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Delphi analysis of national specificities in selected innovative areas in Germany and France

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Abstract

The increasing complexity of the relations between technologies and economics combined with more social pressure, global competition, technological change, as well as national budget restrictions, imply new challenges for public policies. Thus, to be able to forecast the development of knowledge and technological change in some well-known trajectories could be one of the major stakes for science technology and industrial policies. It is then not surprising that recent years have brought a significant revival of public foresight activities in many countries. The purpose of the paper is precisely to propose a new foresight method in order to obtain a taxonomy of the future technologies, and consequently to provide a better understanding of industrial dynamics. We present a statistical analysis of a Delphi investigation, based on scientific and technological knowledge complementarities, in order to obtain coherent clusters, which may be looked upon as a theoretical tool for political decisions. Our methodology is then applied to French and the German sectors of life sciences, elementary particles, energy, environment and natural resources.

Keywords: Technological clusters; Delphi analysis; Foresight process

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1. Introduction

The increasing complexity of the relations between technologies and economic problems combined with the occurrence of increased social pressure, more global competition, accelerated technological change, as well as national budget restrictions, imply new challenges for public policies and especially for science and technology policies. Hence, the desire to identify those technologies, which will have the greatest impact on economic competitiveness and social welfare is expressed from various sides [1]. Therefore, it is not surprising that recent years have brought a significant revival of public foresight activities in many countries around the world [2]. At the starting point of foresight is the belief that there are many possible futures and that the future which will occur partly depends on the decisions we take now. Hence, foresight is defined here as the "process involved in systematically looking into the longer-term future of science, technology, economy and society with the aim of identifying the areas of strategic research and the emerging generic technologies likely to yield the greatest economic and social benefits" [3]. The ultimate goal of foresight is to ensure that areas of science and technology that are likely to yield future socioeconomic benefits are promptly identified. Identifying emerging generic technologies is very important not only in order to ensure high socioeconomic benefits but also because of the path-dependency character of industrial dynamics.

As a matter of fact, in the evolutionary tradition, the development of a technological trajectory is the outcome of the intrinsically cumulative nature of learning processes and therefore, the generation of new knowledge builds upon what has been learned in the past [4–7]. Hence, research is typically characterised by increasing dynamic returns in the form of learning by doing, learning to learn and the fact that today's research generates tomorrow's new opportunities [8,9]. Therefore, technological cumulativeness and localised learning generate irreversibility, which is expressed by the property of path-dependency in the evolution of the trajectory [10,11]. Thus, the mode of development of a technology and the choice of many potential trajectories are strongly influenced by initial decisions.[1] Initial or transitory actions put the system on a path that cannot be left without costs, as pointed out first by P. David [12] with the famous example of QWERTY. One of the major problems, which can block industrial development, concerns the context of these initial decisions made under great uncertainty and ignorance about the respective qualities and properties of the various options. Taking decisions and at the same time eliminating options in a context of ignorance, entail the risk of missing the best path of development because technological variants with unique properties may be lost and never properly explored [10]. Thus, the technical and economic features of a trajectory may lock the economic system in some suboptimal alternatives [13–15]. Many cases of such suboptimal alternatives are developed in the literature of "potential regret in economic history" [10] with the well known examples of the QWERTY keyboard [13] or nuclear power [16]. Another problem concerns the possible existence of bottlenecks in the development of a technological trajectory which can

[1] See, for example, the work on economic standards which shows that technologies selected first have greater chances to diffuse faster (Katz and Shapiro, 1986, Farell and Saloner, 1985, Foray, 1989).