A NEW APPROACH TO IDENTIFY RISKS IN INNOVATIONS, BASED ON THEIR GRAPHIC TIME COMPARISONS

Milena KIROVA [a*]

[a] *University of Ruse, Bulgaria*

ABSTRACT

The complexity of the cause-effect relationship between events is giving rise to risks and their influence on the realizations of innovations. This creates the need to create a risk portfolio that would best justify the efforts and costs of exploring and managing them. This paper presents a new approach for developing such portfolio process. The essence of the procedure is the time comparison of the different risks factor graphs with these of the innovations development. For this purpose, selected S-curves are drawn, and in the same coordinate system are marked the positions of the risks in question – the moment of transition of one stage of the innovation development into another. Above this graph are drawn the graphs of the development of the individual risks, as the moments of their start coincides with the moment the innovation development, in which it can emerge. The decision whether a risk will be included or not in the portfolio is based on the comparison of the assessments of the magnitude, duration, degree of impact, and the ability to prevent and manage individual risks. Based on the estimates of these criteria, the portfolio consists of three to five risks. The presentation of the risk assessment through graphs compared by time, with those for the development of innovation, reveals the relationship between the studied risks and the innovations, and between each risks. The proposed approach is perspicious, easy to use and compatible with other methods, and can be sued for complementary or further development.

KEYWORDS: *innovation, risk, risk management, risks portfolio, S-curves.*

1. INTRODUCTION

In every production process and product distribution, there is a risk for its successful realization. For the innovation processes, compared to the conventional ones, the risk has higher degree of uncertainty, especially for completely new products, scientific novelties and such novelties with practical application. The saturation of the production and everyday life with new technology and products, which differ considerably from the natural phenomena and materials, the colossal scales of the conventional technologies and the not well studied side effects of some of them, elevate the risks considerations to the level of philosophical categories. According to Stanislav Lem, the main hopes for the future are related to new technologies and the main dangers and threats - by misusing them (Hristov, 2008). From this point of view, knowledge of the risks and the ability to manage becomes the most important technology of our civilization (Hristov, 2008).

There are many definitions of the nature of risk that do not have significant differences and can be summarized as "an estimated degree of uncertainty about the expected future results in the implementation of the strategy" (Behzadia et al., 2018; Grecu, 2015; Hurduzeu et al., 2014). Regarding innovation, the definition is "the risk is a chance for a favorable development or

* Corresponding author. E-mail address: mkirova@uni-ruse.bg

probability of loss" (Stoycheva & Antonova, 2018). Therefore, the need to know and manage the risk is definite. Responding to this need, methodologies have been developed to identify, assess and reduce the risk (Behzadia et al., 2018). In their development, they have become too far-reaching and wide-ranging, so some of them are difficult to implement or their application is limited to a narrow business area (Grote, 2012; Valdez Banda & Goerlandt, 2018).They all do not give unambiguous and categorical answers to the questions, is the risk acceptable, what are the possible losses from its acceptance, what are the ways to reduce the negative influence of the risk factors, when they will appear and and for how long time they will express their influence (Leva et al., 2017; Pasman et al., 2017).
The purpose of this paper is to present a new approach for developing a risk portfolio process.

2. THE NEED FOR RISK PORTFOLIO

The complexity of the cause-effect relationship between events is giving rise to risks and their potential degree of influence on the realization of innovations, the number of the risks that may arise and the limited resources for their reduction and management, require that certain risks be selected for research and control. This creates the need to draw up a portfolio of risks that would best justify the efforts and costs of exploring and managing them. This is also necessary because the study of only one risk is not sufficient to reduce the overall risk, and it is not sufficient to consider the individual risks in isolation without their interdependence, consisting in the possibility of developing a risk factor to unlock others (Papazov, 2015).

3. PROCEDURE FOR FORMULATION OF THE RISK PORTFOLIO

The range of risks that are included in this portfolio is determined based on the assessment of their significance for the realization of a given innovation. Methods are known to assess the significance and ranking of individual risks through expert judgment (Voronova, 2008). These assessments are also ambiguous and contain subjective elements.
With the same degree of precision, the significance and ranking of the risks and possible impacts on the innovations, can be determined by a new different approach offered in the current work. For this it is necessary to make a classification and a list of all possible risks. Numerous classifications and definitions of the types of risks are known (Kim & Yasuda 2018). Each has its significance in terms of the criteria and characteristics of the assessment. In this case, it is not necessary to adhere to any classification (Popescu et al., 2015).
The types of risks are considered according to their origin and source as external and internal to the company - the main approach in all classifications. In addition, possible risks to the whole lifecycle of innovation are considered - from the start of the idea through pre-production and marketing to the end of the market presence of the product.
The expert assessments about the ways of the development and the significance of the individual risks are presented graphically, with the periods and moments of their development being compared with those of the development of the innovation. The graphical representation contains the same dose of subjectivity and relativity as other ways of presenting the risk, but the accuracy and precision are sufficient to compare, select and rank the individual risks for compiling a portfolio.
The development of innovation is represented by S-curves. The graphical representation of the risks for clarity and convenience uses the same or ratio scales for all graphs. The graph output point is the maximum value of the assessed variable in absolute units, a percentage scale, or a scale from 0 to 1. Based on this value, the graphs are based on the estimated cause-effect relationship between risk factors and innovation over the whole considered period. In some specific cases, the graphs of the

different risks can be compiled based on a known quantitative assessment method (Behzadia et al., 2018).

The proposed approach is based on the use of S-curves of the main innovation indicators and the graphs of the different risks. They are compiled based on the preliminary studies that are made in every innovation - marketing, technology, technical, resource, infrastructure, environmental, general-economic and political. Their credibility is the same as any risk assessment, based on forecasts and probabilities.

Compared to other methods, the graphical representation of the different variables is not static at any given moment but represents the magnitude of its development for the entire period for which it will act, as well as the assessment of the magnitude and dynamics of its variation.

The choice of the S-curve as a function of a given variable and time is among those that most directly reflect the economic interest of the innovation: market presence (sales-time); cash receipts from sales - time; profit - time. It is possible to present two or more curves in the same coordinate system at the same time, which provides more analytical capabilities. Because these graphs are the basis for the proposed method of analysis, selection and portfolio risk ranking, those features of the S-curves, which have significance for the way they are used and the capabilities they provide, mainly for the relationship between the development of the risk under consideration and the development of innovation, will be considered further.

S-curves are compiled based on preliminary studies and planned parameters of innovation - size of capital, productivity, capacity of the company, cost, price, market saturation. They can be used to analyze and present the development of an innovation, predominantly to predict when its technology will reach its threshold (maturity) and when a risk of subversive technology will occur (Schilling, 2005). The company can determine whether the competition curve will intercept its own as well as at what point this can happen by drawing up the investment curve - presenting its own value-added technology and the industry's own dependencies or benchmarking competition as shown on Fig. 1. On this basis, by changing the steepness of the curve, i.e. by changing innovation indicators, it can avoid intersection of its curve with the competition one, which means avoiding the risk of losing leadership or shrinking market share.

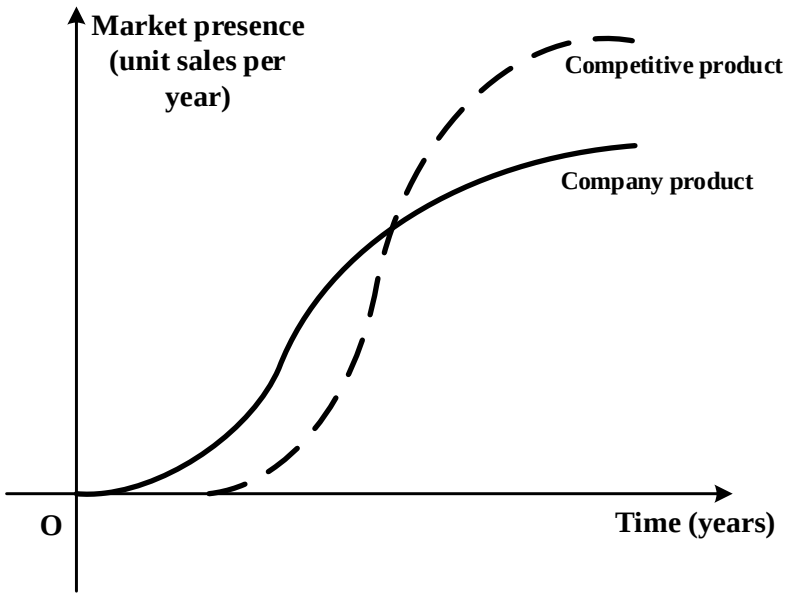

Figure. 1. Graphic representation of the risk of overtaking competing products
Source: adapted from Schilling (2005, p.44)

The S-curve of the technology diffusion, on which the innovation is based, can also be used to predict the risk of loss of leadership or the risk of shrinking of the company's market presence. At the same time, depending on this assessment, variants of the company's behavior regarding the dilemma being a leader or a follower, are considered, to reduce or avoid risk and providing a better economic result in the realization of innovation. Drawing up the curve "number of introducers – time" gives an idea of the possible saturation of the market and at the same time the risk of subversive technology by some of the competitors. Whether such an event will occur depends on competitors' level of knowledge, and its proper prediction depends on the analyst's awareness and experience.

The question of knowledge about a technology can have many sides. For example, the knowledge gained in acquiring an innovative product in each manufacturing process may be in sufficient quantity and degree, but its application to maximize productivity and efficiency is a matter of time and skill creation of the innovative product owner (Sitnikov & Bocean, 2015). This circumstance must necessarily be assessed in terms of the time required to achieve a satisfactory level of skill.

When compiling and using the S-curve graphs in relation to the manifestations and the development of risks, some features should be considered and approached with more caution. The first feature is that, as in all other ways for evaluation of the innovation development, the S-curves development cannot be forecasted. The real boundaries that will later occur are not known at the time of analysis. This would lead to discrepancies in the current assessment and the degree of impact of a risk factor assessed by different experts because the assessment is subjective. This disadvantage is compensated during monitoring the risks in the realization of innovation. More important is the fact that there is an opportunity to determine the possible relationship of a risk factor with innovation at a time and degree of impact and, from that point of view, to decide whether it will be part of the portfolio risks.

Another feature of the S-curves is that their shape is not constant. It varies depending on the impact of the various principal external factors and their single or aggregate changes. This means that analysts can compile the curves, considering certain circumstances, to determine the relationship of the changed curve to the other risks. For example, market changes may lead to shortening or prolonging the life cycle of a product, depending on the entry of substitute products earlier or later, or the end of the life cycle of the innovative product under consideration.

The analyst's role in properly assessing such developments is important and the accuracy of the assessments depends on the ability to use available industry information and the development of science in this area. This includes: advantages of innovative technology over existing ones and those emerging in an innovation-like stage; compliance of technology with the capabilities of the company and competitors; compliance with available networks and installed base; compliance with dominant design and degree of maturity; knowledge of the innovation firm to improve innovation; ability to implement proprietary subversion technology.

Each of these indicators is evaluated in a way chosen by the researcher and is used to draw the graphs reflecting the development of innovation and its associated risk factors over time. The essence of the procedure is the time comparison of the different risks factor graphs with these of the innovation development. For this purpose, the selected S-curves are drawn, and in the same coordinate system are marked the positions of the risks in question – the moment of transition of one stage of the innovation development into another (Fig 2).

Above this graph are drawn the graphs of the development of the individual risks, as the moments of their start coincides with the moment the innovation development, in which it can emerge. For example, the risk of shrinking market presence due to competition effects will most likely occur in the maturity stage or shortly before it. At the market introduction stage, the struggle is for leadership and the chance for a good market share is high (Herrmann et al., 2007).

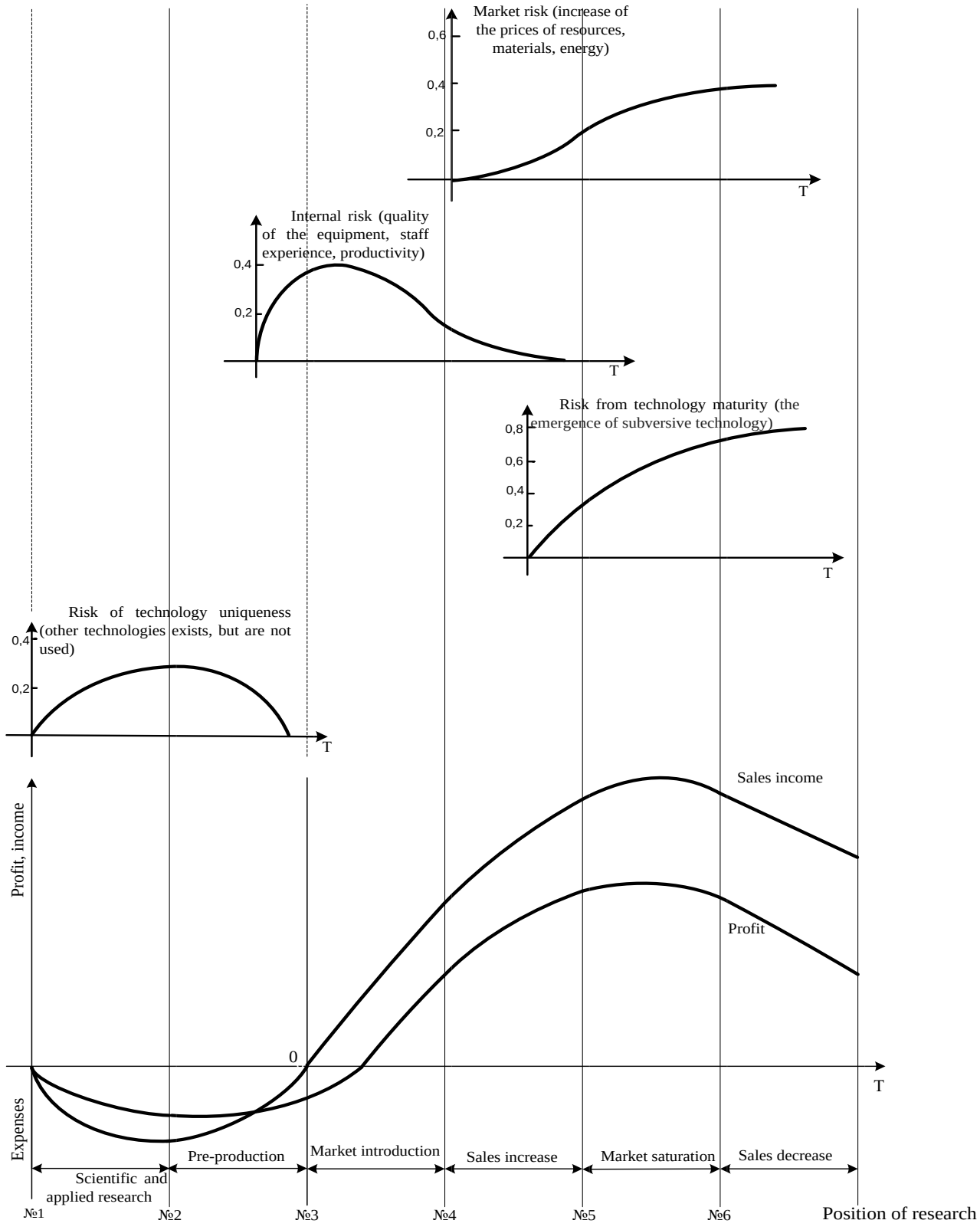

Figure. 2. Example of the graphical representation of the development of innovation and its accompanying risks

Source: author

The growth stage has high market potential, sales of all competitors are increasing, and their focus is on increasing profits. At the end of this stage, some of the competitors will take offensive marketing policy. At the maturity stage, the increase in market share is difficult, and the reduction is very likely, as already there are well-established leaders who will defend their position. The risk of shrinking market presence will occur around the beginning of the maturity stage.
The decision whether a risk will be included or not in the portfolio is based on the comparison of the assessments of the magnitude, duration, degree of impact, and the ability to prevent and manage individual risks. The portfolio composition depends on the moment of the innovation development, in which the procedure for the risk selection is going on. If the procedure is carried out at the beginning of the emergence of the idea of innovation (position 1 of the graph in Fig. 2), it is necessary to consider a greater number of risk factors for a longer future period and with high degree of uncertainty.
This leads to the higher complexity of the procedure and the need for in-depth research. It requires monitoring the risks in the process of innovation development. As progress progresses, some risks drop, new ones appear, others change their intensity - for example, positions 3 to 6 of the graph in Fig. 2.
Upon the occurrence of a new position, a portfolio risk update is made to maintain the risk management and mitigation measures more effective, and above all to be up to date to the new moment and subsequent periods. The quality of the assessment is improved by the accumulated experience, the information gathered and the reduction of uncertainties due to the shortening of time distances to the projected end of the innovation life cycle of the consumer.

4. CRITERIA FOR COMPOSITION OF THE RISK PORTFOLIO

The main feature that determines the portfolio composition is its importance for the development of innovation. The primary criterion of significance is the maximum value of the risk defined for each of the list of risk factors. The risk threshold for entry into portfolio composition is determined by the prevailing levels in the estimates of the individual factors. If the graphs yield four estimates of 0.6, two estimates of 0.7 and three estimates of 0.35, a threshold of 0.6 is selected.
The second criterion is the assessment of the possible period of influence of the individual factors. The longer a factor has been assessed for a longer period of impact, the greater the significance. With equal other estimates, this factor has the advantage of entering the risk portfolio. The probability of occurrence of the risky event also determines its significance. It is defined by known methodologies, most often based on statistical data of frequency and intensity.
The magnitude of the damage from the impact of the risk factor is also assessed.
Based on the estimates of these criteria, the portfolio consists of three to five risks. In the case of close estimates of more individual risks, they are reassessed using some of the known risk-sizing methods until the acceptable portfolio of the risk portfolios is determined.

5. CONCLUSIONS

(a) The proposed approach is developed based on well-researched and used methods for risk ranking during implementation of innovative projects, combining them in a new approach to their consideration by matching the development of innovation.
(b) The graphical depiction of the development of the innovation and its accompanying risks are presented not as static dimensions but as processes with a time development that provides better opportunities for properly selecting the risks of portfolio formation.

(c) The presentation of the risk assessment through graphs, compared by time with those for the development of innovation, reveals the cause-effect relationship links between the studied risk with the innovation and between each risk. This demonstrates the possibility of a complex impact of risks, their interrelationships and conditions, which is a prerequisite for a proper portfolio of risks.
(d) The proposed approach for creating risk portfolios is perspicuous, easy to use, and present the information in concentrated form. In addition, changes can easily be made if they are needed during monitoring.
(e) The proposed approach is compatible with other well-known and well-developed methodologies for assessment, ranking and risk selection for research and management and can be used for complementarity and further development.

ACKNOWLEDGMENT

This paper is an output of the science project 2018 - (FBM) - (01) "Applications of the co-management tools to achieve sustainable development", funded by the Research Fund of University of Ruse "Angel Kanchev", Bulgaria.

REFERENCES

Behzadia, G., O'Sullivan, M., Olsen, T., Zhang, A. (2018). Agribusiness supply chain risk management: A review of quantitative decision models. *Omega, 79*, 21-42.

Grecu, V. (2015). Operational risk issues encountered by insurance companies. *Proceedings of the 9th International Management Conference: Management and innovation for competitive advantage.* Bucharest, Romania, 169-174.

Grote, G. (2012). Safety management in different high-risk domains – All the same? *Safety Science, 50*(10), 1983-1992.

Herrmann, A., Gassmann, O., Eisert, U. (2007). An empirical study of the antecedents for radical product innovations and capabilities for transformation. *Journal of Engineering and Technology Management, 24*(1-2), 92-120.

Hristov, P., Nenova, A. (2008). The terms "disclosure" and "identification" in the context of improvement of the concept of apparatus in the theory of risk and safety. *Scientific papers of the University of Rousse, 47*(1.2), 128-132.

Hurduzeu, G., Huidumac, C., Hurduzeu, R. (2014). The most important agriculture risk. The risk culture. *Proceedings of the 8th International Management Conference: Management challenges for sustainable development.* Bucharest, Romania, 413-418.

Kim, H., Yasuda, Y. (2018). Business risk disclosure and firm risk: Evidence from Japan. *Research in International Business and Finance,* 45, 413-426.

Leva, M., Balfe, N., McAleer, B., Rocke, M. (2017). Risk registers: Structuring data collection to develop risk intelligence. *Safety Science, 100*(B), 143-156.

Papazov, E., Mihaylova, L. (2015). Approaches to Strategy - Driven Sectoral Competition Analysis of Business Organizations. *Perspectives of Business and Entrepreneurship Development (Selected Papaers).* Brno, Czech Republic, 80-89.

Pasman, H., Rogers, W., Mannan, M. (2017). Risk assessment: What is it worth? Shall we just do away with it, or can it do a better job? *Safety Science, 99*(B), 140-155.

Popescu, I., Barbu, C., Popescu, M. (2015). Identity and access management - a risk-based approach. *Proceedings of the 9th International Management Conference: Management and innovation for competitive advantage.* Bucharest, Romania, 572-580.

Schilling, M. (2005). *Strategic Management of Technological innovation*. Boston, McGraw-Hill.

Sitnikov, C., Bocean, C. (2015). The role of risk management in ISO 9001: 2015. *Proceedings of the 9th International Management Conference: Management and innovation for competitive advantage.* Bucharest, Romania, 1009-1016.

Stoycheva, B., Antonova, D. (2018). Investigating factor interactions in formalising the process of developing new products. *Serbian Journal of Management, 13* (1), 173 – 185.

Valdez Banda, O., Goerlandt, F. (2018). A STAMP-based approach for designing maritime safety management systems. *Safety Science, 109*, 109-129.

Voronova, I. (2008). Methods of analysis and estimation of risks at the enterprises of non-financial sphere of Latvia. *Journal of Business Economics and Management, 9* (4), 319-326.