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Future-Oriented Technology Assessment

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Abstract

The purpose of this paper is to reflect on the concept of Future-Oriented Technology Assessment (FOTA) as a particular form of Technology Assessment (TA) which is focused less on risk assessment and more on the innovation governance with regards to the emerging technologies. In the article the author describes a conceptual system comprising Future-Oriented Technology Assessment (FTA), Future-Oriented Technology Analysis and Responsible Research and Innovation (RRI). The deliberations are based on the literature review, bibliometrics and the logical construction method. The paper is expected to provide grounding for further research on the objectives, methods, stakeholders, results and best practices of Future-Oriented Technology Assessment. In the context of the rising importance of the Responsible Research and Innovation idea, Future-Oriented Technology Assessment is discussed as a potentially effective tool to pursue policy goals within RRI agenda.

Peer-review under responsibility of the organizing committee of EPPM2016

Keywords: technology assessment, Future-Oriented Technology Analysis, Responsible Reaserch and Innovation, foresight, innovation policy

1. Introduction

The expanding borders of human knowledge and technological advances result in vast opportunities for a safer, healthier, cleaner and more meaningful human life. The same processes bring about known and unknown threats to sustainability, peace, health, justice, human rights etc. [4, 14]. Hence, the analysis (assessment) of emerging technologies from the perspective of the potential results of their implementation are critical in contemporary economies, societies and businesses. It has been widely accepted and understood that technology and society evolve in an intertwined manner. Diverse practices and tools have been developed and applied to look into the future shape of technological achievements and to understand – and most preferably anticipate – their multi-faceted implications.

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One of such approaches is Technology Assessment which may be briefly defined as a *systematic attempt to foresee the consequences of introducing a particular technology in all spheres it is likely to interact with* [2] or as *the systematic study of the effects on society, that may occur when a technology is introduced, extended, or modified with emphasis on the impacts that are unintended, indirect, or delayed* [3].

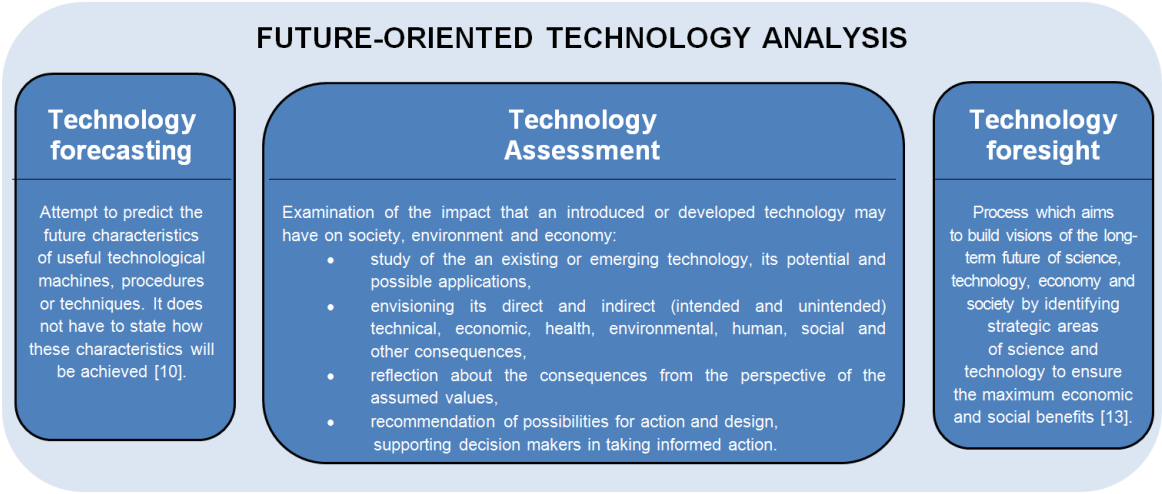

Fig 1. Technology Assessment as an element of Future-Oriented Technology Analysis (FTA)
Source: own elaboration in the basis of [6, 9, 14]

In Figure 1 Technology Assessment is integrated into the wider concept of Future-Oriented Technology Analysis (FTA) and is treated as FTA's analytical form along with technology forecasting and technology foresight.

2. Evolution of Technology Assessment

One may trace the origins of Technology Assessment in the 60s in the US. It was related to the endeavours of the Congress to establish an information gathering service independent from the Administration with the aim to enhance the democratic control over the scientific and technological progress. In the late 80s and 90s TA gained popularity in Europe where networks of institutions involved in TA were established.

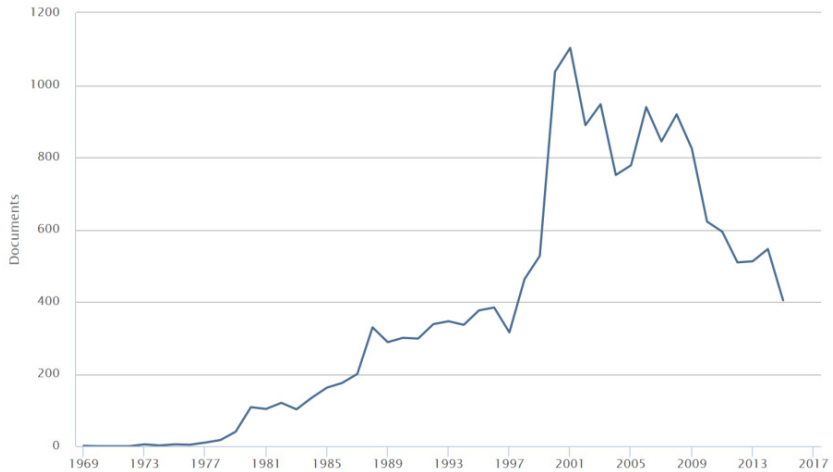

Fig. 2. Number of documents indexed in Scopus database with “Technology Assessment” as a keyword.

When it comes to the scientific output concerning Technology Assessment, a significant uptake in the number of publications may be notice at the turn of 70s and 80s (Figure 2). From that time on the trend remained upward. The first decade of the 21st century was clearly the time of growth for Technology Assessment both in theory and praxis. The second decade is characterized by a downward trend in the number of publications with "Technology Assessment" as a keyword. It is author's belief, however, that the tendency may be soon reversed with TA playing a prominent role in the Responsible Research and Innovation (RRI) agenda.

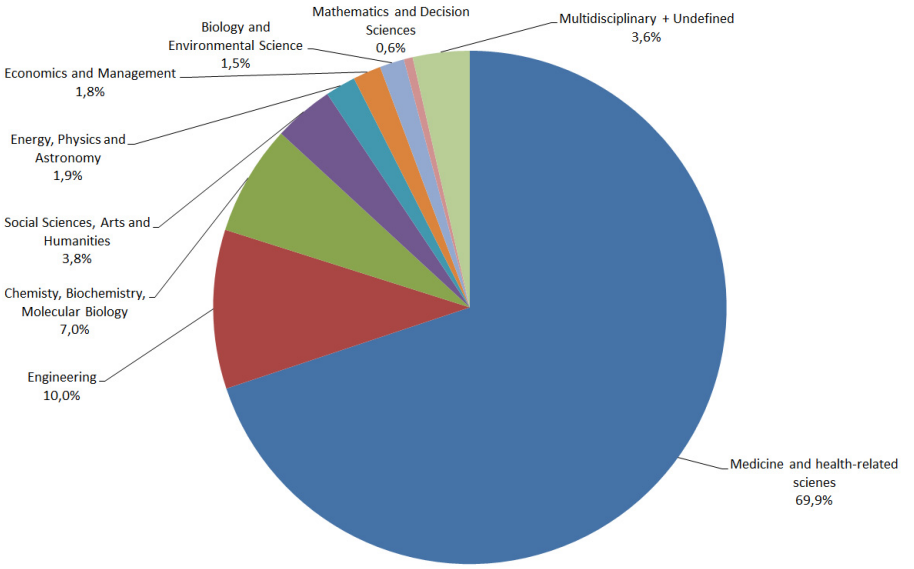

Fig. 3. Subject areas of publications with "Technology Assessment" as a keyword according to Scopus database.

Thematic analysis of almost 18 thousand items on Technology Assessment from years 1969-2015 listed in Scopus database indicates very clearly that the TA landscape is dominated by the subject area of health-related sciences (Medicine, Health Professions, Nursing, Pharmacology, Toxicology and Pharmaceutics, Immunology and Microbiology, Neuroscience, Psychology, Dentistry, Veterinary) (Figure 3). It may be added that the most-cited papers on Technology Assessment also almost exclusively concern medicine and related subject areas. Only 10% publications are in broadly understood Engineering (including Computer Science, Chemical Engineering and Materials Science). Social Sciences, Humanities and Arts combined with Economics and Management take up together less than 6% of all publications on TA. The domination of health sciences is clear from that figure, however it is worth noticing that Health Technology Assessment is very often far in its nature from a participative and deliberative process involving various groups of stakeholders and providing space for group reflection on the possible long term effects of a particular medical technology. It is rather a very rigid scientific (clinical tests) and administrative (projection of the increase/decrease of public spending) process aiming at obtaining relevant permissions from authorities to introduce a particular technology into medical practice.

Map in Figure 4 which was obtained with use of VOSviewer software represents the terms which occur most frequently in the most recent two thousand publications on Technology Assessment indexed in Scopus database. This way of data representation may reveal some classes and clusters and enhance understanding of a particular phenomenon [7]. In the following figure one may observe three classes of terms. The first class relates to Health Technology Assessment (life, patient, treatment, quality), the second one reveals the focus of most of the TA studies (result, effectiveness, evidence, costs, implementation, application, context) and the third one points at the utilitarian value of TA activities for decision makers (decision making, decision maker, decision, stakeholder).

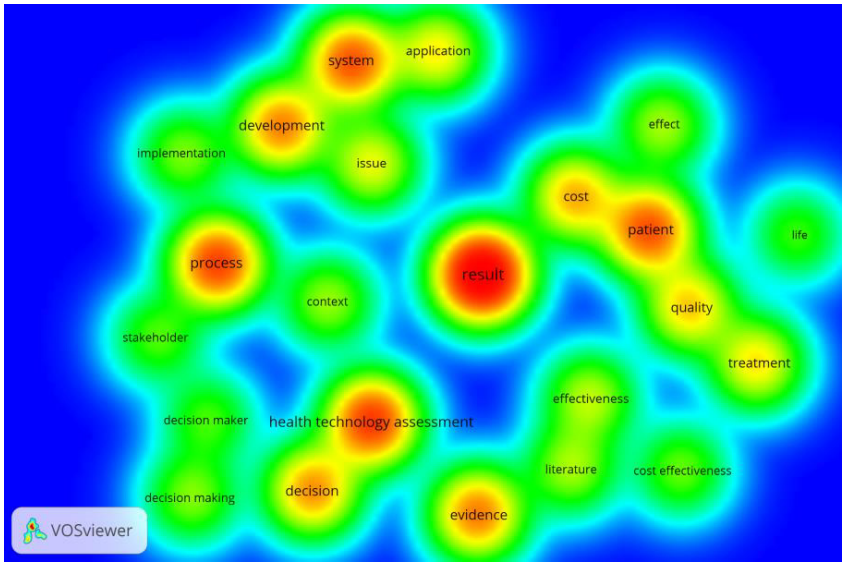

Fig. 4. Terms most frequently occurring in the most recent 2000 publications on Technology Assessment.

3. Future-Oriented Technology Assessment

The main argument for revisiting the main assumptions and established practice of Technology Assessment lies in the emergence of a major innovation policy-oriented concept called Responsible Research and Innovation (RRI). RRI may be defined as *a transparent, interactive process by which societal actors and innovators become mutually responsive with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society)* [16]

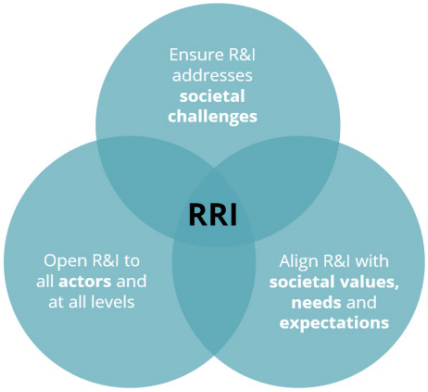

Fig. 5. Functions of Responsible Research and Innovation.
Source: [15]

Figure 5 describes the functions of Responsible Research and Innovation. One may say that RRI requires that research and innovation is planned and performed in an open and transparent manner so that the wider society have a chance to anticipate their consequences. It is very easy to notice that such functions may be well ascribed to Technology Assessment if we orient it at the innovation processes and the anticipation of emerging technologies. This the point of departure for the proposition of Future-Oriented Technology Assessment (FOTA) understood as a TA component of RRI.

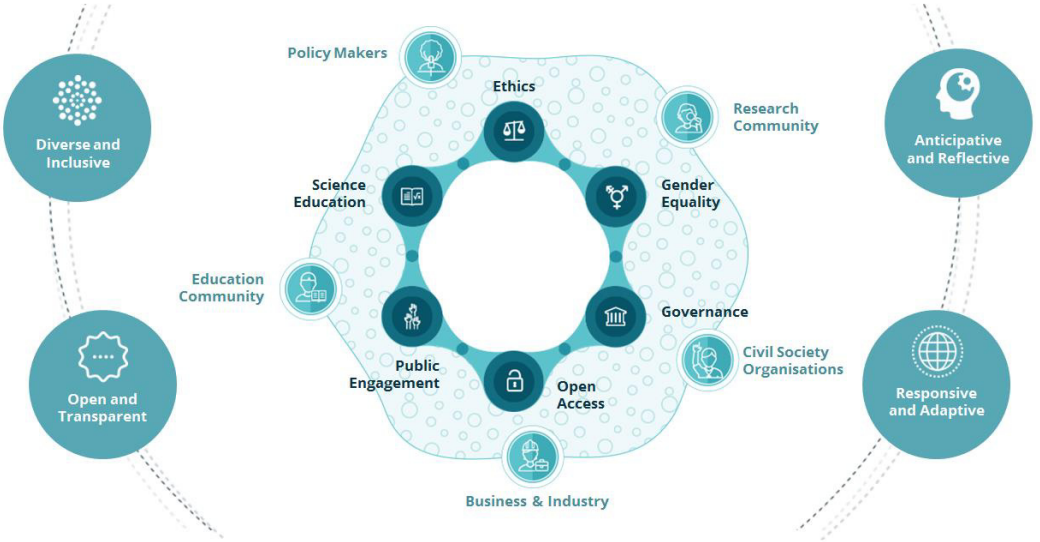

Fig. 6. Stakeholders, key issues and characteristics of RRI
Source: [15]

RRI prioritizes the inclusion of all stakeholders (policy makers, research community, civil society organisations including media, business and industry as well as the education community) of innovation ecosystems in a deliberative process in which specific key issues (Ethics, Governance, Public Engagement, Science Education, Open Access and Gender Equality) are considered in an open, inclusive, adaptive and anticipative manner (Figure 6).

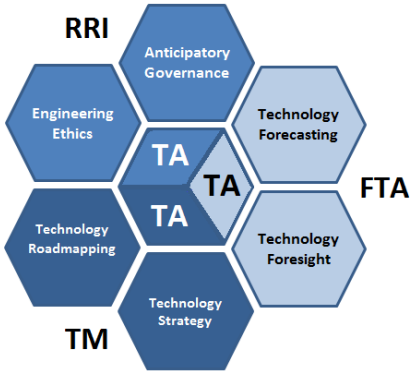

Fig. 7. Future-Oriented Technology Assessment as an element linking RRI, FTA and TM.
Source: Author's elaboration on the basis of [20].

Another way of looking at Responsible Research and Innovation is to enumerate its three distinct building blocs: anticipatory governance, engineering ethics and Technology Assessment. In Figure 7 such approach is presented, which allows to discover the interlinkages between Responsible Research and Innovation (RRI), Future-Oriented Technology Analysis (FTA) and Technology Management (TM). It reveals that Future-Oriented Technology Assessment as an element that binds RRI, FTA and TM. It shows the relevance of Technology Assessment for both the policy community [11, 12] and the business world [1, 5] in addressing the so called Grand Challenges and may herald the revival of TA both in terms of academic output and in policy arena.

4. Conclusion

According to author's intentions, Future-Oriented Technology Assessment is not supposed to be an entirely new type of TA. In fact, one may say that all TA initiatives are (or should be) future-oriented by definition. Rather than insisting on a new type of TA, the concept of Future-Oriented Technology Assessment is intended to project a possible direction in which the TA theory and practice might evolve in in the coming years in the context where science, technology, social reality and human life are increasingly intermingled and where it is often impossible to make distinction between apparently positive and negative impacts of a particular technology. The presented paper suggests that the main characteristics of Future-Oriented Technology Assessment are: (1) re-orientation from risk assessment toward innovation governance [8], (2) integration with Responsible Research and Innovation Agenda (RRI) and (3) more extensive methodological reliance on qualitative and heuristic tools common to foresight studies.

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