The impact of the implementation of an innovative project on the effects arising in the internal and external environment

Dilyara Zaynullina

1Kazan State University of Architecture and Engineering, Kazan, Russia
zaynullina@kgasu.ru

Abstract. The purpose of this research is to determine the effects arising in the internal and external environment of an innovative project, which is supposed to help make a decision regarding the implementation of the project. For that we have selected about 200 innovative projects of various types of economic activity, such as: services, manufacturing and mining sectors. All projects are implemented in the Republic of Tatarstan. For each of the projects we considered the following types of effects: economic and social for the external environment and technological and environmental for the internal environment. To identify the interconnection between internal and external effects from innovative projects, we used the method of correlation and regression analysis. Implemented innovative projects in the service sector, leading to significant internal technological effect, have a significant impact on the external economic effect and do not affect the external social effect. Manufacturing projects are characterized by a significant impact of internal technological effect on external economic and social effects, while the internal ecological effect has the greatest impact on both external effects. Innovative projects in the mining industry are characterized by a significant impact of internal ecological and technological effects on external economic and social effects.

Keywords: innovative projects, effectiveness assessment, internal effect, external effect, decision making, type of economic activity.

1 Introduction

Innovations are currently a result of scientific activities, and innovative way of development is the only way for Russia to get a decent place in the global economy and to switch the fuel and raw material orientation of economy to the innovative vector of development [1].

The main economic aspects of sustainable development according to scientists are:
- development that does not shift extra costs to the next generations [2];
- development that minimizes negative externalities of different generations [3];
- development that allows people living only using the rate of natural capital, not spending it [4];
- development that ensures the continued reproduction of productive capacity for the future [5].

The author of innovative idea, as a subject of innovative activity, is the least protected in terms of free market, other stakeholders also have significant risks [6]. Investors, financing the innovative activities may have risks associated with long-term return on investment and the uncertainty of the outcome. And while the purpose of the investment is guaranteed and quick profits, the situation with the financing of innovation is unlikely to move forward [7].

It can be reached by promoting the usage of results of scientific research in transport, energy, aerospace industry, mechanical engineering and instrument making, information, biotechnology and other knowledge-intensive sectors, as well as in medicine and education [8].
It is necessary to intensify and stimulate significant intellectual, scientific and technological potential, the interaction of science, business and the state and the synthesis of their activities, including the ability to cooperate, social coherence and, therefore, provide dynamic joint and at the same time sustainable economic development [9].

The article “The influence of resistance to change on evaluating an innovation project's innovativeness and risk: A sense making perspective” investigated, how a decision's context and an individual's resistance to change influence the assessment of an innovation project's risk and innovativeness [10]. The authors showed that an individual's resistance to change moderates the positive relationship between an innovative project's innovativeness and its perceived risk. The research is based on analysis of 455 people [11].

The authors of the research “Forward-looking search during innovation projects: Under which conditions it impacts innovativeness” follows the bounded rationality assumption, which views decision makers as lacking complete knowledge and anticipation of the consequences of their decision [12]. That paper posits that project teams must engage in forward-looking search during project development to ensure their project's innovativeness [13]. However, it argues that this is only relevant if there is 1) room in project planning to facilitate forward-looking search, 2) slack resources available to implement such changes, and 3) a dynamic external environment. The research is based on analysis 155 innovation projects of the Danish economy [14].

The role of the logic of adopting innovative solutions studied by the authors of the article “The use of effectuation in projects: The influence of business case control, portfolio monitoring intensity and project innovativeness” [15]. The authors investigate the role of effectuation, a decision logic most commonly associated with entrepreneurship, as an alternative decision-making approach to the rational ‘causation’ logic that has traditionally underpinned project management processes [16]. They develop and test a model to explore the portfolio- and project-level influences on the application of effectuation in project management [17]. They find that portfolio governance mechanisms related to business case use and portfolio monitoring inhibit the use of effectuation, while project innovativeness is associated with increased use of effectuation [18].

If we consider all this, the purpose of our research is the development of a method for assessing the effects arising from the implementation of the innovative projects to contribute to decision-making on expediency of investment in the project [19].

2 Materials and methods

2.1. Materials

The research is based on 196 innovative projects, various types of economic activities implemented in the Republic of Tatarstan, including:
- services sector – 54 %;
- manufacturing industry – 37 %;
- mining industry – 9 %.

The decision regarding the implementation of the innovative project depends on the priority trends of activity of the company, therefore, from our point of view, their correlation should be studied with the external effect (table 1).

| Type of effect | The result |
|---------------|------------|
| Economic      |            |
| External      | cash flows related to the additional tax revenues to the budgets of different levels; the accumulation of advanced |
| Internal      | increase in gross profit, increase in financial stability; increase in business activity; reduction of production costs; |
technological and organizational experience  
production costs optimization 

Social  
improving the quality of products;  
wage growth;  
all levels professional  

improving the quality of life;  
the increasing level of education;  
change of living standards;  
employment rates increasing  
equipment, appropriate to modern requirements;  
changes in the market of production factors through the change of supply and demand;  
labor skills accumulation;  
the accumulation of advanced technological and organizational experience  
period of meaningful use change;  
emissions and effluents amount change;  
changes in the level of concentration of harmful substances in the soil, water and in the air  
development;  
the improvement of working conditions;  
effective use of working time  
productivity increasing;  
improving of the quantity and quality of products;  
reducing production cycle by maintaining the basic production of qualitative and quantitative characteristics;  
increasing of the level of automation and mechanization of production  
the level of industrial and transport noise change;  
emagnetic field characteristics changes;  
vibration level change;  
nuclear radiation level change;  
visual comfort increasing  

Source: developed by the author

Accentuated effects show a direct interconnection of the effectiveness of innovative projects implementation in the internal and external environment [20]. The presence of the innovative project implementation effects in internal and external environment underlies for developing the algorithm of assessment of efficiency of innovative projects [21]. The largest number of researched innovative projects has the technological internal effect (83 %), followed by economic (80 %) and ecological internal effects (42 %). Innovative projects internal effects depend on the company’s needs and reserves of production and its economic activity [22]. Average number of internal effects of researched projects is two. In order to reach a bigger number of projects and simplify the calculations we left only two internal effects for each project. The presence of only two effects for each innovative project is due to the feasibility of investment in innovation.
2.2 Methods
As the primary tool for the assessment of the effectiveness of innovative projects we have used the method of correlation and regression analysis illustrating the interconnection between the internal and external effects arising through the implementation of an innovative project. Correlation-regression analysis allows to determine the interconnection between technological ($X_1$) or ecological ($X_2$) internal effects and social ($Y_1$) or economic ($Y_2$) external effects.

3 Results and Discussion
Innovative project efficiency assessment was based on the commensurability of the indicators, therefore, we grouped innovative projects by types of economic activity, investment strategy and results. The distribution of innovative projects effects in service sector is presented in table 2.

Table 2. Distribution of effects on innovative projects in service sector.

| Innovative project | Internal factors % | External effects % |
|--------------------|--------------------|--------------------|
|                    | Technological $X_1$ | Ecological $X_2$ | Social $Y_1$ | Economic $Y_2$ |
| Automation of restaurants | 20 | 20 | 2.6 | 60 |
| System control and monitoring tasks | 32 | 5 | 1.3 | 26 |
| Autovaccine for cancer treatment | 20 | 50 | 0.01 | 10 |
| Biogel for bonding a variety of tissues of a living organism | 60 | 0 | 1.44 | 31 |
| A service that helps under-take "comfortable" travel companions | 38 | 10 | 0.14 | 50 |
| Computer test simulator definitions psychological on mood of the person | 10 | 0 | 1.18 | 75 |
| The service registration of purchases made in real Commerce on the Internet | 20 | 0 | 1.76 | 50 |
| Service that allows operate residential and non-residential Fund | 12 | 33 | 5.68 | 18 |
| Equipment for remote fire fighting | 27 | 20 | 0.36 | 13 |
| Capsule for non-invasive sampling of bile | 40 | 15 | 0.14 | 15 |
| System for targeted delivery of drug substances | 25 | 20 | 0.36 | 10 |
| A device that provides Internet connection and telephone | 25 | 20 | 0.68 | 10 |
| Electro-optical systems, training and laboratory complexes | 30 | 10 | 0.94 | 20 |

Source: developed by the author.

The distribution of effects on innovation projects for manufacturing industry is presented in table 3.

Table 3. Distribution of effects on innovation projects for manufacturing industry.

| Innovative project | Internal effects, % | External effects, % |
|--------------------|---------------------|---------------------|
|                    | Technological $X_1$ | Ecological $X_2$ | Social $Y_1$ | Economic $Y_2$ |
| The source of energy for the processing of waste of agricultural | 50 | 30 | 0.08 | 5 |
| Processing of natural bitumen, fuel oil, highly viscous oil and tar | 40 | 10 | 0.08 | 5 |
The distribution of effects on innovation projects for the mining industry presented in table 4.

| Innovative project | Internal factors % | External effects % |
|--------------------|---------------------|-------------------|
|                    | Technological X₁  | Ecological X₂     | Social Y₁  | Economic Y₂ |
| Energy saving method of soft, non-destructive effects for the well | 10 | 80 | 10 | 67 |
| Reusable compact multi-function covering device for repair of wells | 32 | 40 | 6 | 3 |

Source: developed by the author

Summary results of correlation regression analysis of effects arising from the implementation of innovative projects is presented in table 5.
Table 5. Summary results of correlation regression analysis effects from innovative projects.

| № | Type of economic activity | Equation of social/economic external effect | Statistical significance | Effect of the greatest impact | Particular coefficient of elasticity | Multiple coefficient of correlation |
|---|--------------------------|---------------------------------------------|--------------------------|-------------------------------|-------------------------------------|----------------------------------|
| 1 | Projects in the service sector | $Y_1 = 2.53 - 0.0436X_1 - 0.00321X_2$ | securely | Technological, $X_1$ | $E_1 = 0.94$ | $R = 0.937$ strong |
| 2 | Manufacturing industry projects | $Y_1 = 0.24 - 0.00406X_1 + 0.0133X_2$ | securely | Technological, $X_1$ | $E_1 = 1.94$ | $R = 0.29$ low |
| 3 | Mining industry Projects | $Y_1 = 11.82 - 0.18X_1 - 0.291X_1 - 0.0508X_2$ | securely | Technological, $X_1$ | $E_1 = -1.48$ | $R = 0.8$ strong |

Source: calculated by the author

Private coefficient of elasticity $E_i$ shows how the changes of external effects $Y_i$ depend on changes of the internal effects $X_i$ at a fixed position of other factors in the model. If $|E_i| < 1$, the influence of this factor is significant, in the case when $|E_i| > 1$, the factor has significant influence.

Multiple correlation coefficient $R$ assesses the tightness of the joint influence of internal effects on the external effect. When $R$ is close to 1, the regression equation better describes the actual data and factors have a stronger impact on the result. When $R$ is close to 0, the regression equation badly describes the actual data and factors have a weak influence on the result.

The analysis of the interconnection between internal ecological and technological effects from the implementation of innovative projects in service sector with social and economic external effects showed:

1. external social effect $Y_1$ does not have not a substantial connection with the internal ecological and technological effects ($X_1$, $X_2$);
2. external economic effect $Y_2$ has strong and significant connection the ecological and technological effects ($X_1$, $X_2$);
3. the most influence on the external $Y_1$ provides internal ecological factor $X_1$;
4. the internal technological effect $X_2$ has the greatest influence on the external $Y_2$ effect;
5. the equation of external social effect $Y_1 = 0.85 - 0.0147X_1 - 0.000499X_2$ is statistically unreliable;
6. the equation of external economic result $Y_2 = 69.61 - 0.79X_1 - 1.06X_2$ is statistically reliable.

The analysis of the interconnection between internal ecological and technological effects from the implementation of innovative projects in the manufacturing industry with external social and economic effects showed:

1. external social $Y_1$ and economic $Y_2$ effects have strong and significant interconnection with internal effects;
2. ecological effect $X_1$ has the greatest impact on externalities $Y_1$ and $Y_2$;
3. the equation of external social effect $Y_1 = 0.39 - 0.00907X_1 + 0.00447X_2$ is statistically reliable;
4. the equation of external economic effect \( Y_2 = 9.67 - 0.11X_1 + 0.0722X_2 \) is statistically unreliable. The analysis of the relationship between the internal technological and environmental effects from the implementation of innovative projects in the mining industry with external social and economic effects showed:

1. external social \( Y_1 \) and economic \( Y_2 \) effects have a significant interconnection with internal effects \( X_i \);
2. ecological effect \( X_1 \) has the greatest impact on the external social effect \( Y_1 \);
3. internal ecological effect \( X_1 \) has the greatest influence on the external economic effect \( Y_2 \);
4. the equation of the external social effect \( Y_1 = -30.61 + 0.6X_1 + 0.41X_2 \) and external economic effect \( Y_2 = 55.64 - 1.06X_1 - 0.58X_2 \) are statistically reliable.

The result of the correlation analysis is equations that show interconnection of internal effects \( X_i \) on external effects \( Y_i \) of the innovative project implementing in the three basic sectors of the economy. Sample size and analysis of such parameters of the regression equation as statistical significance, private elasticities and multiple correlation coefficient, allow concluding that the regularities can be applied to any innovative projects relating to specified industries.

4 Conclusions

1. Assessment of efficiency of the innovative project should be based on strategic and tactical development plans of innovative-active companies and also on effects from implementation of the innovative project to the external and internal environment.
2. The greatest efficiency gains in the external environment occurs due to the growth of investment in the technological direction of the project, which determines the need to concentrate investment on this aspect.
3. Implementing innovative projects in the services sector, lead to significant internal technological and ecological effects have a significant impact on the external economic effect and do not affect the external social effect. The greatest external influence on economic effect has internal technological effect.
4. It is typically for manufacturing and mining innovative projects that internal technological and ecological effects have a significant effect on external economic and social effects.
5. Wherein internal ecological effect has the greatest impact on both external effects. The internal technological effect has the greatest impact on the external social effects and the internal environmental effect has the greatest impact on the economic external effect.
6. Correlation analyze allows concluding that interconnection between studied effects is insignificant, and the greatest influence on external effects \( Y_1 \) and \( Y_2 \) has the \( X_2 \) effect. Therefore, the \( X_1 \) effect may be excluded from the model of innovative project effectiveness assessment, as it does not have a significant external effect, or it can be an accompanying effect of an innovative project.

References

[1] Ustinovičius L, Rasiulis R, Nazarko L, Vilutienė T, Reizgevicius M 2015 Innovative Research Projects in the Field of Building Lifecycle Management. Procedia Eng. Doi.org/10.1016/j.proeng.2015.10.021.
[2] Roy D N C, Roy D N G 2019 Risk Management in Small Hydro power Projects of Uttarakhand: An Innovative Approach. IIMB Manag. Rev. Doi.org/10.1016/j.iimb.2019.10.012.
[3] Vatalis K I, Manoliadis O G, Mavridis D G 2012 Project Performance Indicators as an Innovative Tool for Identifying Sustainability Perspectives in Green Public Procurement. Procedia Econ. Financ. doi.org/10.1016/s2212-5671(12)00046-9.
[4] Lu Z, Peña-Mora F, Wang X R, Shen C Q and Riaz Z 2015 Social Impact Project Finance: An Innovative and Sustainable Infrastructure Financing Framework. Procedia Engineering Doi.org/10.1016/j.proeng.2015.10.094.
[5] Sobotka A 2017 Innovative solutions in engineering of construction projects Procedia Engineering Doi.org/10.1016/j.proeng.2017.11.034.

[6] Syreschikov V P, Yuhtanova O 2012 Applied innovative projects as an incentive of the educational process IFAC Proceedings Volumes (IFAC-PapersOnline) Doi.org/10.3182/20120619-3-RU-2024.00065.

[7] Bari F, Meru D, Damarco C, Greco C, Malan S, Marchetto G, Roa Tirado S, Tisseur R, Violante M, Zangari G, Caruso S, Masoero M, Saba F 2015 The EcoThermo project: Key and innovative aspects Energy Procedia Doi.org/10.1016/j.egypro.2015.11.697.

[8] Baldassarri C, Mathieux F, Ardente F, Wehmann C, Deese K 2016 Integration of environmental aspects into R&D inter-organizational projects management: Application of a life cycle-based method to the development of innovative windows. J. Clean. Prod. 112 pp. 3388–3401 Doi.org/10.1016/j.jclepro.2015.09.044.

[9] Mammadov J, Huseynov E, Talibov N, Akhmadova T, Ganjaliyeva G 2018 Development of Program Tool For Expert Assessment of Innovation Projects in the Scientific Technopark. IFAC-PapersOnline. Doi.org/10.1016/j.ifacol.2018.11.248.

[10] Vrchota J, Řehoř P 2019 Project management and innovation in the manufacturing industry in Czech Republic. Procedia Comput. Sci. Doi.org/10.1016/j.procs.2019.12.206.

[11] Poteralska B 2019 Decision Support System in the Area of Generating Innovative Research Projects of the Future Procedia Engineering Doi.org/10.1016/j.proeng.2017.03.160.

[12] Kaiser A, Larsson M, Girhammar U A 2019 From file to factory: Innovative design solutions for multi-storey timber buildings applied to project Zembla in Kalmar, Sweden. Front. Archit. Res. Doi.org/10.1016/j.joar.2018.12.001.

[13] Bozhko L, Naizabekov A 2017 Challenges of securing the human resources for implementation of industry innovative projects in Kazakhstan Energy Procedia Doi.org/10.1016/j.egypro.2017.09.046.

[14] Bruno T, Gelderman C J, Lambrechts W, Semeijn J 2018 The promise of Best Value Procurement: Governance and (in)stability of specifications within an innovative biogas project J. Clean. Prod. Doi.org/10.1016/j.jclepro.2017.10.251.

[15] Maranhão R, Marinho M, De Moura H 2015 Narrowing Impact Factors for Innovative Software Project Management Procedia Computer Science Doi.org/10.1016/j.procs.2015.08.613.

[16] Papelniuk O 2016 Systematization of Costs and Effects as a Method of Costs Management in Innovative Projects of Underground Construction Procedia Engineering Doi.org/10.1016/j.proeng.2016.11.856.

[17] Baranov A, Muzyko E 2015 Valuation of Compound Real Options for Investments in Innovative Projects in Pharmaceutical Industry Procedia Econ. Financ. Doi.org/10.1016/s2212-5671(15)00980-6.

[18] Gebhardt K, Riel A, Maes T 2019 Corporate entrepreneurship in complex organisations: Towards a holistic decision aid tool set to analyse and plan innovative design projects Procedia CIRP Doi.org/10.1016/j.procir.2019.04.312.

[19] Jissink T, Schweitzer F, Rohrbeck R 2019 Forward-looking search during innovation projects: Under which conditions it impacts innovativeness. Technovation Doi.org/10.1016/j.technovation.2018.07.001.

[20] Kostrzewski M, Kosacka-Olejnik M, Werner-Lewandowska K 2019 Assessment of innovativeness level for chosen solutions related to Logistics 4.0. Procedia Manuf. Doi.org/10.1016/j.promfg.2020.01.080.

[21] Romanova A I, Romanov D S, Maksimchuk O V, Voronin A V 2018 Basic principles of innovation management in the urban economy of Smart-city. Int. J. Eng. Technol. 7 pp. 412–415 Doi.org/10.14419/ijet.v7i4.38.24593.

[22] Sayfullina F M, Mustafina L R, Semenov D N 2018 Innovative technologies as the basis for sustainable development of road construction Russ. J. Innov. Econ. 8 pp 705–714 Doi.org/10.18334/vinec.8.4.39612.