

# The Evaluation of Science and Technology in Iran: Structures and Indicators<sup>1</sup>

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## Abstract

‘Science’ and ‘Technology’ are nowadays considered as such impressive factors in the international arena that the extent in which nations participate in producing global science and technology is regarded as an indicator of their power. Therefore, it has become more essential for the countries to be involved in the production and measurement of science and technology as indicators of their power. Considering the fact that science is usually followed by technology, establishing organizations of science in the countries can improve the quality and quantity of the production of both science and technology. On the other hand, measurement of science and technology is important in clarifying the situations of science and technology in each country. This article strives to represent some of the findings of researchers regarding measurement and evaluation of science and technology in Islamic Republic of Iran. The research data were collected through observation and corresponding. The organizations have been identified according to their mission, productions, and functions. Approximately 30 organizations and institutions have been identified and their mission, objectives, functions and activities were scrutinized. The results of this investigation are reported in this article based on the organizations and institutions involved in the measurement of science and technology.

## Introduction

The Evaluation of ‘Science’ and ‘Technology’ are nowadays considered as such impressive tools in the international arena that the extent in which nations participate in creating, producing and using global science and technology is regarded as an indicator of their power. Therefore, it has become more essential for the countries to be involved in the production and measurement of science and technology as indicators of their power. Considering the fact that science is usually followed by technology, establishing organizations of science in the countries can improve the quality and quantity of the production of both science and technology. On the other hand, measurement of science and technology is important in clarifying the situations of science and technology in each country.

This article strives to represent some of the findings of researchers regarding structure and indicators of measurement and evaluation of science and technology in Islamic Republic of Iran.

## Related concepts and definitions

### Science

Many different definitions have been suggested for the term ‘*science*’ in various sources up to now.

Science and Technology Dictionary (1996) has provided three various definitions for Science:

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1. Knowledge about the structure and behavior of the natural and physical world.
2. A branch of knowledge based on objectivity and involving observation and experimentation.
3. Systemized knowledge derived through experimentation observation and study.

Prothero and Dott (2004) have defined *science* in their book “Evolution of the Earth” as a procedure to formulate and examine hypotheses based on observation.

And according to Longman Dictionary (1995), *science* is knowledge about the world, especially based on examining, testing, and proving facts.

Although, it might seem that these definitions vary apparently to a great extent, all of them concur in systematic nature of *science*. *Science* is derived from the Latin word “Sceintia” which means ‘to know’. In Persian, science comes as ‘*elm*’ which is derived from Arabic meaning ‘to know’; therefore scientist ‘*aalem*’ is a person who knows about science. According to the above-mentioned sources, it can be said that *science* is nowadays referred to the knowledge which is resulted from a scientific method. Numerous books and articles have been published about scientific methods. According to the definitions and interpretations about *science* and regarding the wide range of ‘knowing’, the range of *science* has also become much wider. Scientific fields are so broad that scientists from ancient times up to now, such as Francis Baken, Farabi or Melvil Dewey, have tried to categorize sciences (Wilson, 1952; Kuhn, 1962, Barrow, 1991). *Science* is nowadays categorized in different branches. Classification of science into pure, humanities, medical, technical and engineering sciences has been also conducted on the same basis and each of them is divided into various scientific fields which contain different branches. Each branch also includes a variety of specialities. Therefore, considering the fact that each major or specialty represents special inputs or outputs from the world, it could be argued that *science* is nowadays much more specialized and that it is possible to categorize *science* into more specific classifications.

## **Technology**

‘*FANAVARI*’ is the recently used Persian equivalent for ‘*technology*’ which is approved by ‘Academy of Persian Language and Literature’; however, it cannot be found in many Persian dictionaries, especially the old ones. Many other equivalents are suggested in electronic dictionaries which differ in some segments but all have ‘*logy*’ in common.

‘*Technology*’ is defined in Oxford Dictionary (1997) as:

Scientific knowledge used in equipment, machinery and practical ways in industry, a branch of knowledge which is related to practical sciences.

It seems that Oxford Dictionary has presented the best definition for ‘*technology*’; because it has employed the term ‘practical ways’ to emphasize on technical aspects of science and turn it into *technology*. There is an inseparable relation between ‘*technology*’, science and knowledge. In other words, ‘*technology*’ results from employing scientific products together with practical purposes. Therefore, ‘*technology*’ is created when science and practice come together. International Technology Education Association (ITEA) has also defined technology which could be useful from another point of view:

*Technology* is human innovation in action that involves the generation of knowledge and processes to develop systems that solve problems and extend human capabilities.

It is essential to pay attention to two points in this definition. First, *technology* accompanies innovation. Second, *technology* results in knowledge and processes related to the practical solution of problems and extension of human capabilities.

According to the definitions provided by Oxford Dictionary and ITEA, it can be concluded that it is essential to study science prior to technology; in other words, it is not possible to study

technology without studying science. Studies of technology are essentially considered as a part of science and scientific products survey which can be considered as “practicality of science” to present “practical solution of problems and extension of human capabilities”.

## **Methodology**

The research data were collected through observation and corresponding. The organizations have been identified according to their mission, productions, and functions. Approximately 30 organizations and institutions have been identified and their mission, objectives, functions and activities were scrutinized. The results of this investigation are reported in this article based on the organizations and institutions involved in the measurement of science and technology and their indicators.

## **Findings**

### **Organization of science in Iran**

The three basic components of Organization of science have had similar functions in Iran as well. Government has a great share in scientific areas, organizations and institutes are working as both profit and non profit institutes, and scientists are also dealing with research and production of science as public and private institutes. However, their activities in measurement of science and technology vary to a great extent. Measurement of science and technology in Iran has been carried out by Governments. Major institutes for measurement of science and technology have presented classifications based on the findings of authors.

The studies of the present research, which had been conducted through national approach, indicate that organizations and centers dealing with measurement of science and technology have followed different procedures and purposes. In many cases, they themselves have not considered their activities as measurement of science and technology. Activities which were conducted on measurement of science and technology in these organizations were mainly to emphasize the use of its findings for its organizational purposes. Therefore, many of these institutes measure only a couple of criteria which can not be considered as a perfect marker of the situations of science and technology. However, they can be considered as indicators for measurement of science and technology. Thus, these organizations can also be significant.

There are some points to be mentioned about some organizations which consciously follow measurement and evaluation of science and technology. Their purposes, missions and outputs indicate that their interpretation of measurements differed and did not correspond with each other.

A closer study of purposes and missions of Iranian centers and institutes and investigation of their outputs indicate that some institutes have been involved in measurement of science and technology or have initiated their activities. There are, however, some cases among these institutes which have not performed any activities in measuring science and technology, but are listed among other organizations due to the kind of activities they carry out or the expectations held about their activities in this regard. Thus, it is possible to categorize the organizations under the study in the following format:

### **Ministry of Science, Research and Technology**

- National Research Institute for Science Policy
- Iranian Research Organization of Science and Technology
- Office for Innovators and Technology Assessment
- Head Office of Science and Technology Park Affairs
- Institute for Research and Planning in Higher Education
- Regional Information Center of Science and Technology
- Iranian Information and Documentation Center

- Office for Supervision and Measurement of Higher Education
- Office for Research Investigation and Measurement \*\*

#### **Presidency**

- Supreme Council of the Cultural Revolution of Iran
  - Jihad-e-Daneshgahi
- The Academy of Sciences of Islamic Republic of Iran
- Presidential Office for Cooperation in Technology
- Supreme Council of ICT
- Statistics Center of Iran

#### **Ministry of Health and Medical Education**

- Research and Technology Deputy in Ministry of Health and Medical Education
- Isfahan University of Medical Sciences

#### **Ministry of Communications and Information Technology**

#### **Ministry of Agricultural Jihad**

#### **Ministry of Energy**

#### **Ministry of Education**

#### **Parliament of Islamic Republic of Iran**

#### **Qom Hawzah**

#### **Private Centers Involved in Measurement of Science and Technology**

#### **Other Centers**

With an overall look to these centers and organizations and referring to the findings of this research, it is concluded that most of the activities on the measurement of science and technology are conducted by institutes affiliated to “Ministry of Science, Research and Technology” and “Presidency”. In addition, authorities such as “Ministry of Health and Medical Education” have initiated some activities in this regard. But there have been no clear actions in measuring science and technology among other organizations and centers. However, many of these organizations and centers require the information resulting from the studies on measurement of science and technology to develop their missions and objectives. On the other hand, considering the fact that there is only one non-governmental body involved in measurement of science and technology among all centers under the study, it can be concluded that private centers had no significant participation in measuring and evaluating science and technology.

‘National Research Institute for Science Policy’ (NRISP) is one of the affiliated organizations to ‘Ministry of Science, Research and Technology’ (MSRT) which had the most specified objectives, missions and activities in measurement of science and technology. In this center, ‘Future Studies Department’ is responsible for quality studies of anticipation of science and technology. ‘Economics of Science Department’ collects data via quantitative manner and analyzes them through qualitative approach. Some studies of this department regarding ‘measurement of research funds’ can be considered as a kind of measurement of science and technology which investigates its financial aspect. In addition to these two departments, ‘Scientometrics Department’ covers more direct missions and activities regarding the measurement of science and technology. This department has presented its outputs through national approach to fulfill the requirements of Iranian research policy makers. Another important point about the activities of this department is considering international scientometrical indicators along with national indicators. ‘Iranian Research Organization of Science and Technology’ (IROST) deals with technometrics rather than scientometrics.

Activities of centers affiliated to IROST show that this organization considers technometrics in order to recognize situation of technology in Iran and highlight the latest changes and improvements made in technology. On the same basis, this organization has provided indicators to measure and evaluate 'innovation' and 'development of technology'.

Although 'Office for Innovators and Technology Assessment' (OITS), as an affiliated center to 'Technology Deputy in MSRT', has some responsibilities for measuring science and technology, it has taken no effective actions in this regard.

'Head Office of Science and Technology Park Affairs' is also another center affiliated to 'Technology Deputy in MSRT' which is responsible for measuring and evaluating parks and centers for development of technology; however, it has carried out most of their evaluation through direct observation.

'Institute for Research and Planning in Higher Education' (IRPHE), another organization under the study, has taken limited actions regarding the evaluation of some parts of science and technology which are related to the objectives of higher education, on the basis of its missions and objectives to present exact and clear image of higher education in Iran and the World. One of the most important points about this 'institute' is using higher education indicators which can be seen as part of scientometrical indicators. Furthermore, another considerable point about IRPHE is its recent activities regarding the ranking of universities of Islamic countries.

'Shiraz Regional Library of Science and Technology', which was recently renamed as 'Regional Information Center of Science and Technology' (RICST), has carried out some activities on scientometrics based on its missions and objectives. Considering international indicators, these activities have been carried out to measure scientific products of Iran and Islamic countries. Scientometrics applications of RICST index and analyze papers published in Iranian scientific journals; therefore, it can be used as a quality means for measuring and analyzing Iranian papers that are published in these journals.

In addition to its own activities, 'Iranian Information and Documentation Center' has conducted some activities on measurement of science. Its activities have been limited to the publication of reports about the situation of Iranian papers in WoS and JCR. The latest report contained information about Iranian papers in 2004.

'Office for Supervision and Measurement of Higher Education' (OSMHE) is one of the affiliated centers to 'Educational Deputy in MSRT' which is not involved in measuring science and technology; however, it presents statistics about higher education criteria which can be considered as effective criteria on the production of science. Therefore, their statistics can be used by scientometric centers.

'Office for Research Investigation and Measurement' which is affiliated to 'Research Deputy in MSRT' is responsible for measuring universities and research centers. Many of its indicators have been developed with special focus on the scientific activities and productions. Furthermore, some of its other indicators are concerned with the measurement of research-support affairs. Therefore, many of its indicators and statistics can be used for scientometrical goals.

'Supreme Council of the Cultural Revolution of Iran' (SCCRI) is an affiliated organization to 'Presidency' which had the most significant and sophisticated activities regarding the measurement and evaluation of science and technology. 'The Board of Supervision and Assessment of Cultural and Scientific Affairs' (BSACSA), as the most important part of SCCRI, undertakes this responsibility. Indicators provided by SCCRI aim to measure different aspects of science and technology such as culture, education and research at micro or macro level. Data about these indicators are provided in order to present an exact image from the situation of science, technology, culture, education, and research. However, their main objective is not citations analysis of Iranian papers; rather, BSACSA deals more with presenting statistics about the current situation and conducting annual comparisons.

‘Jahad-e-Daneshgahi’ which is affiliated to ‘Supreme Council of the Cultural Revolution of Iran’ has initiated its activities regarding indexing the articles published in Iranian scientific journals. Although its objective is providing necessary means for scientometrical studies, it has a long way to reach the advanced level of RICST.

‘The Academy of Sciences of Islamic Republic of Iran’ (ASIRI) as another center affiliated to ‘Presidency’ has dealt with measurement of science and technology as well. However, the important point about its activities is emphasizing on qualitative measurements and ignoring quantitative manners. These qualitative measurements have been mainly conducted to introduce capabilities of Iranians in special areas. Therefore, most of the activities of ASIRI can not be considered suitable for scientometrics and technometrics due to ignoring ‘quantitative’ means.

‘Presidential Office for Cooperation in Technology’ (POCT), another affiliated center to ‘Presidency’, conducts some activities regarding technometrics; however, it has not carried out any serious and practical activities in this regard yet. One of the most important activities of POCT in this regard is introduction of some indicators for technometrics which are titled as ‘Indicators of ICT Infrastructures’ and ‘Indicators of Industrial Investigations’.

‘Supreme Council of ICT’ is also another affiliated center to ‘Presidency’ which is responsible for conducting some activities regarding technometrics. But investigations show that it has carried out no effective actions in this regard.

‘Statistics Center of Iran’ (SCI) is another affiliated center to ‘Presidency’. Although this center is involved in producing different statistical reports, it has conducted little activities in providing statistics about science and technology. Some of the activities of this center which can be considered related to “measurement of science and technology” include ‘Cultural Indices and Indicators’ and ‘Indices and Indicators related to Activities of Research and Development’.

In addition to ‘Presidency’, ‘Ministry of Health and Medical Education’ (MHME) has also initiated some activities regarding the measurement and evaluation of science and technology. Most of these activities are conducted by ‘Research and Technology Deputy’ in this ministry. Some of the activities of MHME, regarding the measurement of science and technology, include designing structures to perform “Measurement of Technology of Health” and developing various criteria to measure research centers and universities of medical sciences. ‘Research Deputy of Isfahan University of Medical Sciences’ established ‘Scientometrics and Science Monitoring Center’ which is considered as another step in providing the necessary rudiments for measurement of science and technology. Although this center has conducted no effective activities regarding the measurement of science and technology, it is involved in measuring the scientific productions of Iran Medical Sciences.

According to this study, there are no other organizations involved in the measurement of science and technology. ‘Ministry of Agricultural Jihad’ has conducted limited activities in measuring its own scientific productions and has developed some indicators on the same basis. Ministries and centers such as ‘Ministry of Communications and Information Technology’, ‘Ministry of Energy’, ‘Ministry of Education’ and ‘Parliament of Islamic Republic of Iran’ require the information resulting from the measurement of science and technology; however, they have not carried out any effective activities in this regard yet. Investigation about ‘Qom Hawzah’ shows that ‘Research Deputy of Hawzah’ is preparing some activities about measurement of religious sciences, measurement of funds of research centers of Hawzah, and scientific standardization of religious sciences; however, the results indicate that these activities are not completed yet.

Therefore, the study reveals that organizations and centers affiliated to ‘MSRT’ and ‘Presidency’ have conducted most of the activities regarding the measurement of science and technology. ‘Ministry of Health and Medical Education’ has also been doing some limited activities in this regard. Furthermore, non-governmental centers do not enjoy a suitable place among the centers involved in measurement of science and technology.

## Conclusions

The studies of the present research, which had been conducted through national approach, indicate that organizations and centers dealing with measurement of science and technology have followed different procedures and purposes. In many cases, they themselves have not considered their activities as measurement of science and technology. Activities which were conducted on measurement of science and technology in these organizations were mainly to emphasize the use of its findings for its organizational purposes. Therefore, many of these institutes measure only a couple of criteria which can not be considered as a perfect marker of the situations of science and technology. However, they can be considered as indicators for measurement of science and technology. Thus, these organizations can also be significant.

There are some points to be mentioned about some organizations which consciously follow measurement and evaluation of science and technology. Their purposes, missions and outputs indicate that their interpretation of measurements differed and did not correspond with each other.

With an overall look to these centers and organizations and referring to the findings of this research, it is concluded that most of the activities on the measurement of science and technology are conducted by institutes affiliated to "Ministry of Science, Research and Technology". In addition, 'National Research Institute for Science Policy' (NRISP) is one of the affiliated organizations to 'Ministry of Science, Research and Technology' (MSRT) which had the most specified objectives, missions and activities in measurement of science and technology. This Institute has presented its outputs through national approach to fulfill the requirements of Iranian research policy makers. In addition, 'Iranian Research Organization of Science and Technology' (IROST) 'Office for Innovators and Technology Assessment' (OITS), 'Technology Deputy in MSRT', 'Head Office of Science and Technology Park Affairs' are also other centers and Institutes affiliated to 'Technology Deputy in MSRT' which is responsible for measuring and evaluating science and technology in Iran. According to this study, there are some organizations involved in the measurement of science and technology out of that ministry in Iran.

Although, the whole of these institutes measure and evaluate science and technology, but their roles and duties are different and they use various indicators based on them. Some of their indicators are relative to research and technology outputs and some others are about R&D funding, productivity, function, structure and quality of science and technology and so on.

This article attempts to show some of other indicators and organizations of measurement and evaluation of science and technology in Islamic Republic of Iran.

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