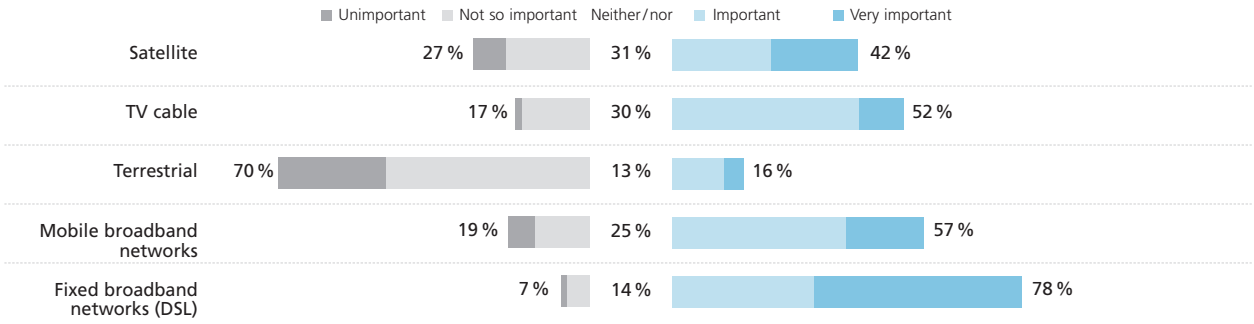
Select up to three barriers from the following list that you consider to be the greatest impediments to realization of Thesis 102 above.



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n = 69

Fig. IV.33: IP-based TV broadcasting channels

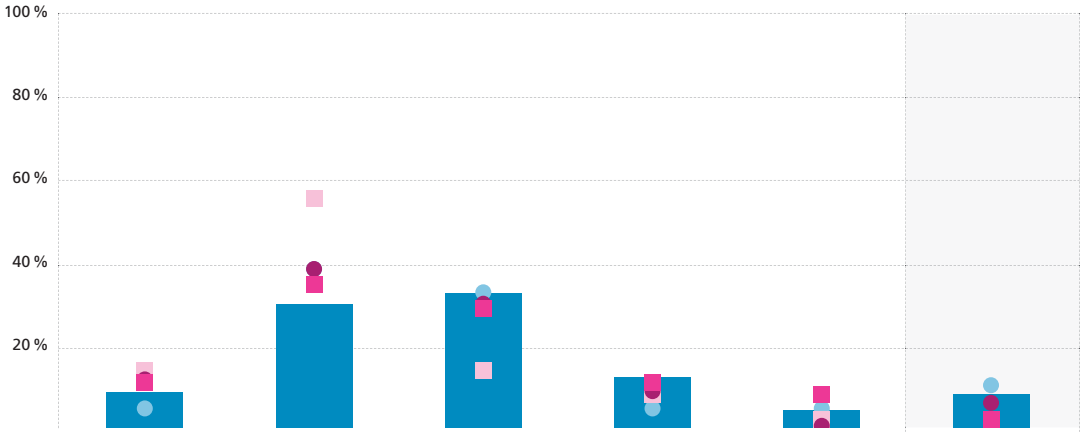
How important will the following IP-based transmission channels (broadcasting) be for the transmission of TV services in Germany from 2020 to 2024?



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, at least n = 67

Fig. IV.34: Thesis 103 On-demand services

More than half the population in <country> use on-demand media and services in their daily media consumption instead of conventional linear television (fixed or scheduled programming).

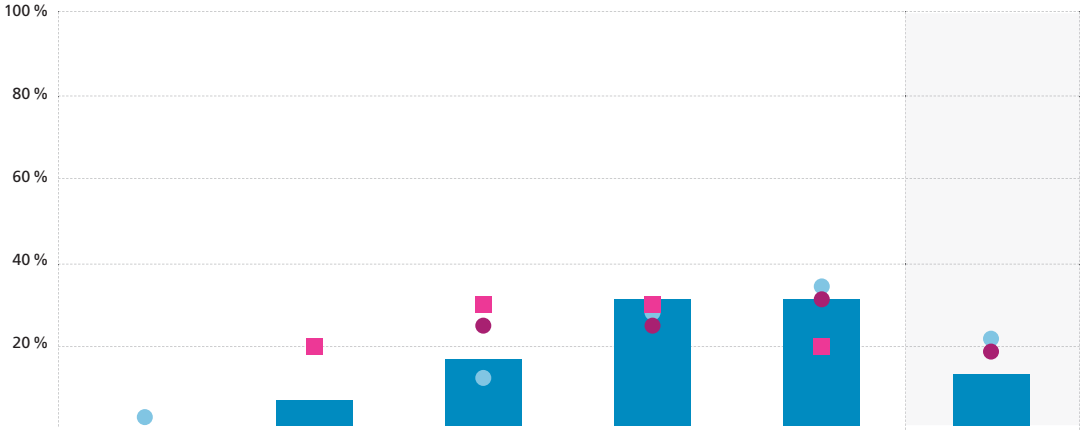


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 371)	9 %	30 %	33 %	13 %	5 %	9 %
EU experts (n = 72) [1]	13 %	39 %	31 %	10 %	1 %	7 %
U.S. experts (n = 34)	15 %	56 %	15 %	9 %	3 %	3 %
Other intern. experts (n = 34) [2]	12 %	35 %	29 %	12 %	9 %	3 %
DNAdigital (n = 36)	6 %	39 %	33 %	6 %	6 %	11 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. IV.35: Thesis 104 3D TV

3D-television is available nationwide in <country>.

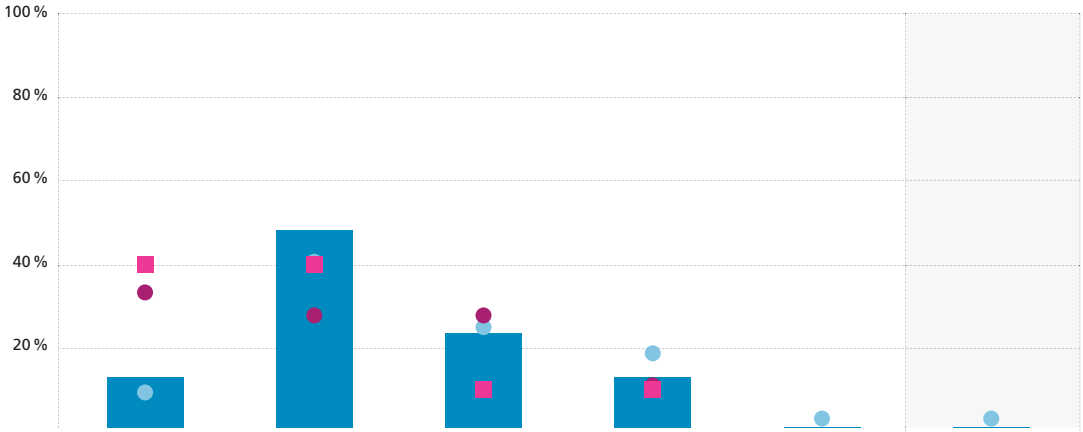


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 83)	0 %	7 %	17 %	31 %	31 %	13 %
EU experts (n = 16) [1*]	0 %	0 %	25 %	25 %	31 %	19 %
Other intern. experts (n = 10) [2*]	0 %	20 %	30 %	30 %	20 %	0 %
DNAdigital (n = 32)	3 %	0 %	13 %	28 %	34 %	22 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, except Germany, Europe and the U.S.; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.36: Thesis 105 HDTV

High-definition television (HDTV) is the standard quality of television transmission in <country>.

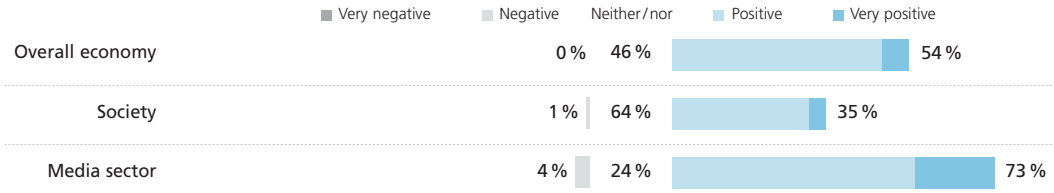


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 85)	13 %	48 %	24 %	13 %	1 %	1 %
EU experts (n = 18) [1]*	33 %	28 %	28 %	11 %	0 %	0 %
Other intern. experts (n = 10) [2]*	40 %	40 %	10 %	10 %	0 %	0 %
DNAdigital (n = 32)	9 %	41 %	25 %	19 %	3 %	3 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, except Germany, Europe and the U.S.; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

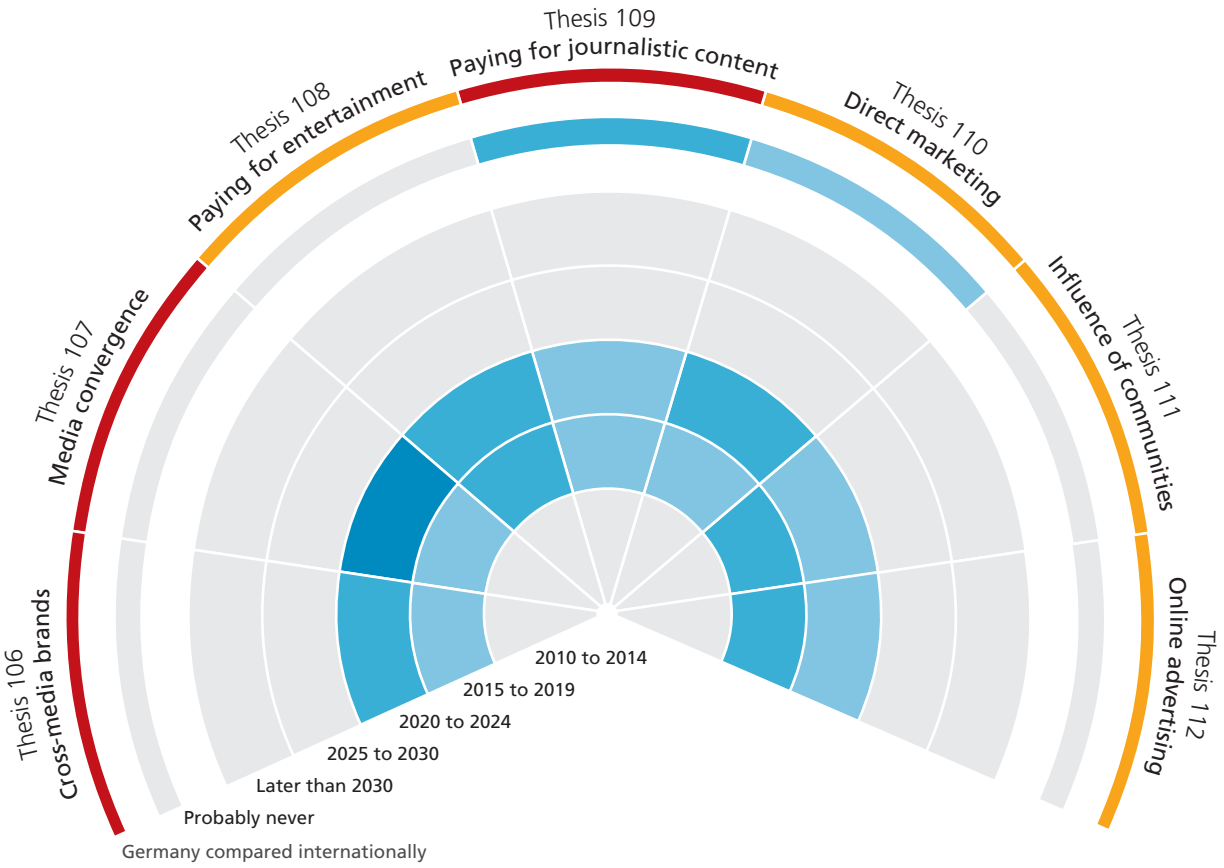
Fig. IV.37: Thesis 105 HDTV – relevance

What impact will the validity of Thesis 105 above have on the areas listed below?



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, at least n = 83

IV.3 (New) media as an economic factor
Future radar*: Forecast occurrences



Sub-group of GER experts: ■ ≥ 40 % of experts ■ 30 % – 39 % of experts ■ 20 % – 29 % of experts ■ < 20 % of experts
Germany in comparison: ■ pioneering role ■ on a par with global developments ■ lagging behind ■ not possible to say

Thesis 106: Cross-media brands

Users in Germany no longer think in terms of media types (e. g., TV, newspaper, magazine, radio, Internet) but rather in terms of cross-format media brands.

Thesis 107: Media convergence

For 75 percent of media users in Germany, it is normal to access the same media content by means of various devices (e. g., newspaper articles on a mobile device, television broadcasts on the PC or Internet content on the television).

Thesis 108: Paying for entertainment on the Internet

For more than half the Internet users in Germany, it is normal to pay for retrieving professionally produced entertainment programs (films, videos, music, etc.) from the Internet.

Thesis 109: Paying for journalistic content on the Internet

For more than half the Internet users in Germany, it is normal to pay for retrieving professionally produced journalistic media content (latest information and background information on various issues) from the Internet.

Thesis 110: Direct marketing

In Germany, direct marketing has become more important than traditional advertising in mass media.

Thesis 111: Influence of Internet communities

In Germany, consumer opinions and experiences of Internet communities and consumer portals have a greater influence on the success of products and brands than traditional advertising.

Thesis 112: Online advertising

Online advertising leads to greater sales in Germany than traditional advertising formats (television, radio and print advertising).

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

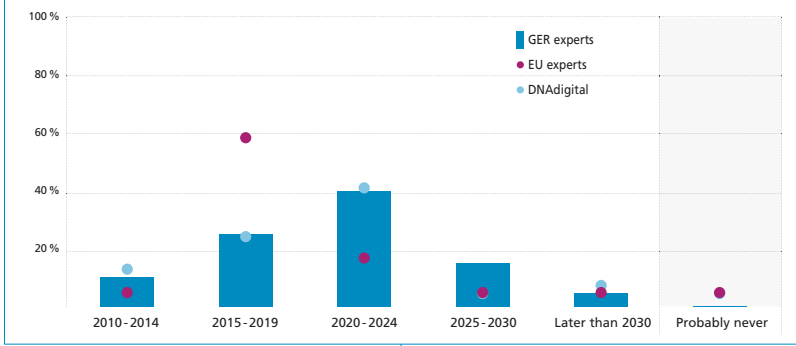
Core results

Content over all channels

Virtually two thirds of the experts for Germany (comparable with all other experts) assume that, in 15 years from now at the latest, users will tend to think not in media categories such as newspapers, TV or the Internet but will opt for preferred media brands - irrespective of the channel used to deliver them (see Fig. IV.38).

An even higher percentage, namely 77 percent of the GER experts, agree with the thesis that it will be standard practice in the next 15 years for most of the population to access the same content via different media (see Fig. IV.41). The experts for Europe beg to differ, with 65 percent of them believing that content will already be used across different media in ten years' time.

Thesis 107: For 75 percent of media users in <country>, it is normal to access the same media content by means of various devices (e.g., newspaper articles on a mobile device, television broadcasts on the PC or Internet content on the television).



Users will make use of the various possibilities offered by the different channels, with varying intensity and in line with their situation at any given time, and will not demand to be provided with the same content to the same degree through all these channels at all times. Unlike the soccer fans of 30 years ago, for instance, today's fans are no longer solely reliant on Saturday afternoon radio broadcasts and the 6:00 p.m. TV sports program. Both are still available, but fans have simultaneous access to live broadcasts on pay TV channels, info pages and live tickers on the Internet, texts sent to their cell phones, videotext on TV, etc. And, like 30 years ago, they can follow all this up by reading "Bild am Sonntag" on Sunday and the "kicker" sports magazine and their daily newspapers on Monday morning.

Cross-media brands are not actually new at all. A strong media brand will always play a vital orientation role within a fast expanding media offering. Media companies already provide a comprehensive range of content over all communication channels, a step that can keep users loyal to the overlying media brand on the basis of individual brand strength. Print brands as well as TV programs and channels have their equivalents on the Internet or publish in the other medium, offer faxes on demand and info services, or try their hands at completely new fields such as book publishing.

These measures serve to boost customer loyalty, generate additional revenue and thus build brand strength.

Users expect "their" brands to offer a universal look & feel and content concept irrespective of the specific medium used yet to include an individual media-specific experience. If a product has XYZ on the cover, then it must have XYZ inside! This also gives brands from other sectors the opportunity for greater dissemination, if they succeed in transferring consistently onto all channels. The best example in this field is Apple, which has already struck out successfully into music, TV and mobile communication.

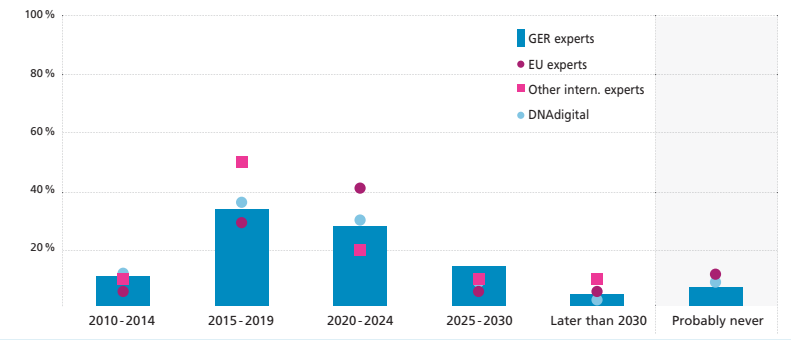
Is the ideal solution for media brands to be cross-media all-rounders? Can they automatically transform users of the original product into users of the new services in other media categories? This is still obstructed by the media preferences of users themselves. It will undoubtedly be vital to grow brand strength in the media sector in order to differentiate from competitors, especially in times like these when the range of available content and possibilities continues to grow apace. A strong brand will continue to play an important role in orientation. Potential customers will not, however, commit themselves to a single provider or brand for different offers and content but will opt to use different providers in line with their specific needs and situations.

Paid content – cautious optimism

The experts consider today's users to be fairly hesitant in their readiness to pay for content from the Internet. A good third of the experts for Germany predicts that Internet users are not likely to show willingness to pay for professional entertainment offers from the Net for ten years to come. Another third does not see this readiness to pay materializing until the period commencing in 2020 (see Fig. IV.42). And yet experts' prognoses on the prospects for professional entertainment offers are still slightly more optimistic than they are for professional journalistic content on the Internet. In this case, around one quarter of the experts for Germany forecast that users will be willing to pay in the periods quoted. Another 36 percent of the experts for Germany reckon that Internet users will never be willing to pay for journalistic content (see Fig. IV.43).

However, one astounding finding in this segment is that only 17 percent of the DNAdigital group share this opinion. This possibly reflects the enhanced "digital" experiences of this group of experts, who have already passed the stage of the "free" Internet and have learned that quality is an asset and therefore has its price no matter which medium is used to access it, and also expect this learning curve to apply to other groups.

Thesis 112: Online advertising leads to greater sales in <country> than traditional advertising formats (television, radio and print advertising).



The iTunes services, movie downloads from the Net and purchasing books/e-books and DVDs through Amazon are bound to have played a key role in developing willingness among users to pay for professionally created entertainment. Things look slightly different when it comes to journalistic content. Newspapers, magazines and the public broadcasters all offer Internet sites with sophisticated content they have produced at great cost to users free of charge. This is something users now take for granted. Getting people to re-think on this issue is likely to be very difficult, above all in the case of B2C content, where "old" and "new" media aim to fill the two platforms with the same content. The solution could lie in a division of labor between the "old" and "new" media along with the possibilities offered by "electronic paper." The Internet offers quick, short and topical information – free of charge. The printed medium offers an analysis of this information – at a price. This content is naturally also available on the Internet, which in this case merely functions as a data source. Various revenue models for downloading individual articles or complete newspapers and magazines are possible here.

Online ads bound for success?

In order to earn money on and with the Internet, online advertising is often the only viable business model if users are not willing to pay for content and services. The experts are convinced that this advertising format is destined for success. Only seven percent of the GER experts (with a similar proportion among the other experts) are of the opinion that the online advertising market will never be able to outdo the conventional advertising market in terms of revenue.

For as many as 45 percent of the GER experts online advertising will already have outstripped conventional advertising revenues in ten years' time (see Fig. IV.46). A comparison between online advertising revenues in Germany and overall market advertising revenues produces a ratio of below 1:10, which should definitely prompt a re-think.

Another of the experts' prognoses is also very exciting, namely the one relating to online advertising. The status of direct marketing tends to be viewed by the experts with skepticism. In this field, 21 percent of the experts for Germany claim that expenditure on direct marketing will never exceed the money spent on advertising in the mass media (see Fig. IV.44). Among the experts for Europe, as many as 33 percent support this estimate. Not quite a quarter of the experts for Germany and Europe see the importance of direct marketing surpassing advertising revenues generated in the mass media over the next ten years.

The strengths of online advertising indisputably lie in its direct, personalized contact with potential consumers. Advertising that is designed to quickly generate recognition features and boost brand image will need to make use of the mass media. However, we must remember that these theses were evaluated at a time when traditional advertising had suffered heavy losses due to the economic crisis (up to 30 percent in the first six months of 2009 in some European countries) but, in contrast, online advertising had experienced major growth (see Media Guide 2009).

Since then, the advertising markets have recovered slightly but it remains to be seen how they will develop in the future. The experts' forecast for the development of the advertising budget is highly optimistic overall. For example, despite the fact that they predicted a slight decline (minus one percent) for 2010, they still anticipate that advertising budgets will grow by 15 percent over the next six years, and by as much as 25 percent in the next eleven years (see Fig. IV.48).

In times of a thriving economy, the proportion of new advertising investments lay at one percent of the gross

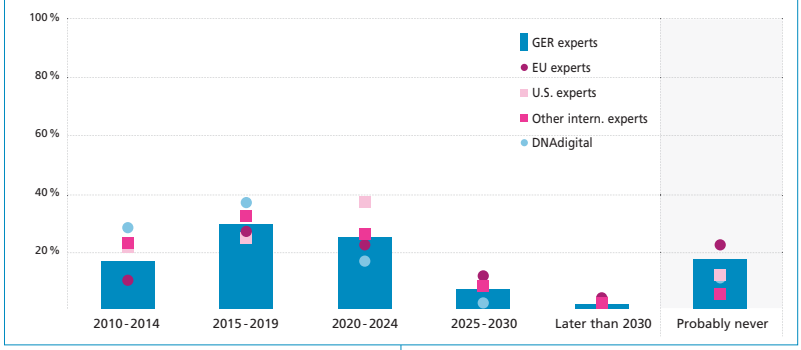
domestic product (GDP). Then, in 2008, it fell to 0.5 percent. If the Delphi forecast is fulfilled, the percentage would be approximately 0.7 percent, with GDP remaining unchanged. In this context, the forecast dominance of online advertising calls for more detailed analysis. In absolute terms, advertising expenditure would then rise by approximately EUR 3.2 billion over the next eleven years – and do so mainly as a result of increased spending on online advertising.

There is no doubting the fact that advertising on the Internet will retain its importance in the future. At the same time, companies should not neglect one specific advertising format that costs them nothing at all: the recommendations and empirical reports published in Internet forums and communities.

The power of Internet consumers

Virtually half the experts for Germany expect that consumer opinion will exert a greater impact on product success by the end of the coming decade at the latest. According to the experts, this influence will even exceed the role played by traditional advertising (see Fig. IV.45).

Thesis 111: In <country>, consumer opinions and experiences of Internet communities and consumer portals have a greater influence on the success of products and brands than traditional advertising.



Traditional advertising in the mass media is certain to be indispensable for the recognition of products, as well as brand building and maintenance. This is the only way to achieve a broad impact within a defined period in a systematic and controlled manner. Internet advertising can, in contrast, make direct contact with individuals and enable direct feedback.

The Internet gives consumers new opportunities for influencing product success. By making a decision to buy or not to buy, consumers have always had an impact on this success. In addition, the image of products has always been defined to some extent by mouth-to-mouth propaganda.

The Internet both simplifies and multiplies this traditional interpersonal communication channel, offering portals where products and services ranging from cars and toothpaste to hotels or doctors can be evaluated.

In a best-case scenario, this communication channel will help to boost product success. Viral marketing is one solution for this phenomenon. Campaign contents are positioned in relevant communities, forums, etc. The network structures are then used to communicate and multiply the content, with the possibility of the process being specifically controlled from outside. This procedure is not without hazards if "real" members of the communities discover that they have been "infiltrated." This type of communication could then soon turn into a boomerang.

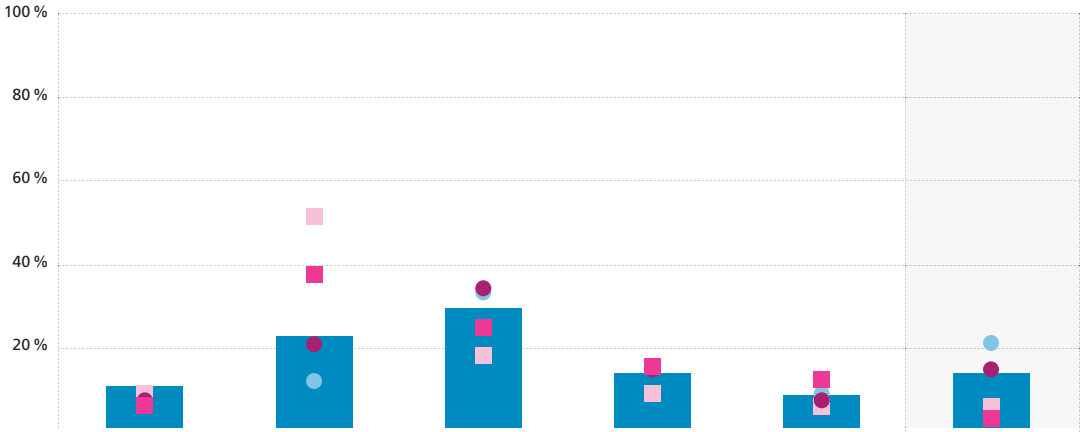
On the other hand, consumer opinion expressed on such sites can be beneficial for the advertiser even if possibly initially painful. A lot can be learned from recipients' reactions in order to optimize products, offers and advertising campaigns. This also offers the opportunity to integrate consumers in certain processes and thus bond them more strongly with the brand.

However, this will only function if consumers are taken seriously and if Internet interaction options are not merely viewed as a quick order channel.

Theses on "(New) media as an economic factor" in detail

Fig. IV.38: Thesis 106 Cross-media brands

Users in <country> no longer think in terms of media types (e. g., TV, newspaper, magazine, radio, Internet) but rather in terms of cross-format media brands.

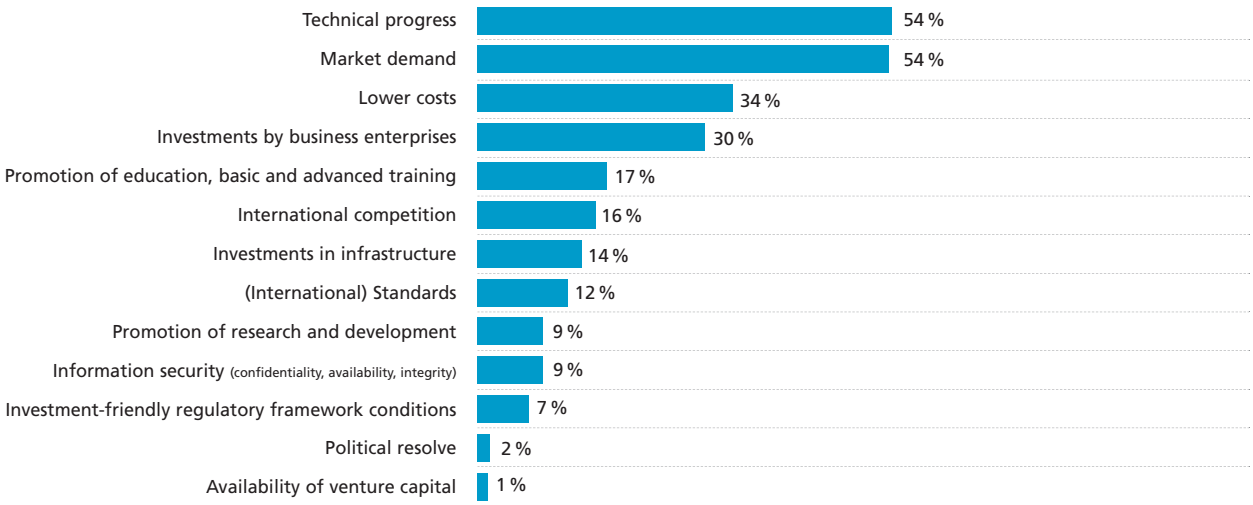


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 351)	11 %	23 %	30 %	14 %	9 %	14 %
EU experts (n = 67) [1]	7 %	21 %	34 %	15 %	7 %	15 %
U.S. experts (n = 33)	9 %	52 %	18 %	9 %	6 %	6 %
Other intern. experts (n = 32) [2]	6 %	38 %	25 %	16 %	13 %	3 %
DNAdigital (n = 33)	9 %	12 %	33 %	15 %	9 %	21 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. IV.39: Thesis 106 Cross-media brands – drivers

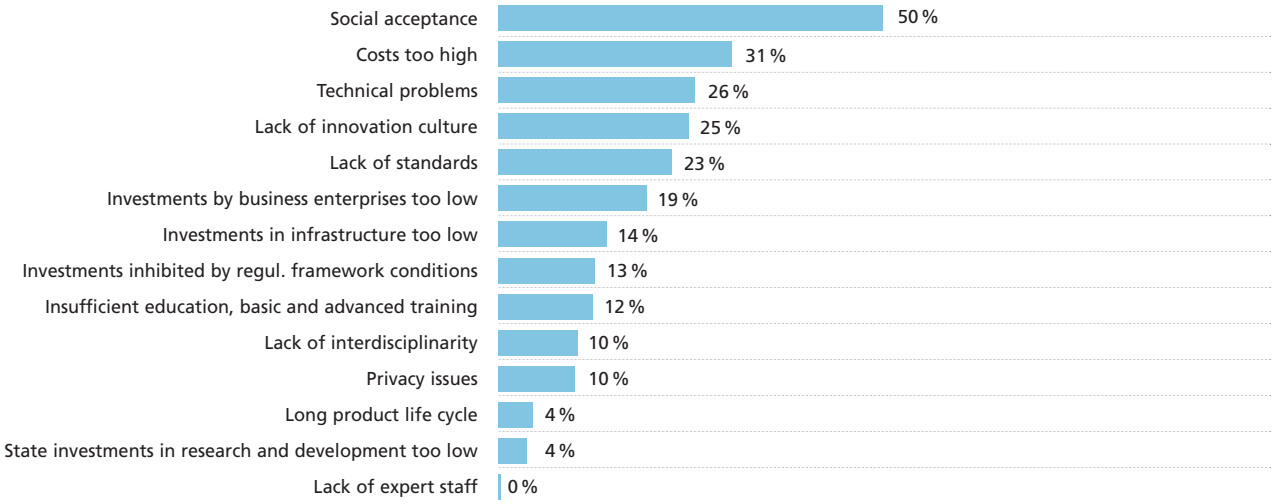
Select up to three drivers from the following list that you consider to be most important for realization of Thesis 106 above.



Basis: All people surveyed; Sub-group: GER experts, n = 274

Fig. IV.40: Thesis 106 Cross-media brands – barriers

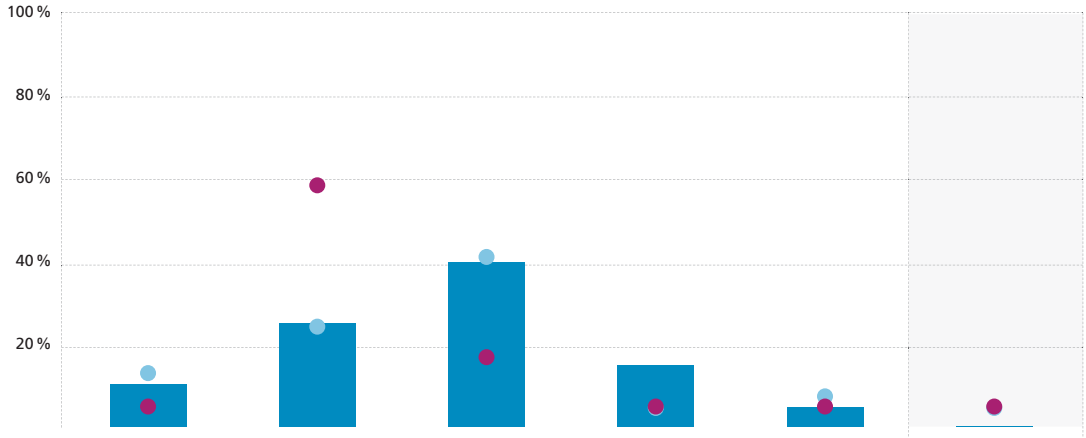
Select up to three barriers from the following list that you consider to be most important for realization of Thesis 106 above.



Basis: All people surveyed; Sub-group: GER experts, n = 268

Fig. IV.41: Thesis 107 Media convergence

For 75 percent of media users in <country>, it is normal to access the same media content by means of various devices (e. g., newspaper articles on a mobile device, television broadcasts on the PC or Internet content on the television).

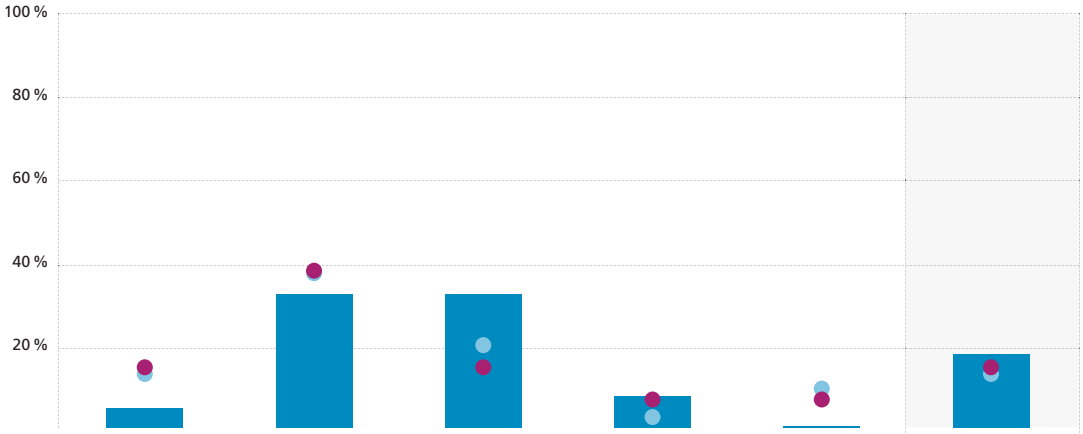


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 89)	11 %	26 %	40 %	16 %	6 %	1 %
EU experts (n = 17) [1]*	6 %	59 %	18 %	6 %	6 %	6 %
DNAdigital (n = 36)	14 %	25 %	42 %	6 %	8 %	6 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.42: Thesis 108 Paying for entertainment on the Internet

For more than half the Internet users in <country>, it is normal to pay for retrieving professionally produced entertainment programs (films, videos, music, etc.) from the Internet.

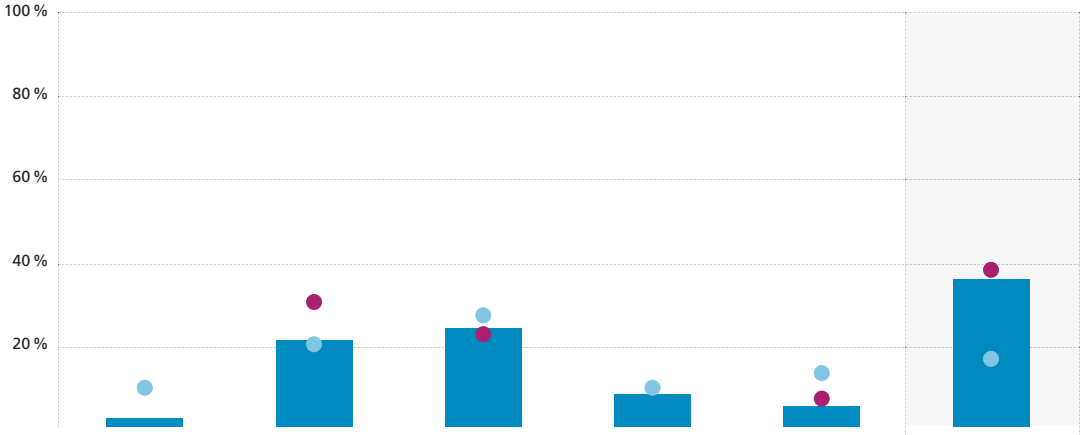


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 70)	6 %	33 %	33 %	9 %	1 %	19 %
EU experts (n = 13) [1]*	15 %	38 %	15 %	8 %	8 %	15 %
DNAdigital (n = 29)	14 %	38 %	21 %	3 %	10 %	14 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.43: Thesis 109 Paying for journalistic content on the Internet

For more than half the Internet users in <country>, it is normal to pay for retrieving professionally produced journalistic media content (latest information and background information on various issues) from the Internet.

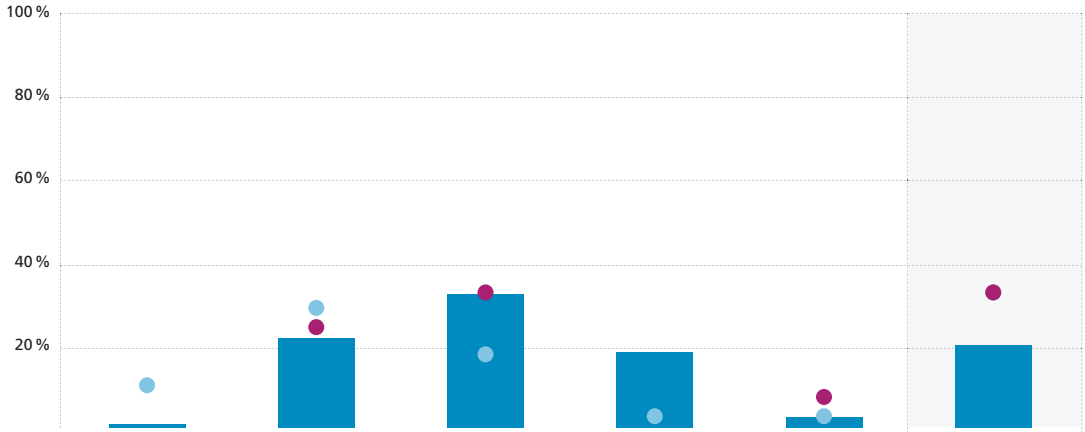


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 69)	3 %	22 %	25 %	9 %	6 %	36 %
EU experts (n = 13) [1]*	0 %	31 %	23 %	0 %	8 %	38 %
DNAdigital (n = 29)	10 %	21 %	28 %	10 %	14 %	17 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.44: Thesis 110 Direct marketing

In <country>, direct marketing has become more important than traditional advertising in mass media.

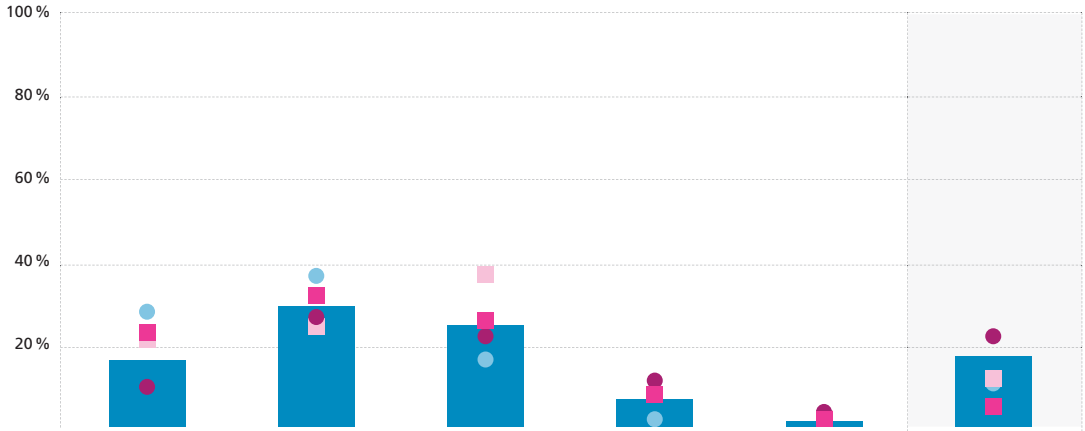


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 58)	2 %	22 %	33 %	19 %	3 %	21 %
EU experts (n = 12) [1]*	0 %	25 %	33 %	0 %	8 %	33 %
DNAdigital (n = 27)	11 %	30 %	19 %	4 %	4 %	33 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.45: Thesis 111 Influence of Internet communities

In <country>, consumer opinions and experiences of Internet communities and consumer portals have a greater influence on the success of products and brands than traditional advertising.

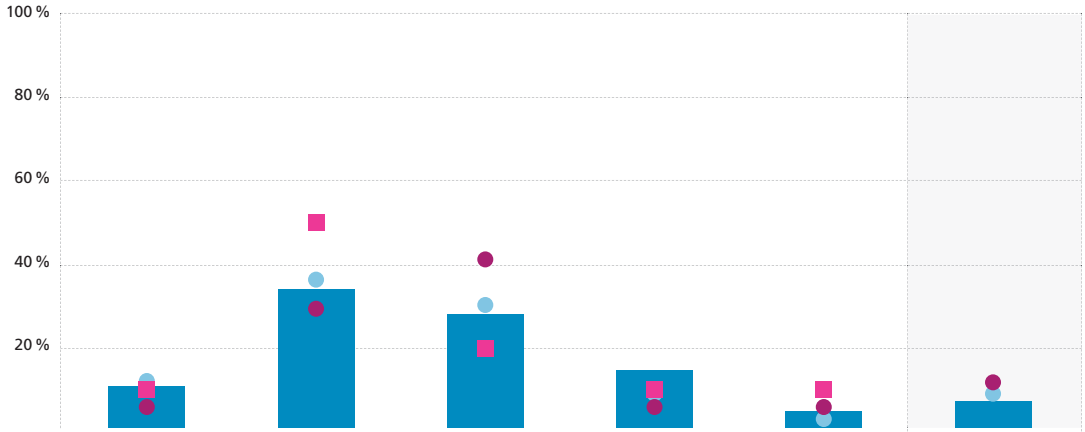


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 365)	17 %	30 %	25 %	8 %	2 %	18 %
EU experts (n = 66) [1]	11 %	27 %	23 %	12 %	5 %	23 %
U.S. experts (n = 32)	22 %	25 %	38 %	0 %	3 %	13 %
Other intern. experts (n = 34) [2]	24 %	32 %	26 %	9 %	3 %	6 %
DNAdigital (n = 35)	29 %	37 %	17 %	3 %	3 %	11 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. IV.46: Thesis 112 Online advertising

Online advertising leads to greater sales in <country> than traditional advertising formats (television, radio and print advertising).

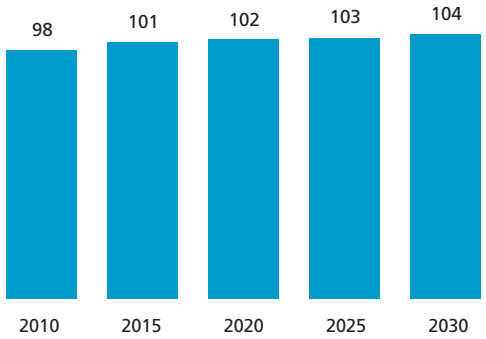


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 82)	11 %	34 %	28 %	15 %	5 %	7 %
EU experts (n = 17) [1]*	6 %	29 %	41 %	6 %	6 %	12 %
Other intern. experts (n = 10) [2]*	10 %	50 %	20 %	10 %	10 %	0 %
DNAdigital (n = 33)	12 %	36 %	30 %	9 %	3 %	9 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, except Germany, Europe and the U.S.; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.47: Development of media budgets

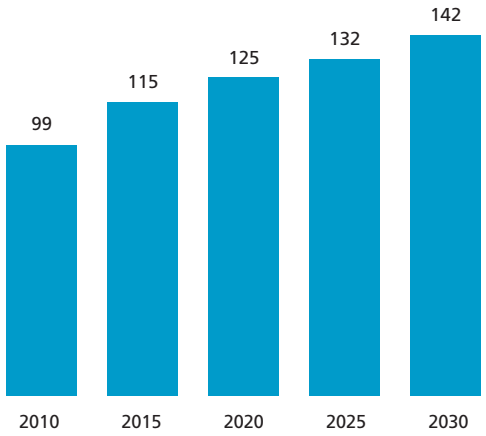
Focusing on Germany: Disregarding inflation, how will average private spending on media (e.g. newspapers, magazines, TV) develop in relation to today's levels in the given years (today – 2009 – equals an index of 100):



The mean value is shown
Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, at least n=21

Fig. IV.48: Development of advertising budgets

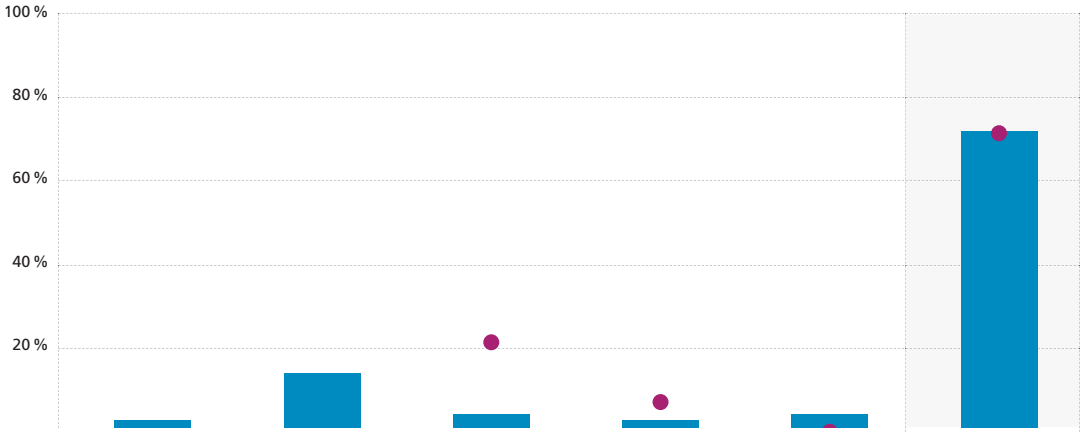
Focusing on Germany: How will the total capacity of available advertising budgets change in relation to today in the given years (today – 2009 – equals an index of 100):



The mean value is shown
Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, at least n=51

Fig. IV.49: Thesis on global regulation

Global regulation has led to the elimination and prevention of monopolistic structures in Internet services.

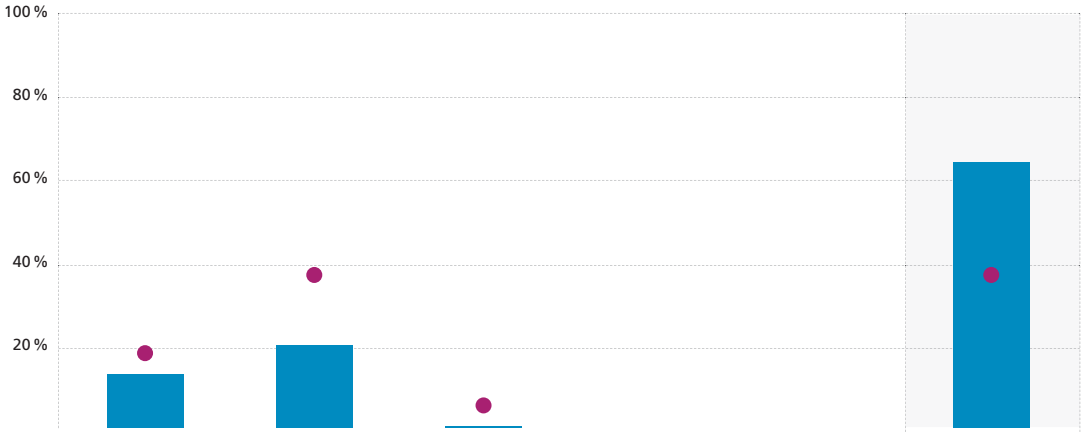


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 71)	3 %	14 %	4 %	3 %	4 %	72 %
EU experts (n = 14) [1]*	0 %	0 %	21 %	7 %	0 %	71 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.50: Thesis on data privacy regulations

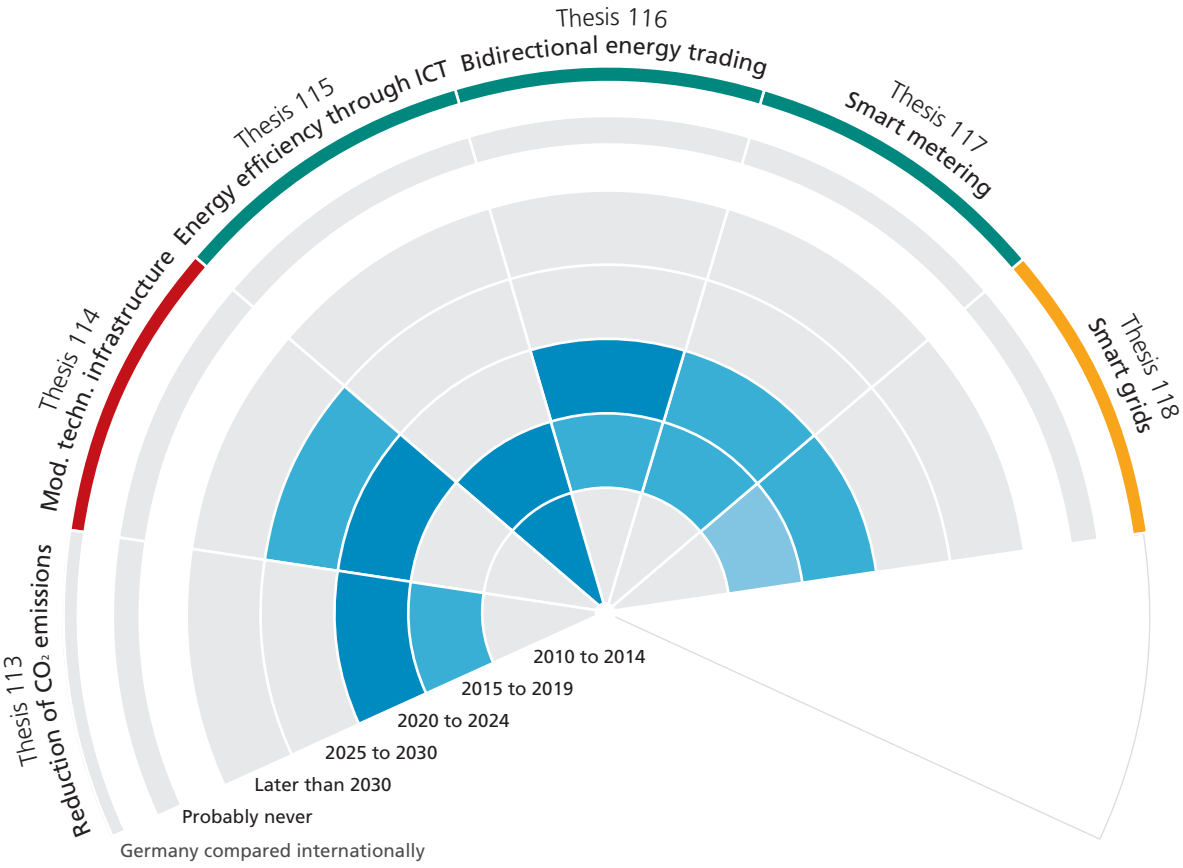
Regulations governing data protection no longer allow the business of personalized advertising to be conducted in a successful way.



	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 73)	14 %	21 %	1 %	0 %	0 %	64 %
EU experts (n = 16) [1]*	19 %	38 %	6 %	0 %	0 %	38 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

IV.4.1 E-energy
Future radar*: Forecast occurrences



Sub-group of GER experts: ■ ≥ 40 % of experts ■ 30 % – 39 % of experts ■ 20 % – 29 % of experts ■ < 20 % of experts
Germany in comparison: ■ pioneering role ■ on a par with global developments ■ lagging behind ■ not possible to say

Thesis 113: Reduction of CO_2 emissions

By using ICT in diverse application industries (traffic, telematics, energy, house building, etc.), CO_2 emission have been reduced by a further 15 percent worldwide.

Thesis 114: Modern technical infrastructure

Social awareness of the importance of sustainable use of energy resources led to a holistic, nationwide modernization of the technical infrastructure, devices and services in Germany.

Thesis 115: Energy efficiency through ICT

In Germany, ICT infrastructures in energy supply are indispensible for ensuring energy efficiency and reliable supply security.

Thesis 116: Bidirectional energy trading

In Germany, households and companies appear on electronic energy marketplaces both as suppliers and consumers of energy and trade energy bi-directionally and in real time.

Thesis 117: Smart metering

In Germany, smart meters (modern energy meters) are used in households nationwide.

Thesis 118: Smart grids

In Germany, household appliances (e. g., washing machines) are integrated into intelligent supply networks ("smart grids") and are controlled by them with energy efficiency.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

E-energy – ICT enables energy efficiency and sustainability

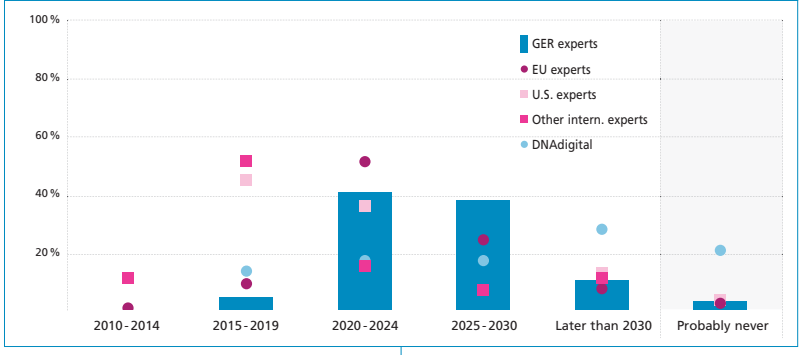
Climate change, the increasing global demand for energy and rising energy costs are raising public awareness for issues such as efficient energy usage and reliable energy supplies. Under the issues known as e-energy and green IT concepts are being discussed which are based on information and communication technologies and which help to promote the efficient, resource-saving and environmentally friendly use of energy.

In stark contrast with other industries, the energy sector has made little use of innovative ICT concepts and technologies so far. However, ICT will be indispensable in effectively integrating renewable and sustainable energy sources (e. g., wind, sun, combined heat and power), which will be far more widely used than at present, in the energy system in future. On the technology side, this will mean integrating numerous decentralized electricity producers and balancing the weather-dependent, intermittent feed into the electricity grid. The solution to these technology challenges will involve a stronger link between energy generation and the consumption sectors for electricity, heat and transport. This itself necessitates innovative ICT platforms, for example in smart grids and electromobility scenarios. Also, in view of future challenges in the field of energy, we can expect the significance of ICT for the energy industry, the economy and for society as a whole to grow.

Intelligent networking can be used to enable individual components of the energy system (e. g., households, industrial consumers, diverse energy producing and energy storage systems, and the electricity grid) to communicate with each other and to exchange information on statuses and requirements (the "Energy Internet"). The resulting innovative grid management concepts make it possible to greatly improve harmonization between what were formerly passive or isolated components. This translates into major efficiency advantages (e. g., with regard to energy balance and utilization of grid capacities).

In this way, ICT can play a vital role in reaching the fundamental energy goals of cost-effectiveness, reliable supplies and climate friendliness.

Thesis 114: Social awareness of the importance of sustainable use of energy resources led to a holistic, nationwide modernization of the technical infrastructure, devices and services in <country>.



ICT must do more than simply guarantee reliable energy supplies: it must also help to reduce harm to the climate and increase energy efficiency

The experts for Germany and Europe are unanimous in their opinion that ICT infrastructures will be indispensable in energy provisioning within the next ten years, i. e., by the year 2019, in guaranteeing energy efficiency and a reliable supply of energy - this is the prognosis submitted by 86 percent of the GER experts interviewed and 77 percent of the experts for Europe (see Fig. IV.53).

Nonetheless, 79 percent of the GER experts do not expect full modernization of the entire technical infrastructure, appliances and services to be implementable until the period between 2020 and 2030 (see Fig. IV.52).

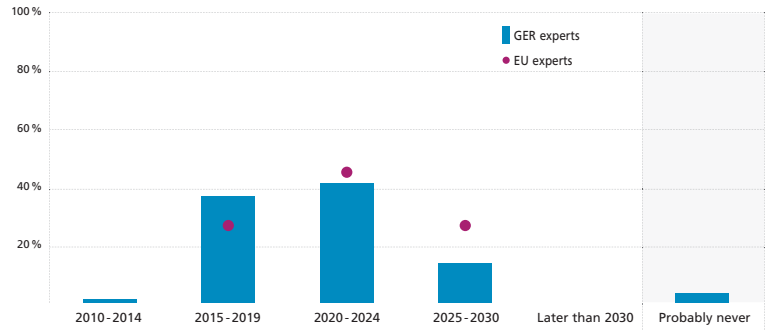
The conflict between identified necessity and anticipated feasibility is likely to generate a dynamic and productive political and economic process. The study reveals interesting differences between the expert groups with regard to prospective implementation schedules.

Experts for the U.S. and other international countries are more confident about the speed of modernization

The U.S. experts and experts for the countries outside Europe expect comprehensive modernization of the energy system in their countries to take place between 2015 and 2024, i. e., within the next six to 15 years (see Fig. IV.52). In contrast, the experts for Germany are more cautious with their prognosis, the majority of them anticipating that this change will take between eleven and 21 years from now, in other words not until between 2020 and 2030. One very interesting aspect is that the experts from the DNAdigital group submit a far more cautious prognosis. 21 percent of this group actually think that full modernization is never likely to occur. The diverging assessment submitted by this group is probably accounted for by the technical problems involved in modernization and the potential conflict of interests among the parties involved. The diverging views may, however, also be due to varying expectations among people surveyed as to the extent to which modernization will take place and the technologies

that will be used in the process. Another assumption that can be made is that the optimistic forecasts of the U.S. experts are to be seen in conjunction with the recent energy initiatives launched by the Obama administration. It is also probable that the urgent need to modernize the aging U.S. electricity grid with its inadequate coverage played an equally important role in the assessment. This problem is likely to be exacerbated by the increasing incorporation of fluctuating energy feed-in. Furthermore, the relative rise in energy prices in the U.S. is likely to be higher than in Germany and Europe due to the present (still) low price level, and will put increasing pressure on the government.

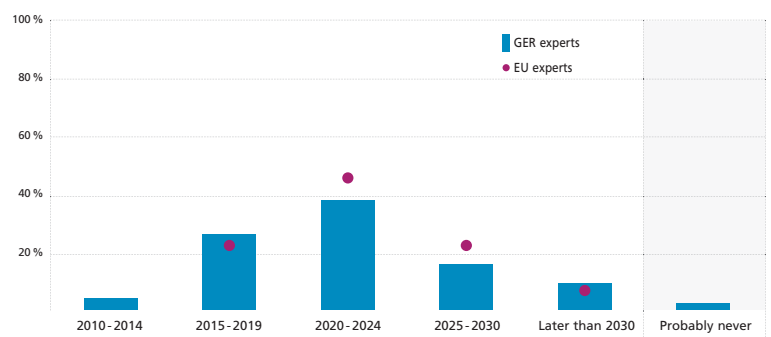
Thesis 113: By using ICT in diverse application industries (traffic, telematics, energy, house building, etc.), CO_2 emission have been reduced by a further 15 percent worldwide.



Household appliances will be integrated in smart grids and will be in use along with smart meters nationwide in six to 15 years

One vital component of comprehensive modernization measures for energy infrastructures is to integrate household appliances in intelligent power supply networks known as smart grids and to ensure their energy-efficient management. Two thirds of the experts for Germany expect to see household appliances being integrated and managed in six to 15 years' time (see Fig. IV.57). Another important element in this context are smart meters. Nationwide coverage with these meters is also expected in the next six to 15 years by as many as 76 percent of experts surveyed (see Fig. IV.56). This is surprising in view of the legal regulations (smart meters will be compulsory in new buildings from the beginning of 2010 and, from the end of 2010, power utilities will be obliged to offer rates based on network load and time of day). The German Ministry of Economics and Technology (BMWi), for example, anticipates a transition period of "only" six years.

Thesis 118: In <country>, household appliances (e.g., washing machines) are integrated into intelligent supply networks ("smart grids") and are controlled by them with energy efficiency.



Experts draw similar conclusions with regard to the potential for using ICT in different sectors, e.g., traffic, telematics, energy and housing investment, in terms of CO_2 emission reduction (see Fig. IV.51). As many as 80 percent of the GER experts estimate that ICT can be expected to reduce CO_2 emissions by 15 percent (e.g., with smart grids, vehicle to grid, electronic energy marketplaces) within the next six to 15 years; likewise, most of the experts for other European countries expect this to become reality during the same period (72 percent).

Vital need to push modernization of the energy infrastructure and research into green energy technologies

For the German government to reach its ambitious goals, it would be desirable for modernization of the infrastructure, appliances and services to occur earlier than the period quoted by the GER experts as the next six to 15 years. The experts are virtually unanimous in their opinion that ICT offers great potential for modernizing the energy infrastructure, in that it guarantees the requisite energy efficiency and reliable energy supplies. Politics and the economy are both called on to play a part in backing modernization of the energy infrastructure and to conduct further research into green energy technologies.

On the legislative side, modernization could be accelerated by installing appropriate regulatory framework conditions and investing specifically in research and development. In addition, politics needs to initiate further projects along the lines of the German Ministry of Economics and Technology's (BMWi) e-Energy initiative, e-Mobility (BMWi and the Federal Ministry for the Environment, Nature Conservation

and Nuclear Safety), and the National Development Plan on Electromobility (Federal Ministry of Transport, Building and Urban Development).

Such projects not only offer major charisma but also support intensive practice-based research into green energy technologies in Germany. These technologies have the potential to develop into a major branch of the economy and to become a vital future growth driver. Investments in this sector would therefore appear appropriate, from a climatic as well as an economic viewpoint.

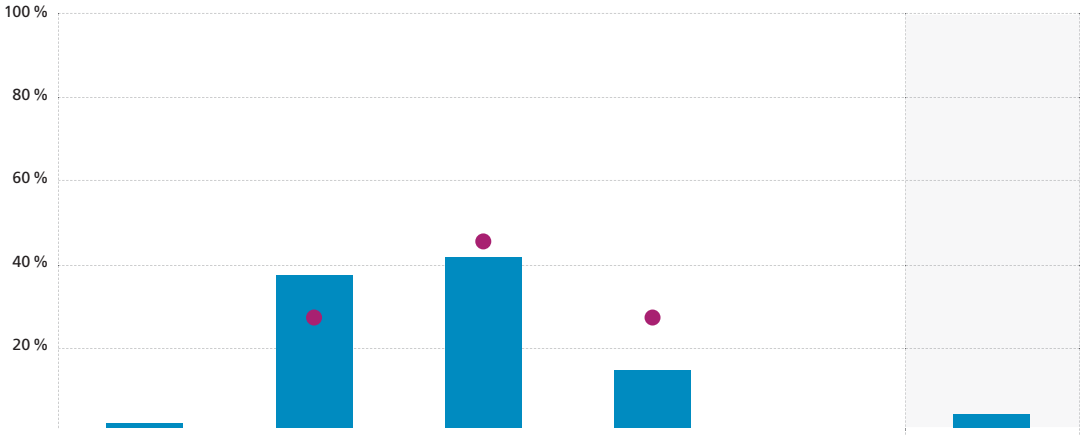
The economy now also faces the need for major action. It is called upon to develop without delay cross-industry e-energy standards that are also accepted at international level. Standards such as those published in the IEC 61850 series would play a significant role in this market environment in ensuring that modernization moves ahead quickly and that the market can develop positively.

Business enterprises would profit from this step themselves, since varying corporate interests and the large number of market players bear the inherent risk of a cost- and time-intensive "standards war," or even standstill as the result of unresolved compatibility issues.

Theses on "E-energy" in detail

Fig. IV.51: Thesis 113 Reduction of CO_2 emissions

By using ICT in diverse application industries (traffic, telematics, energy, house building, etc.), CO_2 emission have been reduced by a further 15 percent worldwide.

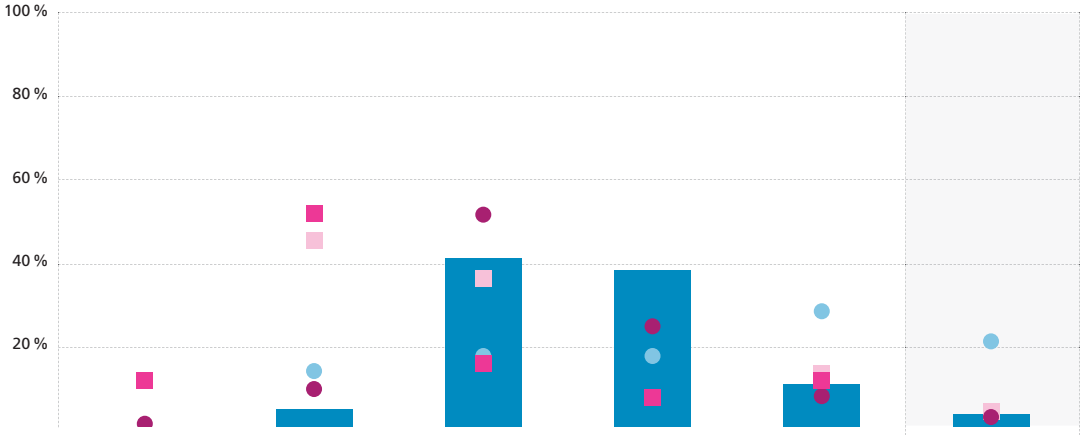


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 48)	2 %	38 %	42 %	15 %	0 %	4 %
EU experts (n = 11) [1]*	0 %	27 %	45 %	27 %	0 %	0 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.52: Thesis 114 Modern technical infrastructure

Social awareness of the importance of sustainable use of energy resources led to a holistic, nationwide modernization of the technical infrastructure, devices and services in <country>.

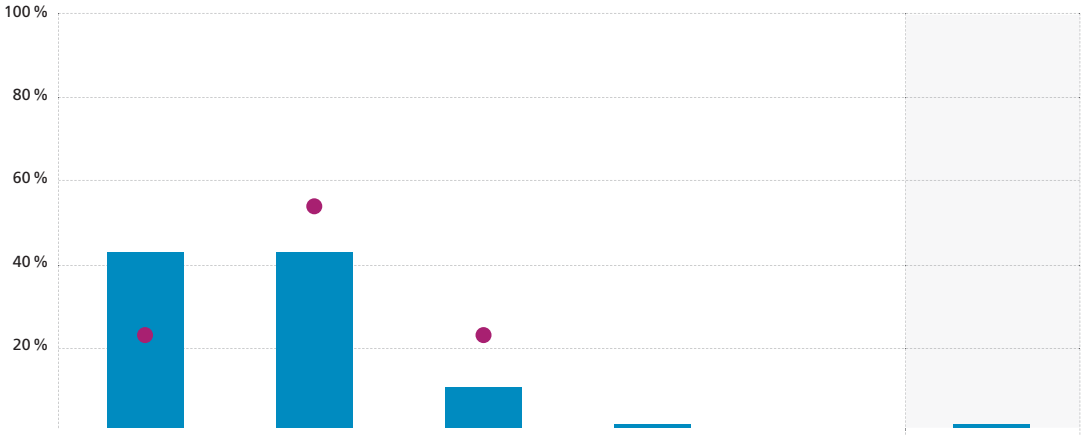


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 286)	0 %	5 %	41 %	38 %	11 %	4 %
EU experts (n = 60) [1]	2 %	10 %	52 %	25 %	8 %	3 %
U.S. experts (n = 22)	0 %	45 %	36 %	0 %	14 %	5 %
Other intern. experts (n = 25) [2]	12 %	52 %	16 %	8 %	12 %	0 %
DNAdigital (n = 28)	0 %	14 %	18 %	18 %	29 %	21 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, excluding Germany, Europe and the U.S.
Basis: All people surveyed

Fig. IV.53: Thesis 115 Energy efficiency through ICT

In <country>, ICT infrastructures in energy supply are indispensible for ensuring energy efficiency and reliable supply security.

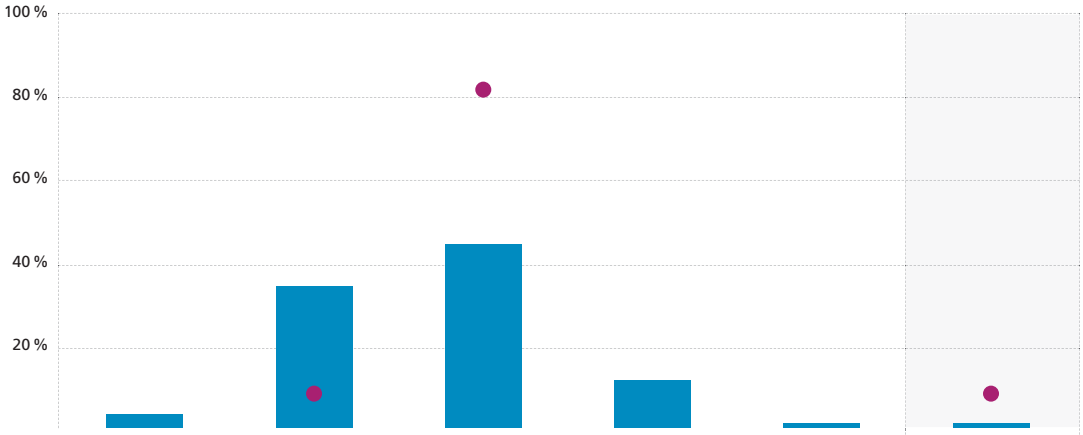


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 56)	43 %	43 %	11 %	2 %	0 %	2 %
EU experts (n = 13) [1]*	23 %	54 %	23 %	0 %	0 %	0 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.54: Thesis 116 Bidirectional energy trading

In <country>, households and companies appear on electronic energy marketplaces both as suppliers and consumers of energy and trade energy bi-directionally and in real time.

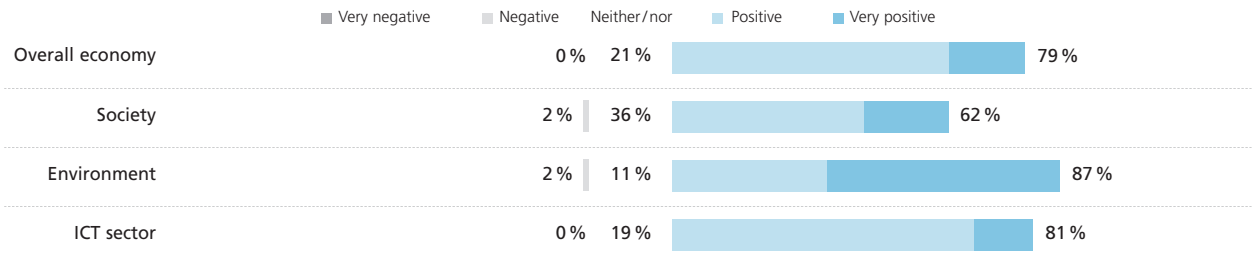


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 49)	4 %	35 %	45 %	12 %	2 %	2 %
EU experts (n = 11) [1]*	0 %	9 %	82 %	0 %	0 %	9 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.55: Thesis 116 Bidirectional energy trading – relevance

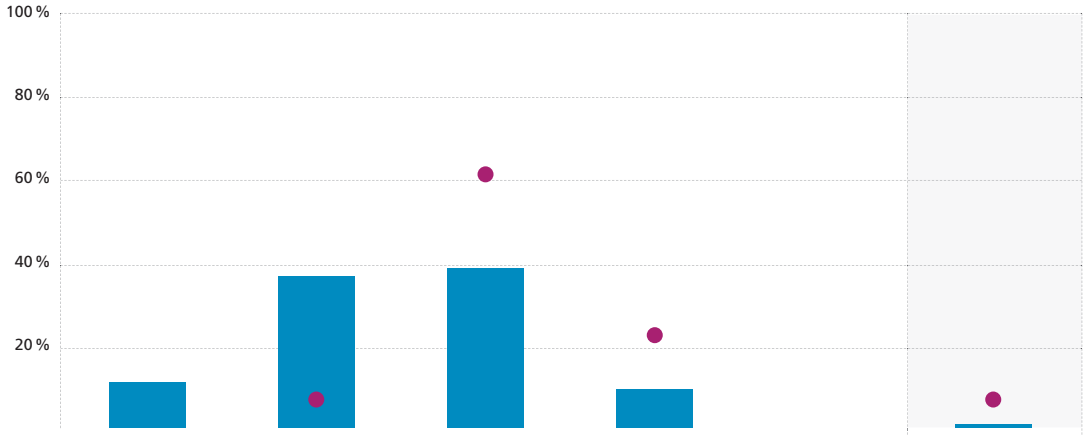
What impact will the validity of Thesis 116 above have on the areas listed below?



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, at least n = 53

Fig. IV.56: Thesis 117 Smart metering

In <country>, smart meters (modern energy meters) are used in households nationwide.

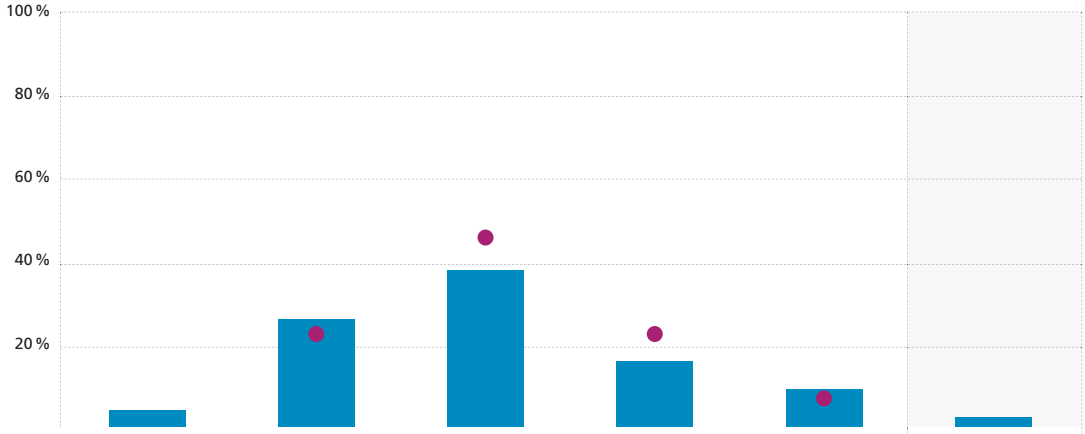


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 59)	12 %	37 %	39 %	10 %	0 %	2 %
EU experts (n = 13) [1]*	0 %	8 %	62 %	23 %	0 %	8 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.57: Thesis 118 Smart grids

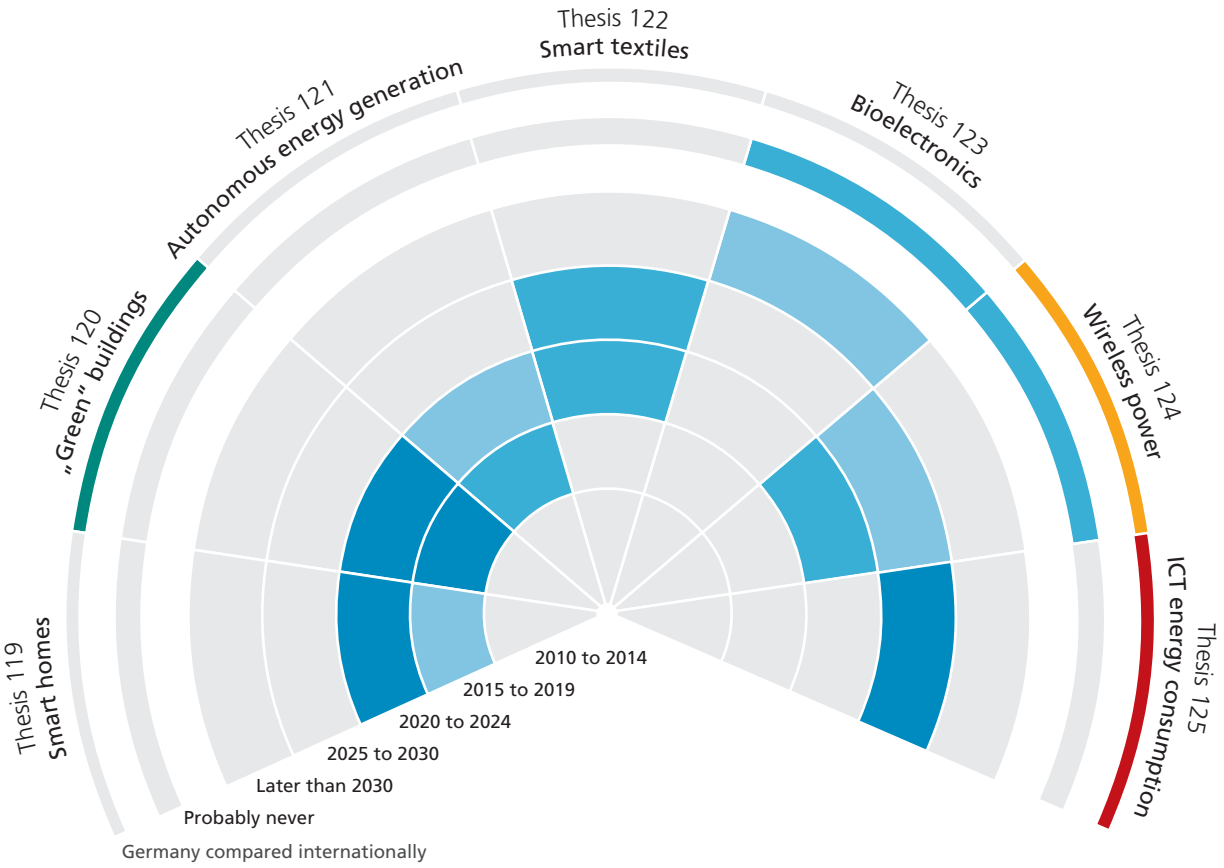
In <country>, household appliances (e. g., washing machines) are integrated into intelligent supply networks ("smart grids") and are controlled by them with energy efficiency.



	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 60)	5 %	27 %	38 %	17 %	10 %	3 %
EU experts (n = 13) [1]*	0 %	23 %	46 %	23 %	8 %	0 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

IV.4.2 Green IT
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 119: Smart homes
ICT-based concepts in intelligent buildings ("smart homes") contribute to savings in energy consumption of more than 30 percent compared to 2009.

Thesis 120: „Green" buildings
Green technologies like energy-saving IT components, automated device switches and renouncement of the standby-function are the standard in more than 75 percent of buildings (private households and commercial buildings) in Germany.

Thesis 121: Autonomous energy generation
Numerous small electronic devices, such as sensors, generate the energy they need themselves.

Thesis 122: Smart textiles
"Smart" textiles ("transistor switches in fibers"), i. e., energy generation at and through the body of the user, make it possible for mobile devices to be self-sufficient and are available on the market.

Thesis 123: Bioelectronics
More than 50 percent of electronic components are "bio-degradable"/decompose in an environmentally sound manner.

Thesis 124: Wireless power
Wireless transmission of electricity to operate low-power devices (small home electronics, laptops, etc.) is widely disseminated in Germany.

Thesis 125: ICT energy consumption
The use of new ICT components has lowered energy consumption of communication networks in Germany by 90 percent over current consumption levels (energy consumption per user).

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

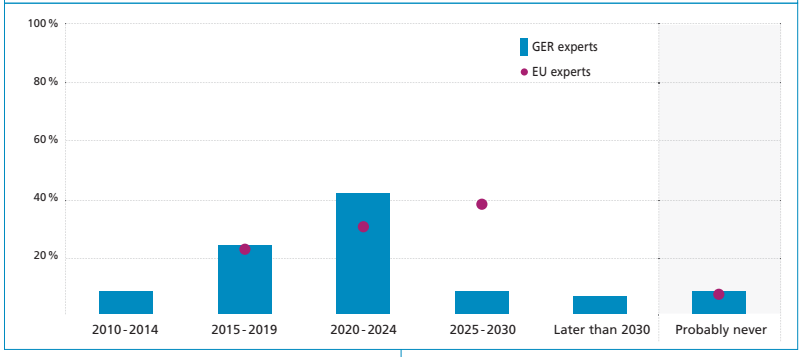
Green IT – how ICT helps protect the climate

Alongside the endeavor to deploy intelligent energy systems as a means of protecting the environment, information and communication technologies (ICT) have another contribution to make toward climate protection. These efforts are subsumed under the term 'green IT'. Its central objectives include lowering the energy consumed by hardware, protecting the environment and using resources sparingly, by opting to use suitable materials and production facilities throughout the hardware life cycle (manufacture, usage, recycling) and, last but not least, offering services that substitute the usage of physical, energy-intensive resources (e. g., teleconferencing, bits instead of paper). Already today, energy- and cost-saving green IT technologies such as virtualization, innovative cooling and heat dissipation concepts, server consolidation and remote collaboration tools are among the standard tools used by CIOs (Chief Information Officer).The substantial potential for both the climate and the economy that is generated by productive interaction between information and energy are reflected in international discussion in the unequation: energy + information < energy.

Fast growth of green IT technologies in building services

More than three quarters of the GER experts interviewed think that it will be possible to save 30 percent of the present energy consumed in buildings through innovative ICT concepts (smart homes) by 2024 at the latest (see Fig. IV.58). The experts are largely unanimous in their estimate of when green technologies such as energy-saving IT components, automatic device switch-off and overriding the standby function will be used as standard in 75 percent of all buildings: 82 percent of the GER experts forecast that this will occur in the period between 2015 and 2024 (see Fig. IV.59).

Thesis 119: ICT-based concepts in intelligent buildings ("smart homes") contribute to savings in energy consumption of more than 30 percent compared to 2009.



The study participants submit a similar estimate on energy generation by sensors and mobile handsets via "smart" textiles; here again. a full 60/41 percent expect a breakthrough in the years 2015 to 2024 (see Figs. IV.60 and IV.61).

49 percent of the experts for Germany only consider it realistic that the energy consumed by communication networks can be reduced by 90 percent on today's figures as a result of deploying ICT components in the period between 2025 and 2030 (see Fig. IV.64). Around 17 percent of the experts express doubts that this ambitious goal will ever be fulfilled. However, the experts for other countries expect this trend to occur at an earlier date than their counterparts for Germany: For example, a full 47 percent of the U.S. experts believe that it will be reality as early as 2024, and the experts for Europe (38 percent) and for other countries (35 percent) see it being fulfilled at a similarly early date. In contrast, the members of DNAdigital volunteer a more pessimistic forecast. Half this group assumes that the goal will not be reached until after the year 2030. The GER experts are convinced that this reduced energy consumption will have a positive impact on the environment (92 percent), the ICT industry (85 percent) and the economy as a whole (84 percent). Technical progress (81 percent) is seen to be the main driver of this trend.

This is followed by promotion of research and development (36 percent), investments in infrastructure (34 percent) and political resolve (32 percent) as the main drivers that can be actively influenced by politics.

If the focus is turned to the positive economic and social effects associated with this thesis, great interest is shown in the development of suitable technologies, a fact that needs to be incorporated in both business and political strategies. When it comes to barriers, 46 percent of participants quote overly high costs, 45 percent technical problems and 35 percent insufficient investments by business enterprises.

The development of wireless power transmission and biodegradable electronic components is seen by all experts to be an extremely pro-tracted, or even unrealistic, development process (see Figs. IV.63 and IV.62). 39 percent of the experts for Germany assume that 50 percent of electronic components will never be biodegradable. 34 percent of the experts express the same opinion about the development of wireless power transmission.

Use of green IT promises a fast impact

Compared with the theses "Modern technical infrastructure" (see section IV.4.1, Fig. IV.52) and "ICT energy consumption" (see Fig. IV.64), the study participants expect that energy-saving IT components such as automatic device switch-off and standby function override will be implemented sooner. As many as 42 percent of the experts surveyed expect these innovations to be implementable in 75 percent of all buildings within the next six to ten years. The experts forecast a similar timeframe for the 30-percent energy-saving that is attributed to smart homes. As was to be expected, they anticipate that realization of disruptive technology developments such as biodegradability and autonomous power generation by electronics components will take longer.

Overcoming barriers to the spread of intelligent building services

While on the subject of intelligent building services, we should, however, not forget that some technical (e. g., data exchange and definition), psychological (e. g., subjective control, motivation, security constraints) and structural (e. g., lack of standardization, motivation problem due to home ownership structures) influence factors have already hampered the dissemination of similar technologies that are already available (e. g., smart home) for some time.

Financial incentives (e. g., grants or subsidized loans for home owners), information campaigns and the definition of universal standards, for example, could play a valuable role in the swift spread of these technologies.

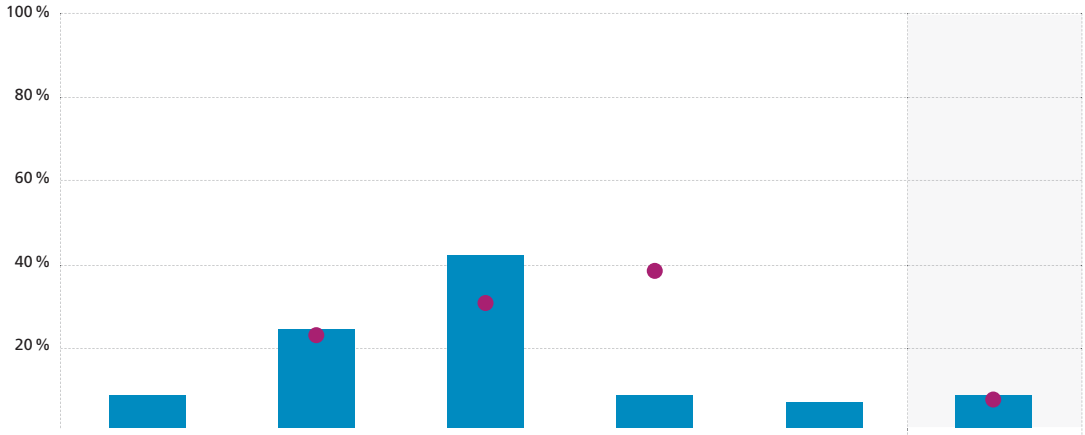
As for the other technologies (more efficient communication networks, autonomous energy generation by components, biodegradability, wireless power transmission), further in-depth research is obviously necessary before they can achieve market maturity and broad coverage.

Seen from the standpoint of society as a whole, promotion would seem to be an expedient approach. Nonetheless, faster results can be achieved in the areas of building services, automatic device control and further reductions in energy consumption on the hardware side.

Theses on "Green IT" in detail

Fig. IV.58: Thesis 119 Smart homes

ICT-based concepts in intelligent buildings ("smart homes") contribute to savings in energy consumption of more than 30 percent compared to 2009.

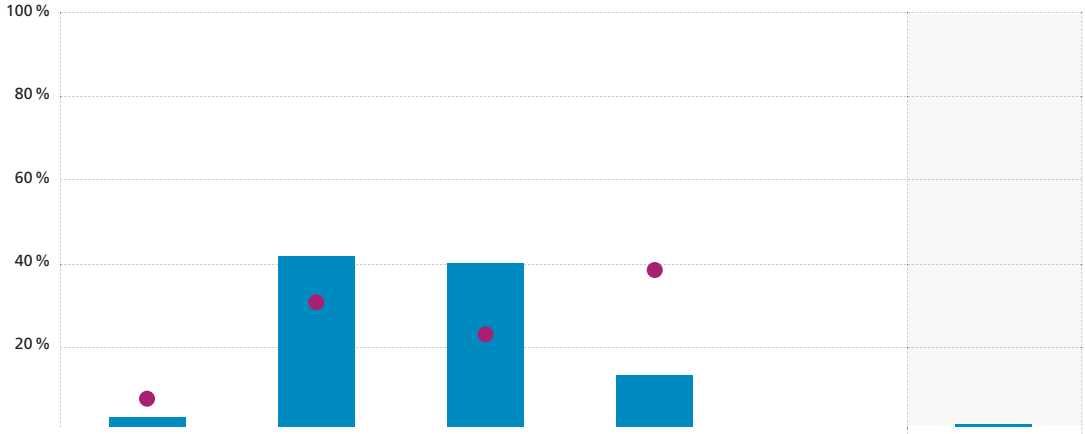


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 57)	9 %	25 %	42 %	9 %	7 %	9 %
EU experts (n = 13) 1*	0 %	23 %	31 %	38 %	0 %	8 %

1 Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.59: Thesis 120 „Green" buildings

Green technologies like energy-saving IT components, automated device switches and renouncement of the standby-function are the standard in more than 75 percent of buildings (private households and commercial buildings) in <country>.

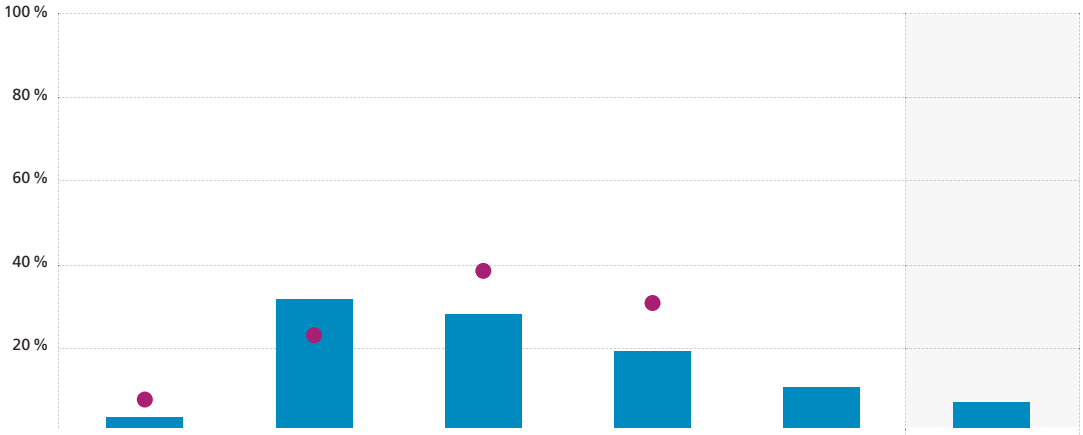


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 60)	3 %	42 %	40 %	13 %	0 %	2 %
EU experts (n = 13) 1*	8 %	31 %	23 %	38 %	0 %	0 %

1 Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.60: Thesis 121 Autonomous energy generation

Numerous small electronic devices, such as sensors, generate the energy they need themselves.

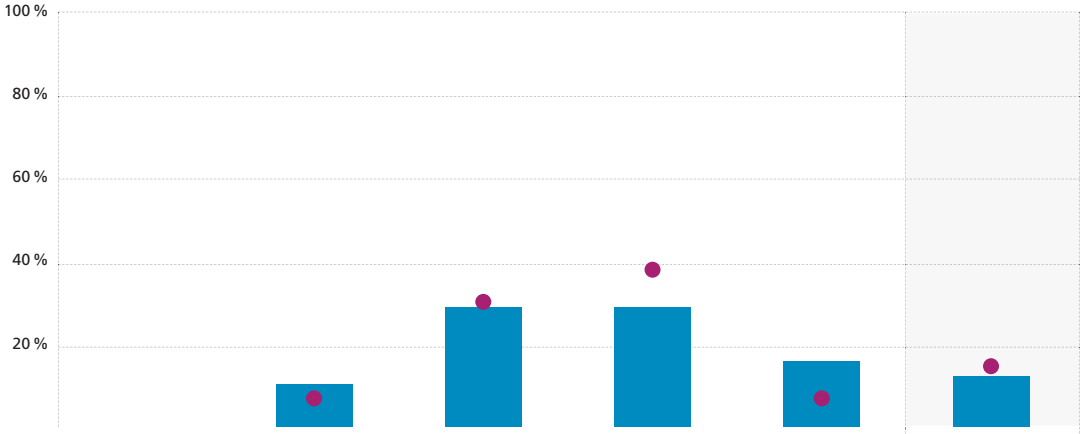


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 57)	4 %	32 %	28 %	19 %	11 %	7 %
EU experts (n = 13) [1]*	8 %	23 %	38 %	31 %	0 %	0 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.61: Thesis 122 Smart textiles

"Smart" textiles ("transistor switches in fibers"), i. e., energy generation at and through the body of the user, make it possible for mobile devices to be self-sufficient and are available on the market.

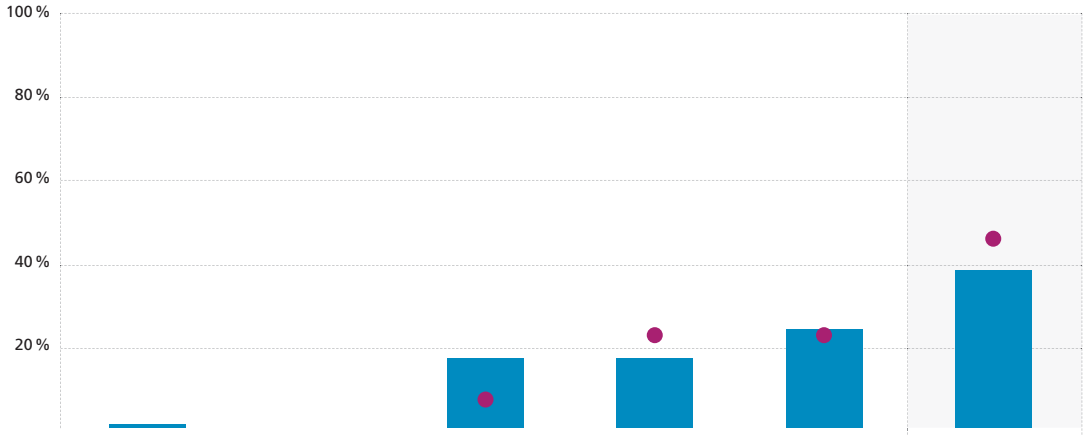


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 54)	0 %	11 %	30 %	30 %	17 %	13 %
EU experts (n = 13) [1]*	0 %	8 %	31 %	38 %	8 %	15 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.62: Thesis 123 Bioelectronics

More than 50 percent of electronic components are "bio-degradable"/decompose in an environmentally sound manner.

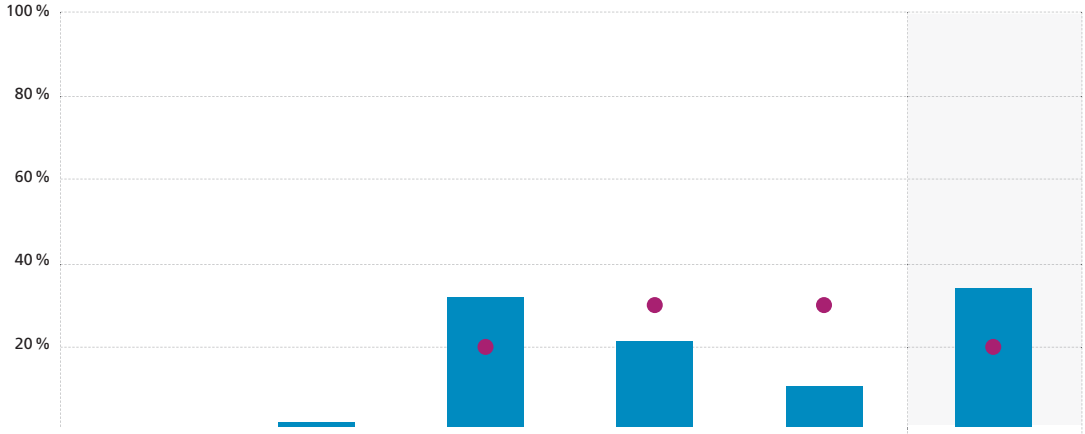


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 57)	2 %	0 %	18 %	18 %	25 %	39 %
EU experts (n = 13) [1]*	0 %	0 %	8 %	23 %	23 %	46 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.63: Thesis 124 Wireless power

Wireless transmission of electricity to operate low-power devices (small home electronics, laptops, etc.) is widely disseminated in <country>.

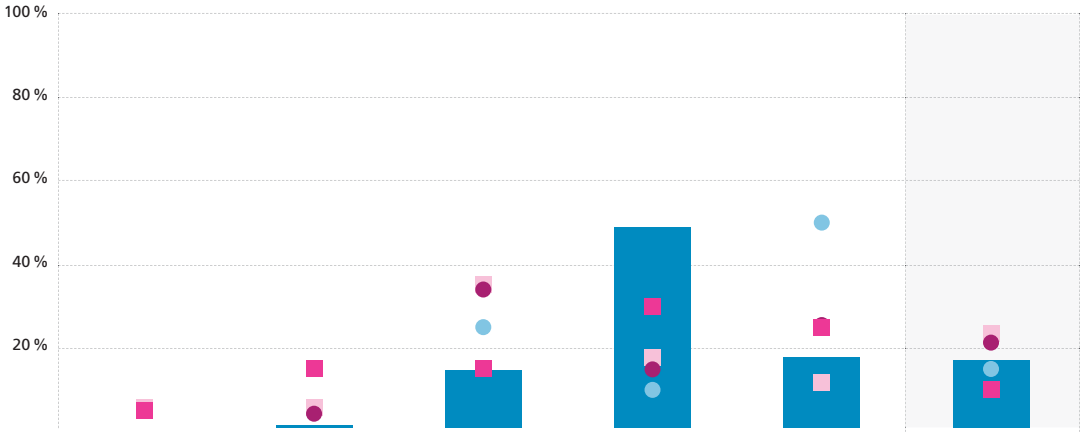


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 47)	0 %	2 %	32 %	21 %	11 %	34 %
EU experts (n = 10) [1]*	0 %	0 %	20 %	30 %	30 %	20 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.64: Thesis 125 ICT energy consumption

The use of new ICT components has lowered energy consumption of communication networks in <country> by 90 percent over current consumption levels (energy consumption per user).

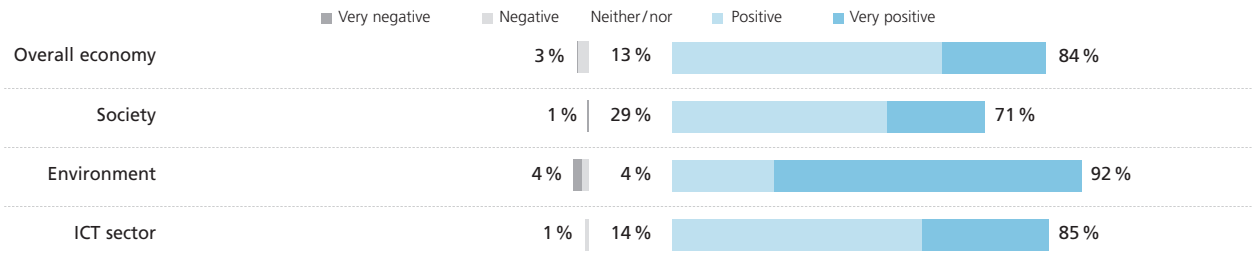


	2010-2014	2015-2019	2020-2024	2025-2030	Later than 2030	Probably never
GER experts (n=203)	0 %	1 %	15 %	49 %	18 %	17 %
EU experts (n=47) [1]	0 %	4 %	34 %	15 %	26 %	21 %
U.S. experts (n=17) *	6 %	6 %	35 %	18 %	12 %	24 %
Other intern. experts (n=20) [2]	5 %	15 %	15 %	30 %	25 %	10 %
DNAdigital (n=20)	0 %	0 %	25 %	10 %	50 %	15 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, except Germany, Europe and the U.S.; *Fewer than 20 cases!
Basis: All people surveyed

Fig. IV.65: Thesis 125 ICT energy consumption – relevance

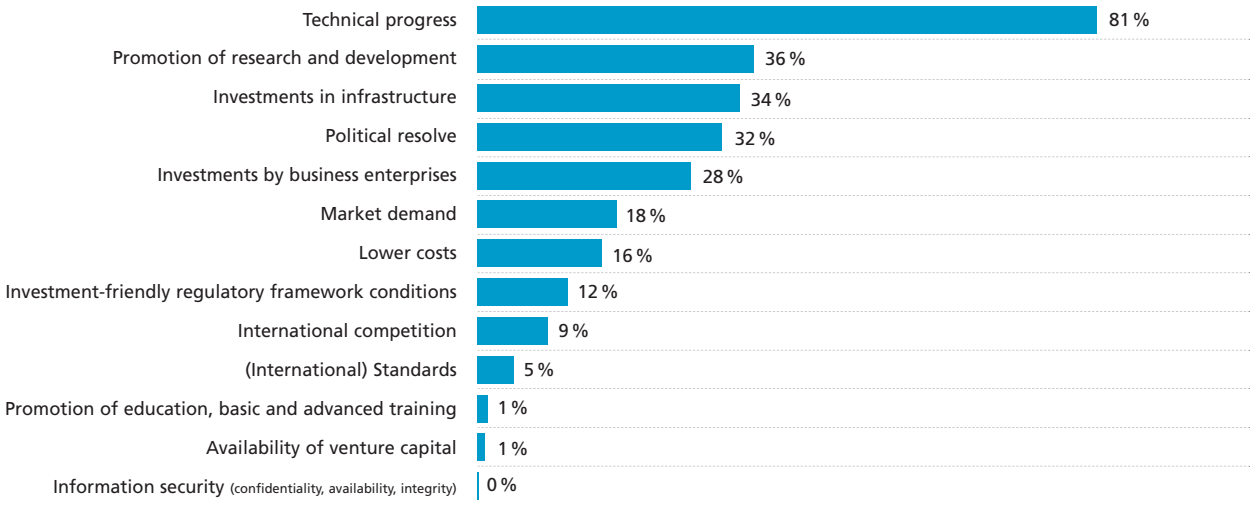
What impact will the validity of Thesis 125 above have on the areas listed below?



Basis: All people surveyed; Sub-group: GER experts, at least n=336

Fig. IV.66: Thesis 125 ICT energy consumption – drivers

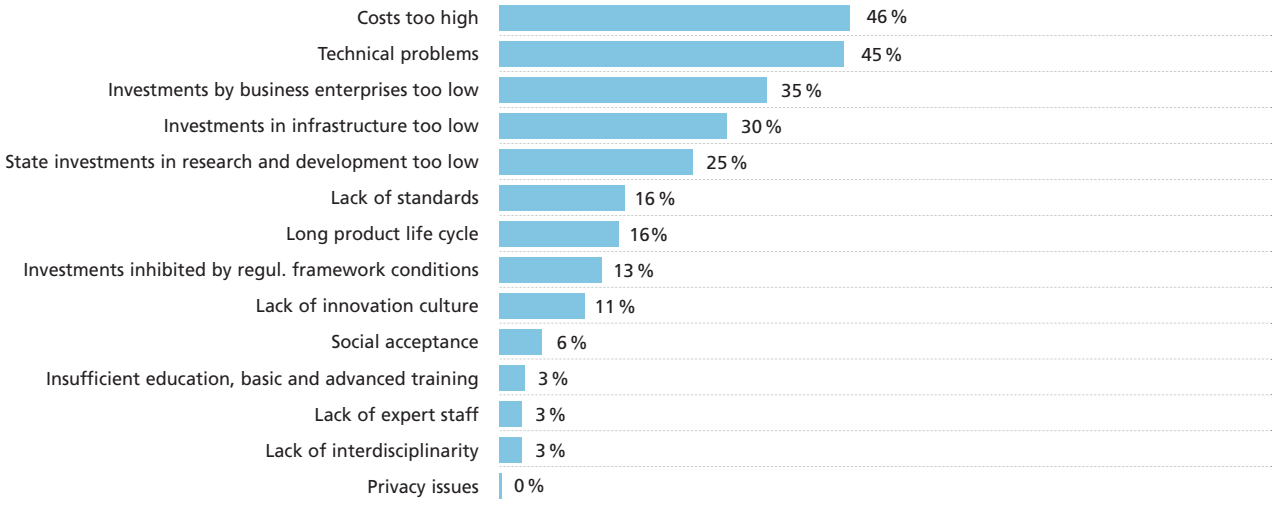
Select up to three drivers from the following list that you consider to be most important for realization of Thesis 125 above.



Basis: All people surveyed; Sub-group: GER experts, n = 267

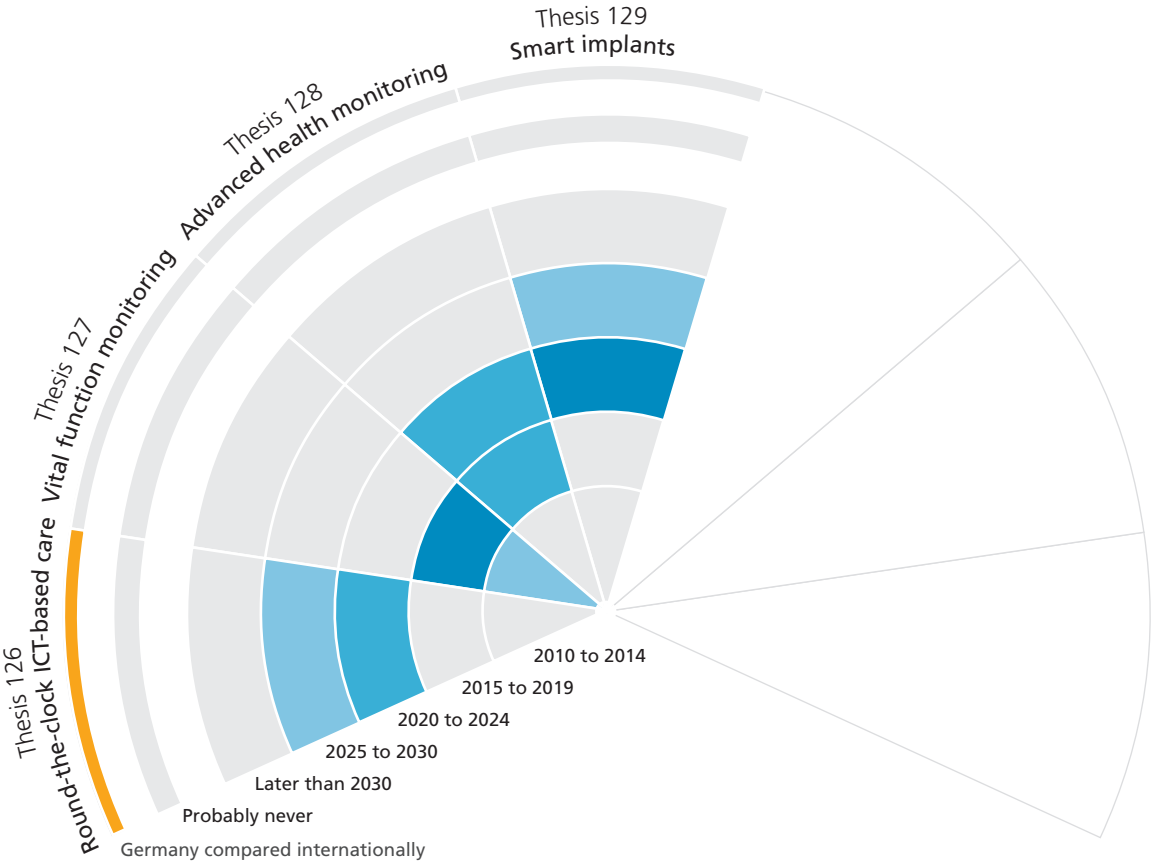
Fig. IV.67: Thesis 125 ICT energy consumption – barriers

Select up to three barriers from the following list that you consider to be most important for realization of Thesis 125 above.



Basis: All people surveyed; Sub-group: GER experts, n = 268

IV.5 E-health
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 126: Round-the-clock ICT-based care

The medical healthcare standard in Germany is "round-the-clock" care of individuals (senior citizens, patients) in their own home by means of ICT systems.

Thesis 127: Vital function monitoring

Entirely new forms of prevention, diagnostics and treatment are available in Germany thanks to ICT combined with vital functions monitoring.

Thesis 128: Advanced health monitoring

The integrated recording of vitals (pulse, blood pressure, blood sugar, etc.) in mobile devices, such as cell phones, is widespread in the health system in Germany for preventative care or medical monitoring (e. g., for chronic illnesses).

Thesis 129: Smart implants

Intelligent electronic medical implants link to and interchange with ICT systems and are used by more than 25 percent of the population in Germany.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

Germany is undergoing a period of demographic transition: both the absolute number of elderly people and the ratio of the elderly to the total population are rising; at the same time, average life expectancy is improving and, consequently, the number of very old people in the country.

Despite the fact that a 70-year-old today is as healthy as a 65-year-old in the previous generation, the risk of infirmity and the need for care increases with age, so that the number of people needing care will grow dramatically in the coming decades.

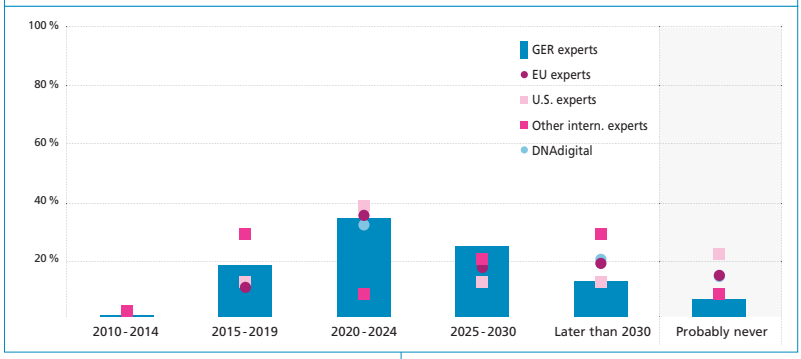
One of the future challenges for our society will therefore be how to maintain today's standard of living from economic, healthcare and social standpoints. Promoting maximum independence, mobility and safety, and maintaining good health are all ways of increasing people's autonomy and their quality of life in old age. Information and communication technologies (ICT) can be applied at various points to break the causal chains of changes associated with old age: to overcome social isolation, largely maintain independence and lessen the impact of disease.

Round-the-clock ICT-based care – pie in the sky?

According to the experts surveyed, round-the-clock care for patients in their own homes based on ICT systems will continue to establish itself in the future. 60 percent of the GER experts are of the opinion that round-the-clock ICT-based care for people in their own homes will be the healthcare standard in the period 2020 to 2030, only one percent believes that this will already be the case in the next five years; seven percent actually assume that this will never materialize (see Fig. IV.68).

The remaining experts are even more cautious in their prognosis: Almost a quarter of the U.S. experts, 15 percent of the experts for Europe, nine percent of the other international experts and 15 percent of the DNAdigital group believe that ICT-based round-the-clock care is unlikely ever to become the standard medical care.

Thesis 126: The medical healthcare standard in <country> is "round-the-clock" care of individuals (senior citizens, patients) in their own home by means of ICT systems.



Round-the-clock ICT-based care – a blessing or a curse?

According to 90 percent of the GER experts surveyed, ICT-based round-the-clock care for patients in their own homes will represent a boost for the ICT sector, for example as a result of new business opportunities (see Fig. IV.69). Despite this, 15 percent of these interviewees also anticipate a negative impact on society, possibly for the following reasons: fear of high-tech medicine, social isolation or lack of human contacts.

These reservations are also reflected in the assessments of factors that could push or hamper the establishment of round-the-clock care as the standard medical care scenario: the continuing lack of social acceptance is seen by more than half (56 percent) of the experts for Germany as the greatest obstacle (see Fig. IV.71). For almost half the people surveyed (43 percent), the continuing excessively high costs represent a major barrier that could impede rollout of ICT in the healthcare sector.

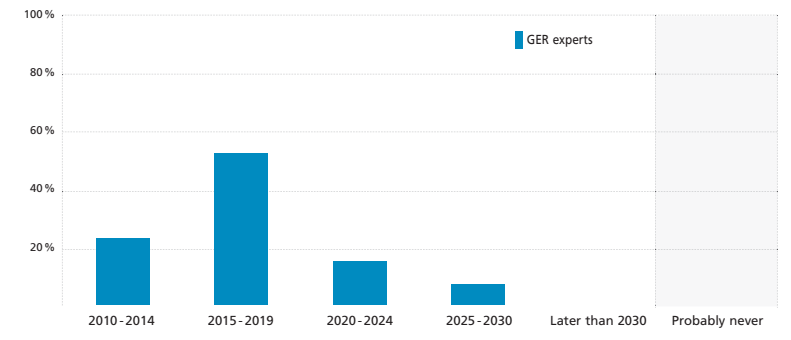
Likewise, a similarly large group of experts for Germany (44 percent) assume that low costs will be a key driver if round-the-clock care is to prevail (see Fig. IV.70). 60 percent see technical progress as the most important driver for enabling ICT-based round-the-clock care to assert itself as the medical standard.

Vital functioning monitoring – realistic in the near future

Entirely new forms of disease prevention, diagnostics and treatment are made possible by ICT and vital function monitoring. Around three quarters of the experts for Germany assume that this will represent reality in the next ten years (see Fig. IV.72). The opinion of these experts is quite different when it comes to capturing vital parameters with a mobile phone or other mobile device for the purpose of disease prevention or medical monitoring: a full

eight of ten experts believe that this will materialize between 2015 and 2024 (see Fig. IV.73). The study shows that experts are unanimous in their judgment that the two scenarios are both realistic: None of the people who took part in the survey expected that these scenarios would never occur.

Thesis 127: Entirely new forms of prevention, diagnostics and treatment are available in <country> thanks to ICT combined with vital functions monitoring.



Intelligent implants will be slow to gain acceptance

By contrast, intelligent medical electronic implants that communicate with ICT systems will be slow to gain acceptance: Only three percent of the GER experts surveyed believe that such implants will be used by more than 25 percent of Germany's population in the next ten years. Just less than half the experts (46 percent) forecast this for the period between 2020 and 2024 but more than ten percent think this will never be the case (see Fig. IV.74).

Summary

There is no denying that demographic change is upon us. It will manifest itself in Germany above all during the coming years. The objective in this case must be to prepare the ground appropriately and in good time, and not to turn a blind eye to its needs.

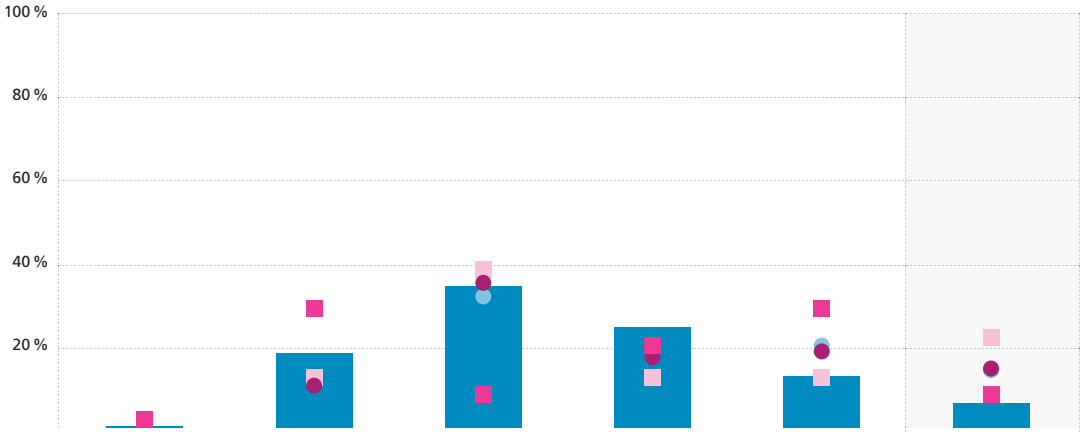
This could make Germany a reference scenario for other countries, and developments made early on with an eye on the future in Germany and/or the appropriate know-how could subsequently be exported to other countries. Although many of the experts surveyed believe that e-health applications are already technically feasible, the aspects of how the applications will be financed, the structure of the requisite infrastructure, and business and cost models are still unresolved.

It will be vital for Germany to build political opinion and awareness so that it can benefit from the potential offered by e-health. To ensure that society can keep pace with technological development, active 'marketing' will need to publicize the potential offered by technology and make it usable. At the same time, it will need to eliminate people's fears about such aspects as social isolation or the feeling of being dependent on technology.

Theses on "E-health" in detail

Fig. IV.68: Thesis 126 Round-the-clock ICT-based care

The medical healthcare standard in <country> is "round-the-clock" care of individuals (senior citizens, patients) in their own home by means of ICT systems.

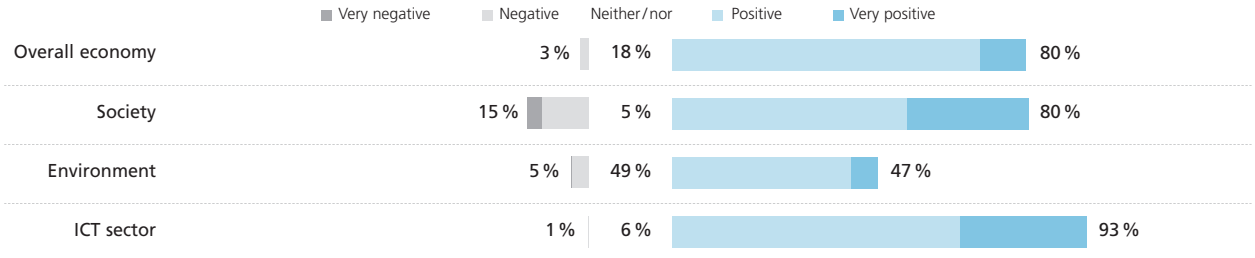


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 363)	1 %	19 %	35 %	25 %	13 %	7 %
EU experts (n = 73) [1]	1 %	11 %	36 %	18 %	19 %	15 %
U.S. experts (n = 31)	0 %	13 %	39 %	13 %	13 %	23 %
Other intern. experts (n = 34) [2]	3 %	29 %	9 %	21 %	29 %	9 %
DNAdigital (n = 34)	0 %	12 %	32 %	21 %	21 %	15 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, except Germany, Europe and the U.S.
Basis: All people surveyed

Fig. IV.69: Thesis 126 Round-the-clock ICT-based care – relevance

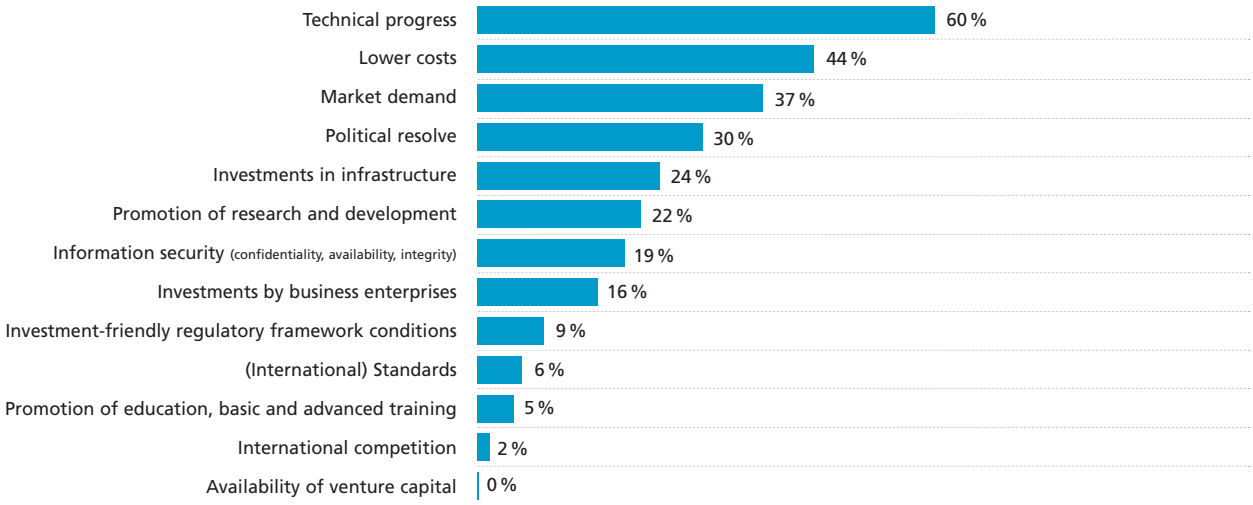
What impact will the validity of Thesis 126 above have on the areas listed below?



Basis: All people surveyed; Sub-group: GER experts, at least n = 344

Fig. IV.70: Thesis 126 Round-the-clock ICT-based care – drivers

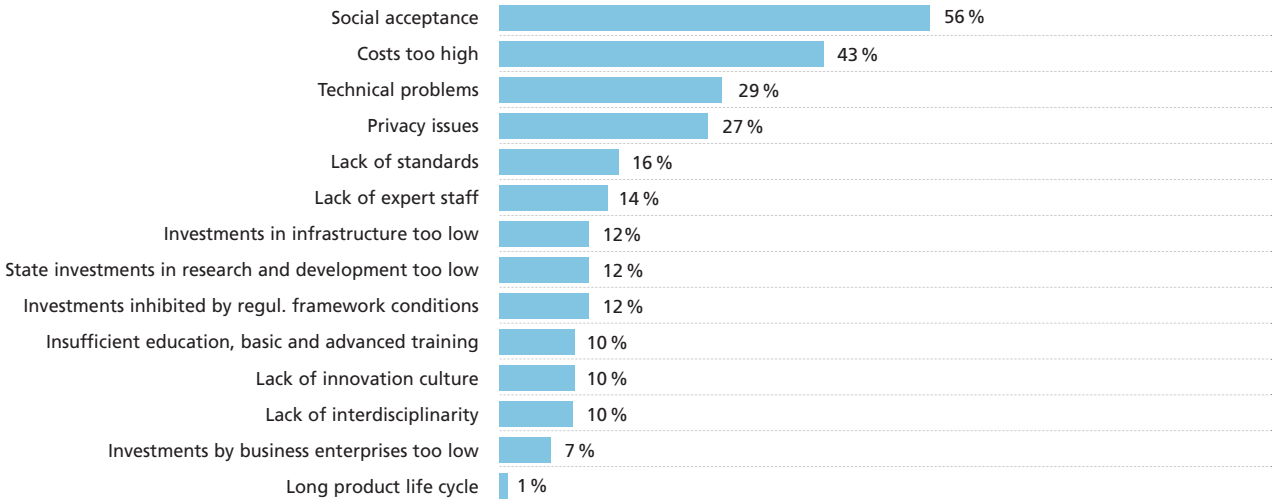
Select up to three drivers from the following list that you consider to be most important for realization of Thesis 126 above.



Basis: All people surveyed; Sub-group: GER experts, n = 283

Fig. IV.71: Thesis 126 Round-the-clock ICT-based care – barriers

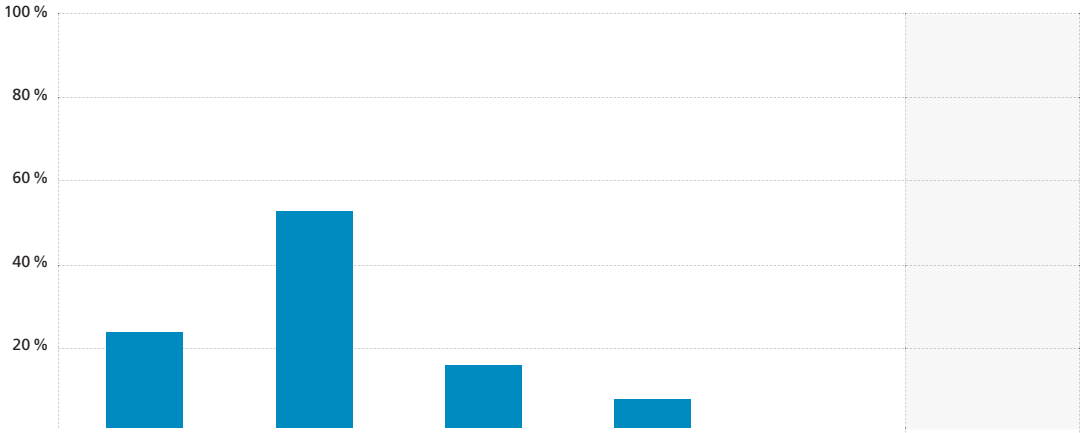
Select up to three barriers from the following list that you consider to be most important for realization of Thesis 126 above.



Basis: All people surveyed; Sub-group: GER experts, n = 282

Fig. IV.72: Thesis 127 Vital function monitoring

Entirely new forms of prevention, diagnostics and treatment are available in <country> thanks to ICT combined with vital functions monitoring.

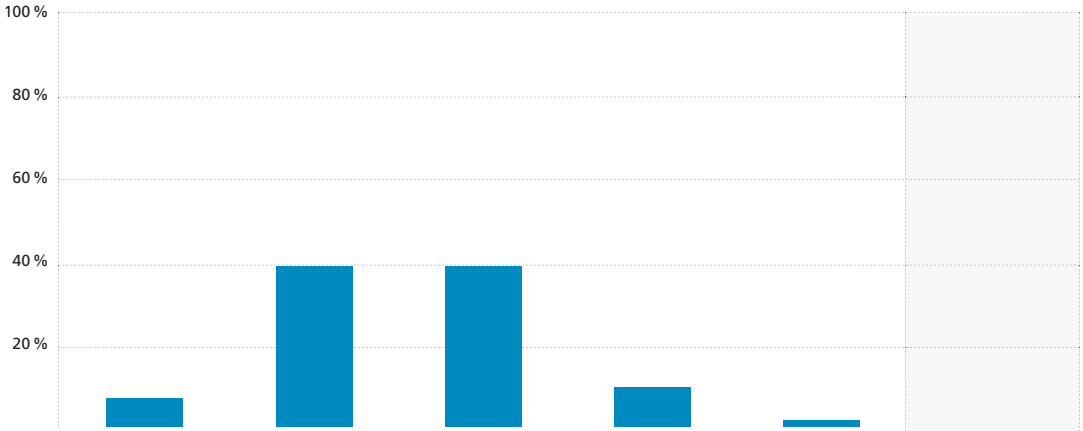


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 38)	24 %	53 %	16 %	8 %	0 %	0 %

Basis: All people surveyed with special expertise in the topic area

Fig. IV.73: Thesis 128 Advanced health monitoring

The integrated recording of vitals (pulse, blood pressure, blood sugar, etc.) in mobile devices, such as cell phones, is widespread in the health system in <country> for preventative care or medical monitoring (e. g., for chronic illnesses).

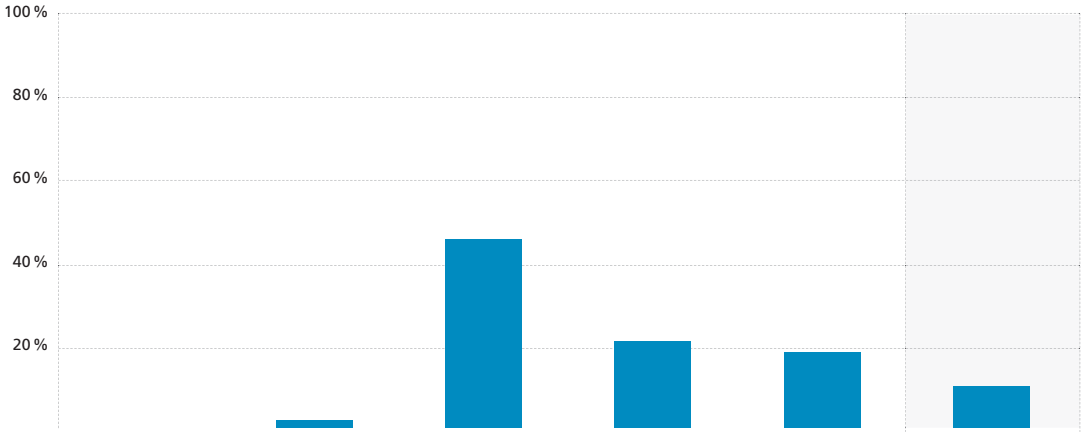


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 38)	8 %	39 %	39 %	11 %	3 %	0 %

Basis: All people surveyed with special expertise in the topic area

Fig. IV.74: Thesis 129 Smart implants

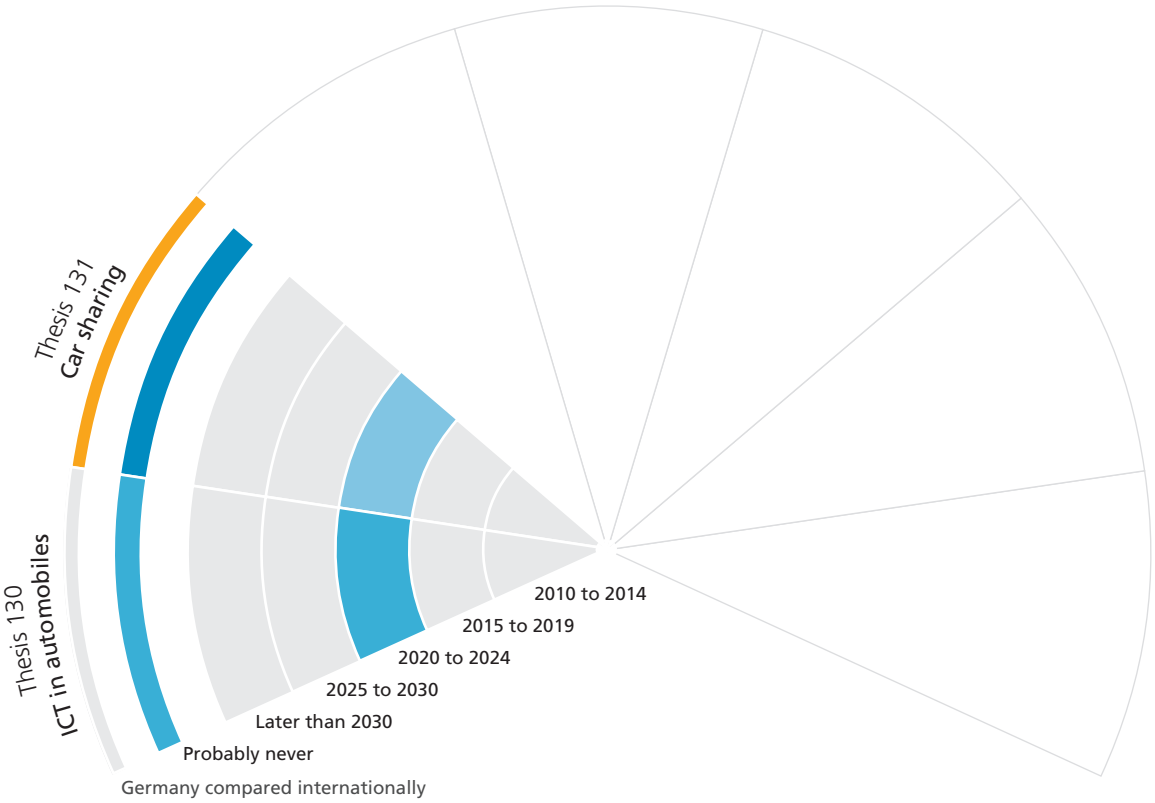
Intelligent electronic medical implants link to and interchange with ICT systems and are used by more than 25 percent of the population in <country>.



	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 37)	0 %	3 %	46 %	22 %	19 %	11 %

Basis: All people surveyed with special expertise in the topic area

IV.6.1 ICT in automobiles and new mobility concepts
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 130: ICT in automobiles

The proportion of value added by ICT in the vehicle has grown to 50 percent.

Thesis 131: Car sharing

In Germany, new mobility offers (car sharing, car to go, etc.) have replaced 25 percent of private vehicle purchases.

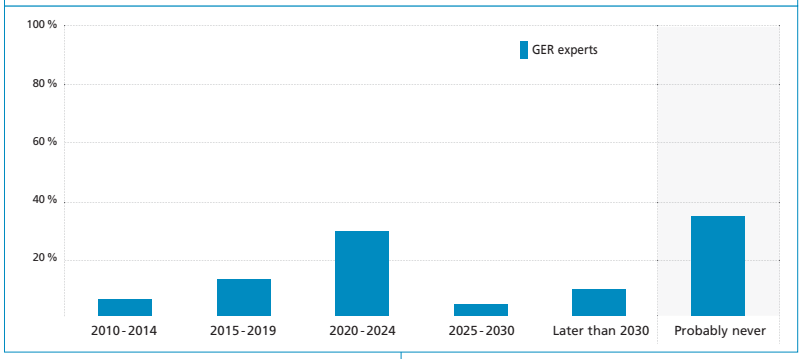
* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

Industry on the brink of the "hybrid product"

With 750,000 jobs and over five million people employed either directly or indirectly in the automobile industry, it is a key industry for Germany as well as for Europe as a whole (cf. VDA 2009). At the same time, more than virtually any other industry, it is currently undergoing deep-seated changes. Even before the 2008/2009 crisis, it was clear that production, products and mobility requirements were changing. The main recent technology trends in the automobile industry comprise intelligent active assistance systems, weight-saving safety concepts, mobile information and communication systems and energy-saving drive technologies.

Thesis 130: The proportion of value added by ICT in the vehicle has grown to 50 percent.



Information and communication technologies (ICT) already play an important role in central areas of the automobile industry today. This affects manufacturing and development processes, as well as the products themselves.

This development has given rise to new forms of cooperation between manufacturers and their suppliers, and has added numerous services in and around automobiles to their portfolios.

The industry's view of itself has also changed. "From car maker to mobility provider," the implementation of this formula is reflected in numerous models offered by all the big car makers. This development is characterized by an extension of the traditional value chain into the sectors of service and information, and by a continuing trend toward a "hybrid product" (Bullinger 1997), combining ICT-based services with standard services.

The study's questions that relate to automobile applications focus on the general rise in significance of ICT in the industry, and on the changes resulting from rollout of intelligent transport systems and service offers. This topic area spotlights not only the potential for future technology developments but also the social and political framework conditions needed for successful innovation. It addresses new cooperation models and business areas in which ICT will gain new relevance over and beyond its already established support and interdisciplinary functions.

Strong growth in automobile ICT

Almost two thirds of the GER experts surveyed consider it probable that the proportion of value generated by ICT inside automobiles will rise to 50 percent (see Fig. IV.75). In this context, the ICT to be found in cars comprises first and foremost the various control units for safety and driver assistance systems, the powertrain, as well as system networking and, last but not least, the infotainment components. Further increases are expected as a result of introducing new communication technologies (see section IV.6.2) and the spread of X-by-Wire (see section IV.6.3). Half the GER experts expect the proportion of value created to reach 50 percent by the year 2024. 30 percent anticipate that this rise will take place during the period 2020 to 2024.

Assuming that an ICT proportion of 20 to 30 percent is already implemented in vehicles today (the broad range is the result of different attributions and the differences between volume and premium manufacturers), the forecast high rise in ICT-based components and functions is surprising.

A full third of the GER experts still negates the thesis that ICT will increase to account for 50 percent of value in motor vehicles. If we extend this to include assessments on the topics of vehicle communication (see, e. g., Fig. IV.84) and X-by-Wire (see Fig. IV.90), we can assume that the negative assessment was inspired by the "50 percent" figure. The experts confirm that the use of ICT in automobiles will expand overall, with a major push expected in and after the year 2020.

The area of electromobility and the link to intelligent power distribution networks will give ICT a new key role, since logistics work and the necessary coordination of energy use and supply need to be meshed in real time. Smart grids, individual real-time resources selection and automatic power charging are all new fields of application for ICT solutions.

Sustainable mobility concepts gain in attraction

Social awareness on climate change and individual mobility are influenced to a great extent by the debate on particulate matter, fine particle filters, reduction in energy consumption and reduction in CO_2 emissions. Energy-efficient vehicle types, low-emission drives and integrated mobility concepts are basic needs along the path to sustainable mobility. A trend toward ecological action is discernible among the younger generation and the higher-income bracket population.

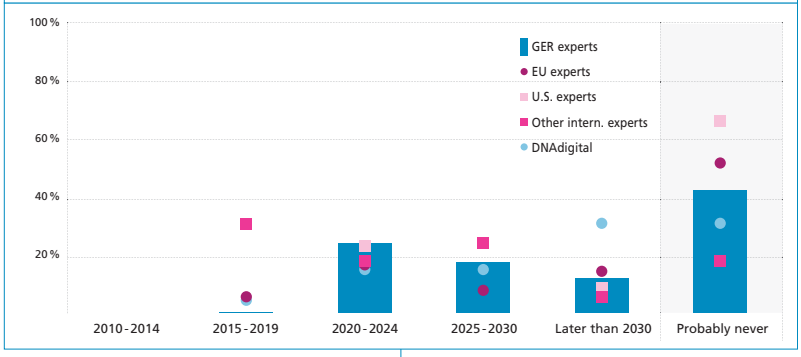
Not only do these people choose not to own a car as a status symbol, rejection of this symbol is now becoming a sign of prestige.

In fact, the new concepts on sustainable mobility mean that people no longer feel this sacrifice to be a restriction.

On the contrary, their main focus is on enabling a high degree of individual mobility and, at the same time – incorporating their own vehicle – on making the choice of transportation more flexible, more (time) economical and more ecological.

Advanced ICT supports planning for situation-based usage of transportation. Already today, cell phones can be used to retrieve diverse traffic information, and car-sharing concepts that offer users a high degree of flexibility are on trial. The "car2go" concept, for example, which was realized in Ulm, allows registered users to unlock a vehicle in the vicinity using a chip attached to their driver's license and – on arrival at any destination within the city boundaries – to lock it again. In contrast to traditional vehicle rental concepts, there are no longer any fixed return stations; in addition, users can spontaneously decide to have an operator display an available vehicle in their vicinity to them on their cell phones. Vehicles can also be reserved over the Internet. Other vehicle manufacturers, public transportation, the railways and air travel are also represented in the segment of sustainable mobility through their carriers, and are building new alliances with the service providers. In doing so, they are responding to a new type of customer, who no longer simply buys a product but also wants to be offered specific, complex solutions to their own individual mobility requirements.

Thesis 131: In <country>, new mobility offers (car sharing, car to go, etc.) have replaced 25 percent of private vehicle purchases.



New mobility offers are a relevant substitute for private car ownership

In answer to the question on whether new mobility offers will replace 25 percent of private vehicle purchases, most of the U.S. experts believe that owning a car will continue to be important (see Fig. IV.76). From the year 2020, however, many people surveyed expect a sharp increase in substitution with alternative mobility offers. This prognosis results in extended usage, car sharing or even a conscious decision to go without a vehicle of one's own or a second car. Nonetheless, 43 percent of the experts for Germany and 52 percent of the experts for Europe do not anticipate that a 25-percent reduction in private car purchases will be achieved, even over a longer analysis period. Seen overall, the experts for Germany and Europe submit a similar assessment on this topic. The greatest resistance to this thesis comes from the U.S. experts, 67 percent of whom rejected it completely. The group comprising other international experts sees a very different development: High potential at an early date, namely within the period 2015 to 2019, is seen by 31 percent of this group; the forecasts for 2020 to 2024 tally approximately with those submitted by the experts for Europe. Only a fifth of these experts reckons that this substitution will never occur. An interesting result again here is the opinion of the DNAdigital group. Its members see the strongest rise in potential for alternative mobility offers implemented after the year 2030, a considerably later date than the other groups.

Regional characteristics shape mobility

The high rejection rate among the U.S. experts reflects the country's geographical situation and its cultural approach to individual mobility. The basis for interpreting the appraisal submitted by the international experts is completely different. The early onset of this trend, as seen by the group of international experts, reflects the problems of major urban areas, for example in Japan, or the specific development situation of countries such as China. The conclusion for Europe is that, despite the increasing significance of alternative mobility offers, owning a car will continue to be important.

This expert opinion suggests that it is certainly worthwhile for the automobile industry to invest in alternative concepts, since such combined products and services will be successful in Europe as well as in Asia. The longer time horizon here allows time for the changes to be made. A positive factor for the car industry is the forecast that mobility with one's own car will still be attractive in the future.

Sustainable mobility attractive for the economy

Asked about the impact of a 25-percent reduction in private car purchases, almost 90 percent quoted the "environmental aspect" as the most important effect (see Fig. IV.77). 70 percent of the GER experts also expect a positive impact on society in the area of private car purchases if the thesis materializes. Looking at the economy, we see a surprisingly even distribution: one third of the GER experts sees negative, neutral or positive effects if the thesis materializes. This allows the cautious conclusion that a decline in private car purchases will not automatically lead to a zero-sum situation. Accordingly, a change could take place in the industry, or new growth impetus could be generated for sustainable mobility concepts in the economy as a whole.

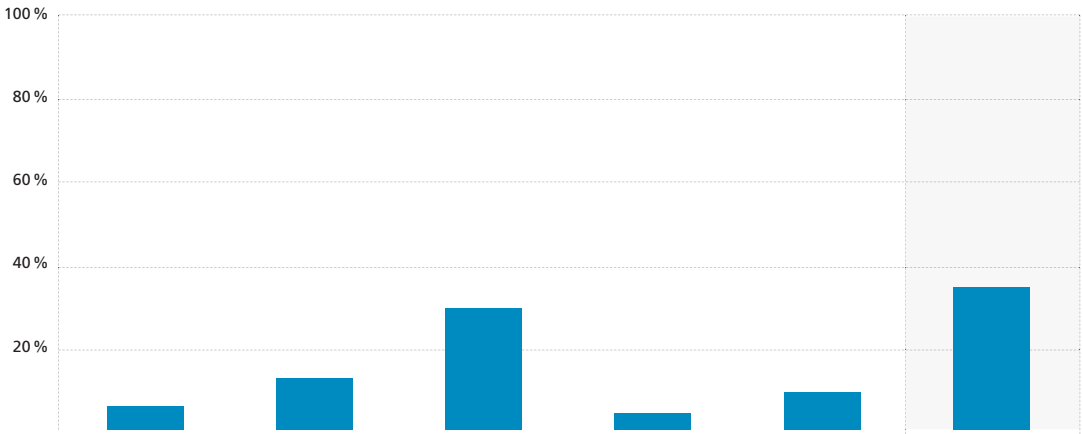
The ICT sector will play a key role in implementation of these concepts, for example in the areas of communication and data management. Of the three key drivers for materialization of this thesis, the cost factor stands in first position with 65 percent. 58 percent opt for market demand and as many as 44 percent see politics as the key driver (see Fig. IV.78). This means that benefit considerations and the attraction of the new offers together with the establishment of political frameworks are the driving force behind mobility concepts. A striking fact is that this is not seen primarily as a technology or infrastructure problem but very clearly as a topic that relies for implementation on interaction between the different players.

Despite the potential for new mobility concepts, 82 percent of the experts named the "social acceptance" factor as a barrier and 34 percent of them quoted, a long way behind, "costs too high" (see Fig. IV.79). This goes to show that the experts consider that it will be very difficult to find a substitute for owning one's own car, due to the car's specific mix of benefit, convenience and status symbol.

Theses on "ICT in automobiles and new mobility concepts" in detail

Fig. IV.75: Thesis 130 ICT in automobiles

The proportion of value added by ICT in the vehicle has grown to 50 percent.

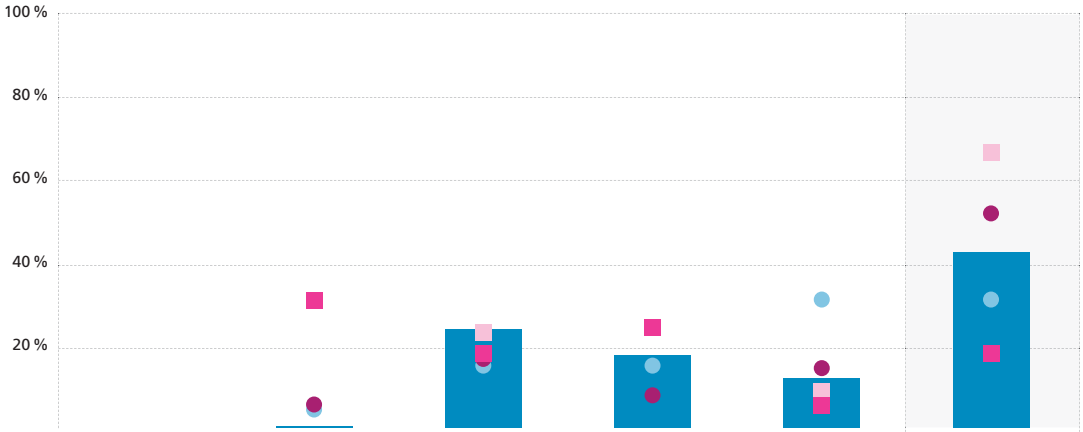


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 60)	7 %	13 %	30 %	5 %	10 %	35 %

Basis: All people surveyed with special expertise in the topic area

Fig. IV.76: Thesis 131 Car sharing

In <country>, new mobility offers (car sharing, car to go, etc.) have replaced 25 percent of private vehicle purchases.

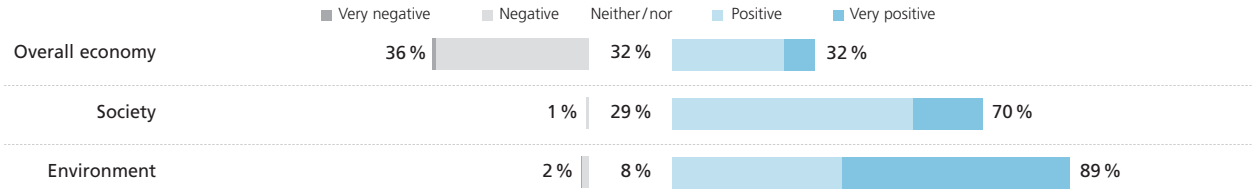


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 228)	0 %	1 %	25 %	18 %	13 %	43 %
EU experts (n = 46) [1]	0 %	7 %	17 %	9 %	15 %	52 %
U.S. experts (n = 21)	0 %	0 %	24 %	0 %	10 %	67 %
Other intern. experts (n = 16) [2*]	0 %	31 %	19 %	25 %	6 %	19 %
DNAdigital (n = 19)*	0 %	5 %	16 %	16 %	32 %	32 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, except Germany, Europe and the U.S.; *Fewer than 20 cases!
Basis: All people surveyed

Fig. IV.77: Thesis 131 Car sharing – relevance

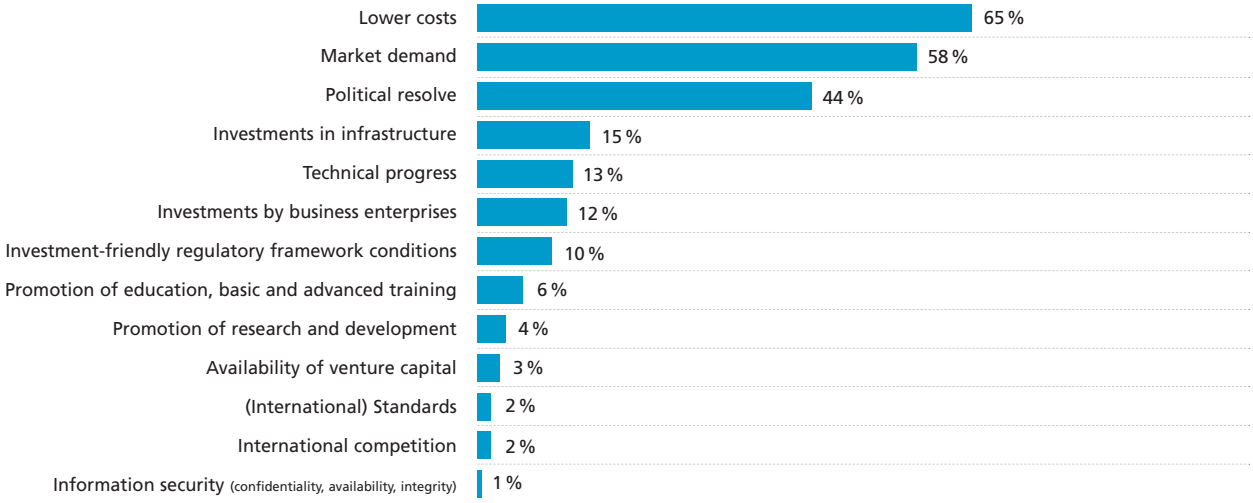
What impact will the validity of Thesis 131 above have on the areas listed below?



Basis: All people surveyed; Sub-group: GER experts, at least n = 337

Fig. IV.78: Thesis 131 Car sharing – drivers

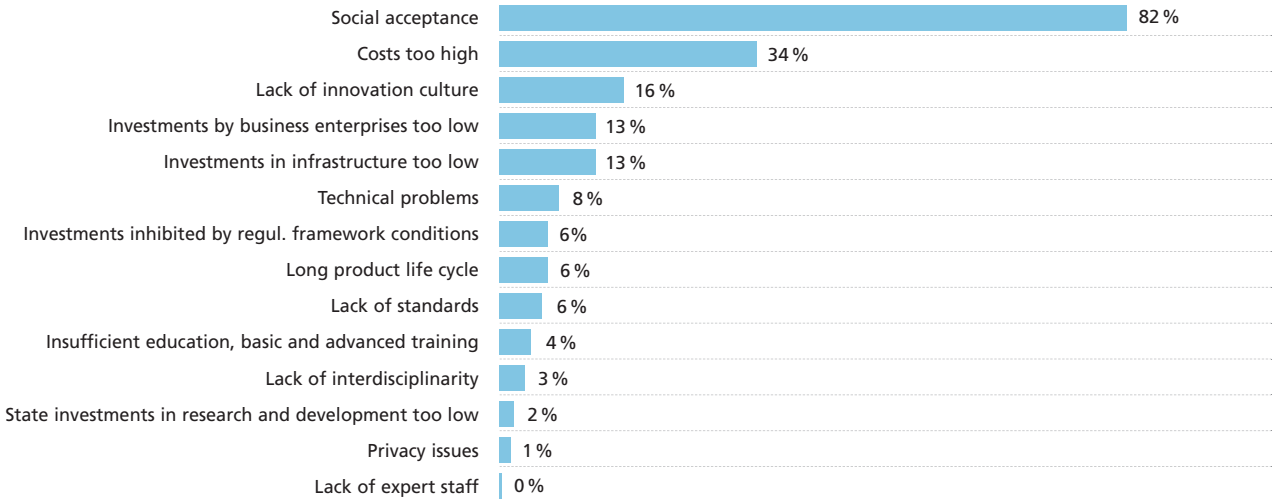
Select up to three drivers from the following list that you consider to be most important for realization of Thesis 131 above.



Basis: All people surveyed; Sub-group: GER experts, n = 262

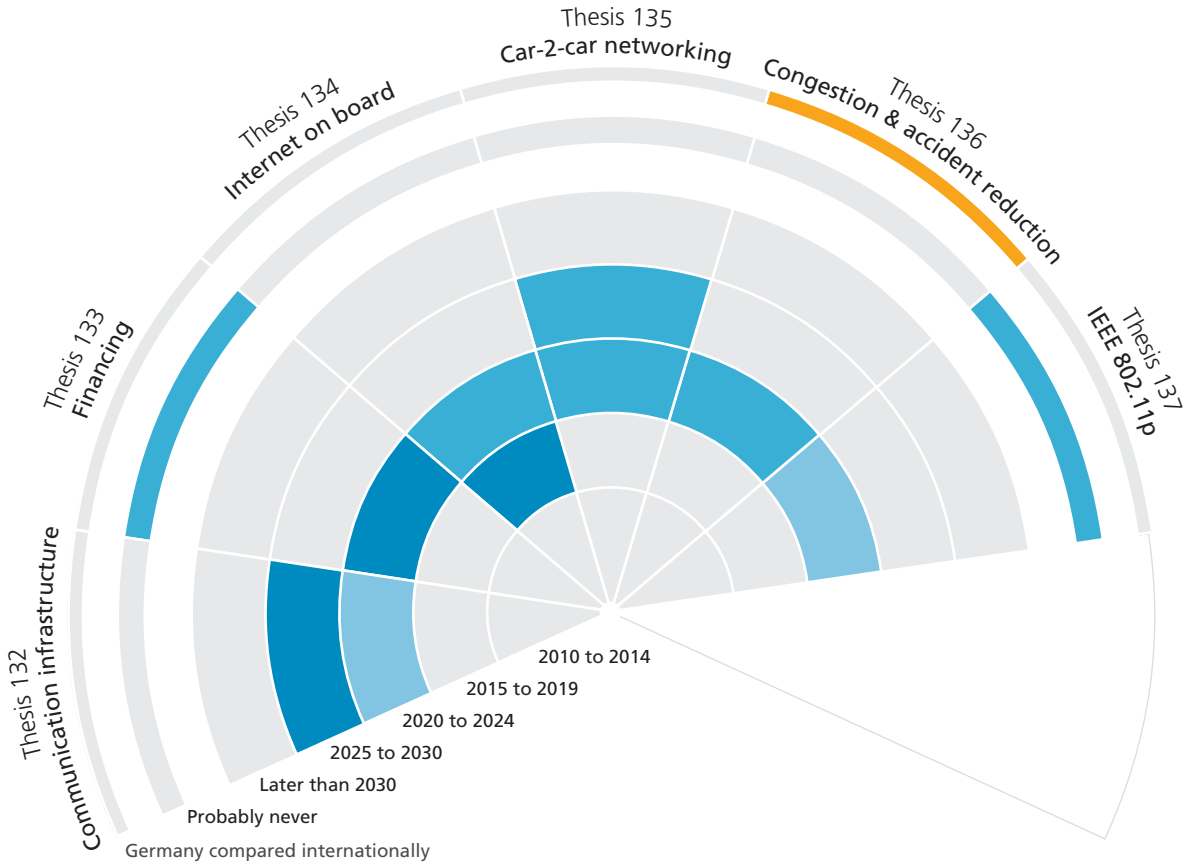
Fig. IV.79: Thesis 131 Car sharing – barriers

Select up to three barriers from the following list that you consider to be most important for realization of Thesis 131 above.



Basis: All people surveyed; Sub-group: GER experts, n = 270

IV.6.2 Infrastructure for vehicle communication
Future radar*: Forecast occurrences



Sub-group of GER experts: ■ ≥ 40 % of experts ■ 30 % – 39 % of experts ■ 20 % – 29 % of experts ■ < 20 % of experts
Germany in comparison: ■ pioneering role ■ on a par with global developments ■ lagging behind ■ not possible to say

Thesis 132: Communication infrastructure

In Germany, there is a common communication infrastructure that links security applications, traffic applications and commercial services.

Thesis 133: Financing vehicle communication

In Germany, the communication infrastructure in automotive traffic is refinanced by revenues from commercial services.

Thesis 134: Internet on board

In Germany, the Internet has become the central means of access to journey-related information in the vehicle (e. g., route planning, traffic information, danger warnings).

Thesis 135: Car-2-car networking

50 percent of all new cars in Germany exchange information with each other about traffic, the environment, etc. (car-to-car networking).

Thesis 136: Congestion and accident reduction

In Germany, new vehicle communication systems have resulted in a 50 percent drop in traffic jams and accidents compared to 2009.

Thesis 137: IEEE 802.11p

In Germany, communication according to IEEE 802.11p is being replaced by mobile technologies and their further developments, including in safety-related applications in vehicles.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

"Cooperative systems," ICT systems used by vehicles to exchange information with each other as well as with traffic management centers and data service providers using suitable wireless technologies, have major potential for improving traffic safety and avoiding traffic jams. They also create new ways of communicating with motor vehicles, potential that science, politics and industry are increasingly opting to exploit. Nonetheless, it is still not clear what form the future communication infrastructure will take, how regional and global coverage will be achieved and who will operate the networks and deliver the services.

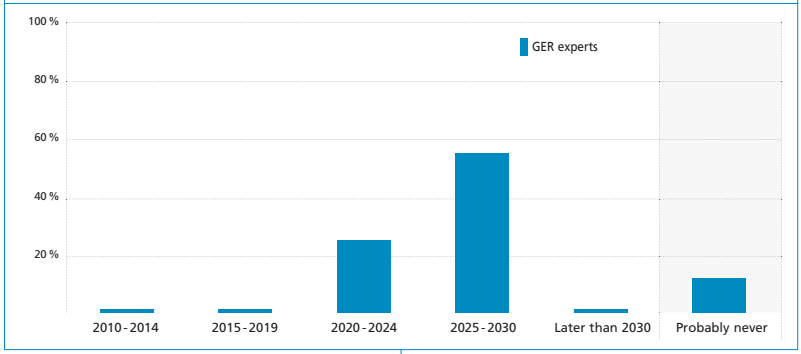
Coordination activities with road operators, traffic management centers, service providers, network providers and local authorities are, in addition to development of the technology, the key success factors for implementing a concept in which the automobile acts as a multifunction and modular network node. The relevance of the individual groups in the value chain depends on the services that customers prefer to use. Should these primarily comprise, for example, info and entertainment, service and communication providers will tend to dominate the market.

In the future, it will be possible to send hazard warnings in real time, transmit individualized information and entertainment services into cars, and make a broad range of data and information on traffic jams, emissions, accident details and ecological drive styles available. The main obstacles to their use will be economic viability and the adoption process, i. e., the availability of a sufficient number of vehicles with the necessary equipment and the requisite infrastructure for resilient communication. Reliability, benefit and attractiveness, coupled with realistic business models, are generally considered to be the instrumental factors in successful market launch and acceptance by customers.

Common infrastructure later than anticipated

The experts' answer to the question as to whether and when a shared communication infrastructure will be available for safety applications, traffic applications and commercial services, to replace the hybrid solutions, comes as some surprise: 55 percent of the GER experts forecast that this scenario will occur between 2025 and 2030 (see Fig. IV.80).

Thesis 132: In <country>, there is a common communications infrastructure that links security applications, traffic applications and commercial services.



As many as 26 percent of the people surveyed see implementation taking place five years earlier, while 13 percent are convinced that there will never be a common communication infrastructure. In concrete terms, the result means that we can expect various infrastructures to co-exist in the future. According to the experts surveyed, there will therefore be more than one option for exchanging data with the car in vehicle communication over the longer term.

This is reflected in the various prototypes now to be found in projects currently running vehicle-based communication. An EU mandate from the year 2008 stipulates that a dedicated communication channel will be provided for information relevant to safety, e. g., on collision avoidance, which will use a frequency band at 5.9 GHz reserved specifically for this purpose. Messages that are not relevant to safety such as the latest traffic news can be exchanged over alternative channels such as WLAN, UMTS, or their further development LTE.

The result reflects the experts' opinion that no communication network will offer the performance and nationwide availability required for a universal solution and cover all aspects of cooperative systems in the mid- to long-term. In its place, we are more likely to find hybrid systems, which will result in increased complexity for the players along the value chain for intelligent transport systems (ITS), above all when it comes to interoperability among the various systems and their synchronization with the different development cycles of telecommunication providers, the electronics and supplier industry and automobile manufacturers.

Cooperation and acceptance as central influencing factors

Among the drivers of this topic, experts consider technical progress (49 percent), international standards (43 percent) and investments in the infrastructure (40 percent) to be essential for this thesis to materialize (see Fig. IV.81). With 28 percent of citations, market demand is attributed a relatively low impact, as is political resolve and investments by business enterprises. The study makes it patently clear that the problem here will largely be one of harmonization and cooperation rather than a research and development issue. The two factors at the top of the list of barriers (see Fig.

IV.82) are insufficient investments in the infrastructure (45 percent) and lack of standards (42 percent). Overly high costs were actually quoted by 35 percent of the experts as obstacles to the thesis materializing. The data privacy aspect is also considered important, and actually ranges before technical problems here. This indicates that, at least in the German context, social acceptance is largely influenced by the regulations and security concepts that are agreed to govern dealings with the huge volume of data on movements, personal preferences and behavior patterns.

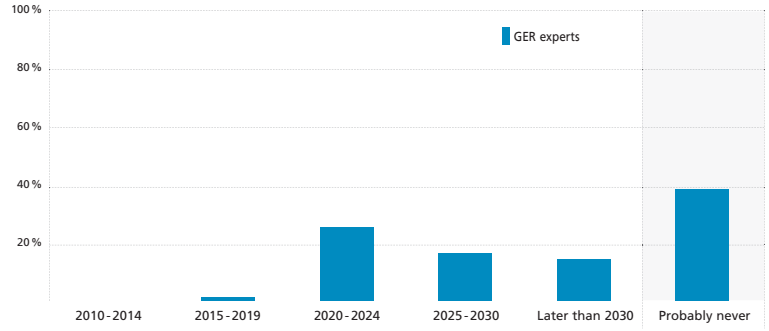
Information via the Internet

The study produced a clear result on the question as to whether the Internet will become the central point of access for travel information such as route planning, traffic news and hazard warnings: The experts all agree that future vehicle communication will take place over the Internet – around 55 percent of the GER experts expect this to be the case as early as 2019 (see Fig. IV.84). One challenge will be how to make the plethora of Internet information available in a form that complies with traffic and driver requirements. A clear trend is discernible in the direction of off-board navigation systems – a fact that is set to greatly reduce the cost of navigation in the future. A conceivable solution is central access via the car head unit and exclusive use of information made available by special service providers.

IEEE 802.11p confirmed for DSRC

What role can mobile communication technologies play in the future of vehicle communication? Will it be confined to a large-scale link to the infrastructure, information and entertainment offers, or will we see a trend toward safety-relevant applications in motor vehicles? These were questions that were put to experts in the Delphi Study.

Thesis 137: In <country>, communication according to IEEE 802.11p is being replaced by mobile technologies and their further developments, including in safety-related applications in vehicles.



The majority of the GER experts has considerable doubts on this score: 39 percent of experts are convinced that this will probably never materialize (see Fig. IV.87). Nonetheless, a quarter of the experts surveyed (26 percent) expect this scenario to occur in the period between 2020 and 2024. Even though a good third expects IEEE 802.11p to be replaced after 2024, there is clearly a trend among experts who doubt whether mobile communication technologies will be used for safety-relevant applications. The study therefore reinforces the current strategy in pursuit of a reliable interface via the WLAN-based DSRC standard IEEE 802.11p, with mobile communication as a complementary technology. The result correlates here with the assumed scenario where different network and infrastructure solutions will coexist in vehicle communication in the future.

Car-2-car networking available from 2020

The view on car-2-car networking is equally clear-cut. Asked when 50 percent of all new cars will be able to exchange information about traffic and the environment, 38 percent of the GER experts are convinced that this will be accomplished during the period 2020 to 2024. 31 percent expect it to take place between 2025 and 2030. 13 percent of the experts actually assume that this scenario will materialize as early as 2015 to 2019. Of note is the fact that none of the experts surveyed doubts that the new technologies will be introduced and implemented – none of them answered with "probably never" (see Fig. IV.85). The results of the study are clear evidence that we can expect different communication infrastructures to coexist in the mid-term. Again, the question arises as to what form suitable adoption scenarios will take in order to guarantee reliable functioning with only a low level of equipment. This also includes the issues of system interoperability and possible upgrade solutions for older vehicles.

Commercial services with infrastructure refinancing potential

In order to deploy reliable and secure communication systems, investments will have to be made not only in in-vehicle systems but also in the highway infrastructure, for example in roadside units that interoperate with traffic management systems to communicate journey-relevant information. Most interest shown in this topic comes from public agencies, federal states and local authorities looking to minimize accident black spots and traffic jams. Other parties interested in the commercialization of information are road operators and private traffic centers. Along with this topic's prospective users, the extent to which new areas of business can

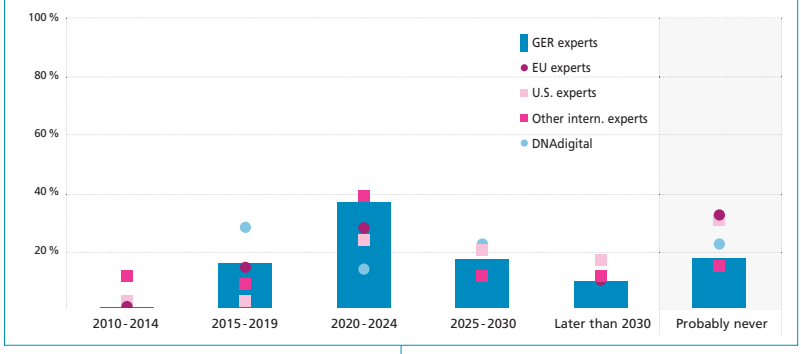
be generated from the new possibilities in vehicle access and the availability of mobility-related data is also still unclarified.

The experts for Germany differed in their answers to the question that asked whether the communication infrastructure in automobile traffic can be refinanced through earnings from commercial services (see Fig. IV.83). Over 60 percent believe that refinancing potential exists; however, more than one third disagree, and state that this will never be achieved (36 percent). Despite the fact that this result allows us to conclude that commercial services will become a business area of "automobility," they will not be sufficient to cover the necessary infrastructure investments.

High potential of modern vehicle communication will be exploited

In their appraisal of the benefits of modern vehicle communication, the experts were asked whether they thought new vehicle communication systems would reduce traffic jams and accident figures by half compared with the year 2009 (see Fig. IV.86). Over 80 percent of the experts for Germany think that new systems will make this scenario possible in the future. Over half of them expect it to occur by 2024 at the latest. The forecast at European level is far more pessimistic: One third of the experts do not see this potential and remain slightly behind the GER experts' estimate – only 44 percent expect this scenario to occur by 2024. The opinions expressed by the other international experts come close to those submitted by the experts for Germany. The U.S. experts expressed quite a different opinion. A third of the interviewees expects less potential than the experts for Germany.

Thesis 136: In <country>, new vehicle communication systems have resulted in a 50 percent drop in traffic jams and accidents compared to 2009.



This could be attributable to accident types, which show greater similarity in a comparison between Europe and Japan, for example, than between Europe and the U.S. The more positive assessment in Germany and at international level (incl. Japan) suggests that public awareness plays a significant role. Both countries see vehicle communication as a key driver in safety and traffic efficiency. Furthermore, players from politics and business are united in the need to promote these technologies. Despite regional differences, the survey confirms the overall high impact potential assigned to vehicle communication en route to accident-free driving.

Summary

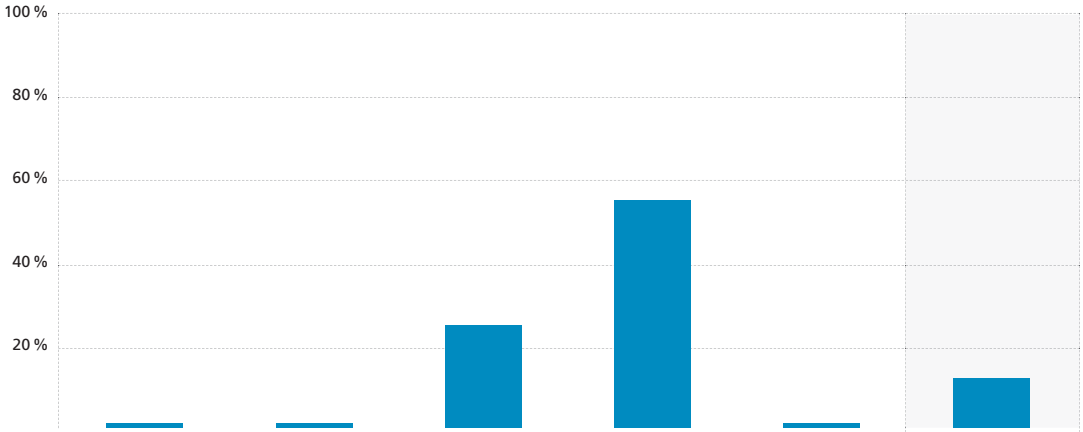
The results show that experts hold the current technology strategy for vehicle communication to be the right one for adoption of cooperative systems. They also confirm the high expectations of the potential of cooperative systems to guarantee more safety and effi-ciency. Largely positive appraisals were also submitted for the introduction of commercial services which could partly refinance the investments needed in the infrastructure.

On the other hand, the results indicate the need for major efforts to be made in order to develop the system features of existing communication networks to cater for data volumes, system response time and nationwide coverage at prices that are economically viable. On this aspect, a consistent technology chain and economically viable operating models could help accelerate the speed at which new products and services can be brought to market.

Theses on "Infrastructure for vehicle communication" in detail

Fig. IV.80: Thesis 132 Communication infrastructure

In <country>, there is a common communication infrastructure that links security applications, traffic applications and commercial services.

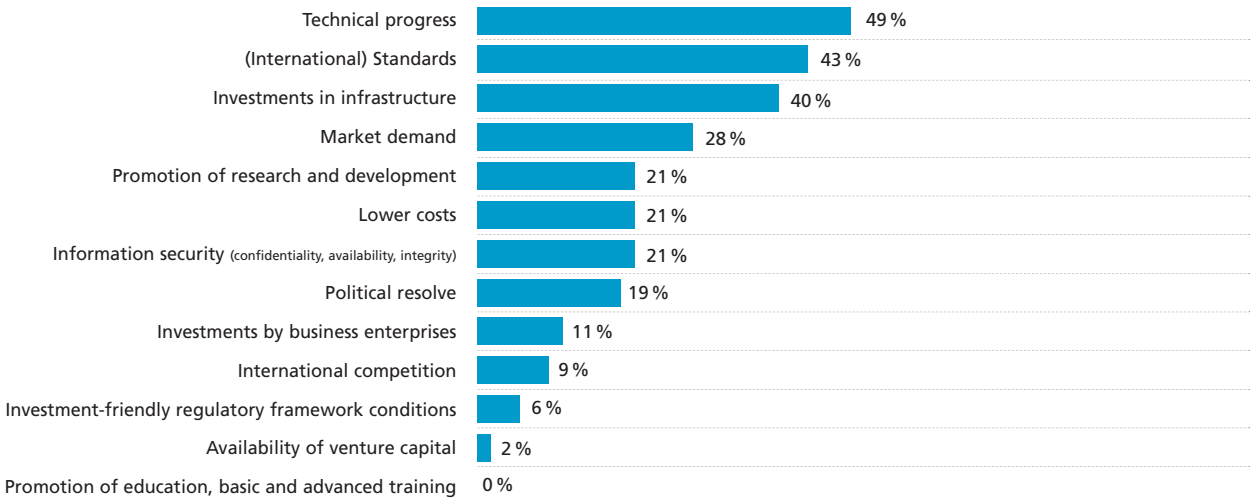


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 47)	2 %	2 %	26 %	55 %	2 %	13 %

Basis: All people surveyed with special expertise in the topic area

Fig. IV.81: Thesis 132 Communication infrastructure – drivers

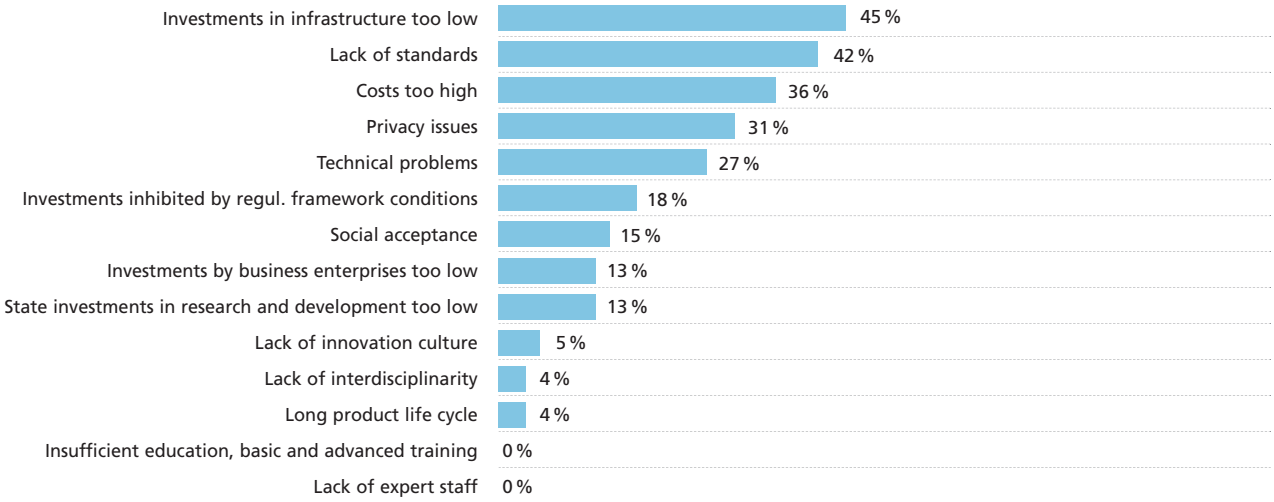
Select up to three drivers from the following list that you consider to be most important for realization of Thesis 132 above.



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n = 53

Fig. IV.82: Thesis 132 Communication infrastructure – barriers

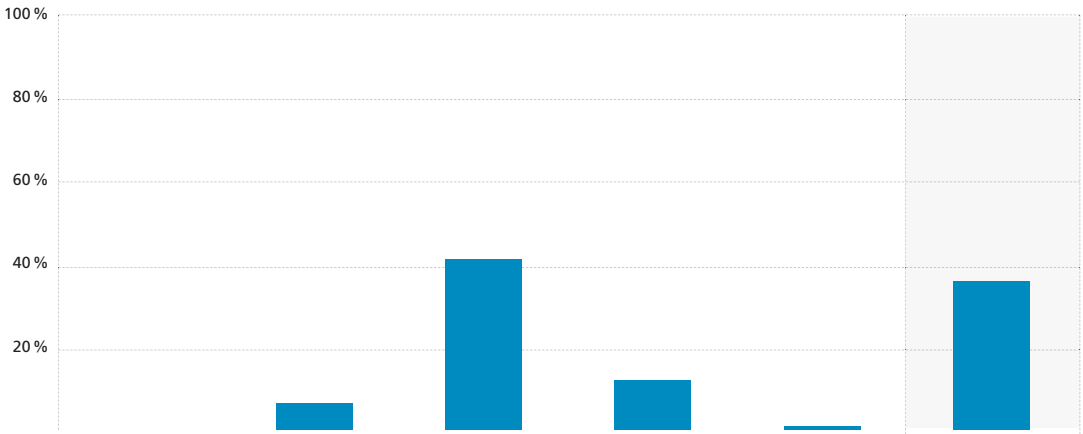
Select up to three barriers from the following list that you consider to be most important for realization of Thesis 132 above.



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n = 55

Fig. IV.83: Thesis 133 Financing vehicle communication

In <country>, the communication infrastructure in automotive traffic is refinanced by revenues from commercial services.

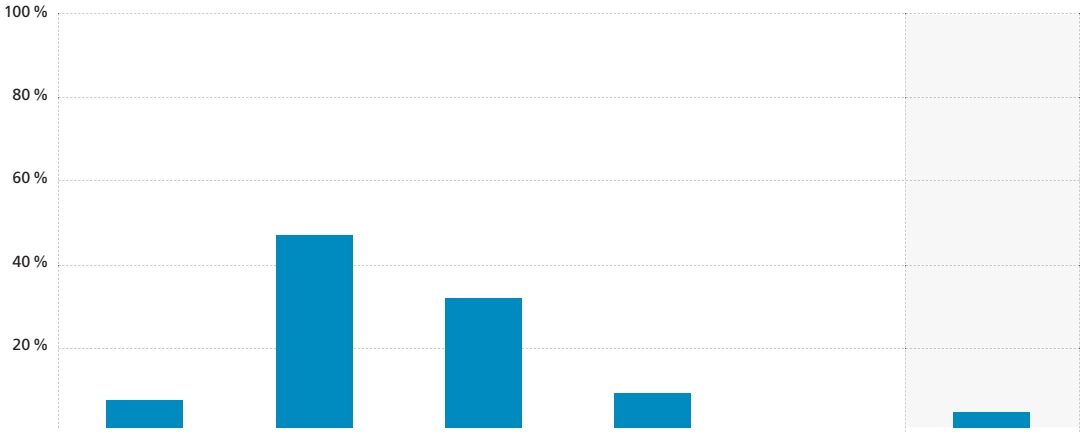


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 55)	0 %	7 %	42 %	13 %	2 %	36 %

Basis: All people surveyed with special expertise in the topic area

Fig. IV.84: Thesis 134 Internet on board

In <country>, the Internet has become the central means of access to journey-related information in the vehicle (e. g., route planning, traffic information, danger warnings).

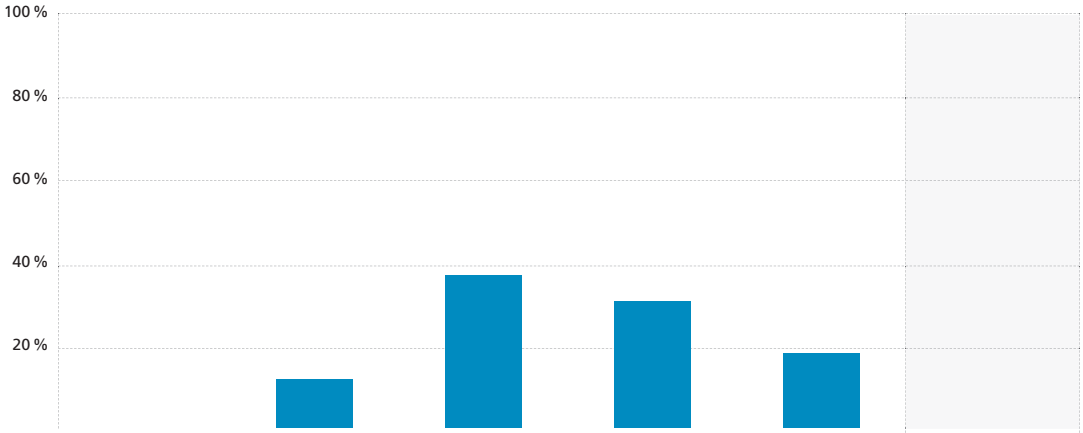


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 66)	8 %	47 %	32 %	9 %	0 %	5 %

Basis: All people surveyed with special expertise in the topic area

Fig. IV.85: Thesis 135 Car-2-car networking

50 percent of all new cars in <country> exchange information with each other about traffic, the environment, etc. (car-to-car networking).

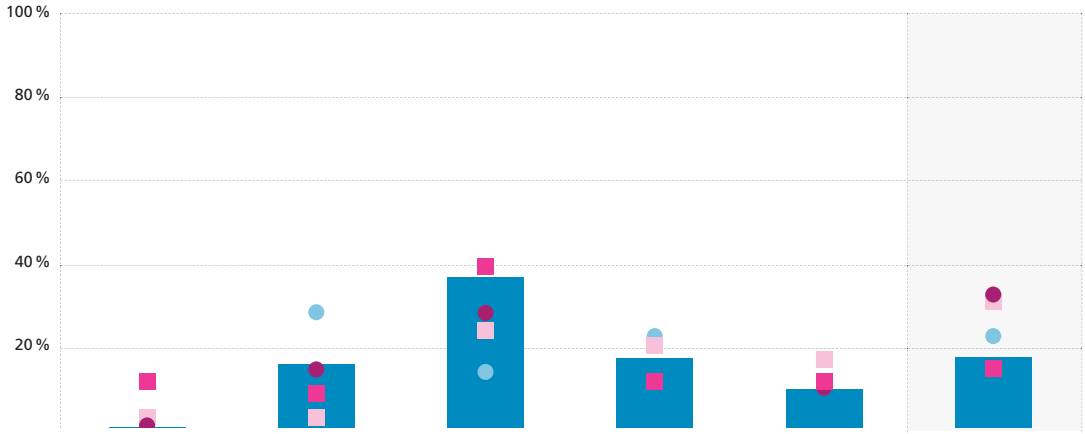


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 64)	0 %	13 %	38 %	31 %	19 %	0 %

Basis: All people surveyed with special expertise in the topic area

Fig. IV.86: Thesis 136 Congestion and accident reduction

In <country>, new vehicle communication systems have resulted in a 50 percent drop in traffic jams and accidents compared to 2009.

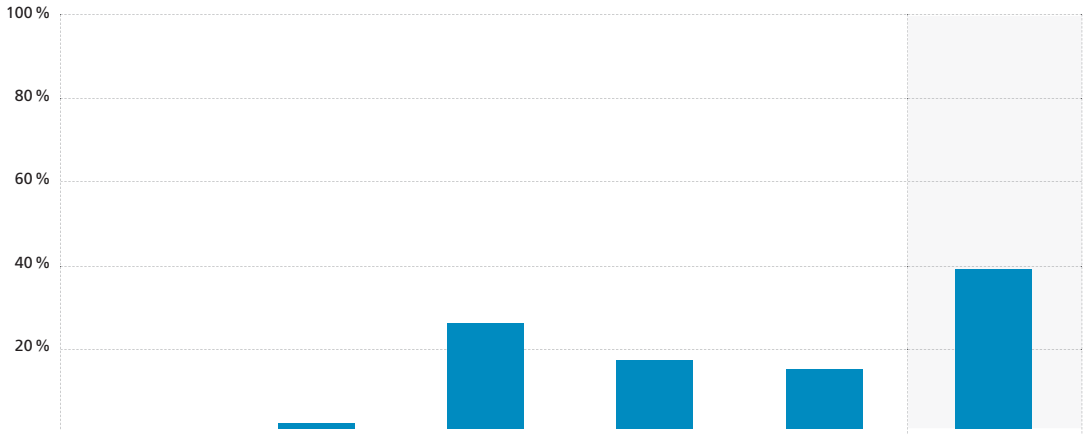


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 357)	1 %	16 %	37 %	18 %	10 %	18 %
EU experts (n = 67) [1]	1 %	15 %	28 %	12 %	10 %	33 %
U.S. experts (n = 29)	3 %	3 %	24 %	21 %	17 %	31 %
Other intern. experts (n = 33) [2]	12 %	9 %	39 %	12 %	12 %	15 %
DNAdigital (n = 35)	0 %	29 %	14 %	23 %	11 %	23 %

[1] Experts for European countries, excluding Germany; [2] Experts for other countries, except Germany, Europe and the U.S.
Basis: All people surveyed

Fig. IV.87: Thesis 137 IEEE 802.11p

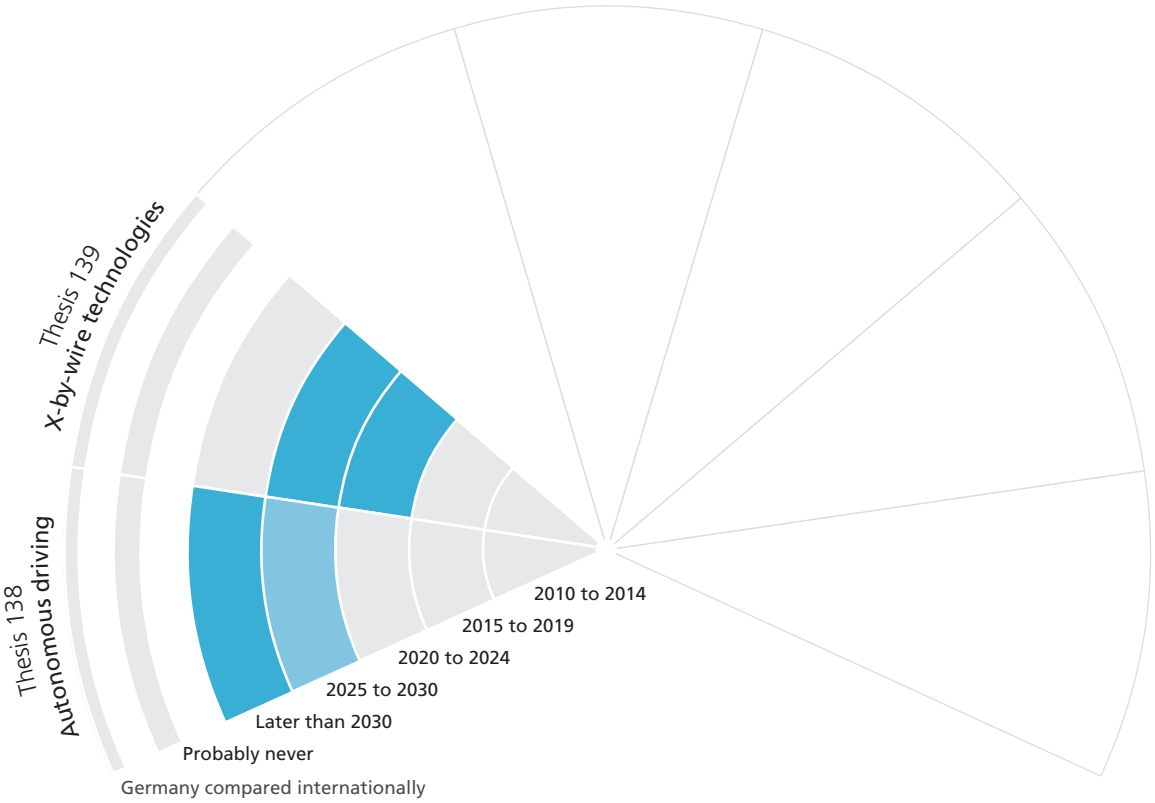
In <country>, communication according to IEEE 802.11p is being replaced by mobile technologies and their further developments, including in safety-related applications in vehicles.



	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 46)	0 %	2 %	26 %	17 %	15 %	39 %

Basis: All people surveyed with special expertise in the topic area

IV.6.3 Autonomous driving / x-by-wire technologies
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 138: Autonomous driving

In Germany, autonomous driving, meaning without the "driver" actively controlling the vehicle, is permitted in subsections of the traffic system.

Thesis 139: X-by-wire technologies

X-by-wire technologies (steer-by-wire, brake-by-wire, etc.) have replaced conventional systems in Germany.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

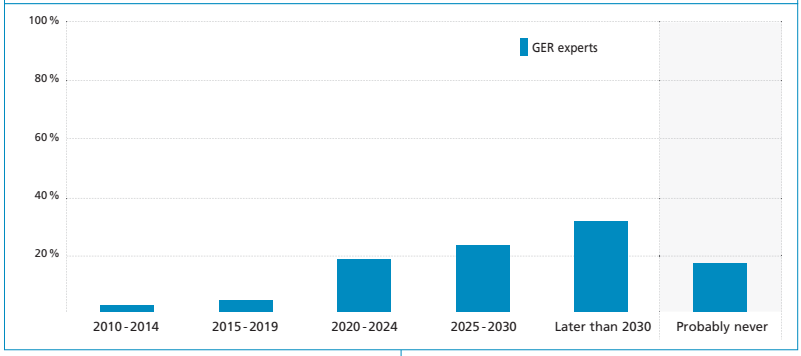
The debate on autonomous driving has been prevalent in the auto industry for more than two decades. Concepts of the term "autonomous" cover anything from fully automatic vehicle driving to the complete assumption of individual driving functions. Lately, however, the term "autonomous" has also been used in conjunction with proactive safety systems, system intervention that goes beyond a warning function when the driver makes an error. Backing the importance of this topic are statistics that prove 90 percent of accidents occur as a result of human error.

Whereas the initial development focus was placed on topics such as distance control and autonomous systems for logistics concepts, it was above all liability risks and high costs for system resilience (redundancy requirements) that brought development to a standstill. Development and roll-out of driver assistance systems, the availability of headway control, an emergency braking system, a lane departure warning assistant and comparable systems already available from many carmakers, have again served to raise interest in autonomous driving functions. Another contributing factor is the significant fall in the cost of components such as cameras, sensors and electronic control systems and their greatly improved efficiency.

Autonomous driving still a future vision

27 percent of the experts for Germany expect autonomous driving to be authorized for some traffic subsections by 2024 at the latest. One third of them is of the opinion that autonomous driving in some sections will not be approved until after 2030. Only 17 percent of people surveyed totally rule out the possibility of autonomous driving for the future (see Fig. IV.88). This leads to the conclusion that autonomous driving will materialize but that there are still significant obstacles to be overcome. One difficulty is the requirement laid down in the UNECE Regulation (the Vienna Convention) and actually dating from the days of horse-drawn vehicles, namely that drivers on public roads must maintain control over their vehicles at all times. This restriction still limits the warning and support functions of today's driver assistance systems.

Thesis 138: In <country>, autonomous driving, meaning without the "driver" actively controlling the vehicle, is permitted in subsections of the traffic system.



In a more detailed question about traffic subsections that will permit autonomous driving by the year 2030, a surprising forecast comes from 69 percent of the GER experts, who think that electronic distance control will be permitted by the year 2030 (see Fig. IV.89): even more so when compared with other features such as systems for automatic parking, and traffic jam and lane departure warnings. The experts are unanimous in their opinion that autonomous driving will not increase in general road traffic in the foreseeable future.

X-by-wire technologies on the advance

Answers to the question about the assumed spread of x-by-wire technologies are again surprising. 71 percent of the GER experts think it likely that they will appear in the period between 2020 and 2030 (see Fig. IV.90). We can therefore expect a further push for ICT in automobiles and replacement of conventional mechanical and mechatronics systems in steering, braking and the drive train.

In the construction of heavy vehicles, in particular, replacing the steering column would make it possible to reduce the vehicle's mechanical complexity and thus gain added safety through optimized crash response. The survey of experts suggests that it would be advisable to reassess x-by-wire technologies, which moved out of the limelight in recent years, due above all to the redundancy issue, which it was feared would generate uncontainable costs.

The renewed environmental debate has probably helped to change the attitude to x-by-wire. This concept makes it possible to save energy by reducing the weight, for example, of the steering system, which in turn reduces fuel consumption and the resultant emissions.

With introduction of the electric car, we can also expect the emergence of numerous new options for energy management and x-by-wire system reliability.

Summary

The experts who took part in the survey anticipate a positive development for autonomous driving functions and, in particular, x-by-wire systems.

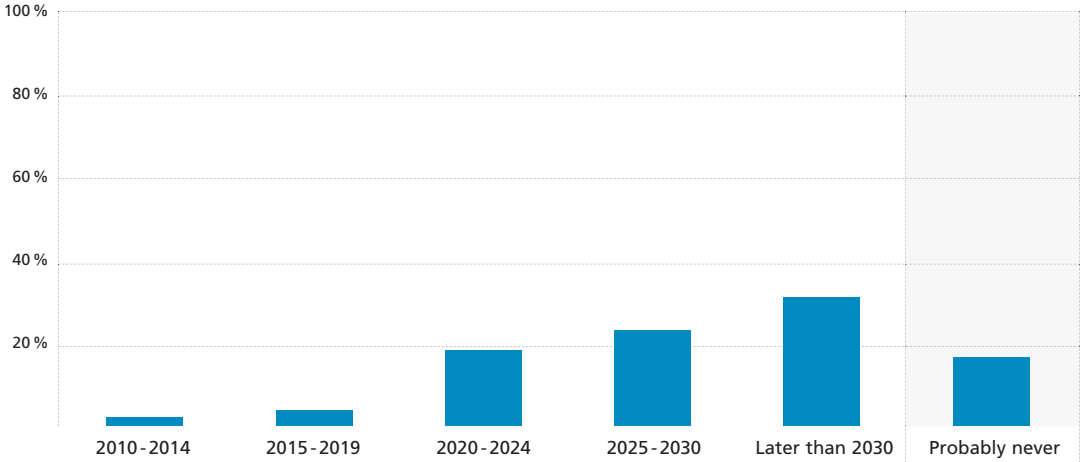
In the long term, this will require new discussion on interaction between drivers and autonomous systems as well as on the further development of today's vehicle architectures.

The extent to which the potential of autonomous systems will be exploited in the interest of greater safety on the roads is therefore likely to be one of the most exciting research issues in the coming years.

Theses on "Autonomous driving / x-by-wire technologies" in detail

Fig. IV.88: Thesis 138 Autonomous driving

In <country>, autonomous driving, meaning without the "driver" actively controlling the vehicle, is permitted in subsections of the traffic system.

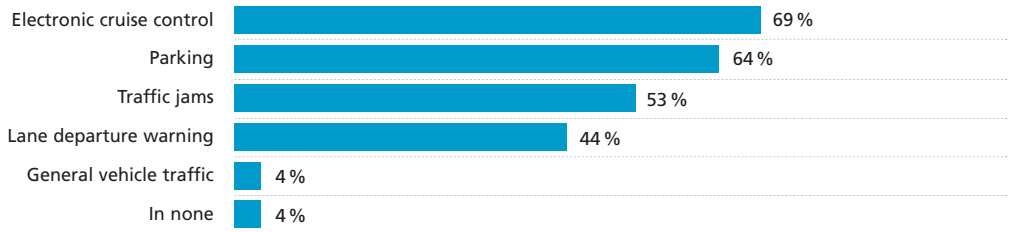


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 63)	3 %	5 %	19 %	24 %	32 %	17 %

Basis: All people surveyed with special expertise in the topic area

Fig. IV.89: Thesis 138: Autonomous driving – subsections

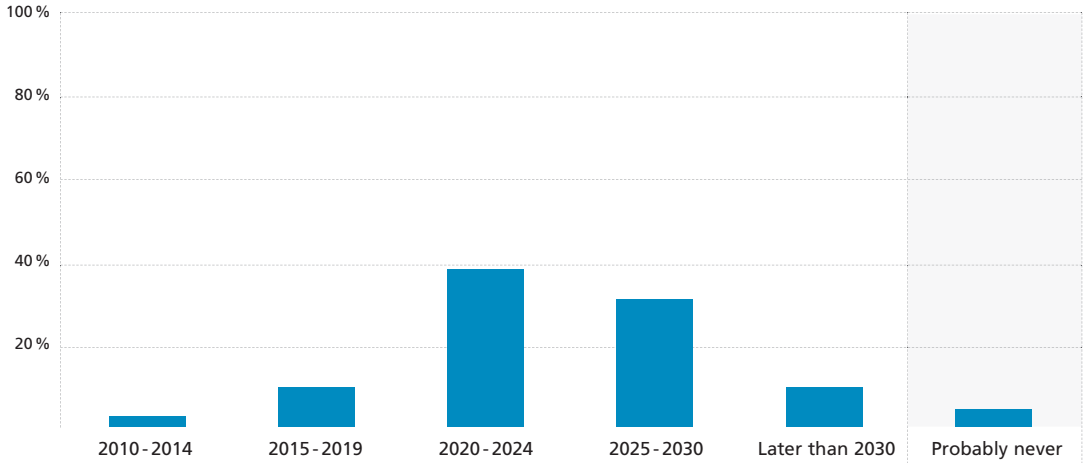
And in which of the following subsections will autonomous driving be permitted in Germany by 2030?



Basis: All people surveyed with special expertise in the topic area; Sub-group: GER experts, n = 55; multiple answers

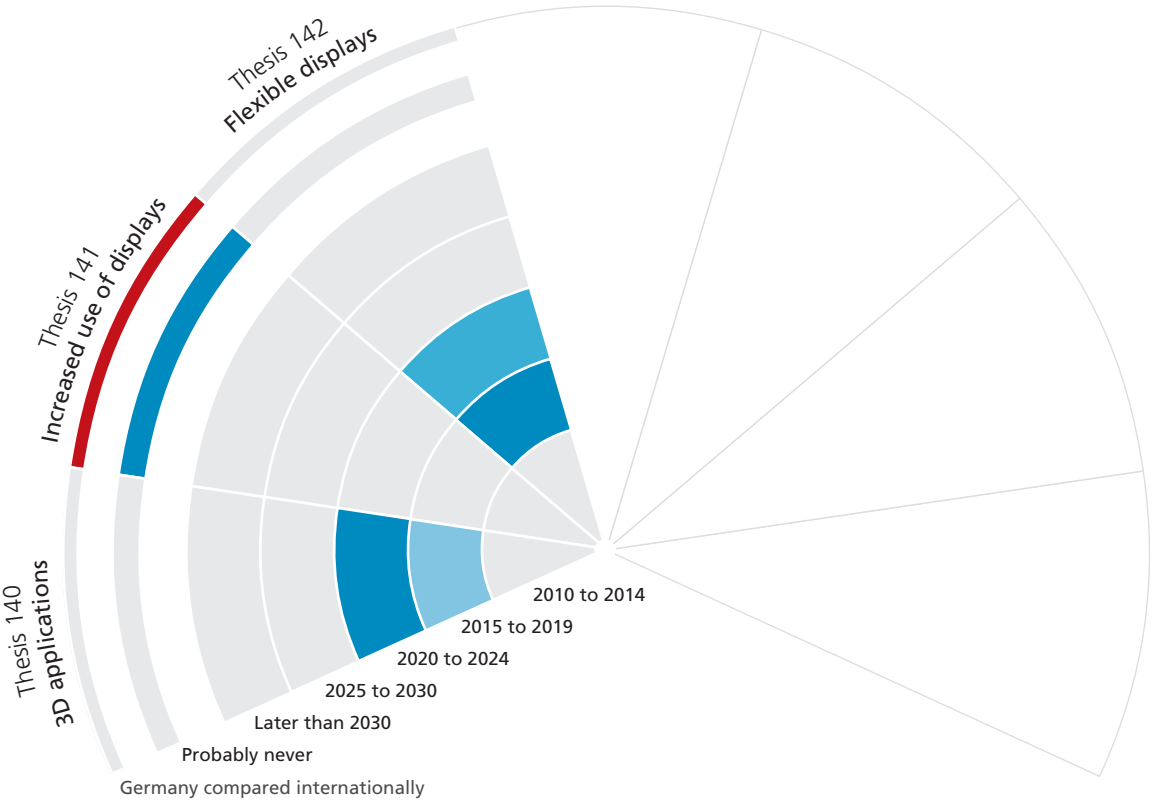
Fig. IV.90: Thesis 139 X-by-wire technologies

X-by-wire technologies (steer-by-wire, brake-by-wire, etc.) have replaced conventional systems in <country>.



Basis: All people surveyed with special expertise in the topic area

IV.7 Displays and 3D: Creating new value webs
Future radar*: Forecast occurrences



Sub-group of GER experts: ≥ 40 % of experts | 30 % – 39 % of experts | 20 % – 29 % of experts | < 20 % of experts
Germany in comparison: pioneering role | on a par with global developments | lagging behind | not possible to say

Thesis 140: 3D applications

3-D visualization and operating technologies are widely disseminated (e. g., for control and entry panels, product catalogues and entertainment offerings).

Thesis 141: Increased use of displays

More than half the fixtures in private households in Germany, such as mirrors, tables, refrigerators, etc., are equipped with displays.

Thesis 142: Flexible displays

Flexible displays that can be rolled together are available on the market.

* On the basis of Deutsche Telekom Technology Radar™ – registered trademark of Deutsche Telekom AG

Core results

Replacement of traditional CRT (cathode ray tube) displays, at the workplace for example, has already reached our homes. The advantageous shape and dramatically reduced manufacturing costs coupled with a range of special flatscreen technologies will continue to increase their use. This will not primarily be as a result of incremental technology developments but of a range of technology derivatives and new technologies that will open up new usage markets for items such as newspapers, books, signage, labeling and even illumination. These technology innovations will spawn new value webs, which will be swift to make the new skills and services mutually usable in changing target markets.

We find not only new monitors and TV appliances as strong drivers but also mobility, foldability, rollability, ultra-thin format, higher image quality, energy efficiency and usage in embedded systems and even clothing (see section III.9) among the new requirements. The resulting improvements to displays are leading to a progressive infiltration of our daily lives, in households, offices, transport and public spaces, right through to the omnipresent work displays. Additionally, diversity will be enhanced by display technologies in projectors - pico projectors for glasses, mini projectors in mobile devices as well as the numerous home and professional projectors – and the broad range of micro displays for areas ranging from near-to-eye applications through to media facades.

Display technologies promote new media formats and skills

Display technologies are developing at lightning speed all over the globe - from translucent and reflective technologies to hybrid systems designed to combine the advantages of the different technologies. These could include different operating modes that can be changed quickly, e. g., a backlight mode in which the backlight is only activated for maximum color saturation, or an e-paper mode that consumes less electricity. e-paper mode makes it far easier for users to read screen contents in sunlight than is possible with most standard displays - to mention just one of the many new technology developments.

However, new display technologies also often incorporate new technologies and methods for image processing, image transmission, or add-on technologies for image viewing and for interaction with the image contents.

This spawns the need for additional skills and products, whose development will provide new opportunities for market positioning.

Image processing – Adapted image processing algorithms for 2D and 3D worlds, synthetic or real, graphics processing on displays and the further development of scanners for object and space perception for 3D content are just a few of the examples of future challenges that are expected to be met by individual display technologies in the image processing segment.

Image transmission – Higher image frequencies at top resolutions will require continued major efforts to keep transmission rates for image delivery in line with the new needs. This applies to embedded systems as well as to the compression algorithms for transmission between interconnected systems in networks and to near-range wireless transmission.

Image viewing – The further developments in viewing glasses and systems where no glasses are required, special technologies for perspective adjustment to 3D structures, and context-sensitive provision of additional know-how (augmented reality) are new design areas along the specific path to a 3D future.

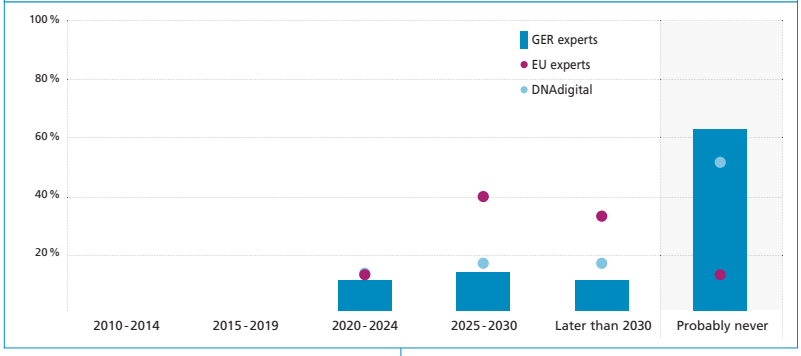
Interactivity – Interaction with static and dynamic screen contents, real-time requirements and several concurrent input streams is gaining dominance depending on the usage environment and the display size. Whereas in the past it represented an autonomous input channel, it is now advancing to become an interactive system: touchscreen, gesture recognition, voice control, applications such as telepresence, augmented reality, games, interactive walls and tables are the driving factors in this field.

Displays invade the household

According to the experts for Europe, the pervasion of household implements such as mirrors, tables or even refrigerators with displays, and thus additional intrinsic functions, will be slow. A total of 53 percent of the Europe experts estimate that half of household fixtures will be thus equipped by 2030; 13 percent of them think this will already occur between 2020 and 2024. The trend is, however, completely rejected by the GER experts and DNAdigital: 36 of the GER experts and 48 percent of the DNAdigital group expect that, if the thesis materializes, it will not do so until after the year 2020.

The majority, 63 percent of the GER experts and 52 percent of the DNAdigital group, completely negates this thesis and assumes that it will never materialize (see Fig. IV.92). The estimated slow advance of displays for most household fixtures could be explained by various known trends, now developing in parallel.

Thesis 141: More than half the fixtures in private households in <country>, such as mirrors, tables, refrigerators, etc., are equipped with displays.

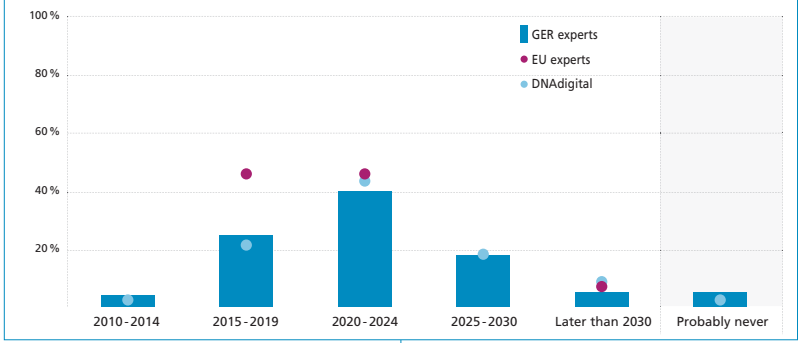


Firstly, for example, intrinsic intelligent functions in household appliances, such as operation support, product memory, problem reports, function optimization and control of operating efficiency, can be visualized via near-range communication with a local household data manager on various media displays (large media screens, daylight projection, interactive walls, interactive spaces) available around the house, which are primarily intended for home applications such as TV, Internet, communication and home computing. Secondly, universal mobile devices that are carried close to the body can be used via near-range communication as multifunction displays to make intrinsic functionalities available to individual household implements.

Flexible displays will be in day-to-day use

New application areas can be created with flexible displays. The focus here is on paper, often in the metaphorical sense: smart documents, newspapers, magazines and books. These applications are largely mobile and focus, in particular, on the use of low-energy concepts, the user interface and day-to-day operations. The experts submit a highly positive assessment for technology developments in these applications.

Thesis 140: 3-D visualization and operating technologies are widely disseminated (e. g., for control and entry panels, product catalogues and entertainment offerings).



Flexible displays that can be rolled up will, according to 77 percent of the experts for Europe, be available on the market between 2015 and 2024. 62 percent anticipate that this will occur earlier, between 2015 and 2019. The majority of the GER experts (41 percent) and members of the DNAdigital group (32 percent) also expect the thesis to materialize within this period (see Fig. IV.93). This development is likely to be followed by other areas of application for the design of curved surfaces (colors, patterns, texts, im-ages), even going as far as use in new illumination concepts.

3D in everyday use: Three dimensions for ICT and media

Three-dimensionality is not really new – people have always had the desire to see spatial images. Hence, ever since photography began, images have been recorded stereoscopically and displayed with complex optical apparatus. The first patents for 3D film technology were applied for before the beginning of the last century, and the first 3D movie, "The Power of Love," made its debut in Los Angeles in 1922. Since then, 3D has regularly experienced a brief renaissance, e. g., in the 50s, 80s and 90s, but never lasted long.

This seems set to change in the future. 65 percent of the GER experts expect 3D to spread broadly in the market, not only in the entertainment segment but also in product catalogs and control and input panels, in the period 2015 to 2024. According to the experts, a regular boom is imminent – and 92 percent of the experts for Europe and 66 percent of the DNAdigital group also subscribe to this opinion (see Fig. IV.91).

The reasons for the breakthrough of 3D are undoubtedly the convergence of various trends, e. g., the availability of higher transmission bandwidths, embedded graphics processing and improved display quality. In the case of linear content, additional reasons include current technology developments in production as well as the display of three-dimensional content. Other factors are the technology leaps achieved for interactive content both in the area of real-time generation and the user interfaces. Increasingly, spatial sensors are turning the latter into "user spaces," which will find application in both the entertainment and the labor and science sectors. The following fields are triggers and accelerators that can also be viewed as indicators of potential in the 3D growth market.

Producing linear content (3D movies)

In the analog age, the production of stereoscopic recordings was time and cost-intensive: the reason for this was that stereoscopic recordings that were not produced with sufficient precision soon led to major disturbances in visual perception among viewers. These can include dizziness, headaches or loss of orientation. To avoid this, scenes were subsequently presented in a flatter rather than a spatial format, thus creating a low-quality three-dimensional impression. This deficit is completely avoided in the case of fully computer-generated cinema movies (e. g., from Disney/Pixar) through calculation of a second separate image based on interocular distance. Today, digital image processing and correction technologies therefore permit precise convergence and synchronization of individual images in the recording of "real" scenes and eliminate this problem. The result is a sensational, deep 3D impression that can be viewed for longer periods.

Displaying 3D content

Special projection systems were traditionally deployed for 3D content. At the start, two-color anaglyphic systems were used, known as "red-green glasses." Since these do not permit any color consistency and also create "ghost images" (in which parts of the image for one eye are also visible to the other), the impression is of lower quality and is ultimately only a gimmick for the user.

Polarization methods made the first improved systems possible. However, these required two separate but precisely synchronized and spatially adjusted projectors.

Readjustments by expensive specialist personnel were constantly necessary and were only available to a few cinemas (e. g., Imax). It was not until the advent of digital projection systems and newer glasses systems that viewing became cheaper to operate and provided users with a high-contrast, bright, true color impression, whose added value is so high that they gladly "tolerate" the necessity to wear glasses. Screen technologies such as plasma, DLP rear projection and LCD are available as alternatives to projectors in the home environment, and will also be usable for 3D technologies in the future, thanks to a high frame rate (120 Hz). Furthermore, research is being carried out into effective autostereoscopic screens and holographic display methods that do not require viewers to wear glasses of any kind.

Driven by commercial success

A current accelerator of the 3D trend is, of course, the economic aspect: By bringing 3D projection systems to market, cinemas and Hollywood studios have launched an attack on user churn to improved "home cinemas" and commercial piracy. They have established that consumers appreciate the added value of 3D, that they are willing to pay more for this than for a two-dimensional experience, and therefore go to the cinema more frequently again.

Equally, consumer electronics firms expect 3D cinema to push home viewing and possibly trigger new product launches, as happened in the past with color images, multichannel audio and wide-screen TV. At this year's CES and IFA fairs, all the leading consumer electronics firms announced the future appearance of three-dimensional displays and distribution systems (e. g., three-dimensional compression formats in the form of Bluray 3D – "Live in it").

Three-dimensional interactivity

Interactive content has to be generated in real time. In the past, this was only possible in the case of 3D content by producing three-dimensional films on huge render farms over periods lasting weeks and months. The development of 3D technologies for PCs now makes it possible to display virtually photorealistic images in real time. Initially, this move was driven by the development of computer games but, most recently, has led to the advent of 3D-like interfaces in operating systems, e. g., Vista's Aero and Apple's Aqua. At the same time, the user interface will transform into a user space:

Gesture sensors and spatial sensors are already part of them – both on games consoles as well as mobile handsets.

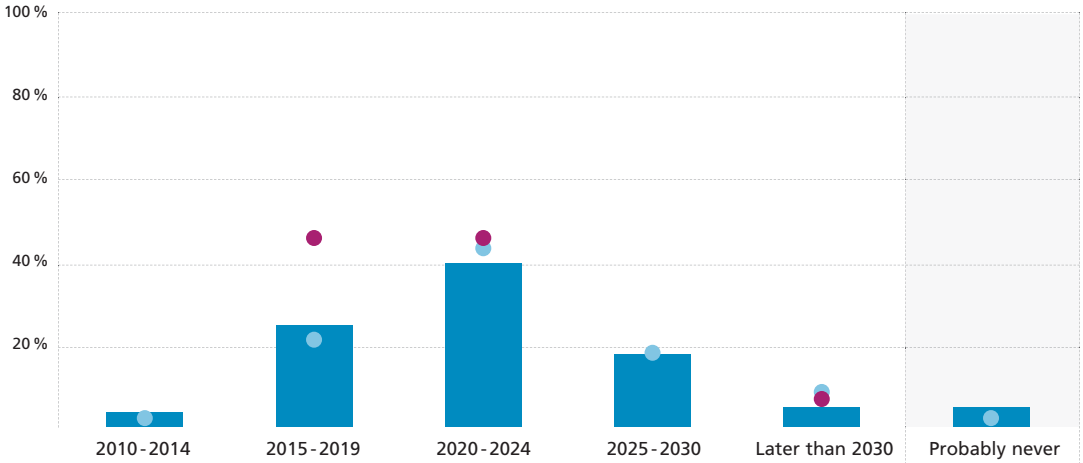
The combination of three-dimensional gestures and real-time display will make true 3D possible in the future. This happens when scenes are generated for viewers from their individual viewing perspectives, a move that will transform screens into true "windows on other spaces." The next step will subsequently be achieved as the result of research into haptic feedback, which will be used to make three-dimensional spaces "feelable."

However, the convergence of these different trends will find application not only in entertainment technologies: 3D makes it possible to present complex structures far more accurately and to make more information available, since a "space" can, of course, contain more than a simple "image." This means that such systems will gain a firm foothold in a broad range of different fields, certainly including traditional German industries such as medical engineering (e. g., in control of robotic surgical systems), mechanical engineering and communication technology.

Theses on "Displays and 3D: Creating new value webs" in detail

Fig. IV.91: Thesis 140 3D applications

3-D visualization and operating technologies are widely disseminated (e. g., for control and entry panels, product catalogues and entertainment offerings).

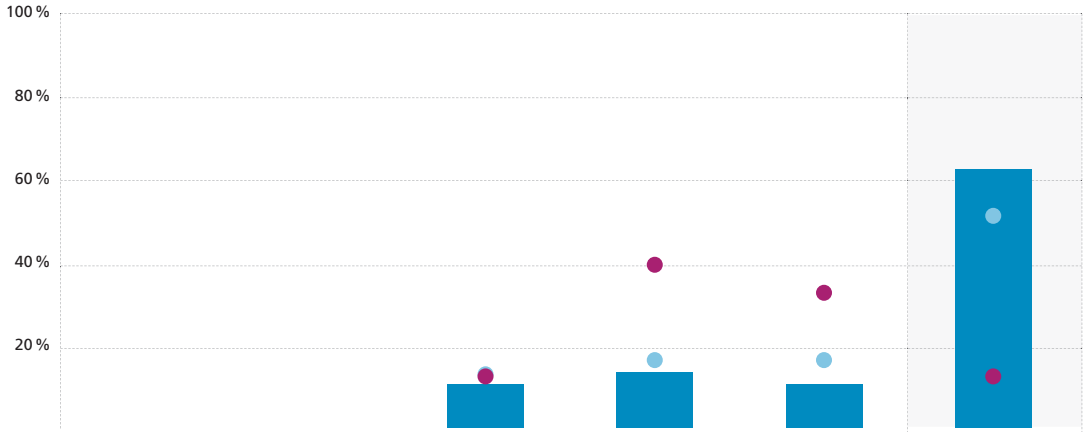


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 87)	5 %	25 %	40 %	18 %	6 %	6 %
EU experts (n = 13) [1]*	0 %	46 %	46 %	0 %	8 %	0 %
DNAdigital (n = 32)	3 %	22 %	44 %	19 %	9 %	3 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.92: Thesis 141 Increased use of displays

More than half the fixtures in private households in <country>, such as mirrors, tables, refrigerators, etc., are equipped with displays.

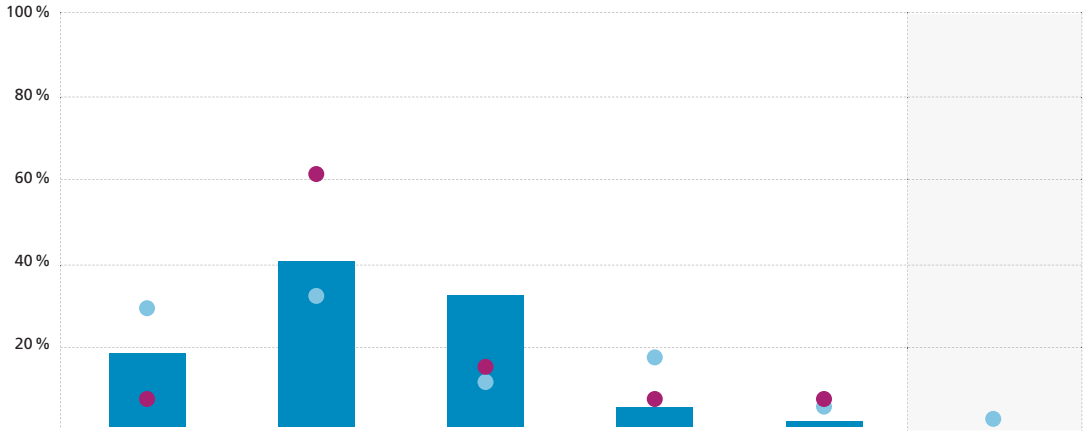


	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 70)	0 %	0 %	11 %	14 %	11 %	63 %
EU experts (n = 15) [1*]	0 %	0 %	13 %	40 %	33 %	13 %
DNAdigital (n = 29)	0 %	0 %	14 %	17 %	17 %	52 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

Fig. IV.93: Thesis 142 Flexible displays

Flexible displays that can be rolled together are available on the market.



	2010 - 2014	2015 - 2019	2020 - 2024	2025 - 2030	Later than 2030	Probably never
GER experts (n = 86)	19 %	41 %	33 %	6 %	2 %	0 %
EU experts (n = 13) [1*]	8 %	62 %	15 %	8 %	8 %	0 %
DNAdigital (n = 34)	29 %	32 %	12 %	18 %	6 %	3 %

[1] Experts for European countries, excluding Germany; *Fewer than 20 cases!
Basis: All people surveyed with special expertise in the topic area

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Publishing information:

Published by:

MÜNCHNER KREIS e. V.
www.muenchner-kreis.de

European Center for Information and Communication Technologies (EICT) GmbH
www.eict.de

Deutsche Telekom AG
www.telekom.com

TNS Infratest GmbH
www.tns-infratest.com

Design and production:

Kathleen Susan Hiller
www.viaduct-b.de

Translation:

Corporate Language Management, Deutsche Telekom AG
(The English version of the Delphi Study is a translation of the German original)

Photos:

Title: © Mikhail Tolstoy (fotolia.com); collage: © Saniphoto (fotolia.com)

Print:

Rasch Druckerei und Verlag GmbH&Co. KG
www.raschdruck.de

ISBN: 978-3-00-029565-2