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The methodology combination of a national foresight process in Germany

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ABSTRACT

In September 2007, the Federal German Ministry for Education and Research (BMBF) launched a new foresight process which aimed at four specific targets. To achieve them, a tailor-made combination of methods was applied. This paper focuses on the concept design of the process and explains one of the methods — the future online survey — in more detail.
The German Foresight Process of the BMBF delivers results on different levels: broader future fields as well as single future topics. Both kinds are relevant and selected according to a set of criteria. Some of the results of this foresight process will be directly integrated into national policy activities, others are just more indirectly filtered into the innovation system of the specific sectors in the country. The future fields are all cross-cutting issues based on science and technology. All of them are specifically knowledge dynamic fields.

1. Introduction

In September 2007, the Federal German Ministry for Education and Research (BMBF) launched a new foresight process in order to sustainably safeguard Germany's status as a research and education location. The process started with four objectives and was tailored along them. "The BMBF Foresight Process" as it was called, subtitle "Implementation and Further Development of a Foresight Process," was conducted by a consortium comprising the Fraunhofer Institute for Systems and Innovation Research (Fraunhofer ISI) and the Fraunhofer Institute for Industrial Engineering (Fraunhofer IAO). Other institutions like the Technical University of Berlin, the Institute for Nanotechnology (INT) of the Research Centre Karlsruhe, the RWTH Aachen, the Austrian Research Centres GmbH (ARC), Systems Research Division — Dept. of Technology Policy, the Manufuture Secretariat Germany of the German "Verband deutscher Maschinen- und Anlagenbauer" (VDMA) supported the approach. The process linked both foresight and monitoring in its integrated approach.

The process had impacts along the six functions of Foresight for policy-making that recently emerged in the Foresight debate (informing policy, facilitating policy implementation, embedding participation, supporting policy definition and reconfiguring policy structures, as well as the symbolic function, see [1]). Accordingly, the German BMBF Foresight Process addressed all these dimensions, albeit with different emphases and in different stages with a new combination of methods. The process was considered to be the major approach of a German ministry in science and technology foresight. Nevertheless, it is not the only one and had strong links to the previous science and technology foresight processes on a national level [13,16,17,28,29]. Even as follow-up of the High-tech Strategy of the government [2], administrated in the same ministry, several sector foresight activities were performed (e.g. in Health, Environmental Issues or Information and Communication) and formulated in roadmaps.

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2. Objectives of the national foresight process

The BMBF itself in a call for tender formulated four specific targets. They were derived from previous foresight experiences and formulated by the responsible department (Referat). The BMBF Foresight Process aimed at:

1) Identification of new focuses in research and technology
2) Designation of areas for cross-cutting activities
3) Exploration of fields for strategic partnerships
4) Derivation of priority activity lines for R&D policy

3. Combination of methods and topic fields

In order to achieve these targets, a tailor-made combination of methods was applied. The process started by monitoring present-day science and technology and was broadened to look into the future of the next 10 to 15 years — and even further. It took into account the developments at the national as well as the international level. As there is not one single methodology that can be used as in an input–output model, like in most foresight processes world-wide [see 3–6] a combination of methods had to be used to meet all the requirements of the objectives (see Fig. 1).

In order to address objectives 1 and 2, in the foresight approach, well-known search strategies as well as other methods from innovation research, from international foresight activities [3] were taken into consideration, as well as new, creative methods. The themes to be investigated, both national and international, were further developed by experts taking into account existing forward-looking road-mapping and strategy processes from the public and private sector.

The first phase stressed the national search for weak [7] and strong signals [like in 8], while the international search was focused on the later second phase. As there is not a single methodology for searching procedures, the methods contained quantitative methods like bibliometrics as well as qualitative approaches like workshops, expert interviews, internet and qualitative literature searches. A new approach of inventor scouting (identifying young inventors and interviewing them) added to the methodology. For the evaluation of the topics, a set of criteria was worked out. This was the basis for an online survey but also the pre-judgements of the selection phase.

The foresight search activities were flanked by a monitoring process. With the assistance of an international panel, latest developments in various technological-scientific subject areas were analysed, consolidated and processed in order to attain a reliable description of the international "state-of-the-art." For the monitoring process, an international panel of well-known and acknowledged experts who have an overview in their fields were asked about the current state and new developments in research and technology. In a second wave nearly 1 year later, they were once more interviewed to consolidate their opinions and give feedback on topic candidates for BMBF that met the requirements of the objectives.

The process therefore started with desk research, research in databases and the internet. This search was combined with a bibliometric approach. Literature was analysed. Experts were identified and interviewed in order to find the most promising topics in research and technology for the next 10 to 15 years or even further in the future. These topics should still be in the research or development phase during this time. Topics that will already be in the implementation phase during the next years, or are already transferred to innovations in 10 years' time were excluded from the lists of topics to be considered. For first selections, a set of criteria was developed together with BMBF.

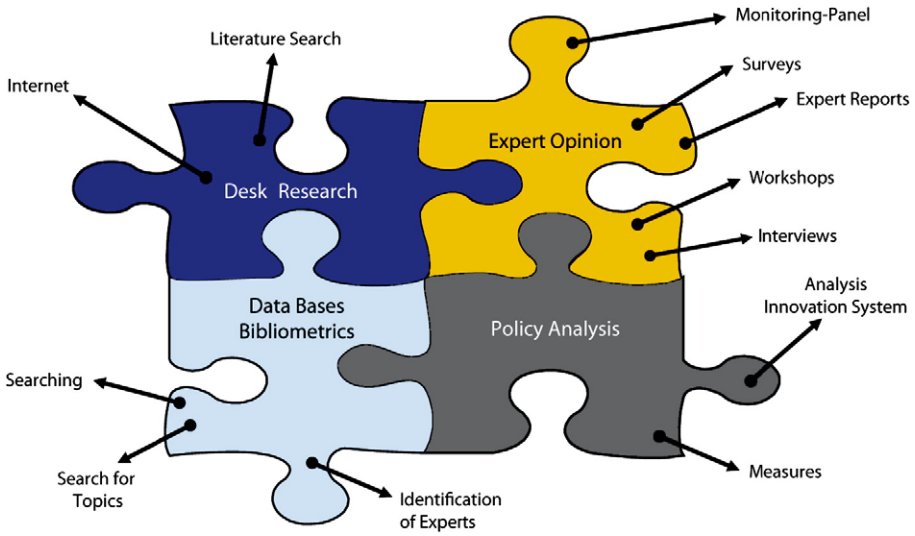

Fig. 1. Combination of different methods.

The topics were handled, internally assessed and re-assessed several times via an internal database and scientific papers. As an input to the first workshop in November 2007, a first set of scientific papers describing the developments in the fields were written and distributed as an input to the discussions.

The milestones of the process are described in Fig. 2. The first workshop was held as a starting point in the process to define those topics which should be elaborated in more detail, but also to define first cross-cutting topic areas. This was achieved by matching all 14 starting fields with each other and naming "interesting" new topics at these interfaces. These interfaces were the starting points for the searches at the national and international level.

For every field, topic coordinators (sometimes two persons) were nominated who were responsible for defining and working out the fields but also for coordinating with other topic coordinators in the cross-cutting areas. The topic coordinators did not only look at the future themes but also the innovation system and the actors working in the fields. A bibliometric analysis provided further input in this process. For this stakeholder analysis, key words were defined by the topic coordinators. According to the key words, literature from the Web of Science was counted on the one hand — and qualitatively analysed on the other hand [9,10]. The (internet, literature and other) searches and first selection processes were complemented by expert interviews and informal talks to arrive at an impression of the importance and potential impact of the huge number of topics under consideration.

Topics, in which BMBF or German research institutions were already very active at that point in time were labelled as 'golden' and in most cases were no longer developed.

The second phase (see Fig. 2) of the searches ended with a first assessment of the topics that were found. An online survey among experts from the German innovation landscape was performed in September 2008 in order to get broader assessment on the topics, their importance and their time frame (see below).

Parallel to this, the corresponding innovation systems were being analysed in order to identify candidates for potential strategic partnerships which are proposed in 2009 at the end of the whole process (Objectives 3 and 4). In the last phase of the process, recommendations for priority activity lines for R&D policy were also derived [in the sense of 11]. The last phase ended with a conference. Nevertheless, this conference marked the beginning of the integration of the topics that were identified into the German innovation system and into BMBF. It was rather a bridging conference than an end.

In detail, the different phases of the process delivered different outputs and served different purposes. The following sections describe which methodologies were applied in which phase of the process. Especially the online survey which had the function of focussing the topics as well as an assessment function is described in more detail (Fig. 3).

3.1. Starting phase of the process

The process started with 14 broader topic fields that were derived from the German High-tech Strategy [2], the BMBF portfolio and information gathered from within BMBF about specific foresight activities in the specialist divisions. In the first phase of the process, these fields were selected as starting points to search for "new" topics in science and technology, at first at the national level, later on internationally.

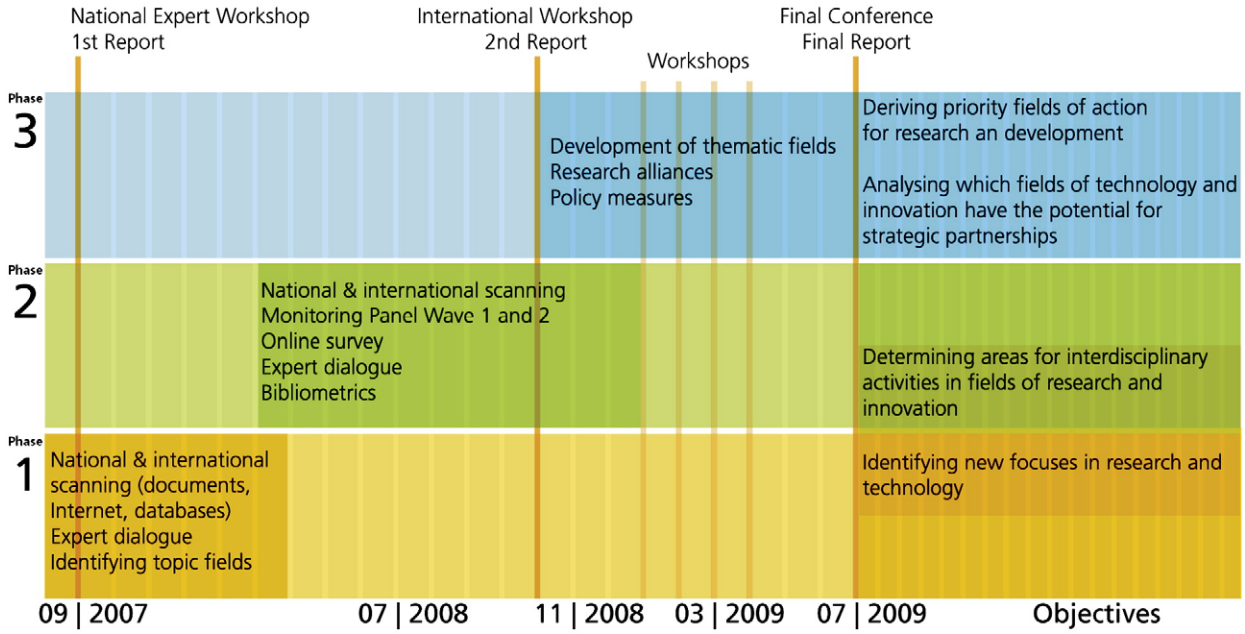

Fig. 2. Milestones of the process.

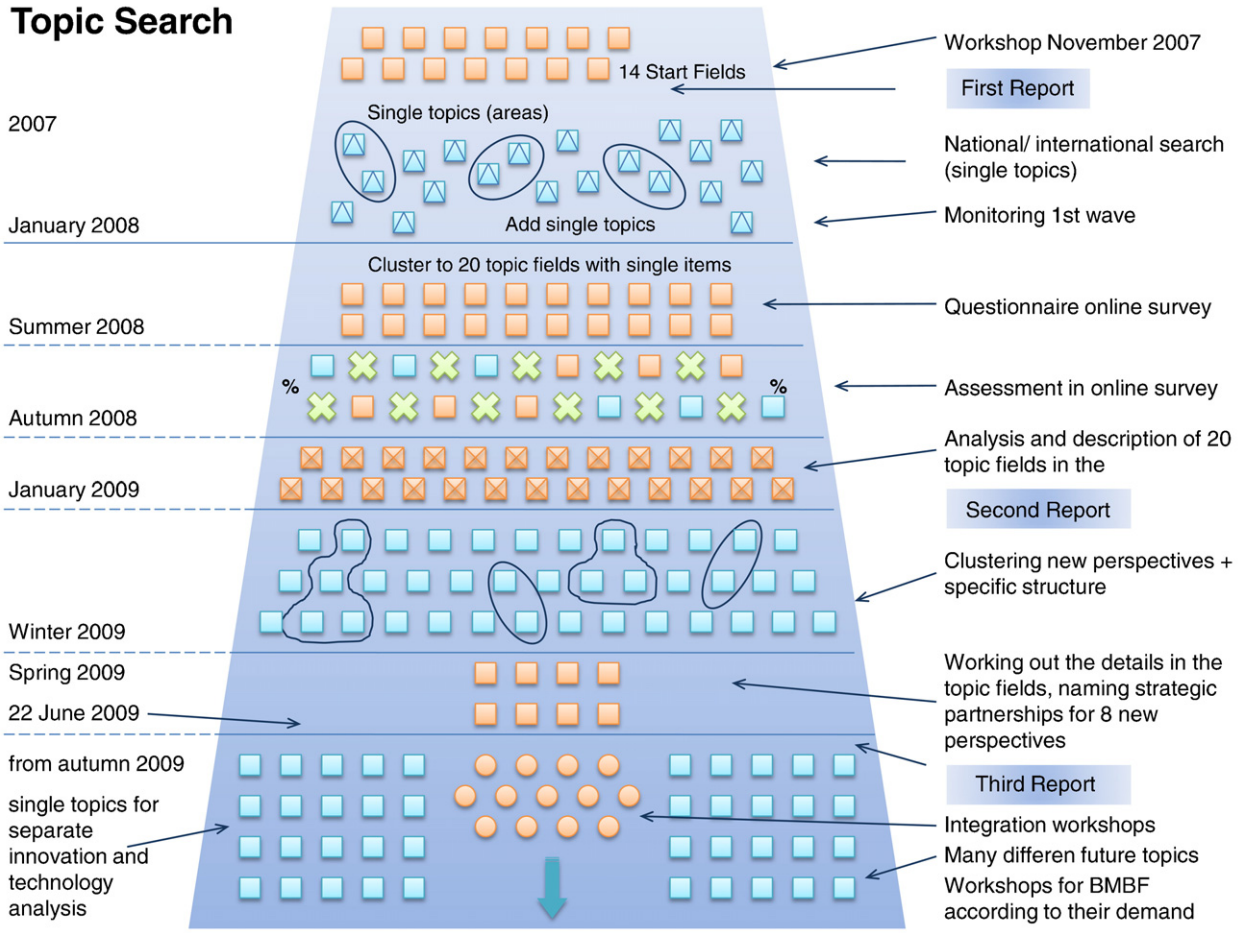

Fig. 3. Timeline of the methodology and different outputs at the end.

The topic fields were:

1. Life sciences and biotechnology
2. Information and communication technology
3. Materials and their production processes
4. Nanotechnology
5. Optics/photonics/optoelectronics
6. Industrial production processes (automation, robotics, mechanical engineering, process engineering etc.)
7. Health research and medicine
8. Infrastructure technology, urbanisation and environmental development
9. Environmental protection technology and sustainable development
10. Energy supply and consumption (generation, storage, transfer etc.)
11. Mobility: transport and traffic technology, mobility, logistics (land, water, air, space …)
12. Cognitive sciences and neuroscience
13. Systems and complexity analysis (including research on technological and scientific convergence; security research)
14. Services Science

In a first workshop with 110 participants in November 2007, these 14 thematic fields were discussed with respect to emerging topics and cross-cutting perspectives. As a result, some of the original fields changed and new fields emerged.

During the workshops' group work, which were facilitated by the expert topic coordinators, some new foresight and working techniques were applied. In the plenum session, a guided fictive time travel served as a mind opener. The workshops themselves addressed the 14 thematic fields themselves and tried to structure them. First future science and technology trends were mentioned and documented in mind maps [12]. In order to address cross-cutting issues (objective no. 2 of the whole process), a matrix was worked out, in which all thematic fields were matched and new developments in science and technology or long-term research questions were described at these “crossroads.” These cross-cutting areas were additional starting points for searches.

3.2. Search phase of the process

The second phase of the foresight process encompassed a further national and international search, interviews with Monitoring Panel participants, bibliometric analysis and a new approach of inventor scouting to bring in new ideas. In this second phase, the most interesting (cross-cutting) topics from the starting phase were further elaborated by the topic coordinators with specific expertise.

The interviews with Monitoring Panel participants were half standardised: part of the questionnaire was the same for all panel members, parts were different for those panel members who had a general overview over all topics and those who have an overview in specific fields. For all of them, comments and open questions were integrated in this first phase. The results were documented in two reports [9,10], one summarising "highlights," the second one was more analytic.

During this second phase of the foresight process, the 14 topics were confirmed, renamed, split, converged and newly formulated. In general, most of them remained in the process, often with a shifted focus and additions at the interdisciplinary borders of the thematic spectrum. In addition, already at this point in time, five new thematic fields were derived from the first workshop results and further search and clustering procedures. Expert discussions and interviews, also in the first wave of the Monitoring Panel interviews confirmed that the following thematic fields are of relevance for Germany:

- Ageing research
- Human machine cooperation (firstly called human machine boundary shifts)
- Infrastructures for Human Living Spaces (the Field 'Infrastructures' was split into Water infrastructures and Infrastructures for Human Living Spaces)
- ProductionConsumption 2.0
- Simulation and modelling
- Time research

In order to assess the relevance of all the topics (fields and sub-areas), a nation-wide online survey was carried out in September 2008. The results from this survey, expert interviews and a set of criteria were supposed to be inputs to select interesting candidates for BMBF relating to the targets 1) and 2) of the process.

3.3. The online survey

Intentionally, the whole foresight process did not start with asking for the demand as e.g. the predecessor process Futur [13,14] but with science and technology push topics. Therefore, the criteria to be matched incorporated some of the demand aspects and asked what the topics are relevant for: quality of life, the economy, the environment etc. The topics that were chosen and identified during the search phase should be checked and by a broader information base, which also means by more persons. Until then, only single experts were involved, now the floor should be open for many different experts, also from cross-cutting topics. The subjective bias [15], of working out topics should be minimised. And also the topics were very heterogeneous, which means a differentiation according to relevancy and future sustainability were necessary.

The online survey was designed as a check if the topics that were already found as future-relevant for German science and technology landscape are really relevant and if they meet the criteria of the process. In order to keep it simple and user-friendly, it was designed in a way that it had different "levels" and the user could always quit. The answers he or she had given up to that level were all calculated. In order to save time, no Delphi survey like in some of the previous German foresight activities was planned [16,17].

The concept was that every participant could choose himself which topics to judge. The principle of the concept of the online survey questionnaire is shown in Fig. 4.

The first page of the online survey explained the BMBF Foresight Process and the online survey in general. The first page of the questionnaire allowed to choose 1 of 20 topic fields. Clicking on the specific field, the questionnaire was opened. on this level, long-term relevant topic areas that were already selected from the process were shown. On the next level, research questions and tasks were formulated. This forced the topic coordinators of the process to formulate the future topics very precisely — similar to a Delphi survey. Windows with help texts gave additional information. The selection of the topics for the survey were not all topics regarded as relevant in general — those topics, which are already currently worked out intensively were not in the focus of the survey.

The second page of the online survey was shown when the participants had chosen their field. In the first evaluation part, the relevancy of the topic area was judged upon. For this, we used a five-step scale from "very important" to "unimportant." After this choice, the participant could choose the thematic areas to judge in more detail. Two other windows followed. On the next level, the participants were asked about their own expertise in order to judge later on if the "high level" experts assess the topics differently from the "mainstream." The expertise was the only criteria which had to be answered. The other questions concerning the relevancy of the topic area (five steps on the scale) could be assessed voluntarily.

The last part of the survey concerned the single research questions in the areas. Again, it was asked for a judgement on a five-step-Likert scale (from "very important" to "unimportant"). The second question was about the time: when do you expect the highest research intensity (in 1 to 5 years, in 6 to 10 years, in 11 to 15 years or in 16 to 20 years). Additionally, central problems which hamper an intensifying of research could be chosen. Because from the first category list, only one "problem" could be chosen, the possibility was given to add others and explain them. On this page, also different new research questions or tasks could be mentioned in an open field — and then judged in the same way.

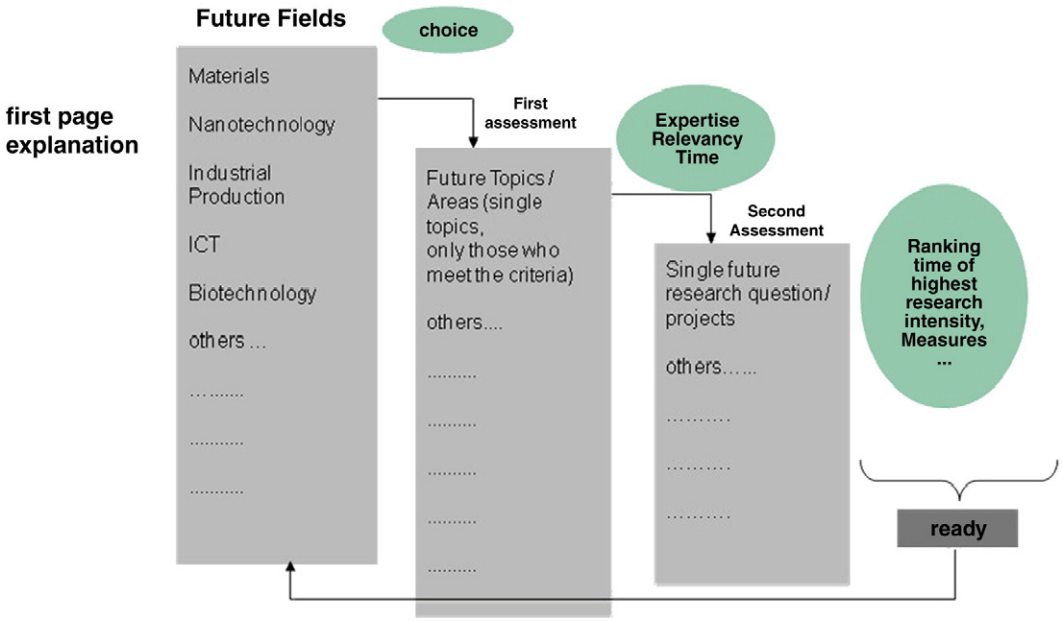

Fig. 4. Principle of the survey design (questionnaire concept).

For the survey, in September 2008 altogether 19.365 persons from German companies, academia, associations and single persons (consultants or persons who knew about one of the fields) were asked to participate. Basis of the choice of participants were public databases and the results from bibliometrics. A reminder was sent at the end of September 2008 and the survey was finished on October 22, 2008. The survey was accessed via the code we sent to the participants. If someone else wanted to participate, it was necessary to contact the project office to receive a new code.

2659 persons filled in one of the questionnaires, other 625 looked at the page (code was registered) but did not fill in anything. Most of the respondents came from academia. For sample control, it was important that some persons passed their code over to colleagues. Statistically, that was noticed because with one single code, very different topics were judged with very high expertise. For the result, that was insignificant.

As an incentive, all participants who included their e-mail received the summarised results (beginning of 2009). But the major motivation to participate was the questionnaire itself. From single persons, we know that the "scientific curiosity" about the future fields and topics was the major motivation for participation.

The results were valid and could be used for analysis. Most of the topics were estimated to be very relevant to medium relevant in the future. Therefore, the differentiation in the end was difficult. But in detail, there were differences when looking at the "relevancy for economy," "relevancy for the quality of life," "relevancy for the environment," and so on...

The results were calculated on SPSS basis. Different kinds of analyses were made but in general, relatively simple charts (mainly in percent) had to be used in order not to over-interpret the database. Some special analyses looked at the different behaviour of the participants — but their judgements were plausible. Many different tables calculated on numbers and on per cent basis were the result. These could be "ranked" like in the Japanese Delphi surveys [4].

One of many tables is shown in Table 1: this is the ranking of those topics, in which many persons ticked the problem "acceptance." These are the most unaccepted research topics for the future. The first examples are both related to nuclear research, one is about the nuclear fuel lifecycle, the other one about security concepts. The third one is energetic use of biomass/second generation, the fourth one is about the influence on the behaviour of users and investors concerning energy efficiency. For all of them, plausible explanations can be given, e.g. the generally low acceptance of nuclear power even leads to an estimated low acceptance on security topics here, or the problem of persons trying to save energy but behaving in a different way — because it is convenient, cheap etc.

On the basis of the survey, topics that will no longer be on the research agenda in 10 years' time, because the research questions are solved, were sorted out. This does not mean that these problems are already solved, but it does mean that science and technology are already receiving sufficient support, and solutions are on the way — or better: the topics are not new, well-known and do not need further or additional attention.

The online survey is a contribution to the assessment phase, but cannot be a static selection mechanism for BMBF (see also [11]). The criteria already defined were refined to specify the selection which was also the basis for detailing the topics. This selection was an input basis for the third phase.

In the last phase, the topics that were defined as future fields and future topics for BMBF were worked out in different papers. For this, a last assessment by the international Monitoring Panel (second wave of partly standardised interviews) took place to validate the results.

Table 1
One example for results.

Ranking problem: acceptance	Number of persons
Nuclear fuel lifecycle	94
Nuclear safety and security concepts	58
Energetic use of biomass/second generation	51
Influence on the behaviour of users and investors concerning energy efficiency	50
Wearable computers	34
Electric cars for long distances	30
Research on illnesses which are induced by social disadvantage	30
New materials for radioactive ray protection	30
Production and use of new living beings with new properties by integrating artificial systems	29
Hydrogen technology systems	28
Research on illnesses caused by lifestyle	27
Affective Computing	26
Geothermie	25

3.4. Some results

In the end, eight new future fields (broader fields) with a different perspective as well as single future topics in all 20 future fields were recommended for consideration. They cannot be summarised here but the eight future fields which should be considered with a different perspective were:

- Decoding ageing: ageing is based on many factors and concerns the whole lifecycle of (human) beings. The field concentrates on human beings. In the future, the mechanisms of ageing on the molecular level of the whole body and specially the brain will deliver new insights for cognition, emotions and psychomotoric or other concepts. From this knowledge, new therapies as well as new products may be derived.
- Energy concert: the energy supply and demand are still a cacophony. As many actors are involved and many disciplines may contribute, energy is a field that needs a symphony. On this way, even research questions have to be solved.
- Energy from the environment: energy harvesting is already known, but limited. New ideas are expected that make it possible to harvest the energy from different environments and transfer it into miniaturized machines. This is especially necessary for environments which are out of reach (implants, build-in house equipment...)
- Human machine cooperation (firstly called human machine boundary shifts): technological innovations that are directly linked to human beings (inside and outside of the body) need new technologies on the one hand, but also solid knowledge about thinking, feeling, communication and behaviour. The dynamic interplay at the borders of disciplines is the focus that opens up a new perspective.
- Infrastructures for human living spaces (the field 'infrastructures' was split into water infrastructures and infrastructures for human living spaces): new drivers like lifestyles or developments in society change the time and space patterns of living and working. For these, new flexible, sustainable technical infrastructures are required.
- ProductionConsumption 2.0: technical and organisational concepts have to be integrated in order to address the critical challenges of the future. This future field needs a new dimension in research on systemic change, including very different disciplines.
- Complexity, modelling and simulation: new aspects to handle complexity with modelling and simulation require multidisciplinary approaches. To work out the similarities in different application may be a first step to adapt the instruments and tools in other disciplines so that in the future even in technical and social science contexts, new simulations are possible.
- Time research: time is the limiting factor in different developments. Therefore, research on time efficiency, parallel structures, a new kind of precise and ultra-short time measuring as well as 4 D precision (for imaging etc.) are some examples. But also the biological rhythms of the human beings (chronobiology) and new knowledge for different applications will be future topics.

When this article is written, most of the results are not published, therefore only the spectrum of the broader fields can be mentioned.

3.5. Integration and implementation phase

An international workshop at the beginning of October 2008 marked the link to generate ideas for recommendations concerning policies and research alliances (objectives 3) and 4)) to be elaborated in 2009 [9,10]. The workshop took place in Hamburg and gathered international and German experts with experience in implementing new or cross-cutting issues. The purpose of the workshop was to discuss, what kinds of measures are successful in the implementation of new or cross-cutting topics, along the lines of examples from the past. The guiding questions were therefore:

– How can future issues and topics with a time horizon of 10 to 15 years and longer be rapidly and efficiently absorbed by an existing innovation system?

– How are organisations or companies in other countries dealing with cross-cutting issues and future topics with a time horizon of 10 to 15 years and beyond?

In five parallel working groups, different aspects of research and innovation policy around novel topics will be discussed:

- Organisation of scientific communities
- Establishment of research alliances
- Research programmes and initiatives
- Innovation policy instruments
- Ideation

A round-table discussion enhanced this discussion and asked if strategic partnerships will be a means to implement new or cross-cutting topics.

The challenge for the BMBF Foresight Process from 2009 onwards was the design of concrete strategies to address some of the topics identified. However, this is far from straightforward as foresight outcomes tend to challenge established configurations by pointing to long-term issues that reach across boundaries of scientific disciplines, industrial sectors and departments in industry, research institutes, and last but not least, in ministries. Therefore, organisations often struggle to come up with adequate and timely responses. At the same time, it is exactly the capability to combine diverse elements in new ways to respond to change which characterises the quality of innovation systems within a learning economy.

To start the integration of the topics into BMBF, first talks already took place with departments that showed interests in certain topics. These talks centered around the topics themselves and the preparation of potential workshops. These talks and first workshops took place in spring 2009. All of them were tailor-made, adapted to the needs of the BMBF departments (as a kind of service) or proposed to deepen the knowledge of some of the topics by inviting external experts if BMBF likes. It depends on the topics if further searches and a deeper discussion on the topics and their specific areas are necessary — or if it is more about identifying actors, innovation policy measures or other issues.

When this paper is written, the foresight process as such is finished as a project, but the process of integration is still continued. Therefore, this paper focuses on *expected* impacts and the conceptual design. We analyse the expected impacts along the five functions of Foresight for policy-making that recently emerged in the Foresight debate [1,18].

4. Expected output and impact of the process

What are the expected outputs and impacts of the BMBF Foresight Process? How does it fit into the recent developments in Foresight methodology, such as the concepts of adaptive and embedded Foresight, and how does the expected impact relate to these conceptual developments?

Direct outputs in the sense of deliverables were three reports to BMBF as well as a scientific report at the end of the whole process. The first official output was the first report to BMBF [9] which described the starting points in the thematic fields as discussed in the first workshop of the process. This report was handed over to the heads of BMBF departments in order to inform them about the start of the process and deliver some first preliminary impressions of topics that would be the start of the search phase.

Nevertheless, the process had four different objectives and there are many more impacts and outputs in-between. One impact is by informing BMBF about things to come. The interesting objective here is to achieve an overview — in more detail all the departments (Fachreferate) are even better informed in their specific areas. But often, they have difficulties in integrating cross-cutting topics or defining responsibilities (and budgets) for them. Creating awareness for these topics is already expected to have an effect in the ministry. In these cases, the expected impact of the process will be an addition to the research agenda, especially in fields that are cross-cutting thematically and maybe also in the BMBF organisational chart. Whether the divisions adopt this information to support new topics is another question.

Another impact is expected in the first definition of new strategic partnerships. Strategic partnerships (objective no. 3) are defined very broadly, including partners from very different institutions, maybe even ministries. They have to be differentiated from a more specific definition of research alliances and innovation alliances like those which already started in the current context of the High-tech Strategy [2] (www.bmbf.de).

As the BMBF Foresight Process can be called a fully fledged foresight process (in the sense of Georghiou et al. [31]), it can be asked if it matches the different policy dimensions identified in the ForLearn Guide [1,18]. The dimensions and specific functions discussed there are

Informing policy: generating insights regarding the dynamics of change, future challenges and options, along with new ideas, and transmitting them to policy-makers as an input to policy conceptualisation and design.

Facilitating policy implementation: enhancing the capacity for change within a given policy field by building a common awareness of the current situation and future challenges, as well as new networks and visions amongst stakeholders.

Embedding participation in policy-making: facilitating the participation of civil society in the policy-making process, thereby improving its transparency and legitimacy.

Supporting policy definition: jointly translating outcomes from the collective process into specific options for policy definition and implementation.

Reconfiguring the policy system: in a way that makes it more apt to address long-term challenges.
Symbolic function: indicating to the public that policy is based on rational information.

Informing policy is one of the major features of the B MBF Foresight Process. Gaining an overview about topics that are relevant for and in science and technology with a longer-term view and codifying this knowledge in reports for BMBF contributes directly to the first two objectives of the process (objectives no. 1 and 2).

It is expected that *policy implementation* will be *facilitated* by this information, by defining strategic partnerships and recommendations, as well as by including BMBF as one of the participants in the later phases of the process.

Participation is supposed to be broadened by involving very different kinds of "experts" in the process. Expert means a person knowledgeable about the topic, it can be someone from industry, policy-making itself, academia or the civil society in general. Most foresight processes include a very broad definition of experts — but the discussion is still going on. The predecessor process of BMBF (Futur [13,14]) tried to involve more persons from "civil society," but in the later phases the need also to involve experts in the focus groups was felt, because "experts" in the broader sense were the persons who knew about the details in science and technology. The current BMBF Foresight Process is about science and technology, it needs experts who are able to understand and explain the topics, but also to assess them according to a set of BMBF criteria. For this, in a broad online survey, many participants are approached to involve more persons than the well-known lobbies in the definition and the assessment of new topics. This makes the complex process — hopefully — more transparent and understandable.

Objective no. 4 directly addresses the *support of the policy definition*. The workshop in autumn 2008 is supposed to directly contribute to the theoretical and case study discussion for the translation of outcomes from the collective process into specific options for policy definition and implementation. Later in the process, this will be performed very concretely in the thematic cases which are identified. Also for them, in joint workshops and discussions, the topics and outcomes will be worked into recommendations for policy options.

Foresight is never performed in a vacuum but is a living system. Therefore, every foresight exercise has an impact on the system the foresight is performed in, in this case the BMBF and the policy as well as the innovation system. It can be doubted, however, whether the policy system can be directly reconfigured by such a foresight process. Nevertheless, even if this is not directly intended, the system will react and change. There will therefore be an effect on the policy system itself, which makes it more apt to address long-term challenges. In the BMBF Foresight Process, an impact is expected on the interdisciplinary or inter-departmental collaboration concerning new and especially cross-cutting topics (objectives 1 and 2).

The question of adaptive foresight remains [19, p. 472]. Therefore, the objectives of the process are formulated in such a way that they are realistic primarily for BMBF strategic departments to deal with and were focused on results that are within the limits of BMBF reach and responsibility (science and technology). Previous processes often tackled topics that were too broad for the ministry to handle (e.g. the society in general). The process is in its first search phases open to all topics, but stress science and technology because other topics may not be implemented directly by a BMBF. Therefore, those topics which are not directly BMBF topics are "handed over" to others by raising their awareness. They can be implemented by others in the innovation system or be part of strategic partnerships (objective no. 3).

Whether the BMBF Foresight Process will be successful in balancing participatory elements and closed internal processes will depend on different factors. At least the methods are designed in such a way that there may be fruitful interplay.

"Adaptive Foresight is designed to help decision-makers develop strategies. You can do a research project using many of the ideas from AF, but the full benefits can only be realised in a consultancy project working closely with a client. Typically this direct client acts on behalf of a broader and less well-defined entity, which we call the addressee." [19, p. 473]. Exactly this is the basis of the BMBF Foresight Process. It is not a research process as such but a "Service Contract" for the consortium.

In this sense, the BMBF Foresight Process is not an inherent, completely embedded process because intentionally, two institutions are performing the methodological part of the process that are regarded as "neutral" in having no direct thematic stakes in the process (although indirectly, as they are part of the Fraunhofer Society whose institutes have strong stakes in the research landscape) — but in close cooperation with BMBF. The BMBF Foresight Process is intended to keep a certain distance to lobbies of topics on the one hand, but integrate them with a neutral perspective on the other hand. BMBF divisions are also involved and continuously informed — but the process tries to channel the different interests. In the integration phase of the process in 2009, the "embedding" is realised step by step.

But it is definitely too early in the process to exhaustively evaluate the impacts according to these five dimensions. Nevertheless, from the current point of view, there are already some contributions.

5. Preliminary assessment and outlook

Until the end, the BMBF Foresight Process worked "undercover" and was not publicised as much as the predecessor processes in order to make the identification of new topics possible and avoid influences on the thematic focus from the beginning. Especially the direct predecessor process Futur [13,14] was directly promoted from the beginning. It was well-known and therefore, the expectations were very high. The Delphi surveys [16] were mainly known by expert communities who participated because at that point in time, foresight was relatively new for German communities and for the ministry itself. It did not have to fight high expectations but was promoted by the coming year 2000 and the demand for "knowledge about the future."

Nevertheless, because of the workshops, interviews and survey, it was known in the research scene. It was very important to include BMBF from the start but without "BMBF advising BMBF." Thus, mutual talks with different BMBF departments and

divisions (Abteilungen and Referate) and experts in BMBF were organised very cautiously so that at different stages of the process the previous work of BMBF (such as in the identification of the starting topic fields) as well as the foresight and other future-oriented processes planned in BMBF were taken into account.

On the other hand, the process was designed as a "neutral" process which is thematically not directly influenced by the ministry and its organisational chart but includes information and knowledge from different sources and by different means and methods. The information and topics gained in these processes may also be interesting for other actors in the innovation system. Further on in the continued foresight, BMBF will be involved more directly — the more the topics to be focused on are identified, the more BMBF is consulted and included in the detailing of the topics, so that finally strategic partnerships and policy recommendations can be made. These will help to implement the longer-term topics directly, even if there is still enough time to prepare the implementation. This is regarded as one of the add-ons from foresight processes: to gain time for the preparation of new research. There is already interest from BMBF departments to get involved into the process. This is already a success.

Nevertheless, a particular challenge is to ensure impact beyond the general elections: in 2009, general elections will be held in Germany. Until now, all German foresight processes ran into election times [19] which made it difficult to continue with the implementation preparations as intended. The process is not linked to any particular political goal. The results can be put to use for different strategy building activities on different levels and different objectives (see the reservoir approach [18] or [20]). To have already interesting topics worked out and ready to be implemented can also be a particular chance — beyond any political party. This is already recognized in Japan [21].

The process is a fully fledged process that takes into account the sponsor and implementor of the results in different feedback loops, different internal discussions and internal workshops. Its preparation learned from innovation and from foresight studies [22–27] and took into account knowledge from 15 years of foresight in Germany and internationally [4,5,6,17,21,28–31]. This is not a linear approach of searching for new topics and then delivering a result, but more for interconnectivities and the loops in-between. Different departments of the BMBF as well as external persons are consulted and included in the process in order to make use of the strategic intelligence of the innovation system [24,27,32] — but this time very cautiously and step by step. It turned out that it is easier to make proposals for new topics and discuss if the topics of the discussion are more cross-cutting in nature and do not lie in the focus of the department's own responsibilities. Therefore, there is a good chance to bring together different departments to support cross-cutting research — which is in many cases the basis for very new things to come. This can be a lesson for other foresight activities, too.

Of course, BMBF and its different departments will have the last word in the decisions. But this time, even if the large process is not acknowledged after the next general elections in 2009, there is already an impact on some of the ministerial departments. Nevertheless, the question remains, how this kind of impact can be demonstrated, traced and "measured."

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