RESULTS AND IMPACT OF NATIONAL FORESIGHT-STUDIES

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Keywords

Foresight studies, evaluation, impact measurement, effectiveness and efficiency of Foresight studies

1 Abstract

Conducting national Foresight studies has become common in many countries. However the impact of such studies on the performance of the national innovation system remains unclear. The paper therefore assesses the impact of national Foresight studies conducted in member countries of the Organization for Economic Cooperation and Development (OECD) and the European Research Area (ERA).

The study provides a first indication of the impact of national Foresight studies on the performance of national innovation systems. However the findings so far are preliminary since input data reflect long term developments of national innovation systems. Thus a long term study of the impacts of national Foresight studies is essential. In the short term, it can be concluded that national Foresight studies contribute significantly to the design and in some countries reshape of the innovation system structure and framework conditions. A direct quantitative measurement of the impact and thus the value of Foresight studies can not yet be done in a statistically reliable fashion. However the changes these studies have caused within the national innovation systems may have an indirect impact on the future national innovation performance. Most recently national Foresight studies have switched from a rather exclusive focus on technology trend assessments towards more integrated holistic approaches identifying future challenges for society and economy as a whole thus deriving strengths and weaknesses of the national scientific, research and technology base to meet these challenges long term in the most appropriate way.

2 Introduction

Foresight studies have been intensively discussed in literature in many aspects and forms in the last years. Most discussions center around the design and implementation of Foresight studies but only a few consider the impacts of Foresight studies. Until recently only few approaches have been developed and experiences made in evaluating Foresight studies. To apply and use evaluation and monitoring tools effectively and efficiently the major characteristics of Foresight studies need to be known and taken into serious consideration. The most frequently applied future-oriented approaches are foresight, technology forecasting and technology assessment [1]. Foresight studies can also be grouped into content and process issues. Content issues include the time horizon, the geographical extent and the level of detail, e.g. micro (company), meso (sector), macro (national, global) level of the Foresight project. Process issues are more oriented towards operational issues like participants characteristics (number, nature, disciplinary mix), decision processes (operational, strategic, visionary), study duration, resources available (funding, data, skills), methods used (data needed, analytical outputs), organization (process management), communication flows (internal, external, nature of participation) and representation of findings (technology information products, usability) [2]. More general groupings of Foresight exercises address different aims, territorial needs, outputs and the results attained [3], [4], [5], [6].

It needs to be noted that Foresight does not aim to predict a pre-determined future but through the involvement of players and decisions taken ‘ today’ Foresight exercises allow them to actively shape the future although to a modest degree only. Current Foresight exercises are quite often not limited to small expert groups but are participatory involving a wide range of stakeholders thereby opening the minds of stakeholders to new possibilities for the future [7]. Foresight studies constitute powerful assistants in planning and managing uncertainty levels. Foresight offers possibilities to identify and take advantage of opportunities; to investigate and understand the nature of risks which are inherent in the innovation process and to develop reaction to mitigate the problems once they start to unfold [8].

Foresight exercises usually have a longer time horizon (10 to 50 years or more) and a broader view of environment, organization and strategies commonly resulting in scenarios which in turn usually the stakeholder’ s learning, stimulate imagination and enhance aspiration [9], [49], [50].

The ultimate goal of national Foresight exercises is to co-ordinate research and innovation agendas across public and private organizations, industrial and service sectors, and academic

disciplines by developing new alliances between the producers and the consumers of knowledge. These projects take into account and make visible the processes by which research agendas and priorities are established, the degree and nature of autonomy in the practices of scientists and engineers, the relations of academic disciplines to each other and industrial knowledge, and the ends to which S&T are directed [10].

Thus for the study the following definition of a Foresight study was used:

A national Foresight study is a participatory process which brings together participants from science, industry, government, administration and other areas of society in order to identify and evaluate long-term developments in science, technology, industry and society. [25]

Foresight studies can take manifold different shapes. Lempert et al suggest to group such studies in top-down versus bottom-up, explorative versus normative, quantitative versus qualitative, and expert-based versus assumption-based [11]. Another approach by Popper proposes the "foresight diamond" which builds on the ability to gather and process information, e.g. evidence, expertise, interaction and creativity [20]. Other approach towards grouping Foresight studies are centred around the particular field of the Foresight study [12], [13], [14], [15], [16], [17], [18], [19] or on the use of methodologies [20], [21].

Salerno et al describe the evolution of Foresight studies during the last years. The 1st generation involved technology experts or professional and futurologists aiming at economic planning. Evaluation indicators used were related to the accuracy of predictions and the diffusion of results. In the 2nd generation representatives from academia and industry were involved to combine market and technological perspectives. In course of the evaluation of these exercises the extent to which priorities have been considered and the networks formed were given much attention. Finally in the 3rd generation increasingly system failures were and are detected thus Foresight bridges the socio-economic gap hence the establishment and existence of broad networks (with social stakeholders) and foresight is being used as evaluation indicator [22].

Georghiou and Keenan distinguish 3 classes of evaluation criteria. Firstly they discuss the efficiency of implementation, secondly the impact and effectiveness and thirdly the appropriateness of the Foresight exercise. The efficiency of implementation mainly concentrates on the procedural perspective, e.g. organisation and management. Typical indicators developed during evaluation are the type of people involved, the degree of support to expert panels, the link to decision-makers but also the appropriateness and efficiency of methods used. Impact and Effectiveness indicators reflect the immediate outputs and outcomes. According to Georghiou and Keenan outputs measure only activity, e.g. they count quantitative data like numbers participation in meetings or surveys, reports disseminated, meetings held, website hits and so on but there is no real assessment of the short and long term impact of these. Moreover these indictors have a potential inherent to lead to misinterpretation and misunderstanding as they do not express novelty, size, significance and sustainability. The appropriateness indicators reflect a scenario type style of evaluation centered around the 'what if…' questions, e.g. highlighting alternative scenarios [23].

The evaluation of Foresight exercises also needs to take into account the dynamics of the project, e.g. be conducted in real-time or immediately after to ensure that the findings are not distorted by hindsight or obscured by loss of data [23].

According to Saritas and Oner there is a lack in translating future requirements into R&D projects and initiatives. In course of most Foresight exercises topic statements are formulated

and assessed using different instruments which place more emphasis on action rather than theoretical understanding of the underlying science of matters [24]. Hence evaluation indicators need to be developed which take account of this lack [48], [43].

An integrated foresight management model has been developed by Alsan and Oner which is essentially composed of the integrated management model (IMM) of Ulrich [30] and Bleicher [31] and the Knowledge–People–System–Organisation (KPSO) framework of Oner and Basoglu [32].

3 Methodology and approach

3.1 Objectives of the study

The meaning of national Foresight studies goes far beyond studies to explore trends in specifically defined scientific and technology fields, as often carried out at regional level. These studies undoubtedly play a role in the context of a national Foresight study nevertheless they have to be expanded to include other general aspects particularly with regard to societal development [34], [36]. Looking into the future is a complex process of analysing uncertainties. On the one hand a wide variety of subjects have to be considered and on the other hand various stakeholders have to be involved in the implementation of Foresight studies [35]. Until recently no comprehensive systematic documentation and assessment of national Foresight studies in OECD-/ ERA countries has been done. The study thus aims at:

- determining the benefit and purpose of Foresight studies;
- documenting the organisational and procedural models used and
- identifying the underlying success factors and obstacles in Foresight studies.

In result an overview was achieved which:

- examines the impact and suitability of various instruments and methods on the effectiveness and efficiency of Foresight studies;
- analyses the objectives, effects and methods used in Foresight studies in OECD-/ ERA countries and evaluates the experience of Foresight procedures in these countries and
- evaluates the impact of Foresight studies on the national innovation policy concerned.

3.2 Study approach

The most recent national Foresight studies in all OECD- / ERA countries were considered. The data are based on the Benchmarking report of the ForSociety, literature and on-line research and a written questionnaire among 38 countries [25]. The questionnaire was send to the project leaders of all respective Foresight studies in all countries, 35 countries[1] did respond to the questionnaire. In addition on site visits and interviews were undertaken in 4 countries.

Countries with longer Foresight experience exhibited usually a well documented and Foresight specific Internet appearance and made the basic data and results accessible. Also the European Foresight Monitoring Network EFMN) and related reports were considered [37], [38], [39], [40],

[1] Australia, Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Great Britain, Hungary, Ireland, Israel, Italy, Japan, Canada, Latvia, Litauen, Luxembourg, Malta, Mexico, New Zealand, Netherlands, Norway, Poland, Romania, Slovak Republic, Sweden, South Korea, Turkey.

[41], [42], [43]. As Foresight practitioners rarely formulate experiences explicitly and success factors and obstacles are usually specific to countries, these factors were seized to a large extent in the questionnaire. Following that in-depth analysis was accomplished in Germany, Finland, Ireland, and Great Britain by means of on-site visits and/or telephone questioning. Interviews were held with project leaders, stakeholder representatives, government officials and public funding agencies. In total 30 interviews were done. In addition 12 telephone interviews with Foresight representatives in 4 countries were done. Inaccuracies and uncertainties resulting from the literature, on-line search and questionnaire could be repaired by means of this procedure as far as possible. Also additional experiences and success and/or failure factors could be identified. Thus results can be regarded as reliable and meaningful.

To ensure comparability of the different Foresight studies an evaluation model was developed. The assessment model is based on the literature discussed in the previous chapter. To ensure comparability of the different Foresight studies and their specific characteristics all national Foresight studies were assessed according to value added of Foresight/implementation, meaning / position of initiators / motivation of Foresight, stakeholder involvement, assigned resources, experience level, instruments applied, context of the Foresight and the degree of independence of the responsible institution [25]

Table 1 shows criteria used for assessing the national Foresight studies and related scales as well as criteria weights assigned used for calculation. The criteria were weighted equally; e.g. 1/8 (0.125); sub criteria were weighted equally; e.g. each sub criteria makes 50 per cent of criteria value. The criteria were rated on a scale as shown in the table, thus the Foresight studies could achieve a maximum of 5 points for each criteria, which after weighting was normalized to a maximum value of 1. Thus the calculated values for each Foresight study hence country express the ratio of achieved values vs. the maximum total value of 1 possible.

Table 1

The criteria were used to assess all national Foresight studies in the OECD-/ ERA countries conducted in the last years. For each country the most recent national Foresight study was assessed. The assessment is based on information publicly available, additional telephone interviews with responsible Foresight study managers, written survey as described and evaluation reports of national Foresight studies. From this variety of information valid conclusion can be drawn to the performance and the impact these studies achieved. However since the time horizon of such studies is especially long no impact can be specified in quantitative terms so far.[2] Figure 1 shows results of the assessment of all national Foresight studies available in OECD and ERA countries including the average score as well as minimum and maximum scores.

Figure 1

The assessment results for the individual countries analyzed are displayed in table 2. It becomes evident that countries with longstanding experiences in conducting Foresight studies, namely Japan and Korea, but also those countries with strong international orientation and cooperation especially in the field of Foresight studies.

[2] e.g. expressed as contribution to absolute GDP, GDP growth or performance of the national science base.

4 Impact of national Foresight studies

4.1 Impact on policy decision making

In particular comprehensive Foresight studies produce results, which concern different facets of society. These are again relevant for political developments in the broad social context. It is valid to note however that straight political influencing is likely to direct the Foresight study results into a politically correct fashion. Such behavior can be observed in countries especially which for first time accomplished Foresight studies. With studies focused on certain ranges the effects are likewise only reduced measurable over sector-specific policies. Foresight studies are often characterized by little intrinsic value, a small or missing involvement of political decision makers and a perception of the Foresight study as informative frameworks only. These results confirm the findings by Johnston 2002 [26].

In generally Foresight studies provide the following outputs:

- Scenarios;
- Technology Roadmaps and forecast;
- Trend analyses;
- Key technologies lists;
- Research and other priorities as well as
- Recommendations for action for the policy.

Trend analyses, recommendations for policy action as well as research and other priorities are the most common results of Foresight studies, while scenarios, key technologies and technology Roadmaps are outputs in clearly fewer countries from Foresight studies (Figure 2). Over 90 per cent of countries use policy recommendations and trend analysis and also 80 per cent use results to set research and other related priorities. Scenarios and key technology lists were developed by ¾ of the countries while only half developed technology roadmaps on a national scale.

Figure 2

Nevertheless it is to be observed that listing of key technologies in the countries, in which these are prepared, have largest influence on political decisions. Political decision makers make use of key technology lists in almost half of the Foresight studies which identify such. This is then supplemental to more broadly seized recommendations for action to the policy as well as

national research and other priorities.[3] While key technologies lists at most are considered in the political decision making, political recommendations for action and determined research priorities stand in a positive correlation to the effectiveness of a Foresight study (Correlation for policy recommendations 0.479 (at 0.01 level of significance) and research area priorities 0.480 (at 0.05 level of significance).

It's common practice in Foresight studies to develop visions for industrial sectors and enterprises, science and technology as well as the education policy. These are particularly relevant and important inputs for innovation, technology and science policy. Other policy areas, which avail themselves of the results of Foresight studies, are settled in the specialized political ranges of the environment, agriculture, energy as well as tourism policy. In the context of innovation and science policy the results of the Foresight studies became in many instances one important basis for decision making about the establishment or the reorientation of existing research infrastructures. Likewise the results were used in the context of the technology policy as inputs for the research strategies of different institutions and promotion agencies.

The most important users of the Foresight studies are national governments (figure 3). Regional governments and administrative authorities however hardly use these results. Research funding agencies attach a high meaning to the results. Further it is to be observed that such results are irrelevant for universities also, while public research organizations use these relatively often. For the effectiveness and efficiency of the Foresight study in particular the use of the results by the national government proved as influential.

Figure 3

On enterprise level national Foresight studies are used for networking and seen as possibility to influence the long-term national innovation policy. For enterprises Foresight studies on national level have less meaning, since they cover a broader horizon than in the direct interest of enterprise.

4.2 Impact on the national innovation performance

Foresight studies have a lasting positive impact on the innovation performance of countries. In most countries this is due to the cooperation of the initiators on highest level with the participants of a country taking part directly in the early stages of the study. Within a Foresight process a top down beginning is often extended in addition by a bottom up approach. The necessary acceptance of the expected results is thus tried to be assured from the beginning.

Foresight studies improve communication and co-operation between participants of different sectors and disciplines. Interdisciplinary thinking is strengthened. Besides common indicative visions of the future new targeted innovation policy measures can be developed from a solid base. Such harmonization of participants within the national innovation system is essential for the exhaustion of the new (technological) potentials and in particular for states with fragmented innovative systems. Foresight studies contribute by the inclusion of the public also to strengthen the technology and innovation acceptance among stakeholders and society. It is to be considered however that national Foresight studies are also a political process during which

[3] At half the Foresight studies with significant influence.

perhaps old requirements for possession in question is placed thus this implies a certain distance to political institution [27], [28].

Besides it is to be added that Foresight is to be understood as a continuous process from the initial goal definition to implementation. However it turns out essential that implementation is considered in the early planning stage of a Foresight study already. A Foresight study is not finished with results presentation rather it begins again and again. Foresight studies rarely function well with the first time application since a long learning process is necessary.

As already pointed out a Foresight study can affect the innovation performance of a country through different channels. A significant correlation between characteristics of national Foresight studies and the innovation performance of countries can be shown (figure 4). That said does not provide an answer to the principle decision whether a sole Foresight study is valuable to a country but rather that a national Foresight study conducted in a certain shape as described earlier is likely to be one driver to strengthen the innovation performance of a country. Thus in the present globalization context in the industrial nations the view became generally accepted that an explicit and coherent innovative and technological policy are essential for the economic and social development. Foresight studies affect these policy strategy decisions over their priority-setting function [46], [47]. They create in addition, crucial networks and interactions between participants in the national innovative system and contribute in such a way to the acceptance of new developments and to the exhaustion of the technological potentials [29]. This explains the clearly positive correlation between Foresight studies and the innovative strength of countries as measured by the global to innovation indicator as described by Hollanders and Arundel [44].

Figure 4

Besides also company innovation management benefits, if customers, society - and thus the demand side - are included early with exactly defined needs and the existing context (e.g. ethical doubts, environmental problems) are along-considered [45]. In addition with both processes good communication, commitment and persuasive power are required. The fact that a positive correlation between Foresight studies and the innovation performance exists can be attributed also to the fact that the success factors already existed in the national innovation system. A successful Foresight study affects itself in such a case not over improved process components of innovations, but over long-term priority-setting in science and technology, network formation and involving of multiple stakeholders.

5 Discussion of findings and conclusions

The investigation altogether showed that no uniform understanding of Foresight studies predominates. The predominating opinion over Foresight studies is to be called diffuse. The correlation analysis showed that countries, which would continuously conduct Foresight studies and integrate the results systematically in policy making and the development of supporting measures and programs perform clearly better in the national innovative performance than other countries.

As a result, it can be established that there is no generally accepted understanding of Foresight studies. It is noticeable that a large number of Foresight studies are used to recognise trends in

science and technology. In most Foresight studies, social aspects are not or are only superficially taken into account.

In retrospect, the Foresight studies are considered as something positive in most countries. Three-quarters of the countries consider the Foresight studies to be an effective and efficient instrument to support innovation, technology and research (scientific) policy. Almost all countries are consequently planning Foresight studies over the next few years.

The analysis of evaluation studies on national Foresight studies and the survey of the people involved in the countries shows that Foresight studies have a significant impact on the structure of innovation, technology and science policy. The results of Foresight studies are frequently used to establish development priorities and design development programmes.

The surprisingly clear correlation between Foresight studies and the innovation performance of countries may be used as an indication that Foresight studies in the long run have an impact on the countries performance. However the analysis did not measure the impact of the Foresight study on the national innovation performance as such rather the analysis measured the correlation between the shapes of national Foresight studies and their respective impact on the countries' national innovation performance. So far it can be assumed and understood that Foresight studies do have a supportive function and role on the innovation culture and awareness for innovation in a country since.

The analysis shows that the results of Foresight studies are often used as input for the design of technology and innovation strategies in countries. However since there is no common understanding of the terms and concepts innovation and technology strategy the results shown in the paper need to be interpreted with care. Thus far no reliable conclusion can be drawn on the real impact of Foresight studies on these policy fields. Qualitative in depth research through interviews complementary to the survey shows that in many cases the results of Foresight studies have the role of a stimulus for the design and implementation of policies. In addition it needs to be kept in mind that technology and innovation policy measures are of long lasting nature hence a Foresight study can be supportive detecting future fields which require policy action but not change the policy mix in a short time. Also Foresight studies can be used as one element of a basis which serves to set priorities for future policy measures. Usually such measures aim at direct support of priority fields but do not reflect underlying framework conditions.

Moreover it can be attributed also to the fact that the success factors already existed in the national innovation system. A successful Foresight study affects itself in such a case not over improved process components of innovations, but over long-term priority-setting in science and technology, network formation and involving of multiple stakeholders

The benefit of Foresight studies is demonstrated by the improved coordination of science and industry with positive effects for knowledge and technology transfer, the improved coordination and cooperation of administrative and political institutions and participants as well as the motivation of individual institutions in the university environment to develop strategies and clear profiles which take into account and partly integrate the results of Foresight studies.

SWOT analyses of the research infrastructure are often carried out within the scope of Foresight studies, as a result of which measures are ultimately taken to improve the research infrastructure of a country and in part the whole innovation system.

As a result, it can be demonstrated that, in general, Foresight studies suffer from a negative image. Countries which have rarely or only half-heartedly professionally carried out these studies could not achieve the required results. By contrast, countries that adopted a consistent and coherent approach to initiating, planning and carrying out Foresight studies as well as to

subsequent implementation experienced a high degree of acceptance of Foresight study results. This acceptance is crucial for successful implementation of identified measures and enables countries to secure lasting scientific, technological and innovative growth.

The eventual, long-term benefit of Foresight studies cannot yet be validly proven scientifically. Experience in most countries has shown a positive effect on research (science), technology and innovation in the countries concerned. At the same time, incorrect estimates have resulted from Foresight studies and this would be an argument against establishing such Foresight study processes to begin with. A key factor seems to be that all participants in a national innovation system need to believe in the process and be in favour of it. Depending on the various interests at stake, there is also the possibility that, as the process unfolds, existing “ownership” will be called into question and some institutions or individuals will feel as if their turf is being encroached upon. Such a process should therefore be understood and perceived as a means to spur governments to prepare society for the future in a targeted manner. It is equally important that a wide range of stakeholders be involved in the process and that the public be made aware from the very outset of action taken to implement Foresight study results.

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6 References

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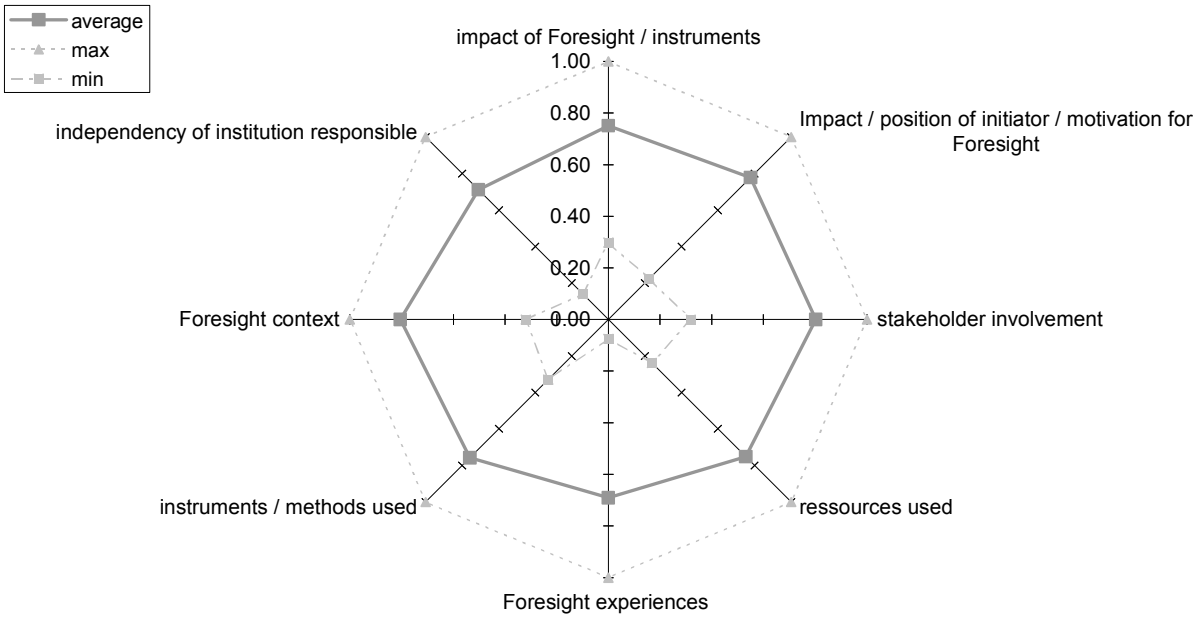
Tables and Figures

Table 1: Assessment criteria national Foresight studies

		Value		
criteria	Sub criteria	1	3	5
Value added of the Foresight/implementation	Value added	No value added	Partially involved in policy definition	Systematic integration in policy definition
	Sustainability of Foresight	Unique	Sporadic	continuous
Meaning / position of initiators / Foresight Motivation	Position of initiator	Neglectable in NIS	Medium powerful national position	Powerful national position
	Motivation for Foresight	No real internal motivation rather initiated externally	Following fashion trend	Need for systematic analysis of NIS and future options
Stakeholder involvement		One sided domination	pro forma involvement	Equal rights participation
Resources assigned		Bureaucratic approach, staff member qualification unclear	No explicit resources	Transparent resources; well qualified staff
Experience level		No experience; first time	First time exercise but international experiences used	Continuously conducted; international experiences used systematically
Instruments applied		Unstructured use of instruments	instruments used selectively	Mix of different Instruments
Foresight context		No clear context	Technology related	Technology and society related
Degree of dependency of responsible institutions		Strongly dependent from individual interests	Slight dependence from individual interests	independent

Figure 1: Assessment of national Foresight studies in OECD / ERA member countries



Remark: reads follows: the higher the value achieved the higher the aspect was ranked. Grey lines show minimum and best maximum. Total values are not displayed by ratios but by the extend the maximum score was achieved (e.g. maximum score equals 1.0)

Figure 2: Influence of the output of Foresight studies on policy making and strategy building

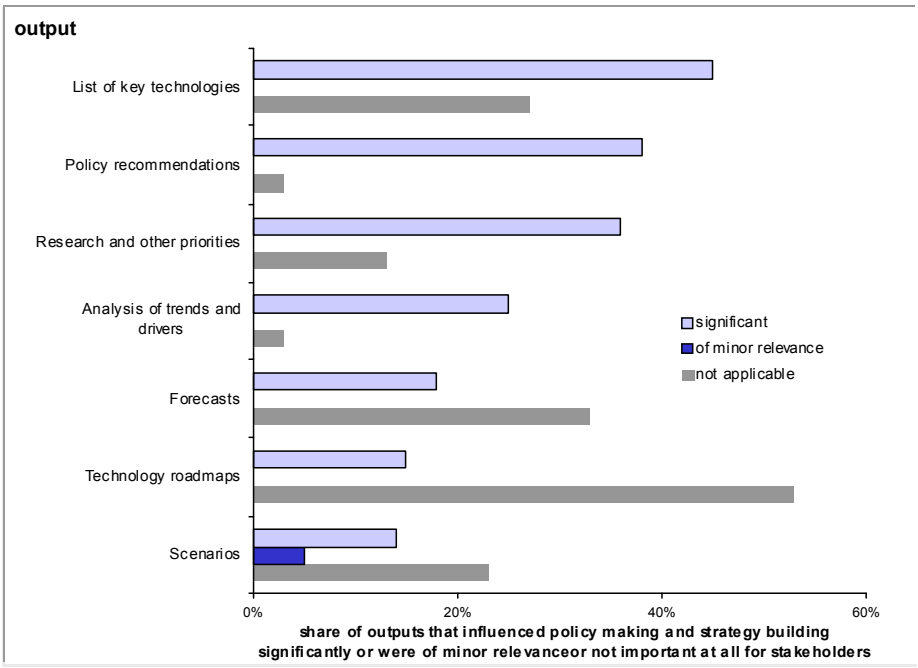


Figure 3: Importance of the results of Foresight studies for different stakeholders

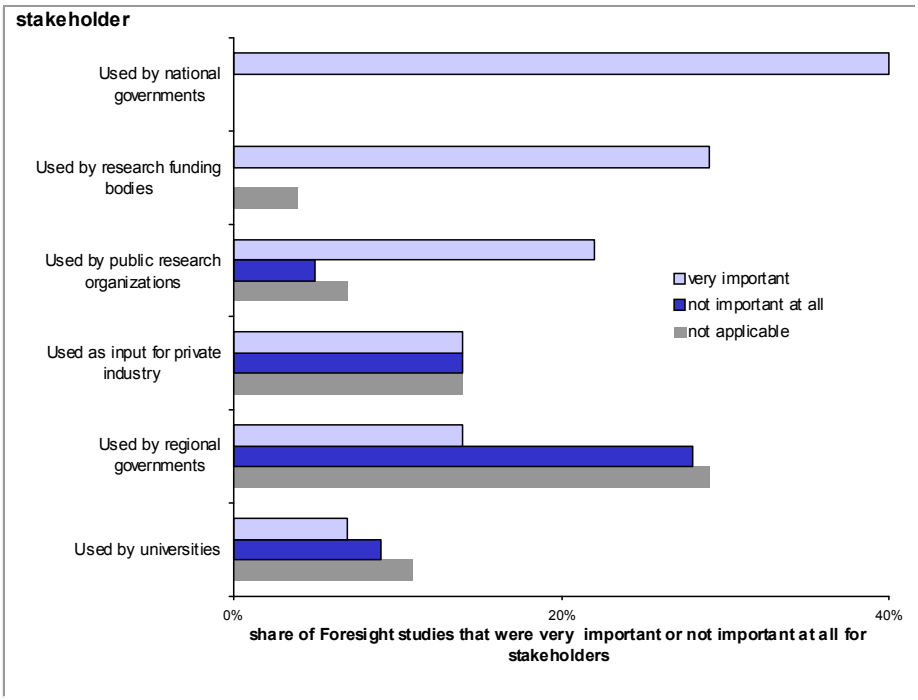
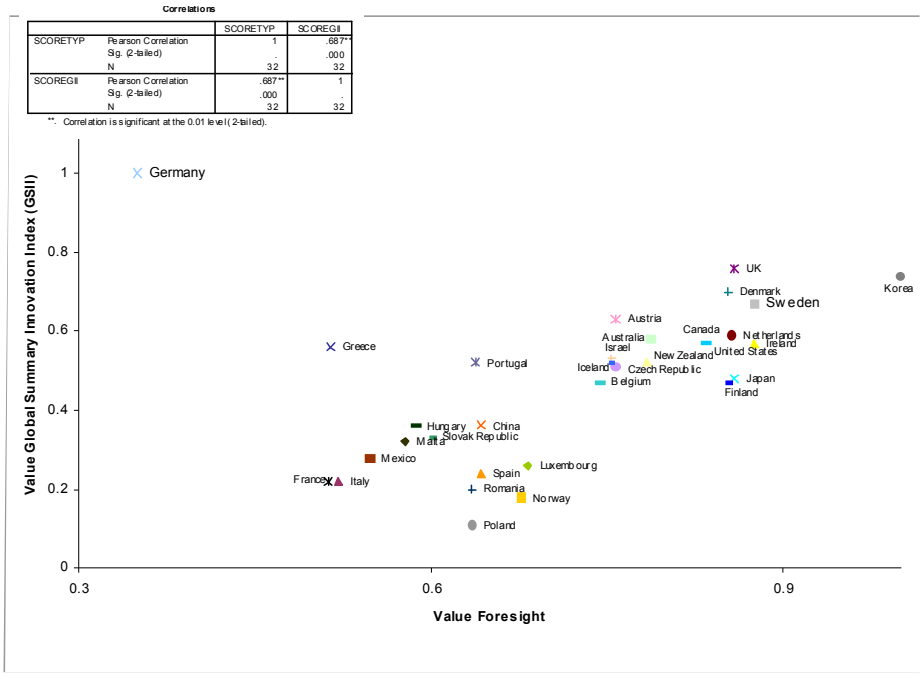


Figure 4: Correlation between characteristics of national Foresight studies [4] and the Global Innovation Indicator



remark: calculation is based on EU Global Innovation Indicator and Foresight assement described in chapter 3.2

[4] For assessment of national Foresight studies see chapter 3.2

Appendix

Table 2: Assessment of national Foresight studies in OECD / ERA countries

country	value[1, 2]	country	value[1, 2]	country	value[1, 2]
Australia	0.79	Greece	0.52	New Zealand	0.78
Austria	0.76	Hungary	0.59	Norway	0.68
Belgium	0.74	Iceland	0.75	Poland	0.64
Bulgaria	0.33	Ireland	0.88	Portugal	0.64
Canada	0.79	Israel	0.75	Romania	0.63
China	0.64	Italy	0.52	Singapore	0.83
Cyprus	0.4	Japan	0.86	Slovak Republic	0.60
Czech Republic	0.76	Korea	0.88	Spain	0.64
Denmark	0.85	Latvia	0.31	Sweden	0.88
Estonia	0.35	Lithuania	0.35	Turkey	0.52
Finland	0.85	Luxembourg	0.68	UK	0.86
France	0.51	Malta	0.58	United States	0.83
Germany	0.78	Mexico	0.55		

Remark: [1] reads as value assigned relative to maximum points (1 possible)

[2] total calculated from weighted sub criteria (explained in table 1)