Technology foresight and forecasting, strategic guideline keys for companies

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Abstract: For strategic decision making in each country and its organizations the future should be considered and determine the position of the country and it's organizations in future, and plan to achieve that position. Therefore, no future planning is possible without prediction, so in technology strategic planning technological parameters that affect the future of the organization should be defined by fore sighting and forecasting technology and uses this parameter for long term planning. This article explains this topic and focuses on technology prediction and futurism that are the guideline keys for strategic planning and gives brief information about two countries that were pioneer in this field (Japan and Turkey).

Keywords: Foresight; forecasting; strategic; company; organization; future

1. Introduction

Science and technology, which can be called the main issue of world's social and economical development, have created much more limitations and new complex conditions in this competing world. Profiting from the fast evolutions of Science and technology and its management requires the meticulous consideration appropriate to the future opportunities and threats, which are actually the products of scientific revolutions. We need to have a perceptive view toward the future threats and opportunities in order to design daily policies. For instance, forecasting can be categorized as one of these skills, which connotes an organized process and cooperation for establishing long term and mid-term perspectives. In fact, the mentioned process helps the politicians collaborating with society's organizations to design the proper plans.

Definition of forecasting and its characteristics:

Up to now, we have encountered different definitions of this process. Nevertheless, the following one may deliver the best.

Forecasting is an organized effort toward the long-term perspectives in realm of knowledge, technology, economics, environment, and society. This process is completed through identifying the modern technologies and determining well-invested plans, which contain the probable social-economic profiting values. In other words, it can be said that forecasting means preparing for the future and profiting from the present resources.

For example, Mr. Martin and Uropan have proposed the following issues under the label of CSf to introduce the characteristics of forecasting process:

1- Focus on long term issues

2- Communication among the personnel of forecasting board

3- Adjusting the personnel's' strategies during the interactions

4- Agreement on different future issues and perspectives

5- Having obligation toward the results

Forecasting place in programming (Planning):

The real place of forecasting regarding the strategic thought for the organizational planning: the purpose of strategic planning is the analysis section and steps toward its achievement. The obtained results and their progress will be estimated. However, the strategic thinking is an objective product, which is conducted through creativity and forecasting to achieve a comprehensive future perspective. The presence of a strategic thinking provides the essential elements of planning.

It is worth noting that there is a remarkable distinction between forecasting concept and the concept of determining a strategic perspective. Both these concepts contain efforts regarding a desired future, but formulating the strategic perspective emphasizes on the organizations' priorities and internal interests, while the forecasting process emphasizes on the external and factorial interests which may or may not lead to our desired future. Forecasting is a broad concept whose findings are used to create the strategic perspective. It is something beyond perspective formulation and its outcomes change our daily views toward the future.

Technological forecasting is the first step of planning and considering the future environmental changes, life spans, and natural limitations, provide an optimistic future idea for its orientations.

2. The technological forecasting theoretical models and frameworks

There are different methods involving the forecasting process. In the literature of forecasting, there are various theoretical and experimental models or frameworks, but here, we focus on three models of Martin, Miles, and Horton.

Martin's forecasting model:

Martin was one of the forecasting theoreticians in 1989. He believes that forecasting is an organized effort toward the long-term perspective in scientific, technological, economical and social fields. He finds forecasting's end in determining the progressive research centers and the appearance of modern technologies with the most social-economical benefits [1]. He pursues the following steps to offer his model:

Pre- Forecasting: The first step is the high decision making level in relation to conducting the Forecasting process. It is unlikely that the Forecasting project be completed without preparing its primary requirements. Therefore, it is necessary to accept the priorities and long-term policy requirements for its accomplishments [4].

Forecasting: The designing of this process is crucial since it should provide the customers the options and solutions of their needs. The other accomplishments presented in this step are the strategic analysis of different options in researches; ascribing the sources and the cost of opportunities (such as social-economical and inter increasing effects).

This design should also contain a future perspective in order to gain much more desired technological and scientific options. Beside, there should be a kind of special strategy following the selected options. Most of these kinds of activities failed to promulgate their experiences. However, the most important issues to consider are the selection of audiences, the designation of proper means for the promulgation of results, the results deliverance, and the conducting of the process.

Post- Forecasting: The first step is deciding to plan fore the research conduction. In this section, we focus on a series of objects, adoption of a strategy, and constructing a management system. According to the presented orientations, the projects are defined and conducted. It is worth mentioning that the projects are expressed descriptively and the planning section is offered in detail. In this part, the potential users, who benefited from the former plans, are selected and the most related approaches are used to promulgate and determine the results and to pursue the process conduction [4, 5].

Horton's forecasting model:

Horton offered a successful general process of Forecasting model in 1999. His theory became the theoretical foundation of other Forecasting models. This framework presents a three-phase process, which at the end of each section, it attains, more values than before. The results of each section come in an informational value chain (from the data to wisdom) [5].

Input: In this phase, Forecasting knowledge is provided through the existing data. This phase is, in a way, a common standard management experience, which is easy to perform by the managers. The best actor is the organization itself. There is no need to employ a third party, if so; it will be for a short time to help the managers. Generally, this step, which involves many activities, is easy performed and exciting [6].

Forecasting: in this step, the obtained data from the input phase is interpreted a comparative viewpoint regarding the concept of future be gained from each organization. This step is of two phases which in fact contains all the necessary elements about the concept of forecasting. The most considerable activities occur in this phase and the next phase, which is the interpretation of the first one, is considered as the most important section in the process [6].

Output and performance: The results obtained from the previous step are evaluated in order to prepare the conditions of organization's activities' equalization. Those working on the results should engage in the equalization process. It means that a representative or even an organization cannot interfere in the forecasting process, since the ownership issue and easy conduction of forecasting process would be taken into consideration. This stage is of two phases: equalization and premise sections in Horton's forecasting process. There is no optimal method in this direction to make a relationship between the forecasting process results and the managers or the other people and to create a requirement for the accomplishment. However the results are manifested in different frames and forms [6].

Mile's forecasting framework:

Miles has proposed his model in 2002 which unlike the other models, has benefited from the reiterative process. In each repetition, the previous reiterative processes get up to date. Miler believes that one cannot work on forecasting process once for all. It is a repetitious practice. The forecasting elements of this model are presented in the following list [6]:

Pre- forecasting: This phase focuses on the main decisions around the project's management and design. In this phase, we decide for the following issues:

The accepted principles, the project's orientation, the objects, sources, practicing methodologies, time, the project's team, the amount of field coverage, the

meaning and literature regarding the field, level and details.

Applying elements: It contains the gathering of interested parties, and the other project's factors. In this phase, we have a discussion around the internal and external structures of the project, the team's skills and its supporters.

Forecasting: It connotes the creation of possible future, useful analysis, obtaining results and offering suggestions. This phase constitutes the starting point, tools and methods, cooperation and the output type.

Performance: It is defined as the assurance of the results' promulgation, performance and their influence on the considered section.

Repetition: In this phase, all the efforts are focused on the institutionalizing, future experiences, their evaluation, and promulgation of the results [7].

3. A brief review of the technological forecasting techniques

We can present the technological forecasting process as the following:

In one division, the forecasting techniques are divided into exploratory and normative groups. In the exploratory techniques, the future is formed from the past knowledge, and its main object is to reach the future from present. However, in normative methods, we first face a technological desired future and then the required planning to reach its determined end.

The other categorization divides the techniques based on the qualitative and quantitative qualities (figure 2):
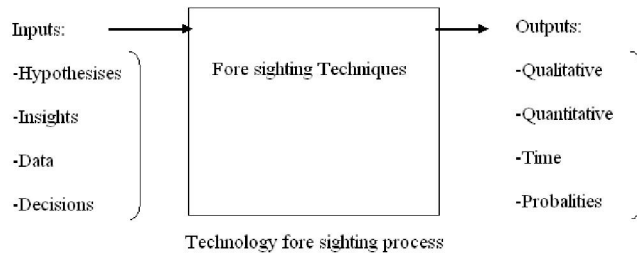

Figure 1: Technology for sighting process

Figure 2: Quantitative for sighting methods against quantitative methods.

The elements and sources of forecasting:

In order to have a useful forecasting decision-making process, we need to consider four elements:
1- Qualitative
2- Quantitative
3- Time
4- Probability

The essential sources of a forecasting process should be accessible to a forecaster. These are categorized into four groups:
1- Assumptions
2- Insight
3- Data
4- Judgment

Assumptions connote the idea of acceptance in time framework. It is recommended that the main assumptions be expresses in the forecasting process even if it is necessary to be evaluated in the future.

The concept of insight is one of the most important features of mankind in expressing the forecasting qualitative elements. It is worth mentioning that forecasting is not merely a quantitative approach. As a whole, it is a way toward future understanding. A good forecaster benefits from his experiences, technological knowledge, and competence to connect to developmental spectrums. This practice needs an open mind and creativity through which converge the disparate thoughts. After preparing for the mentioned process, the forecaster needs forecasting quantifications and techniques, by which he can find the future based on the past data. Obtaining the required data is one of the most difficult tasks of the forecaster. It is recommended that an experienced team take the responsibility of this task and never let the personnel waste the time and concentration. Researchers obtain quantitative data in most cases of forecasting as in the political and social trends. If they cannot express data in quantitative language, there is no way other than that they should benefit from the forecaster's judgment. The subjective judgment of managers is used as a complement to quantitative data in decision-making process [13].

4. The forecasting activities in some sample countries

In late 1960s, the Japanese perceived that Delphi forecasting is a useful potential politicizing tool. Therefore, a Japanese team went on a mission to America in order to consult with the American experts. Interactively, a group of Americans went to Japan to conceive them for having science and technology useful forecasting. However, Japan's science and technology agency began researching Delphi forecasting object in 1970. They did it for the future 30 years that is up to the year 2000.

After the functioning benefits of this method were proved, Delphi studies were widely used once in each 5 years with a 30year horizontal end in Japan. Up to now, 7 categories of these studies are being performed in

Japan. Japan is considered to be the most experienced country in Delphi studies. Some of Japanese' objects in forecasting are as the following:

1- Determining the most social and economical advantages

2- Providing the basic data in order to use them in the governmental science and technology policies and company managements R&D

3- Studying the future technological developments in a long term perspective due to the main role of technological development regarding Japan's consistent economic

In 1990s, the fractional budget and the increase of Japan's debts were a political difficulty. People were sensitive toward the investing and the spending of the government. Banks' bankruptcies, the ignorance of the trade makers were the main causes of concern. Therefore, they all decided that the government system should be changed and becomes a small and more effective one. Si in 1999, Japan's government reduced the ministries and the related organizations from 22 to 13. Educational, scientific, sporting, and cultural ministries were mixed with science and technology agency. Science and technology politicizing office began to conduct the future forecasting plans. Now we present the aspects of Japan's seventh Delphi project in 2000.

Japan's seventh Delphi: forecasting period from 2001 to 2030

MEXT ministry selected the seventh Delphi's members in order to establish 14 technological and 3 social-economical needs categories.

The social-economical needs:
- The modern social economical system
- The age society
- Security

The technological subcategories:
- Information and communication
- The living science
- Transportation
- Health and medical care

Each one of these subcategories needs a group of cultural and social experts. The technological subcategories are covered in the first six studies.

The forecasting activities in Turkey:

After experiencing difficult science and technological politicizing methods, the Turks decided to bring new scientific and technological policies to determine the priority of different sections in tow future decades and to achieve a new society and a modern economic. They presented their first

comprehensive project with a 20 year horizontal end. This project contains four minor projects:
1- Technological forecasting
2- Technological capacity
3- Human power
4- Substructure

The 2023 perspective project, which constitutes the technological forecasting project, is established upon meeting three ends:

1- Creating a scientific-technological perspective for Turkey

2- Determining the strategic technologies and the R&D having fields

3- Establishing the scientific-technological policies for the next 20 years.

The methods used in this project are Panel, Delphi, and SWOT analysis. The first task of the Panels is to provide the long term perspectives in related subjects and to list the supporting technologies. There were held approximately 200 meetings abd educational workshops, so that the panel's reports got prepared. The reports were offered the same and contained the following issues:

- The trends and issues that influenced the whole world

- The evaluation of Turkey's current place (SWOT analysis)

- Turkey's perspective for the year 2023

- Social-economical objects to achieve the perspective

- Scientific technological competences to achieve the social economical ends [14].

5. Conclusion

It is worth mentioning that different methods should be used to strategizing the countries and creating a comparative advantage. Here we preset the reason why each country should do this end separately. We have almost two reasons for it. First, the forecasting activity of each country is doe according to its special characteristics and analysis. Second, the forecasting process conduction in a country leads to the creation of different benefits, such as the conduction of the process itself. Both Japan and Turkey are different in their cultural, social and political fields. They use independent methods to reach the modern technologies.

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