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Technology Foresight Slovenia 2020

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Purpose

The technology foresight study was conducted as part of the process of preparation for the mid term national R&D Programme 2006-2010 in Slovenia. This was the first national foresight exercise. It had several objectives: to promote the continuous forward thinking practice in society, to foster dialogue among main stakeholders in the innovation process, and to set preliminary R&D priorities for the future research and technology policy.

Post Accession Challenges

After gaining independence in 1991, the Slovenian economy has undergone radical socio-economic changes, from privatization of the business sector, introduction of new, market compatible institutional framework, adoption of EU "*acquis communautaire*" to entry into ERM2 (exchange rate mechanism of EU) and adoption of euro at the beginning of 2007.

The public sector, however, including science, high education, health services, and government administration has not been reformed according to the needs and challenges of the knowledge-based society. Next to the "Development Strategy", the preparation and adoption of the National Research and Development Programme (NRDP) is one of the key initiatives endeavoring to meet the new challenges according to the Lisbon agenda: to increase the volume and efficiency of the R&D expenditures and to enhance the competitiveness of the whole economy.

Key objectives of NRDP include:

- Increasing of public R&D investment to 1% of GDP by 2010 and attain research prioritization,
- Shifting balance of public research funds from basic, non-targeted research to targeted and applied research,
- Introduction of support measures to stimulate growth of R&D investment of the business sector to help achieve a 2% GDP target,
- Growth of number of researchers with Ph.D. in the business enterprise sector,
- Higher rate of establishment of new high tech firms, including the promotion of spin-offs from universities,
- Continuous participation in the international research community, especially in the ERA,
- Support of patents as an indicator of business' relevance to research,
- Growth of high-tech exports and of value added in the Slovenian economy.

Preparing the National R&D Programme

The underlying reasons for the adoption of new mid-term R&D programme were the following:



- Expiration of mid term R&D programme,
- Maintaining the strengths of the research system - developed public research and technological infrastructure, quality of scientific research, relatively high level of financial security of the public R&D sector,
- Overcoming the weaknesses of the research system - insufficient cooperation between public research institutions, lack of R&D prioritisation, low absorption capacities for technological innovation in the business sector, especially in SMEs.

According to the opinion of domestic and foreign analysts the implicit technology and innovation policies pursued in the past decade did not lead towards the enhancement of national competitiveness. That is why a new R&D programme with technological priorities and new innovation policy instruments had to be launched.

Delphi Tailored for a Small Country

The first phase of the Slovenian research in technology foresight was conducted in 2004. Its task was to give a preliminary identification of priorities for eight technological and societal areas. The areas of assessment were chosen on the basis of previous research studies and on the basis of experts' opinion.

The main method was a Delphi survey tailored to a small country. The respondents were asked to assess each of the technological priorities for eight areas - thematic fields. Moreover, they had to assess their own knowledge of each field.

The areas of assessment were the following:

- Information and communication technologies (ICT),
- Advanced materials,
- Biotechnology, pharmaceuticals, nutrition,
- Environmentally acceptable manufacturing,
- Sustainable construction,
- Traffic and mobility,
- Life-long learning,
- Medicine - care for the elderly.

The Delphi research involved over 2000 interviewees from the business enterprise sector - researchers from R&D units - and from academia - professors at universities and researchers from public research institutes. When assessing each of the research fields observed, they thoroughly analyzed the current state of the main technological fields in Slovenia.

The average rate of the received answers - almost 22% - was found satisfactory. The surveyed experts committed themselves in a very efficient way, to give their assessment of the priorities identified. Their list was set up on the basis of computer processing of the received answers to the

The objectives of the technology foresight study were manifold. In the context of frequently changing and insufficiently co-ordinated R&D, policy measures are of particular importance to a forward thinking approach, which should be closer to the decision making bodies and to the enterprises. The main goal of the first technology foresight in Slovenia was to identify key technological areas - fields - relevant for Slovenian economy and society as a whole. One of the goals was also to intensify a dialogue between scientists in public institutions - universities and research institutes -, R&D actors in the private business and public servants. At the same time it was aimed at selecting within the chosen technological fields the most promising preliminary research fields in order to prepare a basis for future R&D and technology policy.

questionnaire. They were classified according to their importance and share of high ratings.

The Delphi research was quite an accomplishment for the Slovenian innovation system as it was for the first time that the experts were faced with assessments of individual hypotheses over the various areas in an integrated way, i.e. individual hypotheses were competing against each other. This means that the actors involved in the Delphi had to study in a more serious and broadened way not just their own restricted field of expertise, but also that of other experts. The selection of the areas was made on the basis of evaluation of importance of individual areas and on the basis of studies conducted in comparable countries. This turned out to be a good solution as it permitted all the most outstanding and vitally important areas to be included. In the second phase of the research it will be necessary to deepen the investigation and to narrow the scope of technological theses.

The evaluation questions / criteria were as follows:

- Knowledge of the respondent,
- Innovation level of a particular research field,
- Importance of development - of a particular research field - for Slovenia,
- Prospects for accomplishment of the research field within the period of the next 10-15 years,
- Development stage,
- Possibilities for Slovenia for assuring one of the leading positions - within a particular research field - with regard to its R&D stage,
- Possibilities for Slovenia for assuring one of the leading positions - within a particular research field - with regard to the organisational transformation,
- Possibilities for Slovenia for assuring one of the leading positions - within a particular research field - with regard to the economic use in terms of new products / services,
- Economy's preparedness and willingness to invest in a particular technological area.

From ICT to Care for the Elderly

The selected thematic fields proposed by expert panels are very much in line with the priorities of 6th and 7th Framework Programme of the EU. Due to the small size of Slovenian economy and limited R&D potential the proposed thematic fields should be verified and narrowed in the forthcoming investigations.

Information and communication technologies (ICT) rank as the most important among the key technologies because of its dominant role in all manufacturing and service industries. It deserves a continued special attention due to its economic and social relevance not least for innovation. ICT is important for its inherent cross-disciplinary and cross sectoral nature and for its new ways of producing, trading and communicating. In the period 1995-2002 the Slovenian ICT market has grown considerably (17.3% yearly growth rate). In 2003 the share of ICT value added in the business enterprise sector has reached 8.2%. The selected technological research fields for Slovenian economy range from intelligence networks, broadband systems to bioelectronics and optoelectronics.

Next to ICT **biotechnology** was one of the Delphi priorities in the survey. It is possible to classify biotechnology applications into three fields: health related, agriculture related and industrial biotechnology. Biotechnology is based on several scientific disciplines and can affect different industrial sectors. In all these three applications Slovenian economy has due to its relatively small size limited potentials. However, pharmaceutical industry is at the pinnacle of the Slovenian economy and the leading exporting industry. The foresight exercise has stressed the need of collaboration among all important market players - pharmaceutical and food processing companies, universities and research institutes - in order to achieve a critical mass of knowledge, experience, personnel and financial resources. The selected research fields range from generic pharmaceuticals, delivery systems to tissue engineering and new production processes in pharmaceutical and food processing industry.

Manufacturing industries as the main exporting sector was the third field analysed. They comprise the processes and entities required to create, develop, support and deliver products. Manufacturing spurs demand for everything from raw materials to intermediate components to software to financial, legal, health, accounting, transportation and other services in the course of doing business. The manufacturing system in Slovenia has considerable economic, social and environmental significance. Presently, manufacturing contributes to almost 23% of Slovenian GDP, 26% of gross value added and 29% of total employment. The selected research fields encompass air, water and sea protection, waste management, renewable energy resources etc.

The priorities identified for **advanced materials** range from intelligent materials with sensor and actuator capacities, polymers, and multifunctional materials to nanocrystalline materials. Transport and construction services have developed in Slovenian economy parallel with the process of shrinking manufacturing industries. The selected research fields in the **sustainable construction** sector are oriented towards energy and cost effective technologies, better work organization and pre-fabricated construction systems. Slovenia as a small transit economy is very much concerned with the improvement of **transport** systems and transport infrastructure by using environmental-friendly technologies, better combination of road, rail, air and shipping.

Education and **lifelong learning** has been perceived as an important element of the national development strategy. The research fields selected focus on better learning organization, establishment of networks for adult education, and the partnership between public and private educational systems.

In an ageing society **care for the elderly** people is of most importance. The research fields point out different prevention methods, early diagnostics and organization of specialized expert systems.

Implementation Gap and Follow-up Activities

The first round of technology foresight study in Slovenia identified eight broad thematic issues - six technological ones and two of broader societal nature. All these themes proved to be relevant for the present mid-term and the future long-term R&D and technology policy. The conduct of the technology foresight and the main findings of the study raise attention to issues important for policy making - closing the so called implementation gap, further narrowing of R&D priorities, change of institutional set up in S&T system - and follow up activities.

In several post transition countries and in Slovenia too, there is an »implementation gap« between the leading national documents – influenced by top political elites and by academic lobbies – trying to preserve status quo in R&D and in innovation systems and the needs of innovation, market oriented globalised stakeholders. It is an important challenge how to close this gap by means of an efficient vertical and horizontal integration of all governing levels and by means of reaching consensus in R&D priorities. The deficits perceived were weak co-operation between public R&D sector and the private business enterprises, uncoordinated and unstable policy measures in the field of science and technology, and inappropriate institutional structure. If these trends continue undermining the on-going reforms in Slovenia, the targeted foresight of the knowledge based and globally competitive society will not be attained.

Judging from the strengths of the Slovenian innovation system - high shares of public and private R&D expenditures, numerous bridging institutions like technology parks/centres, clusters, incubators, different support schemes for innovation, intensive participation in international R&D projects - and from weaknesses found out by the domestic as well as foreign analysts - technologically lagging behind the developed EU countries, low level of industrial specialization, fragmented R&D - three main targets have been achieved by the foresight exercise:

- The main existing and emerging technologies, i.e. technological research fields, were identified. They are useful for conducting an adequate Slovenian R&D and technology policy. They are further appropriate for directing institutions finding a balance between demand-pull and technology push.
- The importance of the connection and continuous dialogue between public research and private business innovation activities was highlighted and the necessity of institutional changes was emphasised as being a precondition for both by increasing the orientation of the public research sector towards market driven R&D efforts.
- Analytical background was provided for further foresight research - 2nd Delphi round – by highlighting R&D and technological priorities to carriers of political decisions and top enterprise management.

The research was conceived in a way that enabled collective learning. It made a free exchange of ideas feasible. The process thus qualified itself as a public learning procedure into which new ideas were initiated. Broad horizons in eight

research fields were chosen. A selection of the most promising ones was made.

The answers obtained were grouped according to R&D potentials and economic evaluation. One of the study results was also that there were determined those research fields and technological research fields, which most likely will need some kind of governmental support.

Following the experiences gained through completion of the first phase of the project, the conclusion was made that it is necessary to also carry out the second phase of the research in order to verify selected technological theses and to obtain consensus of all the participating experts and institutions without any considerable dispersion. The same position has been taken also by researchers in other countries where the second phase was regarded as an integral part of the overall project, which for this reason lasted 2-3 years. It was also noted that it was necessary that the institution that had conducted the TF project participated in the process of project implementation. In addition, it is important that the governmental administration, Chamber of Industry and Commerce of Slovenia, public media and non-governmental organisations participate in the second phase of investigation.

The foresight exercise in Slovenia addressed the current vacuum in long-term visions for Slovenian research and technological development and created better understanding of the evolutionary paths of key technologies. At the same time it created a bridging role from national research activities to 6th and 7th European Framework Programmes. It developed more bottom-up approaches in order to identify long-term research and technological priorities for Slovenia.

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