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A new definition and framework for the development of a national technology strategy: The case of nanotechnology for Iran ☆

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ABSTRACT

In this research, we use the concepts of "national technology policy" as well as the "firm technology strategy" in defining a new definition for "national technology strategy". Then, by examining several national technology strategies in a variety of fields in different countries the national nanotechnology strategy for Iran is developed. Furthermore, using capability-effectiveness matrix and SWOT analysis we identify strategies of nanotechnology development in Iran. Finally, considering other countries' strategies and the results of PROMETHEE Method, we prioritize different areas of nanotechnology for Iranian economy, and test for the validity of the extracted strategies.

1. Introduction

The rapid development of emerging technologies in recent decades and pivotal role these technologies could play in economic growth and development are the issues which have drawn the attention of many policy makers and researchers in both developed and emerging countries. As a result, policy makers have become particularly interested in planning issues relating to both development of high technology as well as applications of these technologies for economic growth and development.

Development of strategies for technological progress at the national level includes an extensive range of techniques and mechanisms which are generally defined under the rubric of "national policy for science and technology". National technology policies consist of aggregate planning which pays particular attention to some primary high technologies such as nanotechnology, biotechnology, and information technology, among others. However, each of these technologies consists of different areas, and adopting a single technology policy is not optimal for all. Accordingly, countries should carefully adopt a set of technology policies so that each policy is aimed at addressing the specific requirements of a specific high-tech category.

This paper uses the case study approach in examining the nanotechnology policies of a number of countries including China, Iran, Israel, and Taiwan. Based on the critical examination of nanotechnology policies of these countries, we introduce a new concept of "national technology strategy" which may be useful as a guide in rapid development of nanotechnology within an environment that is unique to Iranian culture and society. Furthermore, we use capacity-effectiveness matrix in identifying nano-science strategies in Iran.

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2. A brief history of nanotechnology policy development in Iran

Iranian policy makers have placed special emphasis on rapid development of emerging technologies particularly nanotechnology [1]. As a manifestation of Iranian government's policy of considering scientific development as an item of the highest national priority, as well as promoting scientific and technological development, the number of scientific articles authored by the members of Iranian scientific and academic communities increased by ten-fold during 1995–2004 [2].

The government's attention to nanotechnology in Iran started in 2001, when then Iranian President Mohammad Khatami made Technology Cooperation Office (TCO) responsible for coordination of developmental activities for nanotechnology in the country. In 2003, after extensive studies and analysis, TCO recommended creation of a council and was given the task of defining a direction for nanotechnology development in Iran.

Since 2001, and especially after formation of this council, numerous activities were organized by TCO with the following being the most important ones:

1. Networking between country laboratories that have instruments of common interest;
2. Recognizing Iranian scientists active in nanotechnology and supporting their activities;
3. Providing financial incentives to Iranian scientists to publish nanotechnology articles in international scientific journals[1];
4. Finding international partners for research and scientific collaborations;
5. Publicizing advances in nanotechnology in Iran and other countries;
6. Offering of advanced nanotechnology courses in M.S and Ph.D. programs throughout Iranian universities.

Additionally, the TCO concluded that nanotechnology development in Iran requires national initiative, proposed the National Iranian Nanotechnology Initiative Program (NINI) that was subsequently approved by Iranian cabinet in July 2005.

Given the pivotal role NINI plays in the development of nanotechnology in Iran, we state the goals of the Initiative below and present the strategies in Appendix B [3]:

Goal 1. Gaining access to a fair share of international trade of commodities that involve the use of nano-materials or use of nanotechnology.
Goal 2. Forming the appropriate foundation for acquiring the benefits of nanotechnology with the aim of improving the quality of life of people in Iran.
Goal 3. Institutionalizing sustainable, dynamic development of nanoscience, nanotechnology, and nano industry.

In spite of these ambitious goals, the NINI lacks the required strategies for successful implementation of the goals in specific branches of nanotechnology. The strategies are missing because the initiative was formulated based on the model of *national technology policy*. However, successful implementation of these goals requires an optimal set of *national nanotechnology strategies*. To differentiate among these concepts we will critically examine them in the next section.

3. National technology policy, firm technology strategy, and national technology strategy

3.1. Concept of national technology strategy

By examining the definitions of "firm technology strategy" and "national technology policy" in the technology management literature we wish to develop a working definition for "national nanotechnology strategy".

Firm technology strategy is a model of managerial decisions pertaining to the use of principal technology instruments and goals in achieving the business objectives and prioritizing future corporate technological plans.

National technology policy is defined "… as a set of government actions that affect the generation, acquisition, adaptation, diffusion, and use of technological knowledge in a way that the government deems useful for the society rather than individuals" [4].

An important point to be considered in the literature is that "national technology strategy" isn't a well-known term and authors use the term inconsistently. Some author's use of the term implies "national technology policy" (for example: [3,5,6]) and in some other usage the term simply implies national priorities of technologies (for example: [7–9]).

Nevertheless, if we wish generalizing the concept of firm technology strategy to the national level, it cannot be considered as the equivalent of national technology policy. The most important reason for this is that "strategy" is basically a synonym for "path selecting" and when it comes to strategy one may select from the available options; however, for the policy, viable options may not exist. For example, "horizontal policy" doesn't operate selectively on different areas of technology; rather, it focuses on plans, tools or functional policies that aim at improving markets' functions. However, according to vertical policies, governments provide total support to specialized technologies, e.g., nano-electronics. These vertical supports are initiated by the government. While according to horizontal policies, government's supports are general and take the form of subsidies for any R&D activities of the firms without mandating any specific R&D by the subsidized firms. It is reasonable to argue that since R&D investments of the private enterprises are based on profit motive, the government horizontal policy is market driven and enhances market efficiency [10].

On the other hand, if we consider "national technology strategy" only as a country's priority, nothing new has been defined and the term "priority" can convey the intended meaning by itself.

[1] The number of the ISI cited articles on nanotechnology by Iranian scientists increased from 41 in 2003 to 450 in 2007. The ranking of Iran in terms of the number of nano-science related published articles rose from 57 in 2003 to 25 in 2007.