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Structural Analysis as an Instrument for Identification of Critical Drivers of Technology Development

Joanicjusz Nazarko, Joanna Ejdys*, Katarzyna Halicka, Łukasz Nazarko, Anna Kononiuk, Anna Olszewska

Faculty of Management, Bialystok University of Technology, Wiejska 45A, 15-351 Bialystok, Poland

Abstract

Technology development is determined by many factors which have different functions in the socio-economic system. Knowledge and skills in the process of selection of key factors and assign roles to other factors, plays an important part from the perspective of management of technologies. The purpose of the paper is to present the structural analysis as an instrument of identification and classification of factors influencing the development of a particular technology. The paper discusses the theoretical basis of the method and presents its practical implications in the form of a case study of a project entitled "Technological Foresight «NT FOR Podlaskie 2020». Regional Strategy of Nanotechnology Development". The aim of the described project was to find answers to the following questions: What are the key drivers of nanotechnology development in Podlaskie region (Poland) in the perspective of year 2020? What are the interrelations between these drivers? For the research purposes of the article structural analysis was used. The applied method allowed eventually to the select two main factors that determine the development of the analyzed technologies which formed the basis for creating development scenarios.

1. Introduction

In management of technologies, especially in prospective management of technologies [6], a vital role is played by the process of identification and analysis of factors determining the future development of technology. These factors

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* Corresponding author. Tel.: +4-885-746-9802; fax: +4-885-663-1988.
   E-mail address: j.ejdys@pb.edu.pl

may be of technological, economic, social, legal, ethical or environmental type. The multiplicity and diversity of these factors, often call for the in-depth analysis, whose aim is to organize the factors, and to identify factors that play crucial part.

Concentration of future operations and development strategy (businesses, regions) on the key factors of technology development, can contribute to the ultimate success. In the context of prospective management of technology development a selection of key factors can form the basis for the construction of the desired development scenarios of the object or system. One way of creating scenarios proposed by Klooster and Asselt, is the scenario-axes technique [7], which imposes identification of two key factors that determine the functioning of a particular system (technology development). Researches on the use of scenario method for the purpose of foresight research, conducted by Kononiuk and Nazarko [9], confirm its high usability and popularity.

The article presents methodical process whose aim was to select the two key factors that determine the development of nanotechnology in the Podlasie Region aimed at working out scenarios for the development of nanotechnology. For this purpose, structural analysis and scenario method were applied in the first stage of research.

2. Structural analysis background

Structural analysis is a tool that allows the detection of a mutual influence and relationship between the drivers of studied system. The first stage of its implementation is to identify the type of interaction between the pair of factors. Applying structural analysis to each pair of A and B factors will yield answers to the following questions: (i) does the A factor have a direct impact on the B factor? (ii) If so, is this impact small, medium, or crucial? For this purpose, it is necessary to determine whether it is direct and what is its strength (low, medium, high or potential). The advantage of the structural analysis is its ability to identify the ties between the variables, whose mutual influences are not obvious and may remain unrecognized even by experts in the field.

By analysing dependencies between ostensibly irrelevant factors, the structural analysis method allows researchers to describe mutual impact, as well as reaction; based on these reactions it is possible to distinguish which variables are crucial [4]. Structural analysis allows one to distinguish the factors that impact on a given research area: crucial factors, which are characterized by large-scale impact and a high degree of dependency on other factors- due to high instability, these factors require critical scrutiny; aim factors, are dependent on other factors and tend to be influenced by such factors rather than vice versa; result factors, are characterized by low impact and high dependency on other factors and are especially susceptible to changes in crucial factors; determinant factors (motorbikes, brakes) have a strong impact on the system, are characterized by a low level of dependency on other factors, and can be regarded as a driving or breaking force; regulatory and supplementary factors are characterized by minimal impact on the system and can prove to be beneficial in achieving strategic goals; external factors are characterized by having a relatively smaller impact on the system than determinant factors, but a greater impact than autonomic variables, and are not impacted upon by other variables; autonomic factors are characterized by exerting the least impact on changes taking place in the system as a whole unit [5, 7, 11–13], (Figure 1).