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RISK IN TECHNOLOGY ENTREPRENEURSHIP DEVELOPMENT

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The aim of this article is to show risk as an essential factor that plays an important role in the development of technology entrepreneurship. Risk is both an opportunity and a threat in building a high market position. The great challenge for entrepreneurs is how to use the technology chance for the creation of competitive advantage in the global market. Moreover, this article presents the results of research about the barriers to academic entrepreneurship in Poland, which is one the main domains of technology entrepreneurship.

Keywords: risk, technology entrepreneurship

1. INTRODUCTION

Business activity, particularly that of an innovative nature is unavoidably connected with risk. Currently, in spite of an apparently greater access to information, enterprise management is also conducted under conditions of heightened uncertainty. Risk and uncertainty have a different meaning. Risk means possibility the appearance of unfavourable occurrences, which can cause the tasks performing difficult or even impossible. Uncertainty means the situation, when we do not have enough information or we feel a lack of knowledge. The more innovative an undertaking, the higher its risk, i.e. the higher the probability of the occurrence of undesirable events that may hinder or prevent its implementation.

The purpose of the present paper is to present risk as a factor in the decision-making process that can constitute a barrier in technical entrepreneurship development but may also present an opportunity to achieve spectacular market success.

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Risk is a great challenge that entrepreneurs are unable to avoid. They cannot allow themselves to adopt defensive strategies that are – to a much greater extent than offensive strategies – are geared toward risk avoidance. Paradoxically, such actions may prove the most dangerous. This is especially true in the case of enterprises operating in the advanced technology sector. Enterprises that have missed the moment when technology change was necessary have paid a high price, either losing their leading positions or disappearing from the market altogether, the most spectacular example of which was Polaroid.

2. RISK IN ENTREPRENEURIAL ACTIVITY

There are two attitudes toward risk in enterprise theory and practice. The first focuses exclusively on risk's negative impact as a destructive factor. The other emphasises the positive aspects of risk, seen as an opportunity to achieve benefits that may generate above-average added value (Lachiewicz i in., 2013, p. 18). At present, the second approach is gaining more adherents. It is especially appropriate when dealing with technological entrepreneurship, understood as the utilisation of the opportunity created by the stimulation of new needs of which the customers are frequently not even aware.

The definitions of risk encountered in the literature are based on the above-mentioned attitudes and emphasise the inseparable connection between entrepreneurship and risk. According to Józef Penc (2008, p. 859) "Entrepreneurship is a search for change, a desire to attain new goals – that which, although unknown, is attainable. Change is always associated with a certain degree of risk but without it, there can be no efficiency improvements or progress. All new development systems are burdened by the risk caused by uncertainty." Table 1 presents a comparison of selected definitions of risk and its interpretations.

Table 1. Risk in entrepreneurial activity. A review of selected definitions and their interpretation (own study)

No.	Authors	Definition and concepts	Interpretation and comments
1.	(Penc, 2008, p. 839)	Managerial risk is a permanent element of the activity of every entrepreneur. Risk evaluation and management contribute to the achievement of objectives but there are no infallible methods that could guarantee the elimination of risk	In this perspective, the author points out the inevitability of entrepreneur's confronting risk. However, he emphasises the importance of risk as presenting an opportunity to achieve organisational objectives

Table 1 continue

2.	(Kaczmarek, 2001, p. 26)	Risk is the possibility of the occurrence of failure and in particular, of events beyond the control of an organisation which can neither foresee them precisely nor prevent them completely	In this perspective, the author points out the negative role of risk and the inability of foreseeing negative events
3.	(Latusek (ed.), 2004, p. 769)	Risk is characteristic of any undertaking whose final outcome is unpredictable or unknown	The authors point to the uncertain effects of this type of activity
4.	(Podlewski, 2009, p. 13)	Risk is a concept that describes a decision-maker's choice between at least two decision-making options the probability of which is be either impossible to determine or is defined with a certain probability. Risk may carry either a positive prospect – the decision-maker attaining benefits or a negative one – that of a loss.	The author emphasise the role of risk both as an opportunity to attain benefits and a threat of suffering a loss.
5.	Cambridge Business English Dictionary (2011, p. 735)	In finance and investment, risk is the possibility of financial loss, which cannot usually be avoided if there is also to be the possibility of financial gain.	Different types of risk are: Credit risk – the possibility that money that has been borrowed will not be paid back. Liquidity risk – the possibility of running out of money. Market risk – the possibility that prices will fall on the financial markets or that some prices will rise in a way that does not benefit you. Operational risk – that relates to the way that a company operates generally and whether it is successful or not.

The above definitions indicate two alternative although not mutually exclusive approaches to the issue. Another element important in taking on risk is the correct attitude of the person making the decision. K. Jajuga (2007, p. 14) distinguishes three characteristic attitudes of decision-makers:

- risk aversion – a decision-maker takes on risk only when expecting compensation in the form of a risk premium;
- risk neutrality – the extent of the risk is of no significance in decision-making;
- willingness to take risks - the decision-maker is willing to incur additional expenses in order to take a decision with a higher level of risk.

The risk associated with economic – and particularly innovative – activity has increased significantly with the last decades, starting in the 1970s. It was at this

time there was a strong development of the theory and the separation of risk management as a very important element of the theory and practice of business management.

K. Jajuga defines enterprise risk management as “making decisions and taking actions in order to achieve the acceptable risk level” (2007, p. 15). It is the term “acceptable risk level” that is of key significance. Risk management involves several phases:

1. Risk identification (definition of the types of risk to which the organisation is liable).
2. Risk measurement (expression of the level of risk in numerical terms).
3. Risk control (measures to adjust the level of risk to an acceptable level, based on the strategy).
4. Risk monitoring and control (proving that risk management is a process and not a one-off undertaking).

In view of the above, it must be emphasised that risk management is an inseparable part of long-term enterprise management and should be tied to the enterprise’s strategy.

A key role in risk management is played by risk measurement. The very important and universal concept of corporate value, defined as the current value of future corporate cash flows.

$$P = \sum_{t=1}^{\infty} \frac{C_t}{(1+r)^t}$$

P – corporate value, C_t – cash flow in period t , r – discount rate.

Regarding measures of risk as such, there are two basic groups. The first (larger) one consists of measures that indicate the level of risk in a way that is objective and independent of the user. The measures in the second group are more subjective in character and depend on the specific characteristics of the organisation undertaking risk management. They are measures of specific decision-makers’ attitude toward risk. Specific risk measurement method groups, such as risk measures based on the statistical distribution of the risk variable, concepts of measurement sensitivity, cases of multi-dimensional or extreme factor measurements will not be discussed further due to the limited length of the present paper.

The problem of risk in technology-based entrepreneurial activity is especially important in the case of small and medium enterprises (SMEs). Large enterprises, with greater resources, possess technology development planning methods implemented in their operations, this provides significant support to technological entrepreneurship and reduces the probability of failure of technological change. In the case of SMEs, which have limited resources, the risk of failure of technological change may determine the organisation’s future existence. It can thus be stated that

management of a small technology-based enterprise requires special abilities in the analysis and evaluation of risk in innovation activity. Such organisations can seek assistance from the numerous available publications that identify SME development barriers. Some of these publications, concerning the factors that hinder technological entrepreneurship in academic enterprises in Poland, are discussed in the present article.

3. DETERMINANTS OF TECHNOLOGY ENTREPRENEURSHIP AND THE RISK FACTOR

Technology entrepreneurship is one of the forms of broadly-defined intellectual entrepreneurship. It most frequently, though not exclusively, pertains to advanced-technology sector SMEs. It is a term that combines elements of academic entrepreneurship and technology management including technology transfer processes. Tony Bailetti defines technology entrepreneurship (2012, p. 9) “an investment in a project that assembles and deploys specialized individuals and heterogeneous assets that are intricately related to advances in scientific and technological knowledge for the purpose of creating and capturing value for a firm”. According to Wiesław Grudzewski and Irena Hejduk (2008, p. 80) “technological entrepreneurship is a necessary condition of an enterprise’s success”. Stefan Lachiewicz et al. (2013, p. 18) state that “technological entrepreneurship can be seen as a process combining elements of academic and intellectual entrepreneurship with the entrepreneurship of commercial business and business support organisations and the entrepreneurship of the owners, managers and employees implementing new technology and the associated innovations in the sense of the application and propagation of their effects in the market environment”.

Technology entrepreneurship is unique within the overall area of entrepreneurship research in that it emphasises technological innovation and its impact on utilising the opportunities that arise in the market. According to Piotr Kordel (2014, p. 20) “by combining a social dynamic with the dynamic created by new technology development, technology entrepreneurship gives a new perspective on the growth of the economy, and particularly the segment consisting of high-tech enterprises, usually referred to as the knowledge-based economy”. The author believes that the key to understanding and developing technology entrepreneurship is the creation and discovery of new opportunities in an organisation’s market environment which has direct implications in the form of actions taken by potential technological entrepreneurs (compare Chyba, 2015, p. 113).

The effectiveness and efficiency of technology entrepreneurship are determined by a number of factors, both external and internal. Of key importance for the organisation is its technology potential which consists not just of the full set of tech-

nologies at the organisation's disposal, i.e. its technology portfolio, but also its employees' creativity and their key technology competences which translate directly into the effectiveness of the enterprise's research and development activity. Fig. 1 presents the key determinants of technology entrepreneurship from the perspective of the role of the risk factor and its intensity.

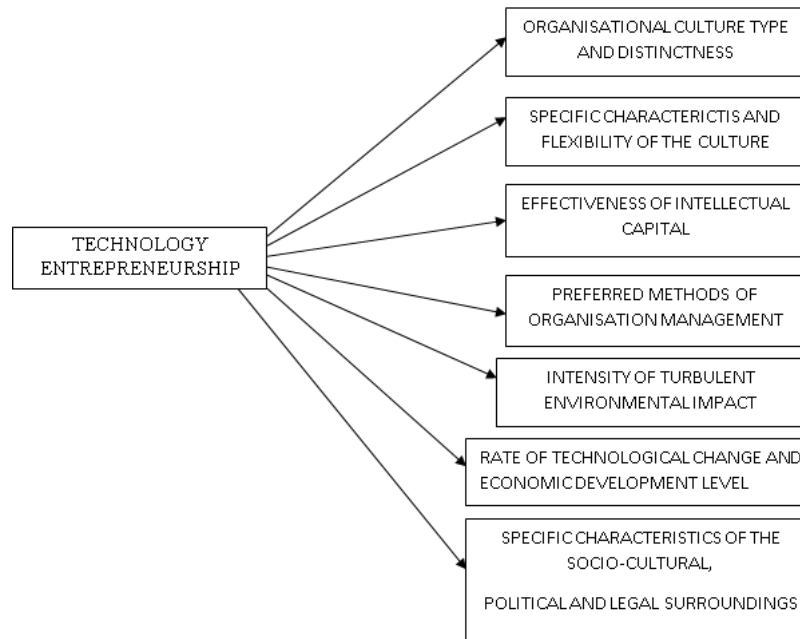


Fig. 1. Determinants of technology entrepreneurship (own materials based on Chyba, 2015, p. 113, see also Lachiewicz et al., 2013)

The first group of factors demonstrates the impact of the organisation's internal environment on shaping technological entrepreneurship. Every organisation builds its identity by establishing a specific organisational culture, growing out of the organisation's history and tradition and based on the common values shared and accepted by all the organisation's members. The organisational culture typology proposed by Deal and Kennedy allows for analysing the impact of culture on the perception of risk in technological entrepreneurship (see Masłyk-Musiał, 2011, pp. 64-65). A "gamblers' culture" promotes the undertaking of bold challenges in spite of the high level of risk, which is especially valuable in the context of new technological challenges. However, the lack of sufficient feedback from the market may undermine the opportunities brought about by the enterprise's aggressive strategy. From this perspective, a culture of individualists that allows for making fuller use of the creativity and innovativeness of individual organisation members with specific technology competences, may prove more effective. In organisations dominated by a "routine" and so-called cautious bureaucrats, reluctance to take on

challenges is the main factor that hinders creativity and technological entrepreneurship. In view of this, the most appropriate solution may be the so-called “balanced culture” model which combines risk-taking with obtaining the broadest-possible feedback from the market. The correct enterprise organisational culture type is combined with effective utilisation of intellectual capital which may be a key factor determining the ability to capture and retain a competitive market advantage.

The next two external determinants are also mutually related. The specific characteristics and flexibility of the organisational structure frequently go hand-in-hand with what methods of organisation management are preferred. A preference for flat organisational structures and a highly agile organisation able to react quickly to changes occurring in its surroundings are especially valuable characteristics of SMEs. It is also connected with an easier flow of bottom-up information and more democratic management methods such as management by objectives. Small and medium enterprises’ tendency and sometimes need to take risks does not always lead to innovation or competitive success due to their limited resources which also significantly hinders their technological entrepreneurship.

Regarding the external determinants of technological entrepreneurship, certain aspects of the surroundings (political and legal, socio-cultural) must, especially in the case of SMEs, be treated as a given. In order to function in a tempestuous environment, enterprises – especially those from the advanced-technology sector, which are taking part in a technology race and shortening product and service life-cycles – must be able to implement change quickly and possess a high level of organisational intelligence and agility, which are advantages possessed by small and medium enterprises. However, SMEs do not possess sufficient resources to make effective use of this advantage and that is why it is difficult for them to compete with large enterprises in innovation and technological entrepreneurship. If they achieve an advantage over big organisation, it is usually in specific niches in which big business is less interested.

Technological entrepreneurship is particularly sensitive to risk. At the same time, however, it can lead to a very significant increase in the enterprise’s value, and hence to a large increase in its competitiveness. Based on the above, it can be said that the relationship between risk and the determinants of technological entrepreneurship is an interplay of many factors, both objective limitations and opportunities in the surroundings and subjective attitudes of individual employees and entire organisations.

4. BARRIERS TO TECHNOLOGICAL ENTREPRENEURSHIP AS SEEN BY ACADEMIC ENTREPRENEURS

Technological entrepreneurship, a market phenomenon at the same time a complex multi-stage innovation process, encounters numerous barriers. These may be institutional limitations related to the not always favourable political and legal

and economic surroundings as well as mental barriers among innovating entrepreneurs. These are coupled with the ever rarer but still encountered instances of ostracism by the scientific community. This is the case with academic entrepreneurship, which is one of the main domains of technology entrepreneurship.

Presented below are results of research conducted as part of the statutory work at the Institute of Production Systems Engineering, Faculty of Production Engineering of the Warsaw University of Technology, concerning the conditions of formation and the dynamics of the development of academic enterprises in Poland (see Chyba, Marciniak, 2013). The research was updated in 2015 (compare Chyba, 2016).

The research allowed for identifying 65 academic enterprises, mainly spin-offs and enterprises – start-ups – in the incubation phase. Poland's academic enterprises are predominantly small or medium-sized advanced-technology companies. In terms of legal form, the group is dominated by commercial companies, mostly limited liability (a business structure especially appropriate for academic businesses at an early stage of development) and joint stock companies. The research was carried out through surveys, with more in-depth study taking the form of interviews with representatives of the enterprises' managements. 30 enterprises took active part in the research which was based on answers to 'cafeteria' type questionnaire. The surveys were supplemented by interviews with representatives of the analysed academic enterprises' managements. The selection of the research sample was deliberate. The study involved the entire population identified entities.

The research also made it possible to define the main barriers hindering the development of academic entrepreneurship in Poland. Many of the university enterprise representatives' statements were critical toward Polish academic circles as well as the national economic policy and the principles of awarding grants by the Ministry of Science and Higher Education. There were statements that the "principal barrier is the research funding system that promotes passiveness and an attitude of 'waiting for manna from Heaven'. In addition the system, instead of promoting those authors who successfully implement their achievements, favours writers whose works gather dust on the shelves" (see Chyba, Grudzewski, 2011, pp. 159-160). Although not all statements were negative, an attitude of pessimism was dominant. Table 2 presents the results of the interviews on the main barriers to the development of academic entrepreneurship in Poland conducted with representatives of university enterprise managements.

The highest number – over half – of the enterprises surveyed pointed to research workers' difficulties with adapting to market requirements. The second most-frequently given response was that research workers are unwilling to take the risk of establishing their own business enterprise. This answer was given by 12 respondents. This situation is due on the one hand to the differences in scientists' and entrepreneurs' predispositions and ways of thinking. It is difficult to find a person who possesses the traits of a scientist-inventor as well as those of an enterprising businessperson. This, however, is also a sign of an awareness of the high risk level of innovation activity, especially in the area of technologically-advanced products

and processes. This conforms the previously presented opinion that academic entrepreneurs perceive technological entrepreneurship mainly in terms of the risk of failure. Interestingly, many critical remarks were made by those academic entrepreneurs who had achieved the greatest market success.

Table 2. Barriers to academic entrepreneurship development in Poland vis-à-vis the importance of risk in technological entrepreneurship (N = 30) (own, based on surveys, see: Chyba, 2016, p. 73)

Response variant	Number of responses
Research workers' problems with adapting to market requirements	16
Research workers' reluctance to take the risk of establishing own business activity	12
Opinion that doing business is below a scientist's dignity	3
Other responses	5

The representatives of three enterprises expressed the opinion that many researchers believe that doing business is below a scientist's dignity. There was also one ironic comment that "in the opinion of 'real scientists,' nothing with any attributes of usefulness can be regarded as science or research work." Certain representatives of university enterprises stated that a barrier that obstructs academic entrepreneurship in Poland is "the current system of rewarding research and implementation successes". Another reason given was "the typical science career path, the obtaining of successive lifetime scientific titles and degrees the value of which remains unverified for decades." In scientific circles it is "fashionable to perform research that will astound the world but which is disconnected from the country's economic needs".

The analysis and evaluation demonstrate the seriousness of the barriers to the development of academic entrepreneurship in Poland. The results of economic recession or crisis can also be assumed to have played a role. In such a situation, we encounter a certain paradox. On the one hand, there is greater need for innovation (in the context of sustainable economic development, environmental and social aspects play a significant role) but on the other, a higher risk of failure discourages from undertaking projects with a high degree of uncertainty (Chyba, 2016, pp 72-74).

Academic enterprises are organisations that operate primarily in specialised market niches in which other, particularly larger, enterprises are frequently not interested. Thanks to this university enterprises can, based on commercialised unique technology knowledge, attain a fairly sustainable competitive advantage on the global market.

5. CONCLUSIONS

Risk is inherent in any business activity, especially one as innovative as the establishment and implementation of technological entrepreneurship. Modern management concepts emphasize the perception of risk in terms of market opportunity and feasibility of offensive strategy. It should naturally be remembered that there exists a possibility of failure which has been repeatedly experienced in the past by those inventors and entrepreneurs who introduced radical or breakthrough innovations. This is especially worth remembering today, when the surroundings of enterprises are more and more turbulent. Unfortunately, there are no universal and universally effective methods of minimising risk.

The theoretical considerations and empirical research conducted point to the following conclusions:

- an enterprise's organisational culture has a significant impact on its employee's entrepreneurial behaviour and efficient utilisation of intellectual capital,
- flexibility of organisational structures facilitates the utilisation of market opportunities and minimisation of risk, which promotes the development of technological entrepreneurship,
- the agility and flexibility of small and medium-sized enterprises may constitute an advantage for the technological entrepreneurship. However, in most cases they are unable to compete with larger enterprises, due mainly to their limited resources, mainly material and financial,
- barriers to academic entrepreneurship, one of the chief forms of technological entrepreneurship, are largely due to mental constraints manifested by, among others, aversion to risk,
- an opportunity for successful technological entrepreneurship in small and medium enterprises is operating in specialised market niches in which large enterprises are not always interested,
- in technological entrepreneurship, risk should be also perceived as a special market opportunity that can lead to a significant increase in the enterprise's value and competitiveness.

The above statements demonstrate the key importance of perceiving risk correctly in innovation activities in order to ensure effective technological entrepreneurship within an organisation. Technological entrepreneurship, activity which is innovative par excellence, requires that risk be perceived as a neutral factor, with special emphasis being placed in seeking out opportunities in the market environment. It is thus worthwhile to undertake efforts to make an organisation's employees aware that, while not ignoring the possibility of failure, they should perceive risk as an opportunity to more fully utilise the intellectual capital and other resources possessed by enterprises.

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RYZYKO W ROZWOJU PRZEDSIĘBIORCZOŚCI TECHNOLOGICZNEJ**Streszczenie**

Celem artykułu jest prezentacja ryzyka jako istotnego czynnika, które może utrudniać rozwój przedsiębiorczości technologicznej, a jednocześnie może stanowić szansę na osiągnięcie spektakularnego sukcesu rynkowego. Ryzyko jest zawsze wielkim wyzwaniem, od którego przedsiębiorcy nie mogą uciec. Ryzyko jest szczególnie istotne w odniesieniu do kreowania i rozwoju przedsiębiorczości technologicznej. W takim ujęciu jest ono postrzegane głównie jako możliwość wykorzystania szansy technologicznej. W artykule zostały przedstawione również wyniki badań, dotyczących barier rozwoju przedsiębiorczości aka-

demickiej w Polsce, która stanowi jeden z głównych przejawów przedsiębiorczości technologicznej.

Słowa kluczowe: ryzyko, przedsiębiorczość technologiczna