



Research Article

Evaluation of Methods Used to Study the Impact of Innovation on Enterprise Value

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Abstract

The main goal of the paper is to critically review the concepts of studying the impact of the implementation of innovation projects on the value of the company and their critical assessment, as well as to identify the conditions affecting the choice of an appropriate method for valuing innovation projects. The paper explains the specificity of innovation projects and then discusses trends in the methods used to study the impact of innovation on company value. It then critically compares three methods, namely the risk adjusted NPV method, the real options valuation method and the Venture Capital method. It also reviews the leading studies on assessing the impact of innovation projects on enterprise value. Finally, conditions affecting the choice of valuation method for companies implementing innovative projects are identified.

Keywords: enterprise value, innovation projects, valuation method

Introduction

The value of a company consists of both tangible and intangible assets. In the conditions of knowledge-based economy and technological progress, intangible aspects, which are difficult to quantify, gain more and more importance. Intangible value generators are directly related to research and development activities.

This topic is of interest to academics and practitioners in accounting, finance and strategic management. The "new

generation" companies that use intangible assets and highly developed technologies in their activities obtain higher valuations compared to traditional companies that do not invest in innovative projects. The higher valuation of innovative entities is primarily due to their potential to gain competitive advantage and flexibly adapt to current market conditions, which often change in a turbulent environment. Therefore, it can be considered reasonable to state that intangible factors significantly determine the value of the company, in other words,

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the role of intangible aspects in relation to tangible ones is much greater.

The main goal of the paper is to critically review the concepts of studying the impact of the implementation of innovation projects on the value of the company and their critical assessment, as well as to identify the conditions affecting the choice of an appropriate method for valuing innovation projects.

The specifics of innovative projects

Research and development works (GUS, 2018), defined as creative work, are undertaken on a continuous basis in order to develop knowledge resources. The R&D area includes organizational units which conduct industrial research and development works resulting in a new product, new technology or service as well as a new organizational or marketing solution (Sosnowska, 2001, p.18).

Within the framework of scientific research, various concepts can be distinguished to divide the categories of research and development activities. For the purposes of management, the research conducted as part of R&D may be divided into the following types:

- incremental research, includes "small" R (basic research) and "big" D (development and implementation);
- radical research, includes "big" R and "big" D;
- fundamental research, includes "big" R and "small" D (Roussel et al., 1991, p.15).

According to the Technology readiness levels (TRL) model, developed by NASA, basic research, industrial research and development work are distinguished (Mankins, 1995, p.1). Fundamental research is defined as original, experimental, or theoretical research work whose purpose is to acquire new knowledge of fundamental phenomena and facts that are not necessarily applicable in practice (TRL I). The purpose of industrial research (TRL II-VI) is to acquire new knowledge and skills that will allow to create new products, processes and services or to introduce significant improvements to existing products, processes, services. Development works (TRL VII - IX) consist in acquiring, combining, shaping and using currently available knowledge and skills in the field of science and technology and business activities to develop and design new, changed or improved products, processes and services (NCBiR, 2016).

Research and development activities can be one of the main sources of innovation. This thesis is confirmed by the models of innovation creation presented in the literature, such as: the supply model of innovation and the demand model of innovation, the demand-supply model, integrated models and open innovation models (Wiśniewska, 2011, p. 101).

Based on the proposals of I. Schumpeter, further explanations of the essence of innovation were developed. Table 1 presents an overview of the definitions of innovation.

Table 1: Overview of innovation definitions

Author	Definition	Source
J.A. Allen	Innovation is the introduction of new products, processes or ways of doing things into widespread use.	J.A. Allen, <i>Scientific Innovation and Industrial Prosperity</i> , Longman, London 1966, p. 7.
K. Koziół	Innovation involves organizing production based on new ideas that serve the innovators' goals better than the old ones. There are two stages in it: the discovery of new knowledge that will increase the supply of goods and services, as well as the implementation of this knowledge into production processes.	K. Koziół, W. Janasz, <i>Determinanty działalności innowacyjnej przedsiębiorstw</i> , Wydawnictwo Uniwersytet Szczeciński, Szczecin 2007, p. 13.
E.M. Rogers	Innovation is an idea or object that is perceived as new by a person or other entity adopting.	E.M. Rogers, <i>Diffusion of Innovation</i> , Free Press, New York 2013, p.12.
P.R. Whitfield	A sequence of complex problem-solving activities; the result is a complex and elaborate novelty.	P.R. Whitfield, <i>Innowacje w przemyśle</i> , PWE, Warszawa 1979, p. 26.
S. Kuznets	Innovation is a new application of old or new knowledge to production processes initiating the application of an invention.	K. Koziół, W. Janasz, <i>Determinanty działalności innowacyjnej przedsiębiorstw</i> , Wydawnictwo Uniwersytet Szczeciński, Szczecin 2007, p. 13.
Ch. Freeman	Innovation is the first commercial introduction of a new product, process, system, device.	Ch. Freeman, <i>The Economist of Industrial Innovation</i> , F. Pinter, London 1982, p. 57.
L. Pasieczny, J. Więckowski	Innovation is a discovery resulting from the invention of people, causing progressive changes in certain states of affairs.	L. Pasieczny, J. Więckowski, <i>Ekonomika przedsiębiorstwa</i> , PWE, Warszawa 1981, p. 136.
A. Sosnowska	Innovations for modern company are: introduction of new products; implementation of new technologies, changes in production and distribution infrastructure; activities for better	A. Sosnowska, <i>Jak wdrażać innowacje technologiczne w firmie</i> , Wydawnictwo

Author	Definition	Source
	use of knowledge and skills coworkers, development internet network.	PARP, Warszawa 2005, p. 58.
B. Fiedor	Innovation is any change in the given characteristics of a production function.	B. Fiedor, <i>Teoria innowacji: krytyczna analiza współczesnych koncepcji niemarksistowskich</i> , PWN, Warszawa 1979, p. 31.
P.F. Drucker	Innovation is a specific tool of entrepreneurs by which changes lead to new economic activities or services. It is a specific tool of entrepreneurship, an activity that gives resources new opportunities for wealth creation.	P.F. Drucker, <i>Innowacja i przedsiębiorczość: praktyka i zasady</i> , PWE, Warszawa 1992, p. 29.
A. Pomykalski	Innovation is a process that includes all activities related to the creation of an idea, the creation of an invention, and then the implementation of a new improved product, process of organization of a service.	A. Pomykalski, <i>Zarządzanie innowacjami</i> , PWN, Warszawa 2001, p.17.
S. Marciniak	Innovations are creative changes in the social system, economic structure, technology and nature, i.e., all solutions to problems that change the current state of affairs, introduce novelty and have a creative character.	S. Marciniak, <i>Innowacje i rozwój gospodarczy</i> , Wydawnictwo KNSA PW, Warszawa 2000, p. 21.

Source: Authors' own elaboration based on the indicated references

Based on the definitions presented in Table 1, it can be concluded that the concept of innovation is considered in either a narrow or a very broad sense. Despite the differences, these definitions point to the common features of innovation, which include:

- an intentional beneficial change planned by a person;
- the change must have a practical application;
- first application;
- it may concern a product, service, manufacturing method;
- innovation accelerates technical progress and brings economic benefits;
- the requirement of a specific type of technical, economic, market knowledge resource (Baruk, 2006, p. 102).

On the basis of the above considerations, it has been assumed that the innovation project means a sequence of unique, complex and interrelated tasks with a common objective, intended to be used within a specified period of time, without exceeding the specified budget, in accordance with the assumed requirements, and the purpose of the project is to introduce a novelty on the market, which has so far been unknown and unused. The creation of innovation is a process whose final effect should be the implementation of a new solution. Therefore, the condition for recognizing a given project as an innovative project is its completion in such a way as to introduce a given solution on the market.

Trends in methods for studying the impact of innovation on enterprise value

The development of a knowledge-based economy, dynamically changing competitive environment and increased accessibility to financial capital result in the emergence of many new enterprises, are characterized by high innovation potential. Researchers are trying to develop methods to determine the impact of innovation on enterprise value. Research work is carried out in two main streams, which can be described by questions:

- how to assess whether a project planned for implementation is innovative?
- how to determine the impact of the implementation of an innovative project on the value of the company?

Table 2 presents methods for evaluating, ranking and selecting innovations and the commercialization potential of an innovation project. They are an attempt to answer the question posed in the first research stream, concerning the assessment of the degree of innovation of the project and to determine whether it should be implemented by the company.

Table 2: Classification of methods for evaluating, ranking and selecting innovations and the commercialization potential of an innovation project

Name of the method	Method characteristics
Hsu, Tzeng and Shyu's Model (2003)	<p>This model was developed for the purpose of selecting projects with high development potential for funding, assuming limited resources - financial means and the need to select the most promising projects from the point of view of national development. The authors of the model identified 21 project evaluation criteria.</p> <p>The authors of the model indicated 21 project evaluation criteria, i.e., market potential, growth potential, added value, connection with industry, potential benefits, innovativeness, possibility of technology development, availability of complementary assets, etc.</p> <p>The model does not indicate how to measure each criterion, which causes problems in the objective application of the model (Hsu et al., 2003, pp. 539-541).</p>
Jolly's model (2003)	<p>The model was based on technology assessment in 50 European and Chinese companies. The model consists of two main areas - technology attractiveness and technology competitiveness assessment. In the first area, the following aspects are evaluated: market potential, competitive situation, technical potential, social and political situation. In the second area, the following criteria are used: technological resources, complementary resources (Jolly, 2003, pp. 383-385).</p>
De Coster and Butler's Model (2005)	<p>This model was developed in the UK and is used to evaluate companies, but it is possible to apply it to innovative projects. In the model, the criteria cover the following areas: technological and business risk, level of product innovation, market criteria (meeting consumer needs, relating to the current situation on the market and fitting into its trends), product life cycle, entrepreneurial experience, protection of competitive advantage. The authors of the method indicated within each area how a given criterion should be evaluated along with the scale of points in</p>

Name of the method	Method characteristics
	each category. In the case of innovative undertakings, the model applies to projects consisting in the introduction of a new/improved product to the market (Coster Butler, 2005, pp. 534-540).
Chen, Chung and Wei's model (2006)	The model is used for technology assessment. The authors refer to previously conducted scientific studies. The criteria proposed by the researchers are: environment (user needs, stakeholder opinions, economic development, funding sources), organization (workforce, implementation costs), technology (technology characteristics, emissions). The method was developed based on the most frequently repeated criteria in other studies. The authors of the method did not indicate how to evaluate particular criteria (Chen et al., 2006, p. 439-441).
Łunarski's model (2009)	It is a Polish method that assumes the use of the following criteria for project selection: evaluation of technical, competitive and environmental aspects. The method is mainly dedicated to manufacturing technologies (Łunarski, 2009, pp. 130-131).
Lucheng, Xin and Wenuang's Model (2010)	The model is based on an assessment of industrialization potential that uses the following groups of criteria: technological factors, market factors, eligibility factors (infrastructure, human resources, financing), compatibility factors (with environmental protection, development plans, etc.), efficiency factors (job creation, saving natural resources, increasing quality of life). Environmental aspects are important in this model, making it an important influence on the development of sustainable development projects (Lucheng et al., 2010, pp. 77-80).
Shen, Lin and Tzeng's model (2011)	This model is an extension of the Hsu, Tzenga, and Shyu's model by assigning a way to evaluate each criterion (Shen et al., 2011, pp. 1468-1470).
The O-R-S method by Klicewicz and Manikowski (2013)	The model presented by K. Klicewicz and A. Manikowski is based on the evaluation of a given decision scenario. Groups of criteria were selected with regard to the decision scenario, i.e., investment in a new product, investment in a new technological process, organizational changes (Klicewicz, Manikowski, 2013).
Evaluation of the added value of an innovation according to Doblin consultants	<p>This method involves calculating an economic value factor, which is defined as the ratio of the additional economic value (increased revenues or reduced costs) associated with an innovation, relative to a reference value (an alternative product). Doblin consultants have defined 10 types of innovations:</p> <ul style="list-style-type: none"> • business model, • networking - a way to differentiate the offer from competitors, • enabling processes (having capabilities, skills that are acquired from others), • core processes (processes that add value), • product, • product environment, • customer service,

Name of the method	Method characteristics
	<ul style="list-style-type: none"> • distribution channel, • customer experience, • brand. <p>Each project should be evaluated by the above criteria according to the temperature of the idea and the heat index. On this basis, the potential for additional economic value is defined.</p>
Assessing the commercial potential of a technology or innovation according to IC Institute University of Texas in Austin	<p>The method to quickly assess an idea and its potential for commercialization is called Quick-look. By definition, it should take a maximum of 40 hours to answer the question of whether the idea is interesting and should be further explored. This is followed by an in-depth analysis. Quick-look method is based on the following four aspects:</p> <ul style="list-style-type: none"> • Identification of potential markets for the innovation project; • Identification of potential users (target group); • Obtaining expert opinions on the project and its feasibility; • SWOT analysis (acronym from: <i>Strengths, Weaknesses, Opportunities and Threats</i>) of the project - identification of opportunities and barriers of the project.

Source: Authors' own elaboration based on K. Klineciewicz, A. Manikowski, *Ocena, rankingowanie i selekcja technologii*, Wydawnictwo Naukowe Wydziału Zarządzania Uniwersytetu Warszawskiego, Warszawa 2013, s. 45–58, 124; E. Gwarda, *op. cit.*, pp. 93–105.

The main difficulty in applying the methods listed in Table 2 is the selection of individual evaluation criteria and the use of subjective knowledge of evaluators. Moreover, these models are not adjusted to the specificity of projects, i.e., the type of innovative project (process, product, organizational, marketing innovation) and the situational conditions of the industry in which they can be applied (Jajuga, 2011, p. 10).

A second important area in the analysis of the impact of innovation on enterprise value is research on the adaptability of traditional methods to innovative ventures. The following methods are discussed in the literature:

- 1) risk adjusted NPV (rNPV) method,
- 2) real options valuation method,
- 3) Venture Capital method.

Risk-adjusted NPV method

Researchers point to the rNPV (risk-adjusted NPV) method as one of the methods for valuing innovation projects -

risk-adjusted NPV (Žižlavský, 2014, p. 508). This method requires estimating the revenues, costs, risks, and timing of the cash flows involved within the project. According to the rNPV method, cash flows are estimated, which are then adjusted by the probability of their occurrence with respect to the project development process and the ability to generate cash flows (Bebel, 2015, p. 131).

Real Options Valuation Method

The real options valuation method can provide information on the profitability of R&D investments and also identifies the value of ongoing R+D work currently being carried out in the company (Wanicki, 2015, p. 256). Research and development projects are characterized by high uncertainty and lack of direct financial effects of their implementation. Therefore, classical models do not allow for an accurate estimation of the value (Janasz, 2014, p. 175). Research and development projects alone are not expected to bring financial benefits, only the effect of this work is expected to create investment

opportunities that will bring income. When preparing an analysis of the profitability of research and development work, one should take into account the entire process and all decisions related to it - the research phase, the implementation phase and the commercialization phase (Urbanek, 2008, pp. 200-201).

S. Myers (1984) was the first to state that the classical DCF model is not appropriate for the valuation of research and development projects, because it does not take into account the option value associated with the possibility of making different decisions within the framework of the project. On the other hand, T. Faulkner (1996) shows on the example of a decision tree why the option method is better than the classical DCF method. The option valuation method is more effective because of the long-term management efficiency.

Venture Capital Method

The method was developed by institutional investors who commit financial resources to higher risk ventures. This method examines the value of a company from the point of view of post money and pre money values. The method assumes that first the so-called post money value is estimated, i.e., the value of the company in a few years (the moment of the institutional investor's exit from the investment). In this phase, a financial model is prepared on the basis of a properly defined value carrier (number of users, etc.). Post money value is calculated as a quotient of the forecast result at the end of period n of the planned capital allocation and the required rate of return, increased by unity and raised to a power equal to the period of capital employed. Then, the value of pre money is calculated as the difference between the post money value and the initial capital employed (Rogoziński, 2011, pp. 16-17).

The presented trends in studies on the assessment of the impact of innovative projects on the value of the company indicate an increasing role of innovative projects in the process of creating value. There is a change in the methods traditionally used and new varieties of these

models appear, taking into account the specifics of innovative projects. However, due to the complex nature of innovation projects, the application of these models is complicated, additionally burdened with high uncertainty due to the subjective evaluation of projects, as well as the turbulent environment (Szczepankowski, 2013, p.153).

A Review of Empirical Studies on The Evaluation of The Impact Of The Implementation Of Innovation Projects On The Value Of The Company

The importance of competitive advantage in recent years is one of the most important factors shaping the value of the company. One of the ways to achieve competitive advantage is to carry out research and development work aimed at developing new or improved products and technologies. The trend associated with innovation and its impact on enterprise value management has led researchers to take an interest in this research area. The main research questions can be defined as follows:

- 1) How does innovation affect the value of a company?
- 2) How to effectively finance research and development projects?
- 3) How to create enterprise value through innovative projects?
- 4) Does an innovative project have the same value for each enterprise?

In order to answer the questions posed above, a critical literature review was conducted.

The first step was to define the keywords that were used to review the database. The following keywords were selected: *value creation, innovation, R&D, value chain, crowdfunding, impact innovation on performance, real option, R&D project*

valuation.¹ As a result of searching electronic databases (EBSCO, BazEkon, Lower Silesia Digital Library), more than one hundred records were obtained, but after reviewing their content, seven publications describing the conducted

considerations on the initially formulated research questions were specified. Table 3 presents the results of the analysis of publications, including the subject of research, research methods and key conclusions.

Table 3: Overview of leading studies on assessing the impact of innovation project implementation on enterprise value

Subject of research	Research methods	Key conclusions
Dirk Czarnitzki, Cindy Lopes-Bento, <i>Value for Money? New Microeconomic Evidence on Public R&D Grants in Flanders</i> , "Research Policy" 2013, 42, 76– 89.		
Effect of government subsidies on commercial R&D projects	After an initial assessment of the impact of government subsidies on investment and employment in R&D, the authors also analyze the occurrence of funds from other sources raised by the firm, the number of supported projects in the firm and the number of consecutive projects. The analysis results in an assessment of the impact of government grants on R&D employment from a macroeconomic perspective.	The effects of providing public funds in the form of a grant do not change over time. Receiving grants from other sources does not increase their effectiveness. Receiving more grants proportionally increases the scale of effects of implemented R&D projects. The research carried out shows that in the Flemish economy, R&D grants create on average 5 new jobs.
Maria Fedele, <i>Firm Value Creation and Viability Between Product and Process Innovation</i> , "African Journal of Hospitality, Tourism and Leisure" 2014, Vol. 3(2), s. 1–10.		
Product and process innovation in the process of creating value - gaining competitive advantage	A qualitative methodology based on secondary data	This paper discusses the importance of innovation and the impact of technology on a company's position in the market. With the help of various projects concerning the development and planning of new products, a company can gain a competitive advantage. With the use of innovation, it is possible to develop new products/services, increase product quality and reduce

¹ Keyword selection was based on specific research questions.

Subject of research	Research methods	Key conclusions
		production costs. It is also important to have cooperation between public research centers and companies to carry out research and development projects.
Cristina Sousa and Mónica Azevedo, <i>The Impact of Crowdfunding on Entrepreneurial Value Creation: Differences Between Social, Cultural and Commercial-Oriented Projects</i> , Conference: 13 th European Conference on Innovation and Entrepreneurship ECIE, Portugal.		
Impact of crowdfunding on the development of innovative projects related to the creation of corporate value in Portugal.	An empirical study of the oldest crowdfunding platform in Portugal and an in-depth analysis of successful development projects from the platform's foundation until December 31, 2016.	Crowdfunding is a new and alternative form of financing innovative ventures (mainly start-ups). Projects that have successfully completed fundraising are related to culture and development of society. Successful commercial projects manage to raise more funds than the minimum specified as the purpose of the collection.
Iztok Palcic, Robert Ojstersek, Borut Buchmeister, <i>Creating Value in Manufacturing Companies</i> , 29 th DAAAM International Symposium, s. 70–75.		
Value-added activities in Slovenian manufacturing companies.	A comparative analysis of manufacturing companies and their outsourcing decisions in R&D, manufacturing, and assembly	Product quality is one of the most important factors to compete in the market. A survey of manufacturing companies found that companies with R&D departments have a greater ability to develop innovative products. Additionally, they have better qualified employees.
Graca Mirada Silva, Chris Styles, Luis Filipe Lages, <i>Breakthrough Innovation in International Business: The Impact of Tech-Innovation and Market-Innovation on Performance</i> , "International Business Review" 2017, 26, s. 391–404.		
Impact of modern technologies and market innovation on economic and strategic performance in exports.	Analysis of data from Portuguese manufacturing companies (exports)	Technological innovations have a positive impact on company growth. Key factors for creating company value include international markets, i.e., the ability to export products/services outside the domestic market. It is also important to adapt the product/service to the needs of

Subject of research	Research methods	Key conclusions
		consumers on international markets.
Glaucia Fernandes, Fernanda Finotti Cordeiro Perobelli, Luiz Eduardo T. Brandao, <i>A Model of Valuing New Technologies Under a Pull Incentives Environment</i> , "Renewable and Sustainable Energy Reviews" 2016, 59, s. 482–493.		
A model for evaluating new technologies	Presentation of a new technology valuation model using real options and using Monte Carlo simulation. Application to the valuation of a company in the electric market in Brazil.	The model allows us to determine the minimum guaranteed demand that is necessary to develop a new product. Determining this type of demand can have a significant impact on the valuation of innovation projects, which are high risk.
Jung Ho Park, Kwangsoo Shin, <i>R&D Project Valuation Considering Chances of Economic Environment: A Case of Pharmaceutical R&D Project</i> , "Sustainability, MDPI, Open Access Journal" 2018, vol. 10(4), s. 1–15		
Evaluation of R&D projects using the Markov method	Presentation of a case study for the valuation of an R&D project in the pharmaceutical industry. Verification of the method in relation to traditional methods - DCF.	The pharmaceutical industry requires large investments in R&D projects and a long implementation period. The proposed method for valuing R&D projects was more effective than the DCF method. The method is based on real options combined with the traditional DCF method and Monte Carlo simulation.

Source: Authors' own elaboration based on cited sources.

As a result of the analysis of the research results disseminated in the papers cited in Table 3, the following conclusions can be drawn:

- the growth of research and development activity in enterprises allows to achieve competitive advantage;
- companies that are innovative perform better in the market in case of changing market conditions, e.g., during a financial crisis;
- unconventional methods of financing innovation, such as crowdfunding, are not fully used by enterprises. Over time, the role and importance of crowdfunding in the

way of financing innovative ventures is growing;

- the conducted research has been presented in the context of a particular industry or a particular country, according to the place where the research was conducted;
- the analysis of the literature shows that the problem of valuation of innovative enterprises in the context of assessing the impact of innovation on the value of the company is a rare subject of empirical research, as indicated by the scarcity of scientific research papers on this topic.

The results of the conducted literature review indicate the existence of a cognitive gap in the field of unconventional sources of financing, the way of evaluating innovative projects, their impact on the value of the company. Thus, there is a wide field for empirical research identifying the above research problems.

Critical Evaluation of The Existing Concepts of Researching the Impact of The Implementation Of Innovative Projects On The Value Of The Enterprise

On the basis of the conducted considerations relating to the specifics of innovative projects, it can be indicated that they are innovative projects with a high level of risk, and they are also difficult to model financially at the stage of project conception. Traditional methods of company valuation do not reflect the real market value of the company. This is due to the following conditions:

1. Cash flow modeling is difficult at the conceptual stage of a given project due to the fact that every innovative project is a novelty; there is no available comparative data and reliable historical data. As a rule, if a competitor conducts R&D activities, it informs about their results only after obtaining satisfactory effects and the launch of a new product on the market.
2. The value of companies implementing innovative projects is determined by the presence of intellectual capital or know-how, which are not reflected in the book value of the company.
3. The project life cycle is long. This is mainly due to the ongoing research and development work, the duration of which is difficult to estimate. It may take a long time from the beginning of the works to the introduction of a product/technology on the market. It is connected with the problem of estimating the demand for a new solution, due to frequent changes in the market demand, which is conditioned by changes in consumer needs.
4. Innovative projects are connected with incurring high costs at the initial stages of developing a new product/technology. Due to their uncertain character, there is no assurance that the implementation of the project will contribute to the achievement of the initially assumed effect. It may also turn out that the continuation of the project is not justified, due to the lack of satisfactory results of research works.
5. For highly innovative projects, a long cash flow modeling period should be adopted due to the long-time horizon of project implementation.
6. There is a problem as to whether individual projects should be valued and then the value of the enterprise should be treated as the sum of implemented projects. It should be clarified whether the enterprise implementing more than one innovative project does not use the additional synergy effect, which should also be estimated in the enterprise value.
7. Advanced, specialized knowledge is needed to value innovative projects. A detailed comparison and analysis of the concepts presented in this chapter is included in Table 4.

Table 4: Comparison and analysis of conceptual methods for the impact of innovation on enterprise value

Name of the method/technique	Analysis of the method/technique	Applicability to valuation of innovative enterprises
Asset-based	Asset-based methods assume that individual assets are the subject of the valuation, rather than the entire enterprise	No possibility of valuation of intellectual capital, know-how using these methods. Additionally, it is not possible to evaluate the enterprise as a whole, taking into account the synergy effect. The property valuation procedure does not take into account the company's development potential. In the case of the accounting method, the value is determined by the historical costs, which may result in a difference between the real value and the book value of projects with high development potential. In the case of the replacement method, it is difficult to determine the outlays and costs for the replacement of similar assets, due to the definition of innovative projects that are novel projects. In the liquidation method, the value of the enterprise implementing innovative projects may be understated due to the assumption of quick sale. Moreover, the innovation potential for one enterprise will have more value than for another.
Income	Income methods focus on estimating future cash flows.	Long project life cycle, in which the main expenditure is incurred at the beginning of the project implementation, and the result of the implementation is subject to high uncertainty.

Name of the method/technique	Analysis of the method/technique	Applicability to valuation of innovative enterprises
		<p>In cash flow modeling, the forecast period is very long. Entities implementing innovative projects are usually characterized by high fixed costs. No historical data, which would allow drawing conclusions about future revenues, costs, sales structure in connection with the implementation of an innovative project. Another barrier is the lack of benchmarks for comparisons - information shortage related to the implementation of high-uncertainty and high-risk projects.</p> <p>Another important aspect when estimating the value of innovative enterprises using the income method is the determination of the cost of capital.</p>
Comparative	Comparative methods involve valuing a company based on comparisons with similar companies that have been the subject of market transactions	Lack of historical and comparative data. Companies engaged in innovation activities report their innovation activities when satisfactory results are achieved. Lack of business entities that could be the subject of comparison.
Option	Option methods complement classical methods for valuing companies. They take into account the decision flexibility resulting from the implementation of projects.	The application of this method to the valuation of innovation projects most closely matches the specifics of these projects. However, for each project, it would be necessary to assume other key parameters, the incorrect estimation of which can significantly change the valuation of the company. In option methods, much depends on the developed options of decisions to be made.

Name of the method/technique	Analysis of the method/technique	Applicability to valuation of innovative enterprises
		Therefore, there is a risk of mismatching decision nodes for a given project and misestimating the scale of risk in a given variant.
Risk adjusted NPV	This method is a modification of the classical NPV method - the change consists in taking into account the risk of generating cash flow	This method is criticised for the possibility of erroneous risk assessment, which has a significant impact on the value of the enterprise's valuation. However, it is a method that can be applied to the valuation of innovative enterprises while maintaining adequate caution in estimating the risk of planned cash flows.
Venture Capital	A method developed by institutional investors. This method calculates the value of <i>post money</i> and <i>pre money</i>	The use of the Venture Capital method is exposed to the risk of overestimating and underestimating value. The method is mainly focused on determining potential sales revenues; other factors influencing the value of the enterprise are marginalized. A realistic estimate of sales revenues in the case of innovative solutions may be difficult and does not correspond to the future economic benefits. The advantage of this method is the ability to determine the value before and after the commitment of financial capital by a <i>venture capital</i> or <i>private equity</i> fund.
Valuation of intellectual capital	Methods of valuing intellectual capital and intangible assets in a company. The methods are divided into two main groups:	Intellectual capital valuation methods do not allow for the estimation of the impact of innovation on the value of the enterprise, because these methods

Name of the method/technique	Analysis of the method/technique	Applicability to valuation of innovative enterprises
	global valuation of intellectual capital and valuation of individual intangible assets.	allow for the global valuation or individual intangible assets, where the synergy effect is not recognized.
Ranking and selection of innovations	Methods by which choices are made about pathways for firms to grow through innovation with limited resources	The presented methods allow analyzing possible development paths by means of innovation. As a rule, they are based on the subjective assessment of experts on how a given innovative solution can affect the development of the company and achieve competitive advantage. These methods do not allow determining the quantified impact of a given solution on the value of the company.

Source: Authors' own elaboration.

Many methods can be used to value innovative ventures, and as indicated in Table 3, they have numerous imperfections. In the case of innovative projects, risk plays a very important role in the process of assessing value creation. It should be considered from four perspectives:

1. the project implementation effect - when implementing innovative projects, one should take into account a risk of failure to achieve the assumed objective of the works carried out, which will result in the lack of implementation possibilities or failure to achieve the assumed cash flows resulting from project implementation;
2. identification of risk factors of the project - an indication of all possible causes of failure of the project and a

- proposal to identify measures aimed at mitigating them;
3. defining the scope of variation of the economic effect of project execution in relation to the assumed effect of project implementation;
4. determining measures of the probability of occurrence of a given risk (Bijańska, 2015, p. 44).

Identification of determinants influencing the choice of valuation method for enterprises implementing innovative projects

The following considerations should be taken into account when selecting the appropriate method:

1. Income methods are more applicable to the valuation of innovation projects than asset-based methods. The latter do not reflect the impact of intellectual capital on the value of the company, which from the point of view of an innovative company is one of the key value generators.
2. The only method from the group of asset-based methods that can be applied to innovative projects is the replacement method. It allows including intangible factors, which have an impact on the enterprise value. It can be applied to organizations, which at the moment and in the short time horizon, do not generate economic benefits.
3. The most commonly used methods for valuation of innovation projects are methods that require discounting of cash flows and those that take into account real options. The use of both of these methods allows the real valuation to take into account the value of intangible assets, which are important in the process of valuation of innovative organizations. With the help of these methods, it is possible to take into account changes in the dynamic environment of the entity that is the subject of valuation.
4. Unconventional methods should be used for valuation of enterprises that develop based on innovative solutions, which will increase their importance in the valuation process. Their advantage is the inclusion of intellectual capital and obtaining additional cash flows, due to the development of competitive advantages.
5. There is no single, ideal method that can be used in the valuation process of innovative company. When making a valuation, one should take into account the conditions and the purpose of valuation, additionally one should consider important factors that generate value and assign them an appropriate rank.
6. Valuation process of innovative organizations requires constant updating due to the fact that the life cycle of technology or new products is getting shorter. In addition, the

frequent change in consumer behavior has a significant impact on the achievement of competitive advantage by companies, and the achievement of competitive advantage itself is very important in the valuation process of innovative entities.

Summary

In practice, there are many methods for determining the value of a business. The use of different methods for valuation may result in obtaining divergent results. The reasons for this situation are both methodological and procedural conditions, as well as the type of the valued company. The quality of decisions depends on the type of information, so different results may determine different decisions by managers. The most important aspects affecting the process of valuation of the company include: the preparation of reliable cash flow projections, risk assessment, determination of the discount rate and the correct calculation of the final value.

In the procedure of assessing the impact of the implementation of an innovative project on the value of the company, it is important that the analysis is carried out from the point of view of the company implementing the project. Consideration of the project without taking into account the method of commercialization of the results of research and development work does not allow determining its value. It is the commercialization method that will allow determining future sales' revenue in the context of the current market position of the enterprise.

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