

Identifying and prioritizing the factors influencing the success of science and technology foresight in the field of economy

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ABSTRACT

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Promoting complex global environment, tremendous growth and increase of network communication technology in the world, strategic planning and foresight activities in science and technology have become very important. Gradually, organizations and businesses are realizing the importance of foresight; many organizations attempt to execute such activities. However, this concept is not still well known in our country and among our organizations. Therefore, recognizing the factors influencing the success of this concept is a kind of issues that the organizations and activists are faced. Thus, this research seeks to identify and to rank the factors, particularly in the areas of economy, and it has developed five hypotheses. In this paper, factors affecting the success of foresight are given in four groups of rational, structure, scope, and results. Data collection for this study is a questionnaire and the binomial tests, Pearson correlation and Friedman test have been used to prove the hypothesis. According to the analysis of data obtained from the questionnaire conducted by SPSS software, all research hypotheses were confirmed. It also became clear that the rational component had the greatest impact on the future success of science and technology in the field of economic.

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1. Introduction

By the end of the twentieth century, inefficiency of ordinary methods and predicted actions were evident. This is because of the lack of attention to some of the quantitative techniques and the pseudo-scalar. One of the requirements for development in all areas is to have good insight towards environment, timely decision making, and comprehensive targeted program, and it is not possible, unless the future thinking would be executed, properly (Efraim et al., 2006). One factor in general and specifically in the current era in the history and future cause rapid changes in the environment, and it also determines the priority of the nations and countries in the regional and international levels is the technical ability and evaluation based on technology (Keenan, 2003). It is expected that the increase growth of technology in future influence the shaping of global authority. Since future technologies and strategic research strengthening these technologies are often too expensive to

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receive support them. On the other hand, due to budget constraints, governments cannot provide the necessary capital for the IT department and research scientists, industrialists and economic activists, thus, some sort of the selection must be accomplished (Ali Ahmadi, 2010; Saghafi & Ali Ahmadi, 2013, Von Schomberg et al., 2005). In fact, rapid changes in the business world today and insufficient accountability of these methods lead to the emergence of technology foresight, which may create serious change about the techniques used to solve problems.

Planning, especially long-term planning, such as perspective, strategy are successful, if it is along with sufficient and proper knowledge of future. Accordingly, it can be said that futurists, key actors in the process of creating a national perspective, are part of an organization. Macro view of the world and its main actors suggest the existence of effective institutions in the centers of power and decision-makings of powerful governments and developed countries. Perhaps, their ethnographic approach to world issues and future planning for the future make the roots of their dominance over the future world stronger than ever (Miles, 2002). Today, mission planning in developed countries and a major effort in addition to attention to current challenges and providing cross-sectional approach is to think about the future challenges and how to encounter with them. Planning now with its enhancement of its role is looking for conquer the future with serious role-playing of ideas (Ruff, 2006). There are many factors and elements involved in foresight. Identifying the components and determining their importance in foresight will help economists identify and focus on time saving and investment opportunities, which eventually lead us to reach the desired goals of foresight. Japanese used foresight as an instrument of policy of science and technology for the first time in the 80s. For several decades, this method has been used in public and private firms in various fields such as science, technology, culture, environment, etc. (Schlossstein & Park, 2006). Technology foresight is a systematic tool for scientific and technical research on the development of intelligence and experience of the transplant team, men's work and public institutions, which could have a profound influence on industrial competitiveness, wealth creation and quality of life (Becker, 2002). Another and equally important feature of foresight is that rather than a specific plan that leads to a specific target, the more possibilities and options are identified in foresight, and a set of recommendations is provided to decision makers so they can reach the desired objectives and to reduce the risks. Thus, foresight is to look ahead, learning process and conclusion for now (Ali Ahmadi, 2010, 2012; Saghafi et al., 2013).

2. The proposed study

Foresight can be divided based on its objectives, time horizon and geographical area. One of the most important divisions that will provide the kind of foresight activities is types of foresight activities in the area of a country. In each country, three types of foresight activities may happen at three various levels, and the priorities are:

- *At the National Level:* National foresight programs are the oldest and the best-known program of foresight. Japan is the leading country in the conduct of national foresight and about forty years ago, many of the foresight exercise is executed regularly and consistently.
- *At the Regional Level:* At this level, local government manages foresight activities in their area. This kind of foresight widely used in Europe. In addition, Europe Union has supported the Regional Foresight program especially and it has applied various programs to expand it.
- *At the Organization Level:* Most firms in different sectors have developed foresight and strategic planning groups within their company in order to analyze new technologies and their effects on the long-term outlook and market strategies (Karimi-Fard & Habibi, 2010).

Future studies based on looking to the future and the methods and data collection methods are divided into four general categories.

1. Heuristics and Normative Methods: Heuristic methods are associated with methods, which seek to discover the future. These methods start from the present time and go into future called outward-oriented and they are trying under different conditions, to discover what happens next. However, other category is normative methods, which are introverted. These methods start from a favorable position in the future and reach to the present time and examine the possible ways to get to the desired position.

2. Quantitative and Qualitative Methods

Quantitative methods are based on figures and it presents the progress and future developments in a qualitative framework. In contrast, qualitative methods are based on the opinions and judgments of quality. Data-based methods (the default) or methods based on expert consensus.

3. Other Categories

Ways to identify topics, extrapolation methods, creative techniques are the other priorities of such category. In implementation of foresight process, a combination of methods such as environmental scanning, scrolling issues, extrapolation process, communication tree, sociological analysis, mind mapping, workshops and science - fiction, scripting, key technologies and methods (critical), track record, Delphi panel method are used (Shahkuh, 2008).

4. General Objectives of Foresight

These objectives, which should be achieved out of subject matter and normally after foresight process are as follows:

Communication: Gathering groups of different parties subject to appropriate practices and procedures so that they can exchange ideas and make use of each other's opinions.

Concentration on Longer-term: Participants would better change their short-term horizon to long-term horizon.

Coordination: It is expected that at the end of the program, more coordination are occurred among participants.

Consensus: Creating a shared perspective for the future is very important and if not achieved, favorable outcomes will not be obtained.

Commitment: It is expected that those involved in foresight would be prepared for the implementation of proposed changes (Nazmi & Ghadiri, 2006).

Foresight has become prevalent in the literature by Slater for the first time; of course, his ideas were borrowed from Detour, Mosinee, Galtung, and Dejour Judet and their discussion was centered on the issue that the future of humanity is constructed by their participation (Salmenkaita & Salo, 2004). There are several factors, which have suggested these components in the form of foresight definitions in numerous studies. Martin (1995) considered the foresight as a systematic process, with a view to long-term future in the fields of science, technology, economic and social views and its goal is to determine the areas of strategic research and emerging technologies with the greatest social and economic benefits. Foresight is a process, which requires a systematic approach for developing collaborative and efficient strategies and policies for the medium term and long-term future. In fact, foresight has been begun as a planning tool in the science and technology. Another definition is provided by Luc Giorgio is "A systematic review of technological development and science which has strong impact on industrial competitiveness, wealth creation and life quality enhancement" (Georghiou, 2003). Department of foresight in Europe Union, Horton (Major & Cordey-Hayes, 2000), Costanzo (2004), and Webster (Salmenkaita & Salo, 2004) also have defined different

dimensions of foresight. It is important to note the following points about the foresight (UNIDO, 2005): Emphasis on systematic and process aspects, emphasizing the long-term future, the emphasis on creating partnerships between stakeholders in a process of network, gathering data and perspective, emphasizing the balance between science pressure/ technology" along with "demand ".

Holistic approach in foresight has special significance. Table 1 shows the various components of the proposed definitions involved in foresight.

Table 1
Comparison of foresight components by definitions of different scholars and institutions

	Decision Making	Gathering perceptions and attitudes	Mobilizing actions	Long-term Future	Perspective Making	Collaborative	Holistic	Systematic	Process
Martin				√	√	√	√	√	√
Webster				√	√	√	√	√	√
Fourn			√	√	√			√	√
Luke Giorgio	√						√	√	
Horton	√	√		√	√	√		√	√
Lora Cortanzo	√	√						√	√
Europe Union		√		√	√	√	√	√	√

This was explained in the previous sections that foresight and systematic process are based on a huge network of people with diverse skills, which create desired future. Here, in order to provide a comprehensive model for the identification of all elements and components that is involved in the implementation of a foresight project, the models provided by Unido organizational and European commission as well as a model in a research by Kognin to identify the components of foresight has been used.

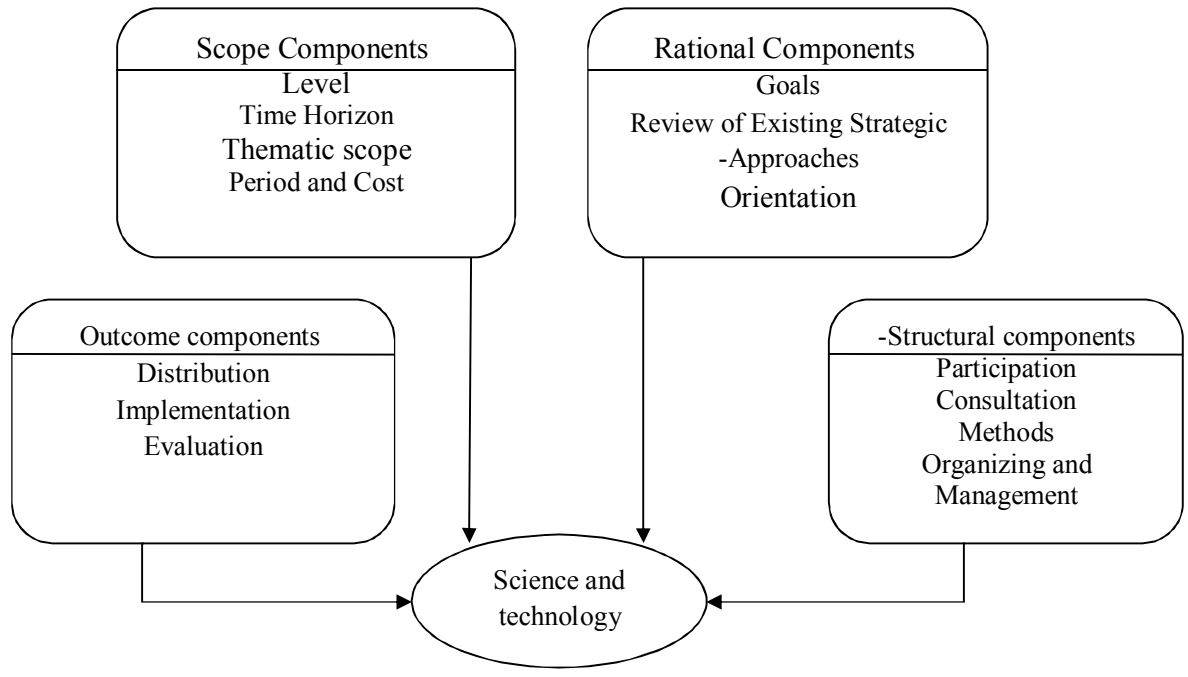


Fig. 1. The conceptual model (Uonido Technology Foresight Manual, 2005)

According to the proposed model, research hypotheses are stated as follows,

Hypothesis 1: Rational components influencing the success of rational foresight in science and technology have a significant and positive impact on the economy.

Hypothesis 2: Scope components influencing the success of science and technology foresight have positive and significant impact on the economy.

Hypothesis 3: Structural components influencing success of science and technology foresight have positive and significant impact on the economy.

Hypothesis 4: Outcome components influencing the success of science and technology foresight have positive and significant impact on the economy.

Hypothesis 5: Factors influencing the success of science and technology foresight have a positive relationship with each other.

Indicators present each of these components measured through them and it explains about each component.

Table 2
Factors affecting the measurement of indicators of science and technology foresight

Indicators	Description
1 Goals	The aim of foresight and its duration should be specified.
2 Review of Strategic Approaches	Sometimes, risks lead to integrate technology foresight in strategic processes.
3 Orientation	Determining the concentration of foresight (Perspective of science and technology, the dynamics of business)
4 Level	Foresight implements in different level of transnational and national, city, organization, company, etc.
5 Time Horizon	Mean of foresight is 5 to 15 years. Although it may take up to 30 years.
6 Thematic scope	It determines the sectors and themes that will work on their foresight determines.
7 Period and Cost	Cost and Period of doing foresight must be specified.
8 Participation	Participants involved are an important factor in the foresight.
9 Consultation	Advice to the foresight of how to determine the views of stakeholders are identified.
10 Methods	Foresight methodology must be specified in different stages.
11 Organizing and	Foresight project management should be identified (using committees and panels of experts and stakeholders).
12 Distribution	Policy and distribution of outcomes of foresight should be identified for different audiences and stakeholders.
13 Implementation	The implementation of foresight outcomes must be specified. Usually new responsibility is taken by new groups.
14 Evaluation	To evaluate the results, the parameters must be set so that it shows the goals achieving rate.

To conduct this research, survey research method is used. According to the table in the previous section, a questionnaire consists of 35 questions was developed. Measurement scale of the questions was five-point Likert scale. The reliability of the questionnaire was assessed by Cronbach's alpha and it was 0.91 and thus, it can be argued that data collection is desirable. After identifying experts in the field of science and technology foresight and economic, the questionnaire was sent to them that 53 questionnaires out of 65 questionnaires were received. In our survey, 21 people were male and the remaining 79 people were female. Fig. 2 demonstrates some personal characteristics of the participants.

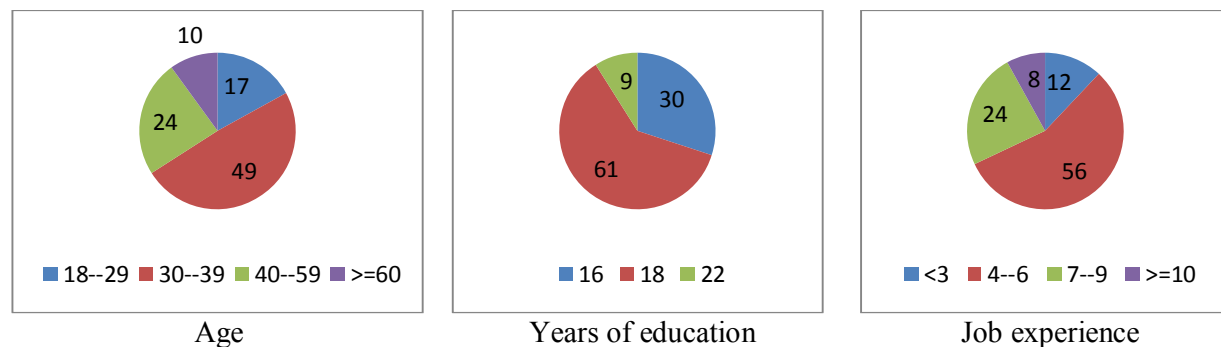


Fig. 2. Personal characteristics of the participants

According to the data, it was found that most participants of the study sample and 79 percent were men. About 61 percent of them hold master degree and 56 percent between 4 to 6 years old have some experience in the field of foresight and field studies. In the next section, descriptive statistics is used to examine the mean and standard deviation of each variable in the questionnaire.

Table 3
The summary of some basic statistics

Item	Description	Mean	Standard deviation	Item	Description	Mean	Standard deviation
1	Goals	4.24	0.873	7	Participation	4.03	0.785
2	Review of existing strategic approaches	4.57	1.065	8	Consultation	3.86	0.912
3	Orientation	3.93	0.979	9	Methods	3.65	1.012
4	Level	4.07	0.857	10	Organizing and Management	4.54	0.980
5	Time horizon	3.66	0.873	11	Distribution	3.97	0.785
6	Period and cost	3.57	0.698	12	Implementation	4.34	0.838
				13	Evaluation	4.02	0.968

3. The results

In this survey, binomial test is used to evaluate the research hypotheses. Table 4 shows the results of the analysis of the questionnaire data.

Table 4
Results of the binomial tests for hypotheses

Hypothesis	From	To	Standardized coefficient	t values	Approved/ rejection
1	Rational Components	The success of science and technology foresight in field of economics	0.63	5.18	Approved
2	Scope Components	The success of science and technology foresight in field of economics	0.47	7.25	Approved
3	Structural Components	The success of science and technology foresight in field of economics	0.48	6.21	Approved
4	Outcome Components	The success of science and technology foresight in field of economics	0.42	6.21	Approved

As shown in Table 4, all four hypotheses are confirmed in this study. Next, we investigate the relationships between four components influencing the success of science and technology, the foresight were evaluated by Spearman correlation test and Table 5 demonstrates the summary of our findings.

Table 5
Relationships between factors affecting the success of science and technology foresight

	Rational	Outcome	Structural	Scope
Rational	1	.541**	.673**	.540**
Sig.	-	.001	.000	.001
Scope	.540**	.787**	.567**	1
Sig.	.001	.000	.000	-
Structural	.673**	.543**	1	.567**
Sig.	.000	.001	-	.000
Outcome	.541**	1	.543**	.787**
Sig.	.001	-	.001	.000

Given the significance level in all relationships, it is clear that the fifth hypothesis is proven and all variables are significantly correlated with each other. However, due to the correlation coefficient, the intensity of this relationship is determined. According to the data in Table 5, it is clear that the relationship between outcome variables and the scope variables is stronger than other relationships. We have also applied Freedman test to rank different components of the survey and Table 6 shows details of our findings. According to Table 6, rational components have the highest impact on the

success of science and technology foresight in the field of economics and structural components have the least impact on the success of science and technology foresight in the field of economics.

Table 6

Results of Friedman Test Ratings

Factors affecting the success of science and technology foresight in the field of economics	Mean Ratings
Rational Components	3.53
Scope Components	3.43
Structural Components	3.05
Outcome Components	3.48

4. Conclusion

Foresight has emerged from the intersection of three areas including futurism, strategic planning and policy development and networking. Thus, it is an interdisciplinary field that has great potential. Foresight components result from the broad functions of foresight and systematic forecasting based on scientific methods for making and creating desired futures. Due to the foresight of the third generation and in addition to the forecast of technology and Market Traction, attention is also paid to the other sectors of economic, social and environmental. Since the successful implementation of foresight depends on the participation of various stakeholders along with policymakers and experts. Thus, foresight, implementation, balance and alignment in the works and gaining the competitive advantage in terms of reducing the extra cost re-enable the works and it leads to sustainable development in long term. ICT network infrastructure is the facilitator of the participation of other experts. Thus, paying attention to the foresight is considered as a continuous activity. Management science in its life period is faced with three different waves: The first wave of management is based on balance and stability, the second wave of change means adapting to the current environment can be accepted, and in the third wave of the future, the emphasis is on changing to adapt to the environment. Foresight is a broad concept that the third wave is characterized in that sense, so that the foresight, communities and organizations meet future by interaction and thinking and they try not only to be compatible with the current environment, but also to be consistent with future environment.

As a result, Iran's move towards economic globalization, it should be accepted that if no role playing in the cycle of profitability and being equipped with the proper resources and knowledge do not exist, we are marginalized. This is the reason why Iran should not solely rely on the natural advantages of its own resources. Expanding the activity area and attracting and retaining the intellectual elites and entrepreneurs to enter the economic arena that was previously in the possession of the state, can prevent the reduction of amount of risk from the accumulation of economic demands in order to avoid unhealthy economy. Avoiding the regional distribution of national wealth and economic activity has priorities, which cause the global economy less marginalized and due to the vulnerability of a sector, the other part of the global competition will remain blind. Moreover, the economic cycle should be organized in a way that the strength of the global network connectivity would be without the limitations of time and place and also, it would have high flexibility in the scope of the decision to integrate with local network and it simply surrenders domination and monopoly nature of the demands and needs of the top companies is not governed. Maybe transferring decision-making authority in charge of the economic and in the social field of governance can deflect many possibilities and consequences that undermine the rule of power.

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