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Futures Studies and Future-oriented Technology Analysis
Principles, Methodology and Research Questions

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Abstract

Futures studies are the scientific study of possible, desirable, and probable future developments and scope for design, as well as the conditions for these in the past and in the present. Modern futures studies assume that the future is not entirely determinable and that different future developments ('futures') are possible and there is scope for design. They are based on the realization that there are indeed a great number of possible futures but that these are not arbitrary. The term 'Future-oriented Technology Analysis' refers to potent changes and challenges for futures studies at the interface of technological change with increasingly science-based innovation, attention to societal issues and concerns.

Futures Studies and Future-oriented Technology analysis are concerned with complex dynamic systems and processes and engage multiple stakeholders in participatory and interdisciplinary processes to assure distributed understanding and sustainable development.

The article discusses principles and context of Futures studies and Futures analyses methodology. It puts forward five core research lines to outline Futures studies contribution to addressing issues in the research area of Internet & Society.

Keywords

future studies, foresight, future-oriented technology

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Futures Studies and Future-oriented Technology Analysis: How Research on the Future is Employed

Introduction

Since time immemorial humans have been fascinated by predicting the future and attempting to recognize and shape future developments. The literature of antiquity contains a wealth of evidence that the ancient Greeks and Romans, as well as numerous other cultures, shared this interest. Until the late Middle Ages, information about the future was largely the product of speculation. Think, for example, of the Oracle at Delphi. In particular, people sought predictions about natural phenomena, such as periods of sunshine, rain, or storms, but prognoses about economic, technological, military, and political events were also popular. People clearly believed that knowing about future events would give them practical advantages by permitting them to influence the future or promote desired outcomes.

In the eighteenth and nineteenth centuries, as the spread of technology rapidly accelerated during the Industrial Revolution, future opportunities became increasingly important for decision-making in the present. The explosive growth of industry, technological infrastructure, and new scientific military techniques began to change living conditions at a previously unimaginable rate, especially in rapidly expanding cities and industrial regions. The future of each individual and of society as a whole looked far less like the past or the present than it ever had before. Those who did not want to deal with the possibilities of the future were at far greater risk of being sidelined or being pushed toward possible futures they had neither desired nor chosen. Yet discussions about possible futures remained largely speculative or exclusively focused on the technological and industrial aspects of impending developments. Questions about the future were increasingly determined by innovations in science and technology. More importantly, conceptions of the future increasingly focused on one single path, that of the scientific-technological-industrial expansion of all aspects of life. This tunnel vision of a future determined by science and technology affected agriculture, home economics, the production of goods and services, domestic security, military technology, consumption patterns, the health care system, and even leisure and

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culture. The path of technological-industrial advance was soon promoted as representing progress itself and questions about the future, and possible ways of shaping the future, culminated in the search for technologically innovative solutions.

Largely as the consequence of having chosen this path of science and technology, other impending problems became evident in the nineteenth century — economic and social disparities rife with conflict, imbalances in military technology that threatened world peace, grave environmental liabilities, and the rise of certain diseases characteristic of modern societies. And yet it was not until the 1930s and 1940s that specific research methods were developed, primarily in the United States, to reach scientific understanding of the future that facilitated practical midrange strategies. Prior to this, philosophy, theology, and the social sciences had been dominated by utopias — speculative, comprehensive designs for the future and historico-philosophical models of society — such as Thomas Moore's Utopia, Tommaso Canpanella's The City of the Sun, or the social scenarios of the utopian socialists; other examples are the historical and social models of Hegel, Marx, and Engels, and of Herbert Spencer, Henry Adams, and Oswald Spengler. In the history of science and theory, there were only the two extremes of speculative philosophical utopias and models of society on the one hand, and the limited projections of scientific technological processes on the other. There was no room for a science-based approach to the future or for designing midrange strategies for achieving possible, desirable futures.

The Formation of Modern 'Futures Studies'

The influence of both the American pragmatists (Peirce, James, Mead, and Dewey) and the American scientific tradition led to new paths for a systematic method of studying the future. It is no coincidence that concepts such as game theory, systems and models theory, cybernetics, the Delphi method, and the scenario method were all developed in the United States. Modern futures studies could only have been born in the U.S. academic environment, where there was acceptance for crossing traditional academic disciplines and for inter-

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and multi-disciplinary cooperation, and where collaboration between science, business, politics and economics was not taboo.

Although the new scientific approach to strategies for the future was never limited to specific topics, a strong emphasis continues to be placed on questions of science and technology. Few would disagree that in today's industrial society—and even with the transition to a knowledge-based society—substantial insights into the future will most likely result from the opportunities and perspectives opened up by developments in science and technology. Considering this bias, it is even more significant that contemporary futures studies have become increasingly aware of the consequences and risks of the dynamics of technology and industry. This new awareness began in the 1960s and resulted primarily from the emancipatory civic movements such as the social and student movements, the peace movement, the environmental movement and the women's movement.

The Scandinavian countries were the first to place important questions about the future within the framework of scientific, political, and economic consulting, with the objective of shaping society, the economy, and the environment in more humane ways. In Germany, it is equally evident that the most relevant issues of the future are defined by the consequences of technological and economic development. Some examples are the glaring global economic, ecological and social disparities; the potential consequences of nuclear, biological, or chemical weapons of mass destruction; the power imbalance between the industrial and the developing nations. The population explosion in the third world; the increasing pressures on the biosphere; the severe imbalance in rights to exploit natural resources; the trend toward individualization; demographic changes in the industrial nations; and globalization in general are also challenges linked to development.

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Limits to Growth: A Groundbreaking Futures Study

Perhaps the most exemplary of the groundbreaking futures studies that have influenced our thinking is Dennis and Donella Meadows's 1972 study, The Limits to Growth. Like no other report, it caught the attention of the public, provoked scientific debate, and caused a major reorientation in politics, industry, and civil society. This in turn led to a flood of scientific follow-up studies. This seminal study was commissioned by the Club of Rome — an association with a membership of approximately one hundred individuals of stature in the sciences, industry, politics, and cultural studies from more than 40 nations — which was founded in 1968 by the Italian industrialist Aurelio Peccei and by Alexander King, then the OECD director general for science and technology. The Meadows study was the first scientific study that did not paint global development in rosy shades, extolling a future fueled by technological progress. Instead, it described the far likelier paths of economic growth, global population explosion, and the consequent depletion of natural resources from the stance of systems theory. At the same time the study sounded an unmistakable warning about limits to the pressure we can put on our natural and social environments. Because of the highly effective way in which these scientific findings were brought to the public, there is no doubt that The Limits to Growth marked a turning point in the way we look at questions about the future of the planet.

The basic simulation model WORLD3, based on Jay Forrester's Industrial Dynamics, permitted not only qualitative but also quantitative forecasting of the complex interrelationship between industry, the environment, and populations at a global level. This study, numerous subsequent global models developed by other teams of scientists, and the global scenario Beyond the Limits (1992) developed twenty years later, had a tremendous influence on the policies of the United Nations, the European Union, and numerous nation states. For example, the principal results of the UN Conference on Environment and Development in Rio de Janeiro, and the content of the United Nations Millennium Declaration (2000) would have been impossible without this groundbreaking work in the discipline of futures studies.

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When Limits to Growth was published, the Internet was not yet an issue: only 10 or more years later did the first PC for private individuals arrive on the market; 20 years later, Tim Berners-Lee shaped the structures of the World Wide Web, which swiftly metamorphosed from being a medium of information to a communication and cooperation platform. Futures studies took up the associated issues at an early stage. Examples of this, from the preceding 40 years, are: the future of work; the consequences of globalization; the changing role of civic society; new opportunities provided by telematics, for example in the transport and health sectors; and — last but not least — the increased resource consumption and global environmental burdens caused by information and communication technologies.

Future-oriented Technology Analysis

Johnston traces the origin of the term 'future-oriented technology analysis' (FTA) to the planning for a seminar organized by the Institute for Prospective Technological Studies (IPTS) in 2004, which is one of the seven scientific institutes of the European Commission's Joint Research Centre (JRC). The title of the Seminar[1] coined the term 'future-oriented technology analysis'. It is interestingly to note that the seminar's preliminary paper prepared to promote participation and to inform potential participants used the term 'technology futures analysis'. (Johnston, 2008; Technology Futures Analysis Methods Working Group, 2004) The term 'technology futures analysis' is abbreviated to TFA.

Johnston (2005), referring to Scapolo (2005), points out the connection between the terms FTA and TFA: "It is interesting that between that point and the actual seminar, a subtle, but crucial change took place in that TFA became FTA. The essence of that change was that 'technology-oriented' gave way to 'futures-oriented'. This indicated that the focus of the seminar would be clearly on the future and ways to develop useful information for shaping the future. The preparatory paper itself fostered the change in focus as it developed a series

[1] 'New Horizons and Challenges for Future-oriented Technology Analysis: New Technology Foresight, Forecasting and Assessment Methods' held in Seville, Spain in May 2004

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of challenging questions about the field of analysis of possible and desirable futures".

Coates (2001, cited according to Scapolo & Porter, 2008) lists potent changes and challenges for future-oriented technology analysis:

- "Changes in the nature of 'technological change' with increasingly science-based innovation
- Shift in the prime drivers of technological innovation from the more narrowly technical concerns of Soviet-American Cold War military systems to industrial competitiveness concerns requiring inclusion of socio-economic contextual influences
- renewed attention to societal outcomes (and sustainability)
- Opportunities to exploit electronic information resources to enrich FTA
- better capabilities to address complexity in technological innovation."

Scapolo and Porter (2008) add:

- Recognition of essential technological innovation process uncertainties that mandate adaptive risk management responses
- Interest in discontinuous advances in science and technology, pointing toward radical innovation
- Suitably engaging multiple stakeholders in participatory FTA processes to assure distributed understanding"

Futures Studies Technology Assessment and Technology Forecast form the foundation of future-oriented technology analysis. Therefore, the methodological approaches show a high accordance. That holds true in terms of basic understanding of challenges and risks of future technologies as well: 'New' and 'Emerging Technologies' have tremendous innovation potential, which must weighed against enormous uncertainties caused by many risks and unknowns. IZT's future-oriented technology studies have always addressed this important modern experience. (i. a. Oertel & Wölk et al., 2005; Orwat et al. 2010)

According to Johnston and Cagnin, future-oriented technology analysis is "an increasingly important approach being adopted in many countries to

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address the many challenges which are emerging at this time in human history." (Johnston & Cagnin, 2011)

Principles of Futures Studies

Futures Studies at a Glance

Futures studies are the scientific study of possible, desirable, and probable future developments and scope for design, as well as the conditions for these in the past and in the present. Modern futures studies assume that the future is not entirely determinable and that different future developments (futures) are possible and there is scope for design. They are based on the realization that there are indeed a great number of possible futures but that these are not arbitrary.

Within international futures research, the term 'future(s) research' is also used, although more often 'futures studies', signifying above all their plurality (futures) and the predominantly issues and project-related research. The terms futuristics or futurology (Flechtheim, 1972) are only rarely used today.

Generally, futures do not develop in line with disciplines; this means that their complexity and interlinked functionalities cannot be determined by any single discipline. The scientific study of futures, too, is thus 'at odds' with the disciplines.

The subject of futures research cannot be restricted to one particular field and does not determine, in this respect, a clear-cut science. Nevertheless it is possible to explicate a series of determining factors that narrow down the topics of research, from the scientific writings and projects of modern futures research. Accordingly, futures research is concerned with: complex dynamic systems and processes; large-scale and/or global correlations and effects; medium- and long-term consequences of decisions, measures and actions from the past and the present; medium- and long-term time frames, perspectives and possible measures in the future; sector-spanning problems, issues and strategies; uncertainties, discontinuities and interconnected outcomes of higher

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orders; ideas about future developments and their influence on current and future behavior.

Megatrends, Trends and Drivers

Given the necessity of developing a global and longer-term perspective, it is imperative that we identify the principal future trends and assess their relevance for future outcomes. Since 1982, when John Naisbitt published another groundbreaking future study, megatrends have become a comprehensive element of futures studies' terminology.

Megatrends describe developments that must fulfill at least three criteria:

- First, the trend must be fundamental in the sense that it will cause potent, even basic changes in human social development and the natural environment, or one of the two.
- Second, the trend must cause major effects and have major consequences in at least the midrange (between 5 and 20 years) or long-range (more than 20 years).
- Third, the trend must have strong global effects and consequences for society and nature (biosphere).

Although these megatrends are even now deeply affecting all areas of life, and although we already have a great deal of knowledge about the future, very little is being done. There is a huge gap between the challenges — even crises — that we know lie ahead and the practical responses offered on the global, national, and regional levels. To date, the political decision-making of governments, parliaments, and supranational organizations, as well as the concrete economic behavior of most businesses and business associations, is in no way adequately informed by the desperate need to find adequate responses to the pressing issues of the futures we have seen coming.

Futures Studies use further concepts to analyze and describe "shaping forces, or sources of change and what might be their impacts, particularly where these may create entirely new challenges and opportunities" (Saritas & Smith, 2010). Saritas and Smith propose the following definitions. We have added gives examples of importance for Internet and Society in table 1.

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Term	Definition	Examples of importance for Internet & Society
Trends	*"Trends are those change factors that arise from broadly generalizable change and innovation. They are experienced by everyone and often in more or less the same contexts insofar as they create broad parameters for shifts in attitudes, policies and business focus over periods of several years that usually have global reach. What is interesting about trends is that normally most players, organizations or even nations cannot do much to change them – they are larger than the power of individual organizations and often nation states as well."*	Globalization, Demographic change Scarce raw materials Increasing mobility word-wide Concerns about emerging technologies
Drivers of change	*"Forces, factors and uncertainties that are accessible by stakeholders and create or drive change within one's business or institutional environment. These tend to be more immediate and relevant and distinct to different types of stakeholders – and also they can be both adapted by and/or strongly impact stakeholders, sometimes rapidly."*	Research policies Regulatory changes Changing customer demand
Wild cards/shocks	*"Wild cards and shocks are those surprise events and situations which can happen but usually have a low probability of doing so – but if they do their impact is very high. These situations tend to alter the fundamentals, and create new trajectories which can then create a new basis for additional challenges and opportunities that most stakeholders may not have previously considered or prepared for."*	Crash of global financial markets
Discontinuities	*"Discontinuities refer to rapid and significant shifts in trajectories without the aspect of being mostly unanticipated or deeply surprising." ...] In general, the Internet and the Web represent technological discontinuities for many sectors and thus both create new opportunities and expose potential threats for those attached to old or inflexible technologies."*	Electronic (scientific) journals and reference systems, GPS navigation Social media youtube, simfy live
Weak signals	"*Weak signals are the first important indications of a change. These may be understood as advanced, somewhat noisy and generally socially situated indicators of change in trends and systems that constitute raw informational material for enabling anticipatory action. The benefits of weak signals can be seen when assessing their significance in an organization or a field concerned and analysing how the phenomena reflected by the weak signals should be reacted on."*	The growing importance of globalization was weakly apparent in the early eighties (see Naisbitt's Megatrends)

Table 1 Further definitions of terminology as proposed by Saritas & Smith, 2010 and examples with importances for Internet& Society according to IZT's research experience

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World Concepts — Two Visions of the Future

Developed and developing societies are currently (or will be in the future) informed by two guiding concepts: the 'science' or knowledge-based society and the 'sustainable' society:

The science society. The 'science society' is first and foremost determined by the mega trend, 'scientific and technological innovations, education, knowledge transfer and qualification'. It receives its strongest impulses from scientific knowledge production, high-tech development and science-based qualification. These new science-based technological, economic and societal principles find their clearest manifestation in modern, highly-efficient information and communication technologies, particularly the Internet. These technologies, combined with social and cultural innovations, enable a previously unimagined increase in efficiency as well as production processes and services, interlinked worldwide.

One can also comprehend this international structural transformation as being a direct continuation of the industrial society by different means. This development will continue, although we can in principle determine its effects and its direction.

The sustainable society. It is not surprising that globalization, and the technologization and economization which pervades all areas of life, have unleashed feelings of fear, impotence and incomprehension regarding the progress and the resolution of the therewith associated social, ecological and cultural distortions in many people. Even the positive effects of globalization and economization, such as the worldwide opening of the job market, the increase of export and import opportunities, the decrease in prices for products and services through the integration of world markets, or the improved access to global knowledge and information, remain somewhat barred to most people in their everyday lives.

By the year 1992 in Rio de Janeiro, at the latest, almost all countries of the international community of states acknowledged that the concept of sustainable development is probably the only plausible vision of the future. Because it provides long-term viable answers to both the big ecological as well

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as the social and economic challenges ahead: the Rio Declaration and Agenda 21 — the most important outcomes of the 1992 United Nations Rio Conference for the Environment and Development — sketched out central aims for the future and the rudiments of a worldwide future programme. These documents are still acknowledged today by almost all countries of the world as a basis for action in the 21st century.

The concept of 'sustainable development' is chiefly founded on the need to maintain the fundamentals of existence and production, worldwide and on a long-term basis, and to distribute the profits of natural and scientific-technological resources more fairly. Sustainable development means that each generation must act to preserve natural capital (quantity and quality of natural life materials and resources) in a way which does not endanger the basis of existence for future generations, and which enables all peoples to live together in economic and social stability on a long-term basis.

Time Frame of Modern Futures Studies

In the social sphere, questions about the future focus less on narrowly defined problems. Instead, they are primarily concerned with complex dynamic systems and processes embedded in social, economic, ecological, and cultural factors. Over the last decades it has become increasingly clear that good results, i.e. scientifically valid results that yield applicable insights, can only be achieved by taking a big-picture approach to the interrelationships and consequences of events and trends. In the age of globalization, this should be a no-brainer, but everyday practice in science, politics, and the economy is still lagging far behind.

There is a similar disconnect regarding the timeframes of inquiries into the future and the time span for which knowledge is urgently needed. Human activity creates futures of 50, 100, or even over 1000 years, for example when we construct residential or office buildings, bridges, public utilities, and waste management facilities, railroad networks, or nuclear power plants. We create long-term liabilities as we produce nuclear waste, exacerbate the ozone hole, or add to the thickening carbon-dioxide layer around the earth. Even more significant for the future are the consequences of irreversible human actions,

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such as the consumption of fossil and metallic natural resources and the extinction of entire species. There can be no doubt that an in-depth, scientific study of mid- and long-range timeframes and practical guidelines is indispensable, in particular for the lives of those generations that will succeed ours, and for the viability of future human societies in general.

Modern futures studies define a timeframe of 5 to 20 years as midrange, and a timeframe of 20 to 50 years as long-range. However, numerous questions about the future such as climate change, the use of biomass, the disposal of radioactive waste, as well as the global development of sustainable energy or traffic and communication structures, can be usefully analyzed only in the context of timeframes that far exceed 50 years. Unfortunately, political programs, and especially governmental programs, are generally laid out for no more than one legislative period, and the economic strategies of businesses are also aimed at very short-term profit perspectives, shareholder value, and ever accelerating innovation cycles of products and services (generally a maximum of two to five years).

We are thus confronted with the absurdity that most strategic planners, conceptual thinkers, and decision-makers in politics and industry claim to understand that our world is shaped by globalization and long-term trends, but their programs and policies do not offer answers. Terms such as ‘sustainable development’ or ‘science and knowledge society’ are common coinage, but concepts for their concrete implementation are a far cry from today’s scientific potential. As it is, we make only piecemeal use of our vast existing scientific knowledge, and we often apply it in one-sided and prejudiced ways. It is no surprise that the inconsistencies in the way we apply our scientific knowledge to the future are even more glaring. Although researchers in the field of futures studies are well aware of the basic uncertainty inherent in scientific understanding of the future, we do have a solid and sturdy body of knowledge with regard to possible as well as to probable and desirable futures and to their foundations in the past and the present. If we ignore this scientific knowledge in shaping the future, there is a high probability that it will lead to fatal consequences — up to and including the self-destruction of humankind. (Steinmüller, 1997)

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Futures Analyses Methodology

Introduction

One important aim of futures research is the systematic generation of orientational knowledge, which should help to address future challenges and crises. From a basis approach, foresight is an interdisciplinary task; it requires in that a methodology, which relies on individual disciplines and integrates them at the same time into a common reference framework. According to Steinmüller (1997) special features of the methodology of futures research arises from their subject. Firstly, 'future' is not a research subject like others. Any statements regarding future could not be verified at that time in which they are established. Nevertheless, there are reliable procedures to ensure the quality of orientational knowledge provided by futures research. Secondly, we should not start out with the supposition that research objects of futures studies can be isolated from their environment. The integration of research objects in collaborative processes always must be considered. Thirdly, futures studies — with a typical time horizon of five to fifty years — start at the point, where usually the short-range, disciplinary planning and forecasting tools ends.

Despite a variety of studies, which list and describe more or less detailed different methods of futures research, almost all attempts to systematize these methods[2] have failed — as Kreibich (1986) stated at an early stage. There are many reasons for this: This is due partly to the variety of methods, the variety of possible classification criteria and the combined use of this extensive variety of methods in research processes. The course of this is secondly existing weaknesses of general methodology (as a part of science theory). Nevertheless, Kreibich (1995) distinguishes four 'basic procedures' of futures research:

- Explorative empirical-analytical approach: Based on the store of accumulated knowledge as well as new facts, data and trends, probable and possible developments are systematized according to precisely-

[2] Scapolo and Porter (2008) agree, that a 'standard recipe' is not possible. Nevertheless, influential journal articles have been published to categorize methods, for instance by Porter. This work is based on the Seville seminars, and working groups (see above), has been updated continuously, and offers valuable reference information. (i. a. Porter, 2010)

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determined assumptions and conditions, and analyzed according to specific rules. This can take place in both qualitative and quantitative form.

- Normative-prospective approach: Using imagination and creativity, in futures studies and futures projects experiences and factual information, which are generally empirically-analytically gained, are consolidated to create visions of the future or preferable future projections.
- Communicative-projective approach: Knowledge and experience stores are prepared for practical implementation in such a way as regards future goals and strategies so as to support communications, decision-making and implementation processes.
- Participative-creative approach: The involvement of actors from social areas increases the content of future knowledge, the creativity in defining visions of the future, and introduces the aspects of desirability, scope for design and implementation, in particular, to the research and design process.

An allocation of individual methods on these procedures is to Kreibich only possible in exceptional cases. Usually different methods are used to perform specific functions at different stages in the process. Furthermore, methods are combined with each other and tailored to perform these functions in an optimal way.

The following sections review important foresight methods 'scenario building', 'Delphi' and 'roadmapping'. Furthermore, conclusions regarding the potential of the Internet are drawn.

Scenario Method

The use of scenarios as a tool for planning originated with Herman Kahn and his associates at the RAND Corporation already in the 1950s. By showing alternative paths to a nuclear war with the Soviets, Kahn convinced the U.S. Air Force that different sequences of events could result in numerous possible outcomes, some of which were desirable and some were not. Kahn's scenarios

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were hypothetical sequences of events, much like a play or movie plot synopsis, which was the traditional meaning of 'scenario'.

In the early 1970s scenarios reached a new dimension, with the work of Pierre Wack, who was a planner in the London office of Royal Dutch/ Shell in a newly formed department called 'Group Planning'. The new wave of interest in scenario planning is often explained by the traumatic effect of the oil crisis in 1973 that draw attention to the possibility of major unexpected changes in the international economic system (Berkhout & Hertin, 2002). As a result, the term 'scenario' employed more and more as a core approach of futures research.

Today a scenario can be defined as a description of a possible future situation, including the path of development leading to that situation. Scenarios are not intended to represent a full description of the future, but rather to highlight central elements of a possible future and to draw attention to the key factors that will drive future developments. Many scenario analysts underline that scenarios are hypothetical constructs and do not claim that the scenarios they create represent reality. (Kosow & Gaßner, 2008)

There are many different ways to construct scenarios: normative, explorative, descriptive, and quantitative amongst others. The process of scenario development can be structured as follows:

- Framing: Scoping the project – developing and defining the key terms, problem formulation.
- Scanning: Collecting data and information – systems, qualitative and quantitative research, interviews, historic developments, and current research results.
- Forecasting: Trends, uncertainties, drivers of change.
- Foresight: Challenge a baseline scenario and develop alternative futures.
- Visioning: Unfolding the preferred futures and do back casting for ways of realization – starting now.
- Planning and action: Strategy, options, agenda setting and acting.

Scenario may be developed by an extremely wide-ranging set of methods. They may emerge from scenario workshops or be prepared by small expert groups, derived from survey results or constructed on the basis of different worldviews.

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Practically any foresight approach can be the occasion for a scenario generating exercise.

The most important strength of scenarios is that they do not describe just one future, but that several realizable or desirable futures can be placed side by side (multiple futures). Furthermore scenarios should be an appropriate way to recognize so called 'weak signals', technological discontinuities or disruptive events and include them into long-range planning. In contrast to these strengths, scenario techniques have several weaknesses: *Firstly*, the practice of scenario is very time-consuming. *Secondly*, a more qualitative approach has to put a strong emphasis on the selection of suitable participants/experts, and in practice this could not be an easy task to fulfill. Further, it should not be overlooked that a deep understanding and knowledge of the field under investigation is absolutely necessary. Data and information from different sources have to be collected and interpreted. (Mietzner & Reger, 2005)

Over the last 30 years, we have developed many scenarios on the following topics: plausible and desirable prospects in the world of transport (Gaßner and Steinmüller, 2011), eLearning scenarios for vocational education and training in the field of renewable energy technology (http://www.izt.de/efit/), scenarios for the development of the future of intralogistics sector (Wölk & Oertel, 2009), future of multimedia equipment in private households (Gaßner et al, 1995) etc. Deutsche Bank Research also makes use of scenario analyses in their project 'Germany 2020 – new challenges for a land in expedition'. The project team set out to sketch what paths of development are conceivable for German business and society in the future (Hofmann et al, 2007).

Technology Roadmapping

Technology roadmapping has become an important issue and has received increasing interest from academics as well as industry and business sectors. The approach was originally developed by Motorola more than 25 years ago, to support integrated product-technology planning. Since then technology roadmapping has been adapted and applied in a wide variety of contexts, at the company and sector levels. (Behrendt, 2010) According to Phaal is a 'flexible technique' and "provides a structured (and often graphical) means for exploring

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and communicating the relationships between evolving and developing markets, products and technologies over time". (Phaal et al, 2004) All statements in roadmapping reports include references over the course of time, for instance time-based charts.

According to Behrendt and Erdmann (2006) in most roadmapping projects socio-economic and socio-ecological aspects play only a minor role. The resulting technology pictures are often restricted, focused on technological feasibility and lacking the socio-ecological context. Even though classical roadmapping with its focus on technology should have its place in strong technology-driven areas, the growing importance of problem-centered approaches in innovation processes as well as still growing societal discussions about risks and opportunities of new technologies require fundamentally new views. In different projects we have developed a new concept to overcome the existing deficiencies: the concept of 'integrated roadmapping'. The aim of integrated roadmapping is to integrate societal needs, customers' needs and the assessment of risks and side effects in the innovation process at an early stage.

The roadmapping approach has in principle high potential for supporting (business and political) strategy. A principal key advantage of roadmapping is that this method is especially effective for synthesizing varying perspectives, deriving, as one case in point, a balance of commercial and technological functions. In Addition, many of the benefits of roadmapping are derived from the roadmapping process, rather than the roadmap itself. Firstly, the process brings together people from different parts of the society or business, providing an opportunity for sharing information and perspectives and providing a vehicle for holistic consideration of problems, opportunities and new ideas. The main benefit of the first roadmap that is developed is likely to be the communication that is associated with the process, and a common framework for thinking about strategic planning in the business. (Phaal et. al., 2004)

The classic example of industry technology roadmapping is the 'International Technology Roadmap for Semiconductors (ITRS)', first published in 1999 and last updated in 2010, which originated from the US-based 'National Technology Roadmap for Semiconductors' (NTRS). It is a cooperative effort of the global industry manufacturers and suppliers, government organizations, consortia, and universities from virtually every

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country active in this field to ensure advancements in the performance of integrated circuits by identifying the technological challenges and needs facing the semiconductor industry over the next 15 years. It has become the world-wide reference document for the semiconductor industry (http://www.itrs.net/). We have constantly developed the method further (Behrendt, 2010) and put it into practice with regard to societal issues: inter aliter the roadmap Safety in case of fire 2020+ (Scharp, 2011), the integrated technology-roadmaps automation 2020+ (focusing on energy, water/ waste water and megacities) (Behrendt et al, 2009- 2011 on behalf, in cooperation and edited by ZVEI).

Delphi Method

The Delphi Method was mainly developed by Olaf Dalkey and Norman Helmer (1963) at the Rand Corporation in the 1950s. Back then, RAND dealt with technological and political prospective studies for military contractors and particularly used methods like simulation gaming (individuals acting out the parts of nations or political factions) and genius forecasting (a single expert or expert panel addressing the issues of concern). Quantitative simulation modeling was quite primitive, and computers that would ultimately make such quantitative techniques practical, were not yet capable enough. Since the limits of this approach were obviously, the researchers of RAND were forced to look for new approaches. In 'Project Delphi' Helmer and Dalkey tested and improved a new procedure that allowed an anonymous process of discussion among experts. (Dalkey & Helmer, 1963)

The Delphi method can be used when there is incomplete knowledge about a problem or phenomenon. Delbecq, Van de Ven, and Gustafson (1975) specifically indicate that the Delphi method can be used for achieving the following objectives: to determine or develop a range of possible program alternatives; to explore underlying assumptions or information leading to different judgments; to seek out information which may generate a consensus on the part of the respondent group; to correlate informed judgments on a topic spanning a wide range of disciplines, and; to educate the respondent group as to the diverse and interrelated aspects of the topic.

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The Delphi method is based on structural surveys and makes use of the intuitive available information of the participants, who are mainly experts. The Delphi Method entails a group of experts. The number of panel members varies according to the subject and targets of the study, the number of suitable experts and the range of expertise needed, and methodological considerations. (Häder, 2000) Experts anonymously reply to questionnaires and subsequently receive feedback in the form of a statistical representation of the 'group response', after which the process repeats itself. More specifically, the feedback process allows and encourages the selected Delphi participants to reassess their initial judgments about the information provided in previous iterations. Thus, in a Delphi study, the results of previous iterations regarding specific statements and/or items can change or be modified by individual panel members in later iterations based on their ability to review and assess the comments and feedback provided by the other Delphi panelists. (Hsu 2007) The goal is to reduce the range of responses and arrive at something closer to expert consensus.

Delphi studies are difficult to perform well. A great deal of attention must be given to the choice of participants; the questionnaires must be meticulously prepared and tested to avoid ambiguity. Multi-round studies require a great deal of time; inevitably, some participants will drop out during the process. Finally, a weakness of the Delphi method is the time that it takes. A single round can easily require three weeks; a three-round Delphi is at least a three- to four-month affair, including preparation and analysis time. (Gordon, undated)

The Delphi Method has been widely adopted and is still in use today. The Delphi method is especially useful for long-range forecasting (20–30 years), as expert opinions are the only source of information available. Meanwhile, the communication effect of Delphi studies and therefore the value of the process as such are also acknowledged.

During the last ten years, the Delphi method was used more often especially for national science and technology foresight. The first German Delphi Study on the development of science and technology was conducted by the Fraunhofer Institute for Systems and Innovation Research (FhG-ISI) on behalf of the then Federal Ministry of Research and Technology (BMFT) in 1992/93. This study was carried out in cooperation with the National Institute of Science and

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Technology Policy (NISTEP) in Tokyo. It was followed by 'Delphi '93' (1992–1993) and 'Delphi '98' (1996–1998) (Cuhls et. al 1998). Furthermore 'EurEnDel',research coordinatet by IZT, was the first pan-European Delphi Study on the future of the European energy sector in 2030 (Wehnert et. al. 2007).

Potential of Internet Technologies for Futures Studies

A lot of methods and approaches of futures research and futures studies can be supported by the Internet. They include questionnaire technique, expert surveys, e-votings, interviews via chat, brainstorming via Skype, text and content analyses for instance in the blogosphere, online political forums or Google alerts, model building and simulation techniques as well as online-games.

Basic potentials of Internet technologies for futures research are:

- High level of availability and immediacy in accessing data/information, for example in the form of documents
- Interactivity: rapid and inexpensive forms for communication tasks of minimal or medium complexity and therefore quick feedback possibility, acceleration of ideas-development and agreement processes
- Possibility to choose between different communication forms, from email to video conferencing
- Reduction in transaction costs by reductions in search, initiation and coordination expenditure
- Enablement of location- and time-independent cooperation possibilities

On the other hand there are risks of Internet-based communication in future orientated processes:

- Danger of a flood of data and information, need for users to be qualified and selected
- Data protection and data security when storing and/or transmitting confidential/personal data of partners and experts (e.g. innovation ideas)

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- Unsuitability of Internet-aided communication for complex communication tasks
- Implied knowledge is not or hardly transferable
- The trust necessary for collaborations cannot be established on a purely technological basis
- High updating expenditure, to some extent, for online content

World Wide Web, search engines and Internet crawlers are used to obtain the data needed in a scenario process. For instance, the search term 'technology forecast' yields 22'700'000 hits in Google, which could be used as input or for further analysis. According to a study of Delft University of Technology crawling the web can identify online communities, and that these communities are easily identifiable and can be easily partitioned from network data. Also Internet mining approaches may be combined with other stakeholder involvement or expert opinion techniques for a more robust analysis. (van der Lei & Cunningham, 2006)

Meanwhile, there are special services available, which support in particular the forecasting process, respectively trend analysis. With Google Trends, for example, you can compare the world's interest in your favorite topics. Enter up to five topics and see how often they've been searched on Google over time. Google Trends also shows how frequently the selected topic have appeared in Google News stories, and in which geographic regions people have searched for them most. In addition, Google launched the service 'Google Correlate' in May 2011 on Google Labs. Google Correlate — sometimes called 'Google Trends in reverse' — finds search patterns, which correspond with real-world trends. Using Correlate, we can upload our own data series and see a list of search terms whose popularity best corresponds with that real world trend. The tool shows the strongest correlations by query over time, as well as concentrations and correlations of the query by state.

In addition, so-called technology wikis are increasingly being deployed within companies, i.e. web-based platforms upon which users can generate new content or edit and adjust existing content by means of a very simple syntax. Technology wikis are used to integrate employees from different departments in the storage and updating of relevant information regarding technologies and

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technology development onto a central platform. In contrast to the open structure of Wikipedia, the use of technology wikis demands a structuring of the interface and contents, corresponding to the company's requirements. (Fraunhofer 2010)

But even social networks on the Internet such as XING, LinkedIn or Facebook today represent an important instrument of futures research for making new contacts or staying in touch with existing ones. In technology monitoring, internal and external experts play a decisive role in the analysis, monitoring and evaluation of technologies or technology fields. In many companies, informal networks thus represent the most obvious means of answering technological questions. Through social technology networks, in which technological competences and experiences are documented, informal networks can be augmented with current information and company-relevant structures. The use of social software systems for technology monitoring within companies is still at a very early stage. However, basic approaches can already be realized with relatively little expenditure, due to the wide availability of open and adaptable social software systems. It should not be underestimated that user acceptance represents the critical factor for successful utilization, and therefore that mere installation of the corresponding software only leads to good results in the rarest of situations.

Civic Participation in Foresight Dialogue and Shaping the Future

Foresight Dialogue with the Public

Transparency and a heightened degree of civic information and participation rank among today's main challenges of political interconnectedness. The German Federal Ministry of Education and Research (BMBF) is currently beginning a civil dialogue initiative regarding future and emerging technologies. According to its initiators, technologies of the future — which are changing our lives — are extremely complex and sometimes hard for laypeople to comprehend. "This can cause fear to develop, or even to false and unrealistic expectations; therefore it is important to discuss the issues raised by these

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technologies amongst the wider public." (http://buergerdialog-bmbf.de/allgemein/buergerdialog.php)

Meanwhile, there are various experiences in the application of methods of futures studies and projects for dialogue with the public or between the citizens on different regional levels, and in many countries. Well-known examples include the Commission's public consultation on RFID in 2006 (http://www.rfidconsultation.eu/) or the TA-SWISS publifocus method and discussions to obtain insights on the views held by the public on an issue in Switzerland (http://www.ta-swiss.ch).

The following examples cover the German foresight dialogue on future technologies. These dialogues confront fears that through the complexity of scientific and technological innovations, the significance of specialized expertise for policy decision-making has increased. Accordingly, decision-makers are tending to rely increasingly on external know-how; this expert knowledge threatens to push civil participation into the background.

But experiences prove, "academic laypeople who advise during discursive procedures in technology assessment (TA) do this not only in a manner which is professionally competent but which focuses on the public good. The decisions made in discursive debates are resilient and founded upon a rational opinion-forming process."

The project 'Technology at the beginning of the 21st century' (1991–1992) can be described as the start of the BMBF's foresight processes. The main results are a list of technologies and maps on technologies of the future, which demonstrate that new technology topics are developing in particular at the interface between 'classical' disciplines. Nanotechnology, for example, was identified as a future topic with a proximity to very diverse disciplines and could therefore be called a central topic. The years 1992 and 1993 saw the first German Delphi Study on the Development of Science and Technology, which was commissioned by the then Federal Ministry of Research and Technology (BMFT). Delphi '98 began in 1996 as a study on the global development of science and technology. Data was updated in this study and 'typically German' topics put forward for discussion.

In 2000, the BMBF launched the 'research dialogue Futur' (2000–2005). In contrast to the Delphi Surveys, which were based on scientific expertise, this project worked with a large group of stakeholders from all areas of society to

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draw up research topics, which could be included in concrete research funding initiatives. The results were four lead visions, some of which, including interdisciplinary topics, have been included in BMBF projects. For example, the lead vision 'Understanding Thought Processes' provided a contribution to the founding of the National Bernstein Network for Computational Neuroscience. (BMBF)

Major Points for Civic Participation

The German research dialogue Futur was designed as a learning process and in-between many small and large lessons could be learned. Some major points are (European Commission Joint Research Center, undated):

- Futur is too complicated to be explained easily.
- It is helpful if the objectives of a foresight are clear from the beginning and do not change in-between.
- Futur got more and more expensive. Saving resources is sometimes difficult.
- How much participation is wanted and needed has to be clarified.
- It is very difficult to reach participants beyond the usual experts. And experts are needed as soon as complicated subjects are discussed.
- Incentives for participation are needed since people invested a lot of time.
- It should be clear from the beginning who decides what and when so that participants are not disappointed when their topics are not the 'winners' of the selections.
- Only informal methods are difficult to communicate.
- It should be clarified what is foresight, and what serves other purposes, e.g. general public relations, large events. In each case, it is helpful if the objectives of a foresight are clear from the beginning and do not change in-between.

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R. Dahl (cited according to Feick, 2007) also specifies criteria for successful consensual and opinion-forming procedures:

- Consultative participation opportunities, so that active population groups achieve a genuine hearing and can influence the political agenda;
- Sufficient information to be able to reflect and discuss crucial issues politically;
- Responsiveness from politicians and governing institutions; without this a participative dialogue can never be achieved.

Civic eParticipation

Since the early seventies of the last century there has been an ongoing scientific and public discussion on 'Democracy and Deliberation'. The core of the idea of deliberative democracy is that the source of political legitimization is public consultation in political affairs by the society's citizens — that is: deliberation. With the spread of the Internet, a particular question gained in importance: What may be gained from the increased adoption of the Internet and what can be lost? (i. a. Dahlgren, 2005) And is the Internet a better public sphere? (Gerhards & Schäfer, 2010)

Today, there is agreement among experts and policy makers: "The Internet and related technologies have created a new public space for politically oriented conversation." (Papacharissi, 2002) Therefore, more and more ministries try to reach the general public on the Internet.

They have not succeeded yet. In September 2011, an online article in Germany's renowned magazine 'Spiegel online' brought the challenges of online participation to public attention und gave various examples. Many departments have developed very costly online platforms, which are used by only a very few citizens, as the following typical example shows: "Kristina Schröder (CDU) opened the 'Dialogue Internet' in autumn 2010. The costs so far: 430'000 EUR. However there was no direct line to the Minister for Families herself, a panel of experts was interposed instead. Professionals should ultimately formulate 'recommendations for action', not laypeople. Conclusion:

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by the beginning of August 124 visitors had registered on the website and written 207 posts.“ (Becker, 2011, translated from German)

Back in 2002 Papacharissi concluded: “whether his public space transcends to a public sphere is not up to the technology itself”. This statement applies equally today.

Major Points for Civic eParticipation

The need to support and improve instruments of participation on the Internet is an issue well beyond democratic deliberation. It is also an issue for futures studies and research in general. According to the principles of futures studies, participation and foresight processes in general need to rely not only on experts and decision-makers but on all stakeholders, and persons concerned and involved: The Internet is a good bet to reach and involve ‘everyday citizens’.

We have been engaged in eparticipation research and developed and have experimented with Internet tools and applications from early on: equestionnaires, evoting, online forums, expert hearings and a future conference on the Internet count among them. Together with research partners, we designed an ‘open’ weblog in 2008. (Oertel et al., 2010) Young citizens were asked to give their opinions on various aspects of human genetic engineering. By contrast to usual weblogs, an open weblog enables both weblog editors and visitors to post statements and comments. In 2007, we assessed Online Dialogue Opportunities, which are released by the German Parliament or by the press and information office of the federal government and the federal ministries respectively (76 portals). The study ‘Quantitative and Qualitative Aspects of Online Dialogue Opportunities of the German Parliament and the Federal Government’ was carried out on behalf of the German Parliament and in coordination with its Bureau for Technology Assessment (TAB). (Wölk et al., 2008) Interactive dialogue opportunities in terms of chats and forums have been analysed based on content-related analytical evaluation. Particular emphasis has been placed on the analysis of the quality of the dialogues since the democratic model of deliberative politics in particular strongly depends on the quality of dialogues among the participants. The results of this study showed that online dialogue opportunities can essentially support the

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realization of a deliberative political style due to their ability to overcome otherwise common constraints posed by time and long distances. In addition to their strengths, political online dialogue opportunities demonstrate weaknesses as well. The results indicate that in a context of interactive dialogue (primarily political online forums), there often exists limited transparency or a complete lack of transparency for the participating citizens with regard to the political utilization of the dialogue contents and their results. Often the aims of interactive dialogue have not been formulated explicitly and therefore are not known by the participants. Often an effective connection is lacking to relevant decision-making processes and political work involved. This means that interactive dialogue opportunities to date have normally been applied more as an instrument of public relations than an instrument of binding political participation.

According to IZT's experience and research results, eparticipation has not yet arrived but may still reveal their full potential. It may take time to learn how to set up good examples but it is worth the effort. This task is not easy to achieve while Internet applications are constantly changing. Whenever we implement online participation, there seems to be a new and promising Internet Application: Email about 15 years age, online forums about 10 years ago, Wikis about 5 years ago, social media now — and we will see what the future brings.

In many cases the results with regard to involving citizens have been less than we hoped for in the beginning. Therefore we conclude, successful online participation needs time to evolve. It may be better to allow time and networking to raise the number of participants and the attractiveness of online dialogue and debate.

But we also dare to point out: Online dialogue platforms can be put into practice with significantly less money than the Spiegel online article states.

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Research Agenda

Preliminary Remark

For future-oriented technology analysis (FTA), the "biggest challenge is to achieve and demonstrate a greater impact of FTA studies. Otherwise the views of the possible futures that await us may continue to go largely unheard and unheeded [...]". (Johnston & Cagnin, 2011)

Against this background, we propose the following core research lines in the research area of Internet & Society. It is our objective, to outline a framework, that

- can act as a technology radar;
- will activate the knowledge and experience of all stakeholders concerned;
- will cross-link various scientific or corporate domains;
- will result in a comprehensive, evidence-based and concise overview of innovation potentials, concerns and possible pitfalls in a variety of areas;
- can be applied by scientific and corporate stakeholders at all regional levels;
- will identify possible and sustainable directions and promising options
- will contribute to solid future-oriented understanding and results in concise policy briefings, position papers or routes to be taken.

We proposes the following core research lines:

1. Horizon Scanning: Identifying keyissues at an early stage;
2. Transdisciplinary technology forecasting: Creating value for decision-making;
3. Scanning and Sourcing the crowd: New sources for social research;
4. Wild Cards: Considering low-likelihood, high-impact surprises;
5. Social shaping of technology: Future-oriented technology analysis's contribution to society.

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Core Research Lines

Horizon Scanning: Identifying Key Issues at an Early Stage

"The first step in ensuring that politicians are ready to listen, and that scientists are able to speak, is to choose the right topics. To appear on the Foresight short list, a topic must represent either some important current issue that science, technology, the social sciences, and economics could help address (for example, flood risk management) or a current aspect of science or technology that is likely to have wider potential in the future [...]. The subject must be future-oriented; must not duplicate work taking place elsewhere; must have potential outcomes that can lead to specific actions; must be multidisciplinary; and, above all, must have commitment from the potential beneficiaries that they are eager to hear the results and act on them." (King & Thomas, 2007)

Horizon scanning is a foresight tool that has been developed to "think, debate and shape the future in the direction of societal desires in a systematic way", and to take a forward look at a range of developments The aim of horizon scanning is not to predict the future, but to identify emerging issues in sufficient time to initiate research and develop policy and practical responses. It has been applied in the area of Innovation and Technology. For instance, the UK Growth Opportunities for the 2020s have been identified. (Foresight Horizon Scanning Centre, 2010) Furthermore, in Denmark and the Netherlands horizon scanning has been applied on the national level. (Rij, 2010) The approach is performed increasingly and particularly across Europe (i. a. UK and Netherlands, Finland), among others, to set science or research agendas. (Johnston et al., 2010; Foresight Horizon Scanning Centre, 2010)

We propose to use horizon scanning to structure the social context, to identify, select and prioritise research issues and to pinpoint the opportunities or critical aspects of future technologies.

Research questions:

- Which developments and issues emerge in the area of Internet & Society?
- How can the issues identified be ranked or clustered?

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- Which opportunities and risks coin each issue in particular, and which opportunities and risks are of a cross-cutting nature?
- Which protagonists and organizations are important in this context?

Transdisciplinary Technology Forecasting: Creating Value for Decision-making

"Transdisciplinarity is understood as the transcendence of disciplinary modes together with the involvement and participation of non-scientists in problem formulation and knowledge provision." (Rasmussen et al., 2007) The approach is based on cross-discipline and cross-stakeholder co-operations. The involvement of actors and actor networks is a distinguishing characteristic of futures studies.

In a time of rapid changes in particular, but not limited to the Internet, the improvement of forecasting methods with the objective to provide robust knowledge for decision makers and practitioners is challenging. Transdisciplinary technology forecasting and consensual vision-building are approaches that have proved themselves valuable to visioning alternative or desirable future developments. It contributes to solid future-oriented understanding and may help to avoid pitfalls for instance with regard to consumer or citizens' concerns.

We propose to focus on transdisciplinary forecasting and interdisciplinary vision building, thereby addressing all relevant stakeholders as the target audience for the results.

Research questions:

- Is transdisciplinary technology forecasting a valuable approach to provide a basis for solid future-oriented understanding for short-term decision-making or policy evaluation?
- How can transdisciplinary technology foresight processes be organized, structured and facilitated?
- How can the results foster innovation possibilities and avoid barriers in a transdisciplinary context?

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Scanning and Sourcing the Crowd: New Sources for Social Research

Scanning is one of the principles of future-oriented social research. Futures scientists (and scientists and practitioners from other fields of expertise) scan academic journals, conference papers, media releases etc. in print and on the Internet. They listen to stakeholders and aggregate and analyze information items. Today, Internet applications, social media or commenting functionalities expand the range of existing conventional scanning items.

Crowdsourcing refers to a specific mechanism that is used to engage with citizens/consumers. Tasks such as quality control, or the setting-up of databases, are now „outsourced" to the general public or specific target groups ('the crowd') via fixed and mobile Internet. A myriad of sites allow users to rate and comment on hotels, restaurants, products, and services as part of recommender systems. Users may also be asked to propose solutions to problems or offer ideas for new products. Individual narratives and ratings are collated into a body of 'evidence' that is used for product development, quality improvement, or policy reform.

Research questions:

- Are there any good examples of scanning and crowd sourcing with regard to futures studies?
- What possibilities exist for using new sources of data for social research?
- Which rules need to be established with regard to privacy concerns as well as competent and appropriate data-handling?

Wild Cards: Considering Low-likelihood, High-impact Surprises

Because most people have experienced surprise situations and unforeseen developments that have in some way altered at least their expectations if not the direction of their existence, the concept of a wild card or shock is not that unfamiliar. In Foresight processes it becomes important to include some of

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these possibilities because they often do reshape the trajectories of events and situations. The real issue is how they should be contexted, and when and with what intensity they can or should be introduced. This is a key element of the art of crafting Foresight to respond well to plausible uncertainties and conceivable surprises [...]."(Saritas & Smith, 2010)

Examples of wildcards or shocks include the attacks of September 11, 2001, previously unknown diseases such as AIDS or the cattle disease BSE, technological breakthroughs or the crash of global financial markets. Steinmüller & Steinmüller (2004) point out that unintended consequences of technical innovations are among wild cards and shocks, for instance 'killer applications' such as mobile phone text messages (SMS) or industrial vulnerabilities or hazards ('Fukushima').

Saritas and Smith (2010) (based on discussions at the FTA 2008 Conference) define Wild cards and shocks as "those surprise events and situations which can happen but usually have a low probability of doing so — but if they do their impact is very high. These situations tend to alter the fundamentals, and create new trajectories which can then create a new basis for additional challenges and opportunities that most stakeholders may not have previously considered or prepared for." Steinmüller refers to them as 'futurequakes'. (Petersen & Steinmüller, 2009)

We propose further analyses in the field of wild cards and shocks with special regard to Internet and Society.

Research questions:

- Which lessons can be learnt from futures research?
- How can wild card research promote technology forecasting and robustness of innovation strategies?
- How can wild card research be helpful in foresight processes and the development of transdisciplinary research agendas?

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Social Shaping of Technology: Future-oriented Technology Analyses's Contribution to Society

"The desire to make futures thinking a part of everyone's education is not, of course, mere futurist chauvinism, but is based on the conviction that futures studies has important contributions to make to human well-being." (Bell 2001)

Currently, social shaping of technology techniques (SST) is developed "as a response and extension to the ideas of techno-economic rationality and linear conceptions of technology development and its consequences." (Jørgensen et al., 2009)

According to Hansen and Clausen (2003), the "term 'social shaping of technology' has been used broadly as a response to techno-economic deterministic understandings of the relations between technology and society. The social shaping perspective has increasingly explored the social choices involved in the co-evolution of technology and society." Thus, social shaping may encompass methodological aspects such as actor-network approach, techno-economic networks, actor worlds, or development arenas. The approach is based on the roots of technology assessment. Consequently, "social shaping has brought together analysts from different backgrounds who share a common interest in the role of social and political action for technology change." (Jørgensen et al., 2009)

Jørgensen et al. work from the premise that instead of taking technology as an (external) driver, "technology has to be seen simultaneously as a driver and as the object being driven and given tasks to solve societal problems." Accordingly, social shaping of technology "seems especially promising in areas of technology where visions are manifold, societal interests conflicting, and applications and markets are non-existing or still under construction. The emerging high technology areas and several areas of more sustainable development [...], where techno-economic networks are unstable or under construction and social and environmental potentials and risks difficult, if not impossible to assess." (Jørgensen et al., 2009)

We propose to address the socio-technical interrelations within the context of Internet & Society and to tailor the approach according to the overall aim of future-oriented technology analysis.

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Research questions:

- How social shaping of technology support the identification of societal preferences, desires or concerns with regard to Internet technology and Internet-based services?
- Which methodological approaches shall be selected?
- How can futures studies objective, to contribute to social, economic and ecological sustainability be met in the context of social shaping of technology?

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