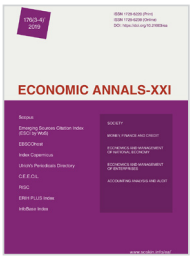

ECONOMIC ANNALS-XXI
ISSN 1728-6239 (Online)
ISSN 1728-6220 (Print)
https://doi.org/10.21003/ea
http://www.soskin.info/ea/

Volume 176 Issue (3-4)'2019

Citation information:
Derenska, Ya. (2019). Approaches to project portfolio formation by pharmaceutical products producers. Economic Annals-XXI, 176(3-4), 99-108. doi: https://doi.org/10.21003/ea.V176-10

UDC 65.012.23:658.512(75)

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Approaches to project portfolio formation by pharmaceutical products producers

Abstract

Introduction. The pharmaceutical market is characterized by a stable annual growth of 5-6%. According to the results of sales in 2018, the key domestic producers of pharmaceutical products were PJSC «Farmak» (the market share was 5.4%; the sales growth was 20.7%, compared to the previous year), Arterium Corporation (the market share - 3.5%; the sales growth - 17.6%), PrJSC «Pharmaceutical Firm «Darnitsa» (the market share - 3.27%; the sales growth - 15.3%), the Group of Companies «Zdorovya» (the market share - 2.32%; the sales growth - 12.4%).

The successful functioning of a modern enterprise largely depends on its ability for sustainable development by means of introducing innovations, developing new products and adopting effective models of management. All these activities require that an enterprise adopts a project approach. As the number of projects is growing, alongside with their cost and life cycle, it is becoming increasingly important to implement the concept of portfolio management. The present research outlines different approaches to creating a project portfolio and describes instruments that can help enterprises select an effective combination of projects in a portfolio. The object of the research is the project activity of a «Pharmaceutical Company «Zdorovya». In order to achieve the purpose of the research, the author applies multiple criteria weighted ranking and cluster analysis.

Methods. Multiple criteria weighted ranking is used on the first stage of project evaluation in order to define its ranking (priority). The method of multidimensional classification, as well as cluster analysis in particular, is used to divide all the projects into groups. The advantage of cluster analysis lies in the fact that it allows businesses to group projects according a great number of miscellaneous parameters. Joining (tree clustering) and K-means clustering methods are employed with the help of STATISTICA software. Ward's method as amalgamation (linkage) rule and Euclidean distances as distance measure are also applied as methods of cluster formation.

Results. Project ranking based on the level of risk, the investment cost, the net present value, the profitability index and the discounted payback period allowed the author to define the priority of each project and suggest recommendations as to how they should be included into the portfolio of projects. Nine projects were considered in order to create a project portfolio for a pharmaceutical enterprise. Multiple criteria weighted ranking shows that Project 3 has the highest priority.

The conducted clasterisation revealed three clusters of projects that characterise different directions in the process of starting a modern pharmaceutical manufacturing facility (Cluster 3), launching a new medicine into the market (Cluster 2) and expanding the existing range of products (Cluster 1).

Conclusion. While forming a project portfolio, it appears worthwhile to use a combination of three parameters: risk, effectiveness and cost. Additively, which is characteristic of net present value criterion, allows businesses to select the most effective combinations of projects in their portfolio. Based on the results of calculations, it is recommended to form a portfolio of 4 projects with a net present value of EUR 179,501.

Keywords: Project; Project Priority; Project Portfolio Management; Multiple Criteria Ranking; Project Portfolio Clusters

JEL Classification: G11; H33; O21; O22

Acknowledgements and Funding: The author received no direct funding for this research.

Contribution: The author contributed personally to this work.

DOI: https://doi.org/10.21003/ea.V176-10

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Підходи до формування проектного портфелю фармацевтичних виробників

Анотація. У статті розглянуто особливості інвестиційного розвитку сучасного фармацевтичного підприємства шляхом впровадження концепції проектного менеджменту, у межах якого здійснюється відбір кращих для виконання проектів. Метою дослідження є визначення підходів до формування проектного портфелю, а також інструментів, які дозволяють здійснити відбір ефективних комбінацій проектів у портфелі. Для розв'язання поставленої мети автором використано багатокритеріальне ранжування й кластерний аналіз. Ранжування проектів за критеріями: рівень ризику, інвестиційні витрати, чиста поточна вартість, індекс рентабельності, дисконтований період окупності дозволили визначити пріоритет кожного проекту й надати рекомендації щодо подальшого їх розгляду у межах проектного портфелю. З метою формування проектного портфелю фармацевтичного підприємства групи компаній «Здоров'я» досліджувалися такі проекти: «Модернізація ампульного цеху»; «Створення сучасного фармацевтичного виробництва та модернізація існуючого згідно стандартів GMP»; «Виведення на ринок препарату проти похмілля»; «Реєстрація лікарських засобів у В'єтнамі»; «Реєстрація анестетиків для стоматології у Німеччині»; «Розширення виробництва дерматологічного крему протизапальної дії»; «Розширення виробництва дерматологічного крему для лікування грибкових інфекцій»; «Розширення виробництва препарату для лікування мігрені»; «Розширення виробництва препарату для лікування кашлю та застудних захворювань».
У результаті проведеної кластеризації визначено три кластери проектів, що характеризують напрями створення сучасного фармацевтичного виробництва, виведення на ринок нового препарату й розширення випуску існуючих видів продукції. Для формування варіантів проектних портфелів рекомендується застосовувати комбінацію параметрів ризик – ефективність – вартість. За результатами розрахунків рекомендовано сформувати портфель із 4-х проектів із сумою чистої поточної вартості 179501 євро.
Ключові слова: проект; пріоритетність проектів; управління проектним портфелем; багатокритеріальне ранжування; кластери проектного портфелю.

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Подходы к формированию проектного портфеля фармацевтических производителей

Аннотация. В статье рассмотрены особенности инвестиционного развития современного фармацевтического предприятия путем внедрения концепции проектного менеджмента, в рамках которой осуществляется отбор лучших для реализации проектов. Целью исследования является определение подходов к формированию проектного портфеля, а также инструментов, позволяющих осуществить отбор эффективных комбинаций проектов в портфеле. Для решения поставленной цели автором использованы методы многокритериального ранжирования и кластерного анализа. Ранжирование проектов по критериям, таким как уровень риска, инвестиционные затраты, чистая текущая стоимость, индекс рентабельности, дисконтированный период окупаемости позволило определить приоритет каждого проекта и дать рекомендации по дальнейшему их рассмотрению в рамках проектного портфеля. В результате проведенной кластеризации определены три кластера проектов, характеризующие направления создания современного фармацевтического производства, вывод на рынок нового препарата и расширение выпуска существующих видов продукции. Для формирования вариантов проектных портфелей рекомендуется применять комбинацию параметров риск – эффективность – стоимость. По результатам расчетов рекомендуется сформировать портфель из 4-х проектов с суммой чистой текущей стоимости 179501 евро.
Ключевые слова: проект; приоритетность проектов; управления проектным портфелем; многокритериальное ранжирование; кластеры проектного портфеля.

1. Introduction

The sustainable development of any modern enterprise and maintaining its market positions requires constant effort. The integral part of this effort is the ongoing implementation of innovative approaches to management where project management is a crucial component. The necessity to adopt the concept of project management remains relevant for Ukrainian pharmaceutical enterprises due to strict requirements for the quality of project implementation. It is caused by the specifics of conducting research, the requirement to adhere to good manufacturing practices in manufacturing, and legal aspects in the registration of medicines. On the other hand, severe lack of time and resources requires a profound analysis of the cost-effectiveness of each particular project. Usually, businesses implement several or even dozens of projects simultaneously. Project selection is a challenging task as it is important to forecast the consequences of possible

combinations of projects and their mutual influence on the effectiveness and security of the project portfolio in general.

2. Brief Literature Review

Issues of project portfolio management are considered in the works by foreign scientists, such as M. Lappe and K. Spang (2014) [1], A. Jordan (2016) [2], M. Wood (2017) [3], O. Zwikael, Ying-Yi Chih and J. R. Meredith (2018) [4] and others. It is essential to mention J.-P. Paquin, D. Tessier and C. Gauthier (2015) [5], M. M. Sharifi and M. Safari (2016) [6], R. Bayney (2017) [7], G. Locatelli, M. Mikic, M. Kovacevic, N. Brookes and N. Ivanisevic (2017) [8], as well as V. Shnaydman (2018) [9] among the scholars who investigated the project priority.

A Guide to the Project Management Body of Knowledge (2008) [10] defines a portfolio as a selection of projects and programs that are united together so that these projects can be managed in a more efficient way in order to achieve certain strategic goals. The connection between project portfolio and business strategy is also highlighted in the Standard for Portfolio Management (2008) [11]. That is why the evaluation of each component of the portfolio starts with the analysis of how a particular project contributes to the strategic goals of the company. This evaluation can be descriptive (e.g. the project fully complies with the strategic goals; the goal can be achieved partially; the project only slightly contributes to the achievement of the strategic goals) or quantitative (the extent of goal achievement can be measured by points or by a simple scale:
1 - the project complies with the strategic goal;
0 - it does not).

However, the objective evaluation of portfolio components should rely on several parameters. Traditionally, projects are evaluated according to financial benefits criteria such as net present value of the project (NPV), discounted payback period (DPP), investment rate of return (IRR), profitability index (PI) and return on investment (ROI). Apart from that, the Standard for Portfolio Management (2008) recommends to use business criteria, risk-related criteria, regulatory compliance criteria, marketing and technical criteria to evaluate the portfolio components. Various calculation and graphic models are applied to make sure that all the necessary criteria are taken into consideration. Some of the most widely spread calculation models for project evaluation are single criterion prioritisation model, scoring model comprising weighted key criteria and multiple criteria weighted ranking. The results of evaluation are visually presented with the help of graphical comparison based on two criteria.

It is worth mentioning that the main peculiarity of project portfolio formation is the necessity to evaluate projects by multiple criteria.

Y. Hadad et al. (2016) [12] suggest ranking project activity by duration (in particular the activity criticality index, the cruciality index, the coefficient of variation, the significance index and the rank positional weight) and costs (in particular the cost and the expenditure rate). This approach allowed the authors to compile pairwise matrices in order to determine weighted ranking of the selected criteria.

A. V. Katrenko et al. (2013) [13] developed a two-stage procedure of project portfolio formation. During the first stage, appropriate project portfolios are selected according to the Pareto principle (the quality of portfolios is considered taking into account the limited availability of resources). During the second stage, project portfolios are finally selected according to the method of analytical hierarchy, i.e. by taking into consideration the general strategic aim of the enterprise.

K. Benaija and L. Kjiri (2014) [14] also suggest selecting projects for the portfolio in two stages. The first stage involves a bivariate analysis that combines risk-value-alignment parameters. These three parameters are considered together in order to evaluate projects and create a relevant scale, which helps to evaluate the potential and decide whether a project should be added to the portfolio. Besides, K. Benaija and L. Kjiri estimate the strategic value of the project, i.e. the extent at which it helps to achieve the key benefits for the enterprise.

According to V. M. Molokanova (2011) [15], a modern way of project portfolio formation is based on value, which means that added value maximisation is the main criterion. The scholar suggests employing an additive general criterion, which takes into account multiplier normalised criteria and the degree of their importance. There are certain limitations for each of the criteria (e.g. budget, resources, time) in order to optimise linear programming. This model helps to rank projects by the target parameter which is the maximization of the aggregate value of the portfolio. Portfolios which are more focused on profit growth should be evaluated by the criteria of investment (e.g. NPV, DPP,

PI, ROI), whereas socially-oriented or mixed portfolios should be evaluated according to a larger variety of criteria.

Another model of selecting portfolios takes into account their social component. O. Ye. Fedorova and O. L. Zhyrov (2015) [16] suggest using three criteria: financial (volume of investment, taxes, pecuniary advantage), social (usefulness, non-tangible benefits) and risk (chances of successful implementation, time, rate of economic alternative).

A. T. de Almeida and M. D. Duarte (2011) [17] apply the matrix method in order to combine profit from implementing a project with the additional profit which this project can bring within the portfolio. In other words, a project portfolio is expected to show a certain synergy effect. B. Canbaz and F. Marle (2016) [18] also recommend to evaluate portfolio components with the help of matrices that reflect interconnected resources, benefits and probability of success. Matrix-based management of project portfolios is also supported by Y. M. Teslia and T. V. Latysheva (2016) [19] who use it in order to coordinate portfolio activities of an enterprise.

In order to create matrices of investment strategies, T. Ivanenko et al. (2018) [20] believe that it is important to evaluate investment projects and make investment decisions on the basis of a number of financial criteria (NPV, DPP, PI, and IRR) and risk criteria (Wald's maximin, Maximax, Hurwicz's criterion, Laplace's criterion, Bayes-Laplace insufficient reason criterion, Hodges-Lehmann criterion).

An interesting approach is proposed by M. Y. Hrytsiuk and L. I. Maksymiv (2010) [21], which involves building a REV-diagram based on three components, such as risk, efficiency and cost. The analysis of project combinations according to these criteria allows businesses to select the most effective project portfolios.

Despite a considerable number of studies, the problem of project portfolio evaluation and selection never loses its relevance. On the one hand, it is explained by the fact that a large number of projects undertaken by enterprises calls for portfolio-oriented approach in business administration. On the other hand, the use of complicated mathematical models for project assessment is not really feasible due to insufficient organisational maturity of Ukrainian enterprises coupled with a lack of time and resources allocated for taking project-related decisions. On the other hand, when choosing criteria for evaluating portfolio components, one should also consider the industry-specific peculiarities of the projects under implementation.

3. The purpose of the article is to suggest different ways of how projects can be grouped and evaluated before being included into a project portfolio. The research also gives recommendations about the feasibility of different project portfolio combinations taking major Ukrainian pharmaceutical enterprises as a reference.

4. Results

The pharmaceutical market is characterised by a stable annual growth of 5-6% and, according to forecasts, will increase by 34% next 5 years (2018) [22]. In Ukraine, the volume of sales of pharmaceutical products in 2017 increased by 20% in money or by 7% in packages. Over the past ten years, Ukrainian pharmaceutical companies have increased sales 9 times - from EUR 111.7 million to EUR 880.2 million. Today, the sector is also characterised by a significant increase in the share of domestic companies' market. In 2010, Ukrainian manufacturers of medicines had 54.5% as a market share; however in 2017 their share rose to 73.5%. The pharmaceutical industry is characterised by a significant number of enterprises, 115 companies have licenses for the manufacture of medicines (2018) [23].

A significant number of manufacturers of pharmaceutical products results is the small market share each of them. According to the results of the sales in 2018, the key domestic producers of pharmaceutical products were:

- PJSC «Farmak» (the market share was 5.4%; the sales growth was 20.7%, compared to the previous year),
- Arterium Corporation (the market share - 3.5%; the sales growth - 17.6%),
- PrJSC «Pharmaceutical Firm «Darnitsa» (the market share - 3.27%; the sales growth - 15.3%),
- the group of companies «Zdorovya» (the market share - 2.32%; the sales growth - 12.4%) (2019) [24].

Since 2010, PJSC «Farmak» has been the leader of the pharmaceutical market in Ukraine and the largest exporter of medicines thanks to product quality and innovation. It is a Ukrainian manufacturer complying with European standards. According to the official site of the com-

pany (https://farmak.ua) its product portfolio consists of 220 names of medicines. In 2018, PJSC «Farmak» brought to the market 34 new nomenclature positions, which are 17 brands. A quarter of the company's products is exported to more than 20 countries of the world, including the CIS and the EU countries, such as Poland, Slovakia, and Germany. Farmak's strategic goal is to expand its foreign economic activity. By 2020, the company plans to increase the share of exports to 40%, while remaining the leader of the Ukrainian market.

Arterium Corporation was established in 2005. It integrates two Ukrainian companies «Kievmedpreparat» and» Galychpharm», which have over 150 years of pharmaceutical manufacturing experience. According to the official site (http://www.arterium.ua), there are more than 150 medicines in the company's product portfolio. With representative offices in Azerbaijan, Belarus, Kazakhstan, Russia and Uzbekistan, Arterium Corporation is committed to becoming a regional market leader in all these countries. It exports products to 11 CIS countries and Vietnam. The share of export in the company's income is 25%.

PrJSC «Pharmaceutical Firm «Darnitsa» is a domestic producer of medicinal products, having long-standing pharmaceutical traditions. The company was established in 1938. According to the official site of the company (http://www.darnitsa.ua), «Darnitsa» produces more than 250 names of medicines. In 2016 «Darnitsa» manufactured the greatest number of products in the form of pills - 121,578,463 packs. The modern development strategy of «Darnitsa» is primarily aimed at strengthening the company's market leadership and competitiveness, based on increasing the performance of the organisation, introduction of innovations in production and management, personnel development, working out and updating of the product portfolio.

The object of the research is the project activity of the «Pharmaceutical Company «Zdorovya». This is a modern high-tech enterprise whose production level meets all international requirements applied to medicines. According to the official site of this enterprise (https://zt.com.ua), the company produces more than 250 names of medicines; more than 50 medicines are in development. The sales are greater by 30%, compared to the previous year. More than 20% of the entire volume of sales accounts for exports. Company exports to 21 countries of the world. The amplification of the investment activity of the company in 2016-2018 revealed a need to use the project management tools. The example of the enterprise data shows recommendations for reviewing the current portfolio of projects (the end of 2018).

In order to create a project portfolio for a pharmaceutical enterprise, the following projects were considered:

1 - «Ampule shop floor modernisation» (2019-2020);
2 - «Establishing a modern pharmaceutical manufacturing facility and renovating the existing one according to GMP standards» (fundamental project, 2016-2021);
3 - «Launching a new hangover remedy into the market» (2019-2021);
4 - «Registration of medicines in Vietnam» (2019-2021);
5 - «Registration of dental anaesthetics in Germany» (2019-2021);
6 - «Expansion of production of anti-inflammatory dermatological cream» (2019-2020);
7 - «Expansion of production of antifungal dermatological cream» (2019-2021);
8 - «Expansion of production of medicine for migraine» (2019-2021);
9 - «Expansion of production of medicine for cough and cold» (2019-2020).

According to the best practices of project management, each investment project was evaluated by key performance indicators: NPV, PI, and DPP. Due to limited funding, the cost of investment was also considered as an important parameter for project evaluation. The industry-specific peculiarities of the projects are reflected in the level of risk which is estimated depending on the complexity, variability and standardisation of works carried out under the project. Table 1 displays the results of project evaluation and ranking.

Multiple criteria weighted ranking shows that Project 3 has the highest priority. Projects 1 and 6 are both ranked as second best. They are followed by Projects 8 and 9. Project 2 turns out to be the least attractive. However, this is a fundamental project for the enterprise, which explains its high cost, long-term payback period and a high level of risk.

Joining (tree clustering) method was employed to unite projects into clusters. The results are reflected in the tree diagram on Figure 1.

The horizontal axis of the tree diagram shows all the projects that were analysed (C1…C9, or case 1…case 9, which stand for Project 1…Project 9). The vertical axis reflects the distance measure. Following this principle, Projects 4 and 5 were the first projects to be joined together as

Table 1:
Multiple criteria weighted evaluation and ranking of the 9 prospective pharmaceutical enterprises' portfolio projects

Project	Level of Risk		Investment Cost (IC), euro		Net Present Value (NPV), euro		Profitability Index (PI)		Discounted Payback Period (DPP), years		Priority	
	Measure	Rank	Result	Rank	Result	Rank	Result	Rank	Result	Rank	Score	Rank
1	0.1	2	50,925	8	46,719	3	2.1	1	1.4	3	3.4	2
2	0.15	3	171,435	9	57,954	1	1.02	7	5.9	8	5.6	7
3	0.1	2	9,318	6	59,933	2	1.8	3	1.12	2	3	1
4	0.05	1	3,783	3	724	8	1.3	6	2.4	7	5	6
5	0.05	1	2,063	1	724	9	1.3	6	2.4	7	4.8	5
6	0.05	1	6,076	4	4,637	6	1.9	2	1.6	4	3.4	2
7	0.05	1	7,156	5	13,724	5	1.4	5	2.1	6	4.4	4
8	0.05	1	3,424	2	1,583	7	1.6	4	1.9	5	3.8	3
9	0.1	2	35,210	7	14,895	4	1.4	5	0.7	1	3.8	3

Source: Compiled by the author

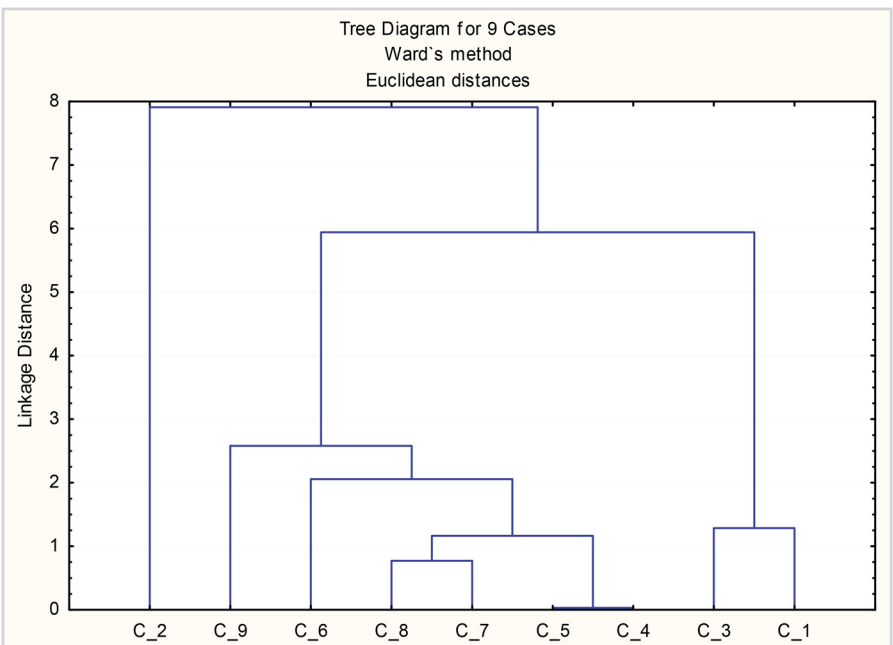

Figure 1:
Tree diagram of the project portfolio clusters
Source: Compiled by the author based on calculated data in the programme STATISTICA

the distance between them is minimal. After that, Projects 6-9 were added to this cluster as well. Another cluster contains Projects 1 and 3. And there is one more cluster which is represented by Project 2 alone. The mean values and standard deviations for each project that was part of cluster analysis are presented in Table 2.

Having united the projects into groups according to K-means clustering method, it was discovered that the first cluster includes Projects 1 and 3. What is characteristic of these projects is that they both have considerable NPV, high PI and moderate DPP and the average level of

Table 2:
Means and standard deviations (cluster analysis) of the prospective pharmaceutical enterprises' portfolio projects

Case	Mean	Standard deviation
C_1	0.612040	0.794950
C_2	1.380347	1.674457
C_3	0.353155	0.898164
C_4	-0.534546	0.404065
C_5	-0.540811	0.403961
C_6	-0.250747	0.751874
C_7	-0.400446	0.257480
C_8	-0.420068	0.424263
C_9	-0.198924	0.584641

Source: Compiled by the author based on calculated data in the programme STATISTICA

risk. Therefore, it is recommended to add these projects into the portfolio. The second cluster (Projects 4 - 9) has a bigger variance of parameter values. This cluster involves projects with a predominantly low level of risk, low cost of investment, low NPV, moderate DDP (except Project 9), and average PI. Project 2 that belongs to the third cluster requires considerable funding, high NPV, high level of risk, long DPP, and low PI. All the characteristic peculiarities of clusters are presented in Tables 3-5.

A well-balanced portfolio in terms of its performance, investment resources and level of risk can be achieved if it contains projects belonging to different clusters. In this respect, it is recommended to include Project 2 (which is fundamental for the enterprise), Projects 1 and 3 (as the most effective ones) and partially some projects that belong to cluster 2. Considering the results of the multiple criteria weighted ranking, it also appears worthwhile to include Projects 6, 8, 9 to the portfolio and suspend Projects 4, 5, and 7.

In order to define possible combinations of projects in the portfolio and predict their outcomes, the overall level of risk was estimated together with investment cost and NPV (see Table 6). The V-risk parameter describes the risk level of a particular project within the portfolio, and it is defined as the relative risk weight of a project within the general sum of all risk levels of all the projects within the portfolio.

Considering possible combinations of projects within the portfolio (63 variants) requires thorough analysis, taking into account the correlation between the cost of investment and the obtained result. The following dependency appears logical: bigger amount of investment ⟶ higher NPV. To make the analysis even easier, all the expected effects of project portfolio implementation with different investment and V-risks are reorganised starting with the lowest NVP (see Table 7).

The project portfolios marked in bold are those that are not recommended for implementation because they violate the principle according to which bigger investment should lead to higher effectiveness. In other words, it is not recommended to choose projects where bigger investment does not guarantee higher NPV in comparison with other portfolio combinations. Likewise, it is not worthwhile to form portfolios that only contain one or two projects. As it was mentioned above, it is recommended to include Projects 1, 2, 3 into the portfolio and later analyse combinations with

Table 3:
Descriptive statistics for Cluster 1. Cluster contains 2 cases

Variable	Mean	Standard deviation	Variance
Risk	0.611775	0.000000	0.000000
IC, EUR	-0.037021	0.535771	0.287051
NPV, EUR	1.229853	0.370636	0.137371
PI	1.209688	0.619175	0.383377
DPP, EUR	-0.601306	0.130987	0.017158

Source: Compiled by the author based on calculated data in the programme STATISTICA

Table 4:
Descriptive statistics for Cluster 2. Cluster contains 6 cases

Variable	Mean	Standard deviation	Variance
Risk	-0.535303	0.561952	0.315790
IC, EUR	-0.410394	0.230789	0.053263
NPV, EUR	-0.645523	0.260601	0.067913
PI	-0.152427	0.676175	0.457213
DPP, EUR	-0.210972	0.424136	0.179892

Source: Compiled by the author based on calculated data in the programme STATISTICA

Table 5:
Descriptive Statistics for Cluster 3. Cluster contains 1 case

Variable	Mean	Standard deviation	Variance
Risk	1.98827	0.00	0.00
IC, EUR	2.53641	0.00	0.00
NPV, EUR	1.41343	0.00	0.00
PI	-1.50481	0.00	0.00
DPP, EUR	2.46844	0.00	0.00

Source: Compiled by the author based on calculated data in the programme STATISTICA

Projects 6, 8, 9. In the first place, it is advisable to implement Project 9, followed by Project 6 and project 8 (Portfolios 6.17; 6.30; 6.32 respectively).

5. Conclusion

Studying current approaches to project evaluation in the process of project prioritisation and selection for project portfolio pointed to the conclusion that project evaluation involves multiple

Table 6:
Estimated values of various parameters after project portfolio implementation taking into account *V*-risks factor

Project	**1**	**2**	**3**	**6**	**8**	**9**	**Values of various parameters of project portfolios**		
IC, EUR	50,925	171,435	9, 318	6,076	3,424	35,210			
NPV, EUR	46,719	57,954	59,933	4,637	1,583	14,895			
V-Risk	0.1/0.55=0.18	0.15/0.55=0.28	0.1/0.55=0.18	0.05/0.55=0.09	0.05/0.55=0.09	0.1/0.55=0.18			
Project portfolio	**Matrix of portfolio compliance with project selections**						**Summary V-Risk**	**Summary IC**	**Summary NPV**
1.1	1	0	0	0	0	0	0.18	50,925	46,719
2.1	0	1	0	0	0	0	0.28	171,435	57,954
2.2	1	1	0	0	0	0	0.46	222,360	104,673
3.1	0	0	1	0	0	0	0.18	9,318	59,933
3.2	1	0	1	0	0	0	0.36	60,243	106,652
3.3	0	1	1	0	0	0	0.46	180,753	117,887
3.4	1	1	1	0	0	0	0.64	231,678	164,606
4.1	0	0	0	1	0	0	0.09	6,076	4,637
4.2	1	0	0	1	0	0	0.27	57,001	51,356
4.3	0	1	0	1	0	0	0.37	177,511	62,591
4.4	0	0	1	1	0	0	0.27	15,394	64,570
4.5	1	1	0	1	0	0	0.45	228,436	109,310
4.6	1	0	1	1	0	0	0.45	66,319	13,119
4.7	0	1	1	1	0	0	0.55	186,829	122,524
4.8	1	1	1	1	0	0	0.73	237,754	169,243
5.1	0	0	0	0	1	0	0.09	3,424	1,583
5.2	1	0	0	0	1	0	0.27	54,349	48,302
5.3	0	1	0	0	1	0	0.37	174,859	59,537
5.4	0	0	1	0	1	0	0.27	12,742	61,516
5.5	0	0	0	1	1	0	0.18	9,500	6,220
5.6	1	1	0	0	1	0	0.55	225,784	106,256
5.7	1	0	1	0	1	0	0.45	63,667	108,235
5.8	1	0	0	1	1	0	0.36	60,425	52,939
5.9	0	1	1	0	1	0	0.55	184,177	119,470
5.10	0	1	0	1	1	0	0.46	180,935	64,174
5.11	0	0	1	1	1	0	0.36	18,818	66,153
5.12	1	1	1	0	1	0	0.73	235,102	166,189
5.13	1	1	0	1	1	0	0.54	231,860	110,893
5.14	1	0	1	1	1	0	0.54	69,743	112,872
5.15	0	1	1	1	1	0	0.64	190,253	124,107
5.16	1	1	1	1	1	0	0.82	241,078	170,827
6.1	0	0	0	0	0	1	0.18	35,210	14,895
6.2	1	0	0	0	0	1	0.36	86,135	61,614
6.3	0	1	0	0	0	1	0.46	206,645	72,849
6.4	0	0	1	0	0	1	0.36	44,528	74,828
6.5	0	0	0	1	0	1	0.27	41,286	19,532
6.6	0	0	0	0	1	1	0.27	38,634	16,478
6.7	1	1	0	0	0	1	0.64	257,570	119,568
6.8	1	0	1	0	0	1	0.54	95,453	121,547
6.9	1	0	0	1	0	1	0.45	92,211	66,251
6.10	1	0	0	0	1	1	0.45	89,559	63,197
6.11	0	1	1	0	0	1	0.64	215,963	132,782
6.12	0	1	0	1	0	1	0.55	212,721	77,486
6.13	0	1	0	0	1	1	0.55	210,069	74,432
6.14	0	0	1	1	0	1	0.45	50,604	79,465
6.15	0	0	1	0	1	1	0.45	47,952	76,411
6.16	0	0	0	1	1	1	0.36	44,710	21,115
6.17	1	1	1	0	0	1	0.82	266,888	179,501
6.18	1	1	0	1	0	1	0.63	263,646	124,205
6.19	1	1	0	0	1	1	0.73	260,994	121,151
6.20	1	0	1	1	0	1	0.63	101,529	126,184
6.21	1	0	1	0	1	1	0.63	98877	123,130
6.22	1	0	0	1	1	1	0.54	95,635	67,834
6.23	0	1	1	1	0	1	0.73	222,039	137,419
6.24	0	1	1	0	1	1	0.73	219,387	134,365
6.25	0	1	0	1	1	1	0.64	216,145	79,069
6.26	0	0	1	1	1	1	0.54	54,028	81,048
6.27	1	0	1	1	1	1	0.72	104,953	127,767
6.28	1	1	0	1	1	1	0.72	267,070	125,788
6.29	1	1	1	0	1	1	0.91	270,312	181,084
6.30	1	1	1	1	0	1	0.91	272,964	184,138
6.31	0	1	1	1	1	1	0.82	225,463	139,002
6.32	1	1	1	1	1	1	1.00	276,388	185,721

Source: Calculated by the author

Table 7:
Variability of expected effects after project portfolio implementation with different amount of investment and *V*-risks

Project portfolios (number of the projects)	V-Risk	IC, EUR	NPV, EUR
5.1 (8)	0.09	3,424	1,583
4.1 (6)	0.09	6,076	4,637
5.5 (6,8)	**0.18**	**9,500**	**6,220**
6.1 (6)	**0.18**	**35,210**	**14,895**
6.6 (8,9)	**0.27**	**38,634**	**16,478**
6.5 (6,9)	**0.27**	**41,286**	**19,532**
6.16 (6,8,9)	**0.36**	**44,710**	**21,115**
1.1 (1)	**0.18**	**50,925**	**46,719**
5.2 (1,8)	**0.27**	**54,349**	**48,302**
4.2 (1,6)	**0.27**	**57,001**	**51,356**
5.8 (1,6,8)	**0.36**	**60,425**	**52,939**
2.1* (2)	0.28	171,435	57,954
5.3* (2,8)	0.37	174,859	59,537
3.1 (3)	0.18	9,318	59,933
5.4 (3,8)	0.27	12,742	61,516
6.2 (1,9)	**0.36**	**86,135**	**61,614**
4.3* (2,6)	0.37	177,511	62,591
6.10 (1,8,9)	**0.45**	**89,559**	**63,197**
5.10* (2,6,8)	0.46	180,935	64,174
4.4 (3,6)	0.27	15,394	64,570
5.11 (3,6,8)	0.36	18,818	66,153
6.9 (1,6,9)	**0.45**	**92,211**	**66,251**
6.22 (1,6,8,9)	**0.54**	**95,635**	**67,834**
6.3* (2,9)	0.46	206,645	72,849
6.13* (2,8,9)	0.55	210,069	74,432
6.4 (3,9)	0.36	44,528	74,828
6.15 (3,8,9)	0.45	47,952	76,411
6.12* (2,6,9)	0.55	212,721	77,486
6.25* (2,6,8,9)	0.64	216,145	79,069
6.14 (3,6,9)	0.45	50,604	79,465
6.26 (3,6,8,9)	0.54	54028	81,048
2.2* (1,2)	0.46	222,360	104,673
5.6* (1,2,8)	0.55	225,784	106,256
3.2 (1,3)	0.36	60,243	106,652
5.7 (1,3,8)	0.45	63,667	108,235
4.5* (1,2,6)	0.45	228,436	109,310
5.13* (1,2,6,8)	0.54	231,860	110,893
4.6 (1,3,6)	0.45	66,319	13,119
5.14 (1,3,6,8)	0.54	69,743	112,872
3.3* (2,3)	0.46	180,753	117,887
5.9* (2,3,8)	0.55	184,177	119,470
6.7* (1,2,9)	0.64	257,570	119,568
6.19* (1,2,8,9)	0.73	260,994	121,151
6.8 (1,3,9)	0.54	95,453	121,547
4.7* (2,3,6)	0.55	186,829	122,524
6.21 (1,3,8,9)	0.63	98,877	123,130
5.15* (2,3,6,8)	0.64	190,253	124,107
6.18* (1,2,6,9)	0.63	263,646	124,205
6.28* (1,2,6,8,9)	0.72	267,070	125,788
6.20 (1,3,6,9)	0.63	101,529	126,184
6.27 (1,3,6,8,9)	0.72	104,953	127,767
6.11 (1,6,9)	0.64	215,963	132,782
6.24 (2,3,8,9)	0.73	219,387	134,365
6,23 (2,3,6,9)	0.73	222,039	137,419
6.31 (2,3,6,8,9)	0.82	225,463	139,002
3.4 (1,2,3)	0.64	231,678	164,606
5.12 (1,2,3,8)	0.73	235,102	166,189
4.8 (1,2,3,6)	0.73	237,754	169,243
5.16 (1,2,3,6,8)	0.82	241,078	170,827
6.17 (1,2,3,9)	0.82	266,888	179,501
6.29 (1,2,3,8,9)	0.91	270,312	181,084
6.30* (1,2,3,6,9)	0.91	272,964	184,138
6.32 (1,2,3,6,8,9)	1.00	276,388	185,721

Notes: * - portfolios the effectiveness of which does not comply with the recommended dependency «cost of investment - effectiveness» but that cannot be excluded because they contain Project 2.

Source: Calculated by the author

criteria. However, in most cases, decisions on whether an investment project should be added to a portfolio almost entirely depends on financial criteria, in particular NPV, DPP, PI, and the level of risk. At the same time, a larger range of criteria for portfolio components requires more flexible approaches.

The paper suggests uniting projects into groups by means of cluster analysis, whose main advantage is the possibility to apply miscellaneous criteria to project description. In order to determine

possible combinations of projects within a portfolio, it is recommended to consider parameters such as cost, risk and effectiveness at the same time. Practical application of this approach helps to identify and reject project portfolios that may violate the principle of direct correlation between cost of investment and effectiveness.

References

1. Lappe, M., & Spang, K. (2014). Investments in project management are profitable: A case study-based analysis of the relationship between the costs and benefits of project management. I*nternational Journal of Project Management, 32*(4), 603-612. doi: https://doi.org/10.1016/j.ijproman.2013.10.005
2. Jordan, A. (2016, November 28). *The Politics of Integration (Part 1): Planning.* Retrieved from https://www.projectmanagement.com/articles/352352/The-Politics-of-Integration--Part-1---Planning
3. Wood, M. (2017, October 2). *Project Portfolio Management: A Practical Process.* Retrieved from https://www.projectmanagement.com/articles/410197/Project-Portfolio-Management--A-Practical-Process
4. Zwikael, O., Chih, Y.-Y., & Meredith, J. R. (2018). Project benefit management: Setting effective target benefits. *International Journal of Project Management, 36*(4), 650-658. doi: https://doi.org/10.1016/j.ijproman.2018.01.002
5. Paquin, J.-P., Tessier, D., & Gauthier, C. (2015). The Effectiveness of Portfolio Risk Diversification: An Additive Approach by Project Replication. *Project Management Journal, 46*(5), 94-110. doi: https://doi.org/10.1002/pmj.21526
6. Sharifi, M. M., & Safari, M. (2016). Application of Net Cash Flow at Risk in Project Portfolio Selection. *Project Management Journal, 47*(4), 68-78. doi: https://doi.org/10.1177/875697281604700406
7. Bayney, R. (2017, November 29). *Project Prioritization: Quantifying the Cost of Strategy.* Retrieved from https://www.projectmanagement.com/articles/421015/Project-Prioritization--Quantifying-the-Cost-of-Strategy
8. Locatelli, G., Mikic, M., Kovacevic, M., Brookes, N., & Ivanisevic, N. (2017). The Successful Delivery of Megaprojects: A Novel Research Method. *Project Management Journal, 48*(5), 78-94. doi: https://doi.org/10.1177/875697281704800506
9. Shnaydman, V. (2018, May 21). *Practical Portfolio Optimization.* Retrieved from https://www.projectmanagement.com/articles/463371/Practical-Portfolio-Optimization
10. Project Management Institute (2008). *A Guide to the Project Management Body of Knowledge* (4th edition). Pennsylvania: Project Management Institute, Inc. Retrieved from https://www.works.gov.bh/English/ourstrategy/Project%20Management/Documents/Other%20PM%20Resources/PMBOKGuideFourthEdition_protected.pdf
11. Project Management Institute (2008). *The Standard for Portfolio Management* (2nd edition). Pennsylvania: Project Management Institute, Inc. Retrieved from http://www.nioec.com/Training/%D9%85%D8%AF%DB%8C%D8%B1%DB%8C%D8%AA%20%D9%BE%D8%B1%D9%88%DA%98%D9%87/PMI/PMI_Standard/The_Standard_Portfolio_Mgmt_Second_Ed.pdf
12. Hadad, Y., Keren, B., & Laslo, Z. (2016). Multi-criteria methods for ranking project activities. *Yugoslav Journal of Operations Research, 26*(2), 201-219. doi: https://doi.org/10.2298/YJOR140618012H
13. Katrenko, A. V., Magats, D. S., & Magats, A. S. (2013). Projects' portfolio formation using two-step procedure. *Informatsiyni Systemy ta Merezhi (Information Systems and Networks), 770*(1), 169-176. Retrieved from http://science.lp.edu.ua/sites/default/files/Papers/22_129.pdf (in Ukr.)
14. Benaija, K., & Kjiri, L. (2014). Project portfolio selection: Multi-criteria analysis and interactions between projects. *International Journal of Computer Science Issues, 11*(6), 134-143 Retrieved from https://arxiv.org/ftp/arxiv/papers/1503/1503.05366.pdf
15. Molokanova, V. M. (2011). Problems of forming a strategic portfolio of projects. *Upravlinnia Rozvytkom Skladnykh System (Management of Complex Systems Development), 7,* 44-47. Retrieved from http://www.knuba.edu.ua/doc/urss7/urss_7!!/44-47.pdf (in Ukr.)
16. Fedorova, O. Ye., & Zhyrov, O. L. (2015). Modeling investment portfolio choice considering social component. *Ekonomichnyi Visnyk NTUU «KPI» (Economic Bulletin of NTUU «KPI»), 12,* 526-531. Retrieved from http://ela.kpi.ua/bitstream/123456789/14205/1/77.pdf (in Ukr.)
17. de Almeida, A. T., & Duarte, M. D. O. (2011). A multi-criteria decision model for selecting project portfolio with consideration being given to a new concept for synergies. *Pesqui. Oper, 31*(2), 301-318. doi: https://doi.org/10.1590/S0101-74382011000200006
18. Canbaz, B., & Marle, F. (2016). Construction of project portfolio considering efficiency, strategic effectiveness, balance and project interdependencies. *International Journal of Project Organisation and Management, 8*(2), 103-126. Retrieved from https://hal.archives-ouvertes.fr/hal-01206933v2/document
19. Teslia, Y. M., & Latysheva, T. V. (2016). Development of conceptual frameworks of matrix management of project and programme portfolios. Skhidno-Ievropeiskyi Zhurnal Peredovykh Tekhnologii (Eastern-European Journal of Enterprise Technologies), 79(3), 12-18. doi: https://doi.org/10.15587/1729-4061.2016.61153 (in Ukr.)
20. Ivanenko, T., Hrushko, V., & Frantsuz, A. (2018). Optimal investment decision making on the model of production enterprise with limited resources. *Investment Management and Financial Innovations, 15*(4), 61-68. doi: https://doi.org/10.21511/imfi.15(4).2018.05
21. Hrytsiuk, M. Y., & Maksymiv, L. I. (2010). An account of risks in the task of management the projects portfolio of tourist industry development in the Ukrainian Carpathians region. *Naukovyi Visnyk NLTU Ukrainy (Scientific Bulletin of UNFU), 20*(11), 48-61. Retrieved from http://tourlib.net/statti_ukr/gryczjuk2.htm (in Ukr.)
22. Center for Contemporary China «TianXia Link» (2018, September 12). *Competition in the global pharmaceutical market is better to overcome together.* Retrieved from http://www.tianxia.link/uk/article/7141-konkurientsiiu-na-svitovomu-farmatsievtichnomu-rinku-krashchie-dolati-spil-no (in Ukr.)
23. Vashe Zdorovya (2018, December 12). *Ukrainian pharmaceutical market demonstrates rapid growth.* Retrieved from https://www.vz.kiev.ua/ukrayinskyj-farmatsevtychnyj-rynok-demonstruye-strimke-zrostannya (in Ukr.)
24. Kirsanov, D. (2019). The pharmacy market of Ukraine in 2018: Helicopter View. *Apteka (Pharmacy), 1173*(2). Retrieved from https://www.apteka.ua/article/486600 (in Russ.)

Received 10.03.2019
Received in revised form 14.04.2019
Accepted 20.04.2019
Available online 20.08.2019