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CONSTRAINTS AND BARRIERS TO TECHNOLOGY ENTREPRENEURSHIP OF ENTERPRISES IN EMPIRICAL STUDIES

Summary. The paper is devoted to the problem of management of technology entrepreneurship. The aim of the paper is to present the most important barriers hindering the activities in the field of technology entrepreneurship of enterprises. In the paper there has been made an attempt to identify the new landscape of innovation and technology entrepreneurship, and there has been presented the results of the empirical studies in this field concerning enterprises of the metal industry of the Silesian Voivodeship. The value of the paper consists in showing the barriers to the implementation of the solutions of technology entrepreneurship of enterprises and the opportunities to support its development based on the minimum viable innovation system.

Keywords: technology entrepreneurship, minimum viable innovation system

BARIERY I OGRANICZENIA PRZEDSIĘBIORCZOŚCI TECHNOLOGICZNEJ PRZEDSIĘBIORSTW W BADANIACH EMPIRYCZNYCH

Streszczenie. Artykuł poświęcono problematyce zarządzania przedsiębiorczością technologiczną. Celem artykułu jest ukazanie najistotniejszych barier utrudniających działania z zakresu przedsiębiorczości technologicznej przedsiębiorstw. W artykule podjęto próbę zidentyfikowania nowego krajobrazu innowacji i przedsiębiorczości technologicznej oraz przedstawiono wyniki badań empirycznych z tego zakresu, dotyczące przedsiębiorstw przemysłu metalowego województwa śląskiego. Wartość artykułu polega na ukazaniu barier we wprowadzeniu rozwiązań przedsiębiorczości technologicznej przedsiębiorstw oraz możliwości wspomagania jej rozwoju opartego na systemie minimalnej efektywności.

Słowa kluczowe: przedsiębiorczość technologiczna, system minimalnej oczekiwanej efektywności

1. New landscape of innovation and technology entrepreneurship

Most authorities in the field of entrepreneurship indicate that the essence of entrepreneurial activities is searching for and exploiting opportunities and creating innovative solutions. Entrepreneurship amounts to innovation; it is the process of creating something new due to creativity of the internal environment and exploiting opportunities arising in the environment. The presented approach, to some extent, complies with the concept of an entrepreneur – innovator, i.e. the person capable of creating new products, markets, production methods, technologies, discovering new resources and sources of these resources, creating new organizational forms irrespective of whether they are the owner or co-owner of an enterprise¹. According to R.W. Griffin, entrepreneurship is the process of organizing, conducting business activity and taking the associated risk. Therefore, in the definition of entrepreneurship, there occurs the function of organizing, conducting a business and taking risk. Defining entrepreneurship from different perspectives allows to indicate its various types. A.A. Koźmiński proposed the division of entrepreneurship according to two criteria: the organizational and legal form and the type of inspiration as a stimulating factor. On the basis of the above criteria, he identified: individual, internal (corporate) and family entrepreneurship². The concept of intellectual entrepreneurship was introduced by S. Kwiatkowski³; it amounts to creating the basis of tangible wealth of individuals, social groups and nations out of intangible wealth, intangible knowledge of individuals, social groups and nations. The author underlines that the most important characteristic of the operation mode of an intellectual entrepreneur is the perception of social conditions of the efficiency of economic activities and skills to creatively solve inevitable conflicts between people. Moreover, intellectual entrepreneurship is developed in two ways:

- by commercialization of activities previously non-commercialized and
- by intellectualization of typically economic activities and institutions⁴.

One of the manifestations of intellectual property, except for academic entrepreneurship, is technology entrepreneurship. It concentrates on providing greater practical usefulness of scientific research results. It is implemented by effective cooperation between scientific centers, financial institutions and its business-related sphere, and enterprises dealing with

¹ Duraj J., Papiernik-Wojdera M.: *Przedsiębiorczość innowacyjna*. Difin, Warszawa 2010, p. 15-16; Schumpeter J.A.: *The Theory of Economic Development*. Harvard University Press, Cambridge (MA) 1934, p. 66, [in:] Stevenson H.H., Jarillo J.C.: *A Paradigm of Entrepreneurship: entrepreneurial management*. "Strategic Management Journal", Vol. 11, 1990, p. 19, [in:] Duraj J., Papiernik-Wojdera M.: *op.cit.*, p. 15.

² Koźmiński A.A.: *Zarządzanie w warunkach niepewności*. PWN, Warszawa 2004, p. 166-167.

³ Kwiatkowski S.: *Przedsiębiorczość intelektualna. Bogactwo wiedzy*. PWN, Warszawa 2000.

⁴ *Ibidem*; Grudzewski W.M., Hejduk I.K., Sankowska A., Wańtuchowicz M.: *Sustainability w biznesie, czyli przedsiębiorstwo przyszłości. Zmiany paradygmatów i koncepcji zarządzania*. Poltex, Warszawa 2013, p. 243.

production and sale of products and services⁵. It is rightly underlined that technology entrepreneurship is a tool for transforming the research and potential of scientific institutions into goods and services; it directly and indirectly increases consumers' benefits and contributes to more rapid economic growth in the future; where new companies are established, there is an increase in the value of investments and size of employment in the field of high technologies⁶. By the combination of social dynamics with the dynamics created by the development of new technologies, technology entrepreneurship provides a new look at economic development, particularly the enterprises of high technologies⁷.

Nowadays, the attention is drawn to a radical change in the world of innovation. This change is the result of three phenomena observed in the business world:

- the first one results from the increasing ease of creating innovation and increasingly lower cost of carrying out such works; start-ups face similar pressure from capital markets, expecting a quick return of the invested funds, which hampers innovation in large enterprises,
- another one is associated with the tendency of large enterprises to follow the example of start-ups and implement open innovation and less hierarchical management models, and also the tendency to expand the capabilities of enterprises to talents stimulating entrepreneurship,
- the third one is related to the observed trend of emergence of innovation which does not refer to product or services (as in the past) but business models using strengths of large corporations⁸.

Up to the present, in the history of mankind, there have been identified four eras of innovation. The protagonist of the first one was a solitary inventor. Most of the breakthrough innovation arising prior to 1915 was associated with specific individuals. An example is Gutenberg's printing press, Whitney's cotton gin, Edison's light bulb, the Wright brothers' plane or Ford's technology and business model. The protagonists of the second innovation era worked in company laboratories; enterprises began to create innovations rather than just exploit them. The examples of inventions of that period, among others, were: the molecules of the Du Pont concern, personal care products and household chemicals by Crest, Pampers and Tide by Procter & Gamble, or the U-2 spy aircraft and the SR-71 Blackbird fighter. In the conditions of vast bureaucracy, complex hierarchical organizational structures, inventors

⁵ Lachiewicz S., Matejun M.: The Role of External Environment in Creating Technology Entrepreneurship in Small and Medium-Sized Enterprises. „Management”, Vol. 14, No. 1, 2010, p. 187-188.

⁶ Lachiewicz S., Matejun M., Walecka A.: Przedsiębiorczość technologiczna w małych i średnich firmach. Czynniki rozwoju. WNT, Warszawa 2013, p. 14-15.

⁷ Kordel P.: Przedsiębiorczość technologiczna jako mechanizm rozwoju strategicznego organizacji, Prace Naukowe. Uniwersytet Ekonomiczny, Wrocław 2014, p. 20.

⁸ Antrony S.D.: Nowa era innowacji. Gdzie się rodzą najbardziej innowacyjne i zmieniające świat pomysły. Harvard Business Review Polska, July-August 2015, p. 124.

began to leave enterprises and set up new companies, which amounted to entering the third innovation era in the fifties and sixties. Start-ups supported new sources of financing – venture capital. During this period there were established: Apple, Microsoft, Cisco Systems, Amazon, Facebook and Google. It is assessed that, at present, we are entering the fourth innovation era. Their protagonists are catalysts, entrepreneurial people working in large companies. They use the resources of these organizations, their range of activity and increasing agility to solve global problems in a way exceeding the possibilities of other organizations. Catalysts, using the global infrastructure of corporations, work on solving global problems. An example of the fourth innovation era is the program ‘Healthy Heart for All’, in the framework of which the Medtronic company reaches the residents of rural areas of India with pacemakers and raises funds for financing medical treatment⁹.

2. Minimum viable innovation system in technology entrepreneurship of enterprises

The minimum viable product was borrowed from lean start-ups and it is the functional prototype, limited to rudimentary characteristics, used as a starting point for development of a new offer. It can be used for increasing abilities to innovate; it is an activity between ad hoc entrepreneurship and creating an extensive and large-scale factory of innovation and entrepreneurship. The concept of “minimum viable innovation system” (MVIS) amounts to indicating essential basic components which allow enterprises to begin work on a reliable, strategically oriented function of innovation. Moreover, MVIS ensures that good ideas will be expected, recognized, promoted, evaluated, hierarchized, financially and HR supported, refined, awarded and celebrated by enterprises. It is also underlined that this system will require neither years of preparatory work nor fundamental changes in the way of enterprise management. MVIS includes four steps that go in no more than three months on the basis of the existing staff and at low cost (see Fig.1).

⁹ Ibidem, p. 124-126.

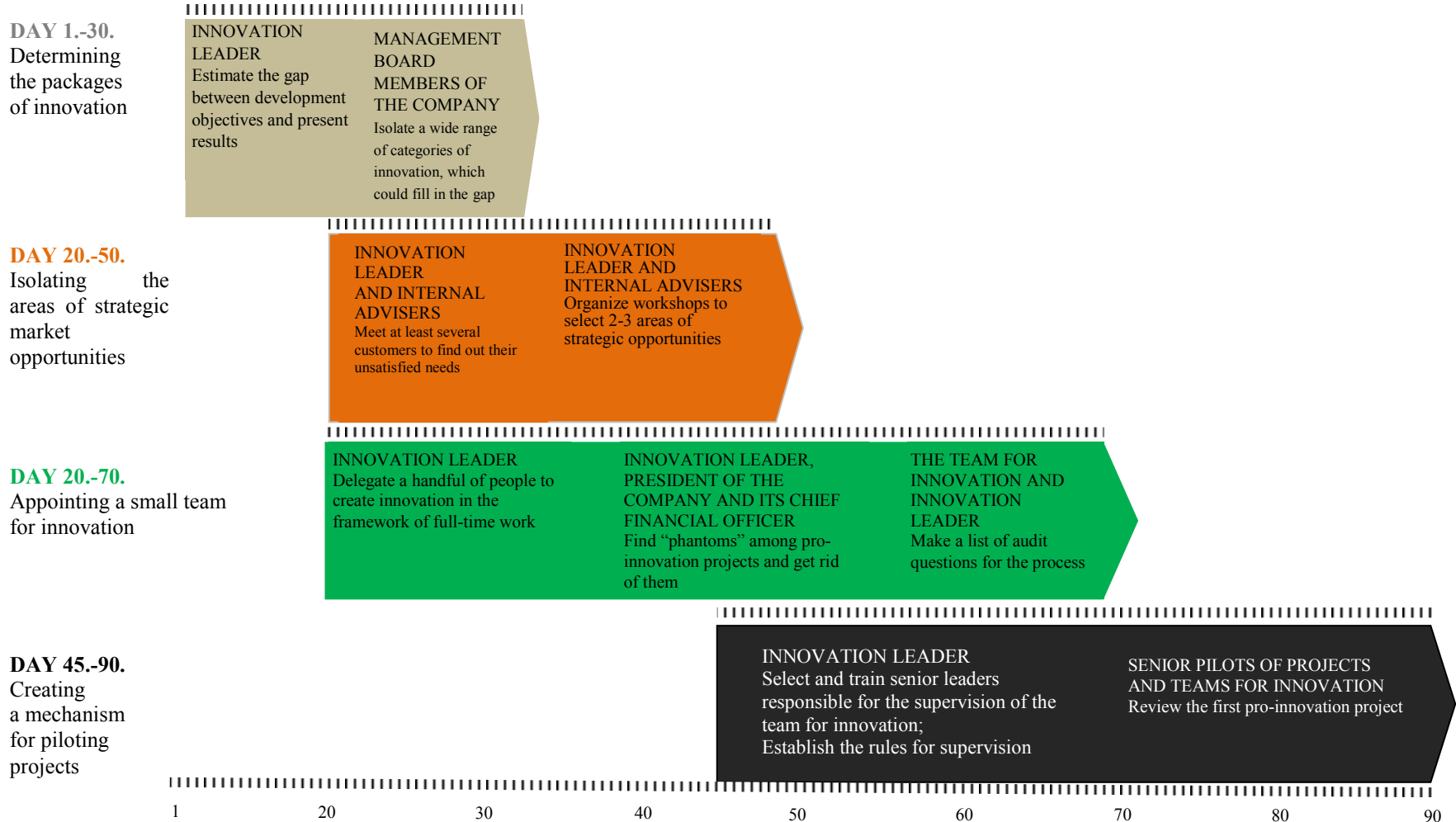


Fig. 1. Monitoring innovation through MVIS system
Rys. 1. Monitoring innowacji przez system MVIS

The MVIS monitoring procedure adapted to the needs of technology entrepreneurship was subjected to verification among the managers of enterprises of the metal industry. The author conducted the survey in the period of January-February 2016. The research was addressed to the managers of small and medium enterprises of the metal industry conducting their business activity in the area of the Silesian Voivodeship. 27 people took part in the research. There were 82% male respondents and 18 % female ones. The most numerous group of respondents was the group of people aged 30-40 - 65% of those questioned. 14% were people aged 20-30, 12 % were respondents aged 40-55; respondents aged 55 and more amounted to 18%. With reference to ownership, among the surveyed enterprises the most numerous group – 92% – were private enterprises owned by domestic companies. Generally, in the whole research group, 43% of enterprises conducted their activity locally and regionally, 32% nationally and 25% internationally and globally.

Table 1

Assessment of the occurrence of specific areas for monitoring the minimum viable innovation system of technology entrepreneurship in enterprises of the metal industry of the Silesian Voivodeship

No.	Specification	share (in %)		
		Yes	No	I don't know
1.	Are there established the packages of measures in the field of technology entrepreneurship	30	50	20
2.	Is there a need for the isolation of strategic market opportunities	80	15	5
3.	Is there a team for planning and developing activities in the field of technology entrepreneurship	30	20	50
4.	Is there a mechanism for monitoring activities in the field of technology entrepreneurship	10	80	10
5.	Can you see the usefulness of the implementation of the monitoring system of technology entrepreneurship in your enterprise	60	20	20

Source: Author's own study based on the conducted research.

The conducted research indicates that the specific areas related to the discussed monitoring are present in the majority of the surveyed enterprises in the field of technology entrepreneurship. The managers see the need to isolate strategic market opportunities (80% of affirmative responses) and notice the usefulness of the application of the monitoring system for the improvement of economic and financial results (60 % of affirmative responses) in their enterprises. The respondents clearly indicated a lack of a team for planning and developing technology entrepreneurship and a lack of a mechanism for monitoring activities in this field (see Table 1).

3. Barriers to development of technology entrepreneurship of enterprises of the metal industry of the Silesian Voivodeship

Technology entrepreneurship of enterprises of the metal industry is the approach to entrepreneurship of knowledge and combines intellectual, academic entrepreneurship and the widely understood commercialization and transfer of technologies. It is combined with the entrepreneurship of owners, managers and employees implementing new technologies and the innovation accompanying them in the field of their application and distribution of their effects in the widely understood market environment¹⁰.

While making an attempt to analyze the constraints and barriers to technology entrepreneurship one should take into account numerous factors, both in the external environment and the internal environment of enterprises.

In the conducted research, the managers determined the main barriers to technology entrepreneurship which, in their opinion, hinder and inhibit technology entrepreneurship in enterprises. The respondents could make only three indications.

In the whole research sample, the most important barriers proved to be: a lack of information on new research results which could be applied in the form of product or process innovation (72%), lack of inflow of new technological solutions from research centers (60%), high risk of failure in the field of technology entrepreneurship preventing from performing research and development activities (45%) and lack of knowledge of business realities among scientists (43%). The respondents also indicated (43% of indications) the reduction in research and development activities due to the lack of qualified staff to carry them out.

The barriers to technology entrepreneurship, most frequently indicated by the managers, mostly come from the external environment of enterprises. They are associated with the complexity of procedures, changeability of provisions and ordinances in the field of technology entrepreneurship. In enterprises of the metal industry, these barriers are implied by the pace of technological changes. Facing the shortening life cycles of products and technologies, 42% of the respondents indicate that their activity is based on purchased licenses.

¹⁰ Kozłowski R.: Dynamika i potencjał otoczenia przedsiębiorstw w procesie rozwoju przedsiębiorczości technologicznej. „Gospodarka Materiałowa i Logistyka”, No. 11, 2011, p. 36-38.



Fig. 2. The most important barriers to technology entrepreneurship in the opinion of the managers of enterprises of the metal industry in the Silesian Voivodeship (%)

Rys. 2. Najważniejsze bariery technologicznej przedsiębiorczości w opinii menedżerów przedsiębiorstw z branży metalowej w województwie śląskim (%)

Source: Author's own study.

Conclusions

Technology entrepreneurship is strongly conditioned by the environment of enterprises, the entities which support and develop efficient commercialization of new technological solutions. In the light of the conducted research, it can be concluded that the lack of information flow concerning new research results and lack of inflow of new technological solutions from research centers are main factors adversely affecting the development of technology entrepreneurship. The internal environment of enterprises also plays an important role, particularly including: a lack of qualified staff to carry it out, both at the level of leaders and executors, and the fear of the risk of failure in the field of technology entrepreneurship, which prevents from engaging in research and development activities. Creating new development activities of technology entrepreneurship requires the appointment of teams responsible for their new growth and management¹¹. In the light of the conducted pilot study, it seems that the implementation of a minimum viable innovation system could efficiently

¹¹ Anthony S.D., Johnson M.W., Sinfield J.V., Altman E.J.: Przez innowacje do wzrostu. Jak przeprowadzić innowację przełomową. Oficyna a Wolters Kluwer business, Warszawa 2010, p. 217-223.

make a contribution in the processes of reducing or even removing the barriers to technology entrepreneurship. Moreover, the system approved by the surveyed managers could support the development of the model of open innovation, directed outside the area of activities of their own business¹². It is necessary to conduct further research explaining to what extent the management of technology entrepreneurship, supported by the minimum viable innovation system, may contribute to market success.

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¹² Wiśniewska J., Janasz K.: *Innowacje i procesy transferu technologii w strategicznym zarządzaniu organizacjami*. Difin, Warszawa 2015, p. 150-156; Roszowska-Menkes M.: *Otwarte innowacje: w poszukiwaniu równowagi*. Szkoła Główna Handlowa, Warszawa 2015, p. 113-136; Pathak S., Xavier-Oliveira E., Laplume A.O.: *Influence of intellectual property, foreign investment and technological adoption on technology entrepreneurship*. Elsevier, “Journal of Business Research”, No. 66, 2013, p. 2090-2101.

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