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FORESIGHT AND SCENARIOS AT FRAUNHOFER ISI

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Foresight, scenarios, strategy, research- and innovation landscape, participative process

Abstract

The Fraunhofer Institute for Systems and Innovation Research ISI analyses the origins and impacts of innovations and research, the short- and long-term developments of innovation processes, and the impacts of new technologies and services on society. Apart from clients from industry, academia and politics, the Fraunhofer ISI supports futures dialogues and the strategy process within the Fraunhofer-Society itself. For this purpose, scientifically based analysis, evaluation, as well as foresight methods are applied and developed. The term "foresight" refers to *a structured debate about complex futures* that is based on a systematic approach using various methods of future research [5, 15, 16]. One of them is the scenario method that provides a systematic process of creating alternative pictures of the future integrating quantitative and qualitative data.

The scenario method concerns the interaction with the relevant actors. The focus is on active preparation for the long-term future by inspiring future thinking and supporting action towards shaping the future. For this purpose, new approaches are constantly being developed or known ones are further advanced. A system perspective is always at the heart of the scenario process design. Hence, a look into the future needs to be broad and comprehensive, including multiple perspectives. In addition, the scenario method is open to different

pathways into the future and to discussing alternative developments. For decisions to be taken today, a future has to be selected, to prepare for it, or to make it real. One option may also be a business-as-usual scenario for the future. It is important to clarify which future is being analysed: a possible future (What can happen?), a probable future (Which options do we have?), a desirable future or a vision (Where do we want to go?).

To answer the question, "What is possible and desirable future of the Fraunhofer-Society?" a thorough look at the possible futures of the European landscape is required. The dynamics of the contract research market combined with the multiplicity of players in the European research landscape create a very high degree of complexity. It can be handled and partially reduced through the process of scenario development. In 2009, a project series was initiated, which started by outlying possible surrounding scenarios for the Fraunhofer-Society describing the European research landscape in 2025 and taking into account the interactions with industry. In a second step, the surrounding scenarios were used to discuss the long-term aims of Fraunhofer by generating a wide range of possible alternative strategy scenarios based on a broad involvement of the employees. As a final step, the Fraunhofer management board derived one orientation scenario out of the alternative strategy scenarios and communicated this scenario within the Society as a long-term vision. This orientation scenario was focused on organizational structures and the future positioning of Fraunhofer with the European research landscape.

The challenge was dealing with the size and the decentralized organizational structure of the Fraunhofer-Society consisting of more than 60 very different and independent institutes that operate in different environments and follow their own strategy. This required the involvement of a large number of internal and external experts. For that purpose, an expert-based approach was used which allowed an integration of the different perspectives and encouraged the interactive exchange with the surrounding environment and within the Fraunhofer-Society itself.

The paper discusses the advantages and disadvantages of the workshop-based scenario development and shows two alternative approaches to take up these disadvantages. Furthermore, it presents typical elements of the scenario development at the Fraunhofer ISI as well as the scenario process with the Fraunhofer-Society at a glance.

1. Workshop-based scenario approaches

1.1. Scenario approach at Fraunhofer ISI

The scenario development for and with the Fraunhofer-Society contained the three main steps of scenario development described above. Moreover, it relied strongly on a workshop approach. The quantitative and qualitative factors were processed alongside each other and integrated into scenarios. Building on different levels of background research, which varies in its comprehensiveness, the first important sub-step was to develop the future assumptions. Taking into account the basic principle of approaching the future with an open mind in the sense of "thinking the unthought," a "leap into the future" is often used in the form of a workshop, which initially only concerns sketching a mentally or argumentatively imaginable world [22, pp. 292] for which the necessary sequence of steps or a roadmap are not yet known. The development of assumptions about the future is based on creativity methods, e.g. brainstorming or brainwriting [4, pp. 124–143], in order to ensure that the assumptions do not simply reflect an extension of past trends. Furthermore, external and internal experts were involved in the process in order to promote the expansion of perceptions.

The objectives of the scenario development process are presented in Figure 1. An important creative element, which has already been used in many scenario processes at the Fraunhofer ISI, is the interactive visualization of future assumptions during the workshop. This visualization not only supports the receptiveness and intake capacity of a group, but also helps to focus attention on the most important information.
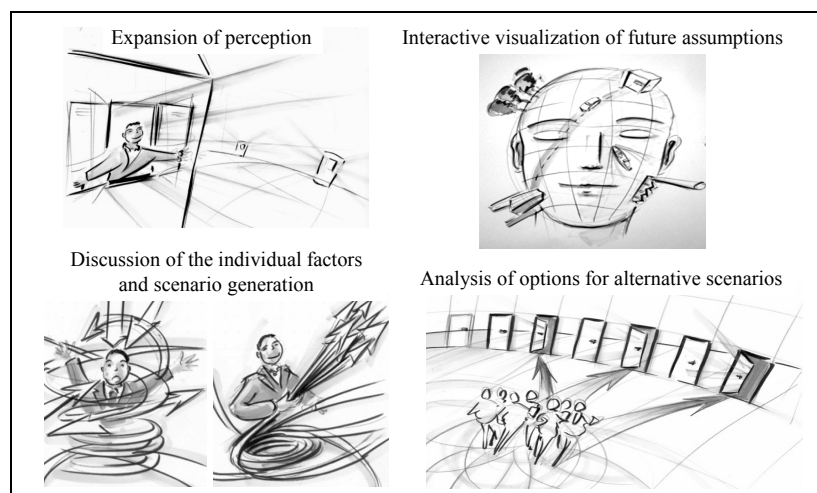

Fig. 1. Objectives of the scenario development process
Source: Fraunhofer ISI; Illustrator: Heyko Stöber.

As is usual in scenario analysis, the assumptions about the future developments are first identified for single factors without considering the interactions between these developments. Based on the generated future assumptions for all factors, the next phase of the scenario process generates the actual scenarios. Both model-based (supported by a software) and intuitive scenarios are developed at the Fraunhofer ISI. Regardless of which method is used, the objective is always to develop several internally consistent scenarios. In summary, the scenario processes at the Fraunhofer ISI can be characterized by the following features:

− Utilization of *collective intelligence* to avoid group thinking;
− *Reduction of complexity* for a creative discussion of the individual factors;
− *"Leap into the future"* without discussing the interim steps;
− Systematic consideration of *alternative developments* for each factor;
− Support of interdisciplinary discussions through *visualization;*
− Systematic *analysis of complex interdependencies;*
− Discussion of *multiple consistent scenarios;* and,
− *Consideration of options* for alternative scenarios.

1.2. *Advantages and disadvantages of workshop-based assumption development*

Our experiences from diverse scenario projects show that the participative process particularly fits the development of future assumptions. These experiences are also confirmed by other scenario users [9, pp. 104–118; 13, pp. 16—17; 20, pp. 153–155]. The relevant advantages are as follows:

− The development of shared ideas about the future in a short time (away from daily business);
− Generating more ideas due to synergy effects (alternative concepts, different possibilities);
− Intensively discussion on alternative developments;
− Promotion of the acceptance of the applied method; and,
− Positive side effects (in successful workshops), e.g. expansion of the own perception or network building.
  There are some special features depending on the kind of scenario.

For surrounding scenarios, participants with different backgrounds play a special role. Due to the attending of representatives of other organizations that operate in the same environment the "group thinking" might be avoided [9, pp. 116–117]. The different, sometime even conflicting attitudes to the discussed topics support the creative exchange, in particular when the cooperating or competing organization are involved in the process. The reason for that is the equally of benefits from the results.

For the development of strategy scenarios, the creation of a common communication basis is crucial. The "face-to-face" communication helps to identify conflicts and supports the discussion about the different values in the organization. The most important aspect is the transformation of a heterogeneous group into an initiator of processes of change in the organization. The transfer of scenarios is based on more traceability and more acceptance of the results [17, pp. 651]. The involvement of decision makers is as important as the involvement of people who could support and hinder the implementation. Darkow (2014) describes, in particular, the strong influence of middle managers "as the `linking pins´ who have the opportunity to create strategic initiatives and to enable, delay or even harm the implementation of strategies.

The criticism focuses on following aspects [8, pp. 170; 9, pp. 115–116]:

−   The area of investigation or its environment is too complex for an in-depth discussion in all corresponding fields (many aspects are discussed only on the surface).

−   Involving all relevant actors leads to a large number of participants (less discussion time for each participant).

−   The group dynamics might have an influence on the results (overvaluation of some events or developments).

−   A change in the framework conditions of a project is hard to be taken into account after a scenario workshop.

In addition to the aspects named above which are related in particular to the assumption development, there are two main weaknesses of workshop-based approaches: Firstly, in addition to the different backgrounds, the assembly representatives can only be achieved by involving persons of different age, profession, and world view. This is not possible in most cases. Secondly, the discussions are often influenced by a short-term change of mood caused by the media. It is unclear, whether the decisions based on the broad consensus of lay people are more beneficial than decisions made by a selected group of decision makers [23, pp. 75].

To meet this criticism and use the advantages of the workshop-based approaches, two alternative approaches are described below. In both cases, the development of assumption was performed several times by different attendees.

2. Workshop-based approach to develop scenarios for
the strategic positioning of the Fraunhofer-Society

The scenarios for the Fraunhofer-Society were developed in a multi-stage process. While only the future environment of the Fraunhofer-Society was analysed, in the first stage, it is under the heading "In which future we will do research?" (see the large circles, Figure 2); subsequently, internal development possibilities were also considered (see the small circles within the larger ones,

Figure 2). While for the environment, analysis only factors were discussed, which cannot be influenced by Fraunhofer itself, the internal examination comprised only factors that can be directly influenced by the Fraunhofer-Society (Which options are available?). For the analysis of longer-term structural developments, the time horizon of 2025 was selected. Both, the surrounding scenarios and the strategy scenarios considered global development, but they focused on the European research landscape. As illustrated in Figure 2, three different internally consistent scenarios were outlined for the developments in the environment of the Fraunhofer-Society. These surrounding scenarios formed the starting point for the development of six strategy scenarios, which can be described as possible reactions to the different developments in the surrounding environment (two reactions for each surrounding scenario). These strategy scenarios are not normative in nature, but they represent possible development and thereby illustrate the scope for action. The strategy scenarios set the ground for developing an orientation scenario, which includes normative elements to a large extent.
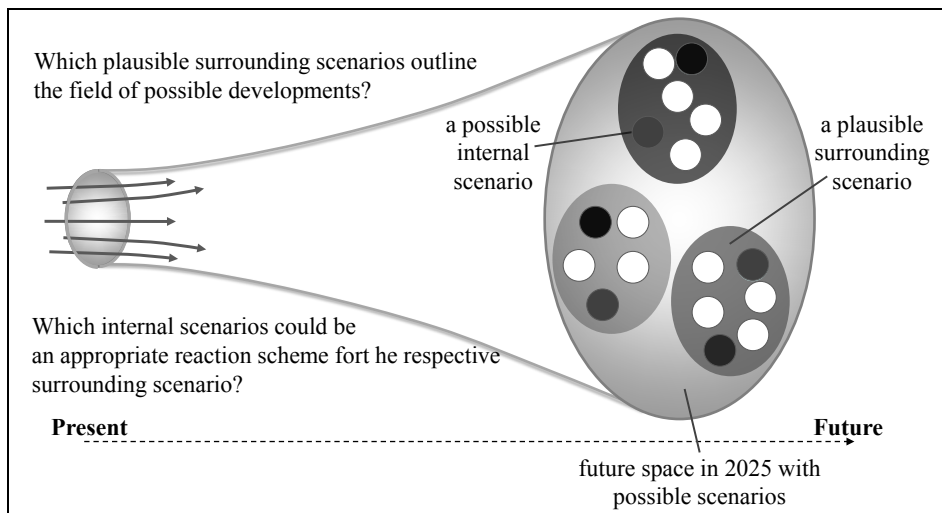

Fig. 2. Surrounding scenarios and strategy scenarios
Source: Fraunhofer ISI.

In case of surrounding scenarios, the complex environment was disassembled into individual subsegments in order to enable the participation of more experts and to cover a wider thematic spectrum. The integration of the subsegments took place after the consistency analysis in each subsegment. In the case of strategy scenarios, several workshops with the same thematic questioning were conducted using the expertise of different attendees in each

workshop. How strong is the influence of the groups on the results was investigated.

2.1. Surrounding scenarios: In which future will we do research?

External scenarios generally describe the framework conditions for the activities of a company, an organization, or its individual sub-areas. The different political, economic, technological, and societal aspects are often interlinked. Taking relevant influences from the surrounding environment into account requires the involvement and integration of various experts in order to ensure that a broad thematic spectrum is covered and to enable the discussion of interactions between different areas. To facilitate an intensive discussion of the two main topics, the public funded research landscape and private actors, key factors were discussed in two workshops with two different groups of about 40 participants in total. In the first case, experts for the European research landscape, representatives of different European research institutions, universities, associations, and politicians were invited. In the second case, several company representatives participated, covering different sizes of enterprises and diverse technological areas and sectors.

This approach of scenario development is characterized by the following features: division of the investigation field in two different subsegments with only few commonalities, the different professional backgrounds of the participants, the small space in-between the two workshops for the assumption development, a similar participant structure with regard to age and gender (about 20 participants in each workshop), the same team of moderators, and the same methodological approach in each workshop.
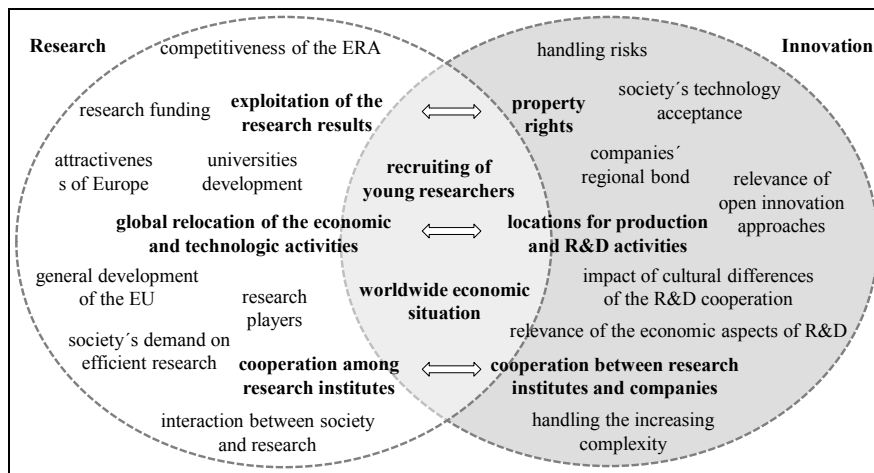

Fig. 3. Surrounding scenarios and strategy scenarios
Source: Fraunhofer ISI.

Several aspects were considered which play an important role, both within the European research landscape and in the contract research market, such as *property rights*, *global relocation of F&E activities,* and *cooperation of public and private research*, *the availability of young researchers,* and *the economic situation* (Figure 3). The first three factors were discussed in different contexts that resulted in different future assumptions. For the last two factors, very similar assumptions were identified in both workshops.

For each key factor, assumptions about possible future developments were phrased. Whether only one possible future assumption or several available alternatives should be considered within the scenario process were discussed. For example, two possible developments were phrased for the key factor *society's attitude towards research*: (i) High approval of research and confidence in technological solutions, and (ii) Low approval of research combined with the demand for increased efficiency effectiveness of research. At least two alternative assumptions were developed for all the key factors.

All common factors built an appropriate basis to integrate the subsegments (sub-scenarios) to four integrated scenarios by combining assumptions about the public research landscape and about the private innovation landscape in 2025 in a plausible way. These scenarios outline the range of possible developments within the environment of the Fraunhofer-Society [3]. The three most relevant scenarios were selected as a starting point for generating strategy scenarios as follows:

-   The scenario `European research and innovation area: Mission accomplished´ is characterized by excellent innovation management and the use of creative scope as well as reforms and transparency in the research landscape.
-   In scenario `Market-driven rules: research and business under pressure´, in contrast, there is hardly any willingness to cooperate in the European Union. Companies are risk-averse and have low innovative capacity. Research in Europe is stagnating.
-   In scenario `Limited innovations in `glocal´ Europe´ there are hotspots in Europe, which attract companies and represent centres of research.

2.2. Strategy scenarios: Which options are available?

While numerous external experts were involved in the development of the surrounding scenarios, in contrast, a mainly internal process was designed for the strategy scenarios, but a high degree of participation from within the Fraunhofer-Society was facilitated. The process was integrated in the high-level strategy process "Fraunhofer 2025" of the management board, initiated by the Presidential Council. For the strategy scenario process, alternative futures assumptions that are relevant to the employees were discussed in several workshops with a total of more than 60 participants from 30 Fraunhofer

Institutes and the headquarters of the Fraunhofer-Society. While the two workshops were deliberately designed to be exclusively internal events, in order to enable an open exchange, the perspectives of representatives from industry and politics were noted in an extra workshop and integrated into the process.

Examples for relevant topics and factors that were discussed during the workshops are Society `mission and performance indicators of Fraunhofer´, `the growth strategy´, `the balance between applied and basic research´, `internalization strategy of Fraunhofer´, `principals for cooperation with industry´ or `Fraunhofer as an employer´. The assumptions about future developments of these factors, outlined in the workshops, were condensed into six strategy scenarios, each of them linked to one of the three surrounding scenarios (Figure 2). This process was done as part of the consistency analysis.

From methodological point of view, whether it is possible to achieve representative results in one workshop with a specific participant structure was investigated. The following aspects describe this approach: three different locations in Germany; a larger space between the first and the last workshop, similar interdisciplinary background of the attendees in each workshop, the same hierarchical levels, similar structure with regard to the age and gender, the same workshop size, and the same team of moderators.

The identification and selection of the key factors resulted in similar findings with a focus on about ten key factors. This major intersection of the three workshops (Figure 4) showed that only a third of participants were able to deliver representative results, if the key stakeholder types were covered.
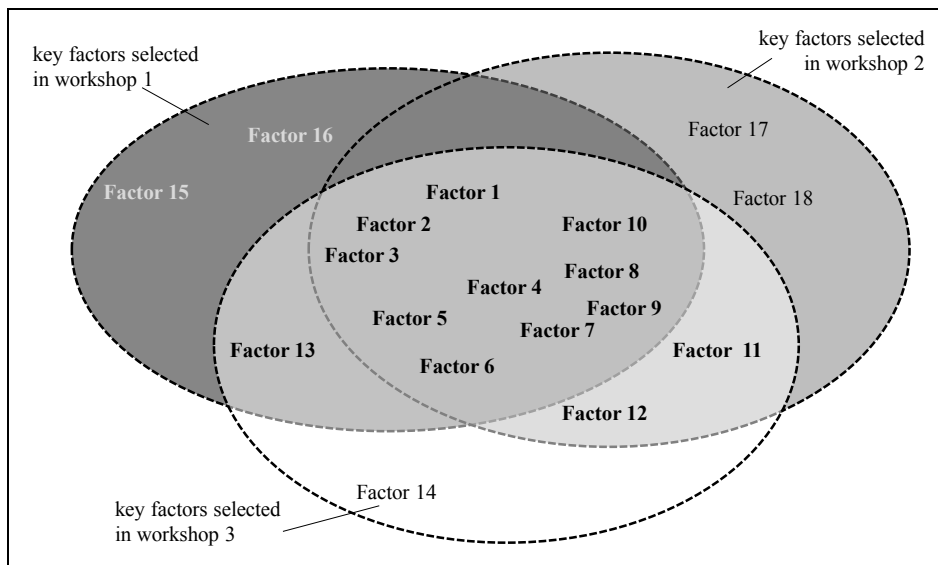

Fig. 4. Thematic intersection of the three workshops
Source: Fraunhofer ISI.

Referring to the assumption development, there were significant differences between the workshops. While a similar present situation of the key factors was discussed, the discussion about the possible future developments of these factors led partly to completely different results (Figure 5). This might result from the interaction between the participants in each workshop and the qualitative nature of the factors that allowed a variety of alternative developments (4–5 different assumption for each key factor).
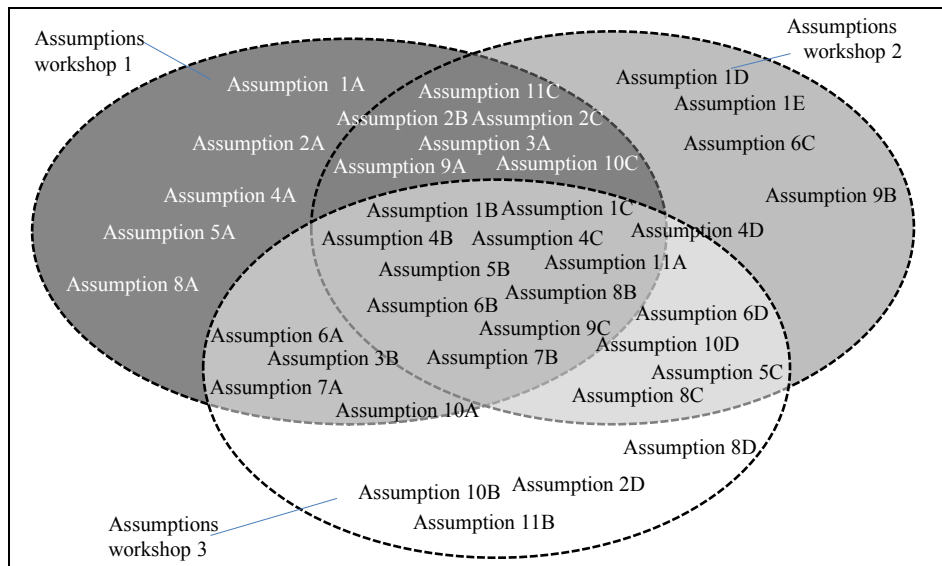

Fig. 5. Differences in terms of assumption development
Source: Fraunhofer ISI.

2.3. Orientation scenario: Which developments are desirable?

The strategy scenarios served as a basis for developing an orientation scenario that included normative elements. The strategy scenarios set the groundwork for the strategy process, which included selecting options, which were considered by the management board to be worth working towards. Based on the existing analyses of the European research landscape and the internal options, the Presidential Council developed a scenario that contains especially desirable and probable developments and thus acts as an orientation for all institutes of the Fraunhofer-Society. The methodological approach for this process was developed by the Fraunhofer ISI. Thus, the participation did not play a big role in the development of the orientation scenario, and it was discussed in an interactive process with the Institutes' directors and communicated to the Fraunhofer-Society in 2012.

The surrounding scenarios not only show the scope of possible developments, but they are also used in an iterative process to analyse and discuss the robustness of the orientation scenario (Figure 6).
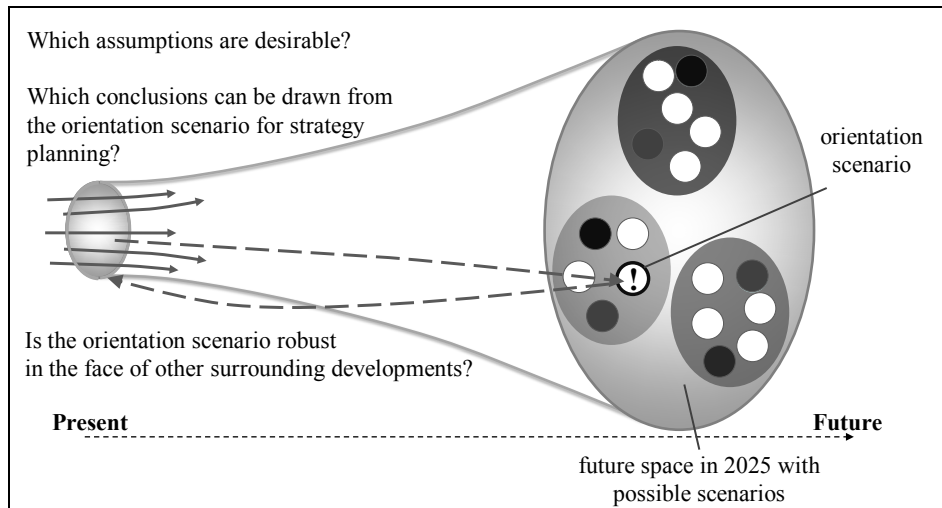

Fig. 6. Conclusions from the orientation scenario
Source: Fraunhofer ISI.

3. Conclusions

The use of the scenario method to look at surrounding developments and the integration of extensive participatory elements in a strategy process are new approaches for the Fraunhofer-Society. The scenario analysis, including participatory elements, seems especially well suited to discuss the internal developments, because the Fraunhofer-Society is characterized by a decentralized structure with more than 60 thematically highly differentiated and highly self-sufficient institutes as well as 20 further research institutions in Germany alone. The Fraunhofer-Society is sustained by its researchers, who have strong intrinsic motivations; and they are used to work creatively and independently, and for whom the identification with the Fraunhofer-Society, and its mission and vision is an important basic precondition. Therefore, it is a particular challenge to bring together the different research directions, link the institutes in a network, and embed a common, long-term orientation in the Fraunhofer-Society.

Moreover, the close networking of the Fraunhofer-Society with other research institutions in Europe and with international enterprises as well as the high relevance of research policy at both a national and European level requires that external developments to be carefully considered. These surrounding

developments are characterized by high uncertainty, as the current economic and financial crisis in Europe shows. Scenario planning is a method of futures research that has been specially developed to meet these requirements and is therefore particularly suited to consider very heterogeneous developments, which can be described quantitatively and qualitatively in a holistic, systemic way.

From methodological point of view, the testing the different approaches of the workshop-based scenario development was important. The multiple performance of the assumption development showed that the weak points of the workshop-based approaches could be at least partly compensated. In case of surrounding scenarios, the independent subsegments were discussed in width and depth; the interfaces were small enough to not duplicate the discussion and big enough to integrate these two subsegments afterwards. In case of the strategy scenarios, the results showed that the selection of the key factors and the analysis of the present situation could deliver representative findings, if the participant structure is representative. In contrast to that a multiple procedure, it can be recommended to develop the future assumptions; thus, in this way, the spectrum of future possibilities could be broadly covered.

It is important to note here that the approaches lead to higher effort for the project team, moderators, and participants. The additional effort during the integration of the workshop results should be also considered. Therefore, it has to be weighted from case to case, whether the improvement of the result quality can justify the additional effort.

The next exciting step, which is being tackled at present, is to apply the orientation scenario in the Fraunhofer-Society, which is such a heterogeneous research organization. It will be exciting to see how it develops.

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Foresight i proces generowania scenariuszy w Instytucie Fraunhofera ISI

Słowa kluczowe

Foresight, scenariusze, strategia, badania i innowacje, proces, partycypacja.

Streszczenie

W artykule przedstawiono wady i zalety generowania scenariuszy z wykorzystaniem warsztatów. Przeanalizowano dwa alternatywne podejścia ukierunkowane na zminimalizowanie wskazanych wad. Ponadto zaprezentowano typowe elementy procesu tworzenia scenariuszy w Instytucie Fraunhofera ISI w Niemczech.