

Public Financial Funds Efficiency Regarding the Development of Innovative Activities in Small and Medium-sized Enterprises: the Case of Slovenia

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In this article, the authors present a method of measuring the efficiency of use of national and European public funds for promoting action in companies, including the process from a draft idea to the placement of a product or service on market. The method of measuring has been done with a matrix system, through which we have shown the distribution of public funds between service brokers that offer services for the raising of the abilities to the companies. The matrix system includes the impact matrix of service brokers on innovation enablers. Based on the assembling matrix, we have composed efficiency measures, which can serve policyholders in guiding and controlling public funds.

Key words: Efficiency, public funds, matrix system, service, enabler, intermediary

1 Introduction

The article is the result of European project called IMPACT-SCAN¹, which has been carried out, by the following seven European regions: Lower Austria, Madrid, Bretagne, Limburg, Slovenia, Lower Silesia and Flanders.

The goal of the project was to develop a model that will enable effective monitoring of the consumption of public funds that are meant (intended) for development of innovative activity in small and medium-sized enterprises (SMEs). The regions have continually been reconciling work on the project and interchanging experiences. They set up a common framework of the model and then every region by itself developed details and an implementation of the model. This model is supposed to be used in regional policies to help to monitor and to redirect invested public financial means for development of innovative activity in such a way that their effects would be the greatest.

The core of the model are three matrices (M_1 , M_2 and M_3) which are described in more detail in Section 2.

Matrix M_1 shows the distribution of means between intermediaries that are offering services to enterprises for developing their innovative activity and policy objectives. Matrix M_2 shows the distribution of means between the intermediaries and types of services that they are offering to enterprises. Matrix M_3 shows an impact of individual services on innovative enablers. The efficiency measure of invested means by individual services, which are offered by intermediaries, is conducted based on these matrices. Based on this measure, regional policyholders can direct or rearrange public means in such a way that they achieve the maximum effects of innovative growth in SMEs.

2 Description of Matrix M_1

As mentioned in the introduction, Matrix M_1 shows a distribution of public funds regarding the goals of policy between service intermediaries, which they offer to enterprises to maximize innovative ability. In Slovenia, we have divided the goals of policy into five categories as:

¹ www.impactscan.net. Project Management team: Uroš Stanič, Robert Rudolf, Vanja Rangus, Nataša Mršol; Expert team: Maja Bučar, Jože Jesenko, Aleš Mihelič; European programme: IMPACTSCAN, City of Ljubljana 2007.

1. Enhancement of the firms' capacity and an increase in the number of innovative firms.
2. Cooperation and networking addressed to technology and business issues.
3. Increase in availability of technology and make it accessible to SMEs
4. Development of international presence and activities of the regional firms, both through access to external markets and international cooperation
5. Support of the creation of new technology-based firms, from university environments.

We have divided intermediaries that offer individual services to enterprises into six categories:

1. Scientific and Technology parks
2. Service centers
3. RTD Institutions
4. Business associations
5. Economic development organizations
6. Administration.

We can write Matrix $M_1 = [m_{ij}]_{6 \times 5}$ as shown in Table 1.

In Matrix $M_1 = [m_{ij}]_{6 \times 5}$ symbol m_{ij} represents the elements of matrix and index 6 x 5 its dimension.

To fill this matrix, we have in particular used data from the state budget for different ministries, including the Ministry of Economy, the Ministry of Higher Education, Science and Technology, the Ministry of Defense, the Ministry of Labor, Family and Social Affairs.

The completed matrix for the years 2005 and 2006 in the case of Slovenia (www.impactscan.net) is shown in Table 1.

All the amounts in Matrix M_1 are in millions of euros, the sum of all elements of Matrix M_1 is equal to the used public financial means for accelerating (promoting) innovation in SMEs:

$$\sum_{j=1}^6 \sum_{i=1}^5 m_{ij} = 69.96 \text{ mio euro.}$$

3 Description of Matrix M_2

Matrix M_2 shows the distribution of public financial means for the acceleration of innovative activity in SMEs according to the types of services that are being offered by individual intermediaries. We have divided the types of services into 10 categories:

1. Access to information
2. Advice
3. Technology services
4. Project management
5. Networking/Clustering
6. Human resources
7. Access to finance
8. Incubating services
9. Finance
10. Infrastructure.

Table.1: Matrix M_1

Policy Objectives \Rightarrow						
Intermediaries \Downarrow	1.Enhancement of Innovation Capacity in companies (+human resources)	2.Business Network Cooperation	3. Increase technology availability & IT	4. Internationalization	5. Creation & support of NTBF	SUM
1. <i>Scientific and Technological Parks</i>	0.811	0.304	0	0	1.925	3.04
2. <i>Service centers</i>	6.987	0.919	3.678	0.368	2.758	14.71
3. <i>RTD institutions</i>	8.61	0	0	0	0	8.61
4. <i>Business Associations (Association Networks & Chambers of Commerce)</i>	2.991	4.625	0	3.294	0	10.91
5. <i>Economic - developmental organizations & funds</i>	9.89	0	0	0	0	9.89
6. <i>Administration</i>	17.1	3.192	0	0.456	2.052	22.8
SUM	46.389	9.04	3.678	4.118	6.735	69.96

Table 2: Matrix M_2

Services →	1. Access to information	2. Advice	3. Technology	4. Project Management	5. Networking/	6. Human Resources	7. Access to Finance	8. Incubating Services	9. Finance	10. Infrastructure
Intermediaries ↓										
1. <i>Scientific and Technological Parks</i>	0	0.118	0	0	0	0	0	0.183	0	0.699
2. <i>Service centers</i>	0.045	0.096	0.542	0	0.001	0.12	0	0	0	0.196
3. <i>RTD institutions</i>	0	0	1	0	0	0	0	0	0	0
4. <i>Business Associations (Association Networks & Chambers of Commerce)</i>	0.096	0.041	0.263	0.065	0.281	0.116	0	0	0	0.138
5. <i>Economic - developmental organizations & funds</i>	0	0	0	0	0	0	0.199	0	0.801	0
6. <i>Administration (Public Finance)</i>	0	0	0.114	0	0.013	0.74	0	0	0.099	0.034

Matrix $M_2 = [m_{2_{ij}}]_{6 \times 10}$ is conducted in such a way that each row shows the portion of means that have been used by some intermediary for performing (implementing) certain services. That is also the reason the sum of every row in this

matrix equals 1, that is $\sum_{j=1}^{10} m_{2_{ij}} = 1$ for $i = 1, 2, \dots, 6$. (See the table 3.1)

To complete Matrix M_2 we have used a special questionnaire, which was filled by intermediaries and experts performed the final distribution. (<http://www.svr.gov.si/filead->

Table 3: Matrix D

	1. <i>Scientific and Technological Parks</i>	2. <i>Service centers</i>	3. <i>RTD institutions</i>	4. <i>Business Associations (Association Networks & Chambers of Commerce)</i>	5. <i>Economic - developmental organizations & funds</i>	6. <i>Administration (Public Finance)</i>
1. <i>Scientific and Technological Parks</i>	3.04	0	0	0	0	0
2. <i>Service centers</i>	0	14.71	0	0	0	0
3. <i>RTD institutions</i>	0	0	8.61	0	0	0
4. <i>Business Associations (Association Networks & Chambers of Commerce)</i>	0	0	0	10.91	0	0
5. <i>Economic - developmental organizations & funds</i>	0	0	0	0	9.89	0
6. <i>Administration (Public Finance)</i>	0	0	0	0	0	22.8

min/srs.si/pageuploads/svet_za_konkurencnost) Matrix M_2 for Slovenia in the period dealt with is given in the Table 2.

As already mentioned, the sum of every row in this matrix equals 1. If we multiply matrix M_2 from left with diagonal matrix:

$$D = [d_{ij}]_{6 \times 6} \text{ Intermediaries } \times \text{ Intermediaries,}$$

which has sums on the diagonal elements, which intermediaries have used for performing individual services, we obtain Matrix M_{2v} expressed in sums:

$$M_{2v} = D \times M_2.$$

In this case, the sum of every row represents a quantity of money that an intermediary has spent for performing of services in SMEs with an intention to increase innovative ability in them. Matrix D for Slovenia is shown in Table 3.

If we perform the indicated multiplication $M_{2v} = D \times M_2$, we obtain Matrix M_{2v} shown in table 4.

By multiplying the transposed Matrix M_1^T with Matrix M_2 , we obtain a distribution of means by individual types of policies and types of services (Table 5). The elements of this matrix present the sums of public financial means that have been used for individual type of services with regard to type of policy; because of that, the sum of all elements of Matrix $M_1^T \times M_2$ equals a common sum of public means used to increase innovative abilities in SMEs, Therefore, we can write:

$$\sum_{j=1}^6 \sum_{i=1}^5 m1_{i,j} = \sum_{j=1}^{10} \sum_{i=1}^5 (m1^T m2)_{i,j}$$

We must mention that distribution of means by types of services and goals of policy provided this way is not uniform, which means that we can obtain different distributions of means using equal sums. The sums by rows and columns, in

contrast, are always the same, which is important for further use.

4 Description of Matrix M_3

Matrix M_3 presents the impact of the individual types of services that intermediaries are offering to enterprises, to innovation enablers in enterprises. We have divided innovation enablers into 10 categories (See detail in www.impactscan.net):

1. Strategy (Business strategy, Innovation strategy, Marketing strategy)
2. Structure & organization (How to structure the organization and decision-making process for innovation)
3. Innovation culture (How to create a company culture aimed at innovation)
4. Financial resources (The firm has strengthened its financing engineering /management)
5. Human resources (How to get the best out of entrepreneurs and employees)
6. Information & technology (How to get access to the right information, the right knowledge and competences and able to exploit them)
7. Idea Generation & creativity process (How to come up with new ideas)
8. Implementation of innovation (How to transfer innovation into ongoing business)
9. Marketing orientation & operation (How to find customers and open up new markets)
10. Exploitation of innovation (How to maximize profit from the innovation).

If we record the types of supporting innovation elements by rows, and types of services that are being offered by inter-

Table 4: Matrix M_{2v}

Services ⇒	1. Access to information	2. Advice	3. Technology	4. Project Management	5. Networking/	6. Human Resources	7. Access to Finance	8. Incubating Services	9. Finance	10. Infrastructure	SUM
1. Scientific and Technological Parks	0	0.36	0	0	0	0	0	0.556	0	2.124	3.04
2. Service centers	0.663	1.405	7.97	0	0.016	1.768	0	0	0	2.888	14.71
3. RTD institutions	0	0	8.61	0	0	0	0	0	0	0	8.61
4. Business Associations (Association Networks & Chambers of Commerce)	1.042	0.445	2.87	0.713	3.069	1.261	0	0	0	1.51	10.91
5. Economic - developmental organizations & funds	0	0	0	0	0	0	1.964	0	7.926	0	9.89
6. Administration (Public Finance)	0	0	2.591	0	0.296	16.873	0	0	2.259	0.781	22.8
SUM	1.705	2.21	22.041	0.713	3.381	19.902	1.964	0.556	10.185	7.303	69.96

Table 5: Distribution of means by individual types of policies and types of services

Services →	1. Access to information	2. Advice	3. Technology	4. Project Management	5. Networking/	6. Human Resources	7. Access to Finance	8. Incubating Services	9. Finance	10. Infrastructure	
Policy Objectives ↓											SUM
1.Enhancement of Innovation Capacity in companies (+ human resources)	0.60058	0.88539	15.12568	0.19547	1.07097	13.84023	1.964	0.14833	9.62025	2.9381	46.389
2.Business Network Cooperation	0.48315	0.31242	2.07732	0.30226	1.34346	3.00724	0	0.0556	0.31626	1.14229	9.04
3. Increase technology availability & TT	0.16577	0.3513	1.99277	0	0.004	0.44206	0	0	0	0.7221	3.678
4. Internationalization	0.33119	0.16951	1.11773	0.21527	0.93293	0.76242	0	0	0.04518	0.54378	4.118
5. Creation & support of NTBF	0.12431	0.49139	1.7275	0	0.02964	1.85005	0	0.35207	0.20331	1.95673	6.735
SUM	1.705	2.21	22.041	0.713	3.381	19.902	1.964	0.556	10.185	7.303	69.96

mediaries by columns, we could write Matrix M_3 as shown in Table 6.

This matrix is the most problematic, because we do not have accurate pointers and standards for measuring the impact of certain activities on supporting elements. To obtain an estimation of magnitude of impacts, we have decided that we will measure them on five-step scale, in which 0 means an insignificant impact of activity on the supporting element and 4 a very significant impact of activity on the supporting element. We have compiled a special questionnaire to request middle and small enterprises, which have used services of intermediaries to increase their innovative ability, to evaluate with marks from 0 to 4 the impact of an activity they have used on supporting elements. The questionnaire had some other questions, which we have not mentioned, because they are not important with regard to Matrix M_3 .

We chose a sample of small and medium enterprises and sent them a questionnaire. We chose the sample by means of sorting the enterprises by their title and then we have chosen every tenth enterprise (see detail in www.impactscan.net). We have gathered the data in Microsoft Excel and processed them with the application SPSS and then recorded the average evaluations in Matrix M_3 shown in Table 6

5 Measure of efficiency

The sum of evaluations in a column in Matrix M_3 gives a common impact of the type of service on all supporting elements:

$$s_j = \sum_{i=1}^{10} m3_{i,j} \quad j = 1, 2, \dots, 10.$$

The sum of elements of every column in Matrix $M_1^T \times M_2$ gives the sum of public means used for increasing the innovative ability in SME s:

$$v_j = \sum_{i=1}^6 (m1^T m2)_{i,j} \quad j = 1, 2, \dots, 10.$$

Quotient

$$q_j = \frac{s_j}{v_j} \quad j = 1, 2, \dots, 10.$$

gives us the efficiency of the use of public means for every single service, which impacts on particular innovation enablers and, by that, does not increase innovative ability of enterprise. The bigger the quotient, the bigger the efficiency of use of means with an individual type of service.

The reality of this measure is questionable, since not all of supporting elements are equally important to increase the innovative abilities of enterprises. To negate this defect, we have established a group of experts, who have evaluated the importance of individual supporting elements with regard to their contribution to the innovative ability of enterprises on the scale from 1 to 100. Group of experts were selected from five innovative enterprises and every one estimated contribution for all enablers to increase innovative abilities of enterprise. The weights in the Table 7 are averages of these five estimations of u_i , for $i=1, 2, \dots, 10$:

We have multiplied with these weights the impacts of types of services on supporting elements. By that, we have weighted the importance of individual supporting elements. The common impact of individual services on all supporting elements is equal to:

$$s_j^* = \sum_{i=1}^{10} u_i \cdot m3_{i,j} \quad j = 1, 2, \dots, 10.$$

Table 6: Matrix M_3

Services →	1. Access to information	2. Advice	3. Technology	4. Project Management	5. Networking/	6. Human Resources	7. Access to Finance	8. Incubating Services	9. Finance	10. Infrastructure	SUM
Enablers ↓											
1. Strategy	3.1	3.1	3.3	2.5	2.6	2.9	3	0	2.9	2.5	25.9
2. Structure & organization	2.8	2.4	2	2.6	1.6	2.6	2.5	0	2.5	2	21
3. Innovation culture	2.6	3.1	3	3.1	2.5	2.8	2.9	0	3	2.3	25.3
4. Financial resources	2.8	2.6	3.1	3	3.1	2.3	3.3	0	2.8	2.5	25.4
5. Human resources	2.6	2.5	3	3.4	2.6	3.1	1.3	0	2.6	2.4	23.5
6. Information & technology	3.3	2.3	3.1	3.4	2.9	2.9	2.5	0	2.3	2.5	25
7. Idea Generation & creativity process	3.1	2.9	2.9	2.6	2.3	3.4	2.8	0	2.3	1.9	24
8. Implementation of innovation	2.9	2.8	2.8	2.4	2.4	2.5	3	0	2.5	2.4	23.5
9. Market orientation & operation	2.8	2.8	2.3	2.6	2.5	2.9	2.6	0	2.3	2.9	23.5
10. Exploitation of innovation	2.6	1.9	2.9	3	2.1	2.9	1.8	0	2.1	1.6	20.9
SUM	28.5	26.3	28.3	28.6	24.6	28.1	25.5	0	25.1	22.9	

Table 7: Weights

Enablers ↓	Weight u_i
1. Strategy	52.333
2. Structure & organization	37.667
3. Innovation culture	48.667
4. Financial resources	41.333
5. Human resources	89
6. Information & technology	78
7. Idea Generation & creativity process	100
8. Implementation of innovation	78
9. Market orientation & operation	41.333
10. Exploitation of innovation	74.333

For simpler interpretation, we have normalized the quotients of efficiency of use of means (the use of means efficiency quotients) by individual types of services so, we have multiplied quotient of efficiency $\frac{s_j^*}{v_j}$ with $\frac{100}{S}$, where

$$S = \sum_{j=1}^{10} \frac{\sum_{i=1}^{10} u_i \cdot m3_{i,j}}{\sum_{i=1}^5 (m1^T m2)_{i,j}}$$

and obtained a formula for the

measurement of efficiency of use of public means to increase innovative ability in SMEs:

$$q_j^* = \frac{100}{S} \cdot \frac{\sum_{i=1}^{10} u_i \cdot m3_{i,j}}{\sum_{i=1}^6 (m1^T m2)_{i,j}} \quad j = 1, 2, \dots, 10.$$

In the case of Slovenia within the studied period and based on collected and processed data, we obtained the following coefficients of efficiency of use of public means to increase innovative ability in enterprises by individual services, which are being offered by intermediaries of services:

These pointers enable holders of developmental policy in certain regions to distribute means by individual interme-

Table 8: Coefficients of efficiency

Services	1. Access to information	2. Advice	3. Technology	4. Project Management	5. Networking/	6. Human Resources	7. Access to Finance	8. Incubating Services	9. Finance	10. Infrastructure
Coefficients of efficiency	17.344	12.112	1.341	41.642	7.5	1.488	12.914	0	2.498	3.162

diaries, which offer different services that have an effect on innovation levers in such a way that they achieve the best use of public means and maximum effect, i.e. the greatest increase of innovative ability in small and medium enterprises.

6 Conclusion

The matrix system adopted in IMPACTSCAN was intended to provide a useful and simple instrument for the European regions, allowing them to analyze the effectiveness of the innovation services system depending on the regional policies and resources. It starts from the consideration of the public budget for regional innovation policies, for regional intermediaries and for the provided innovation supported services (input-oriented view of the supply side).

The actual impact of those services on the factors enabling the firms' innovation and the appreciation of them made by small and medium-sized enterprises is analyzed from the point of view of the services demand (impact-oriented view of the demand side) regional policy markers and stakeholders.

The definition of a set of ratios and indicators interlinking both sides – services supply and demand – will complete a system producing immediate results and be easily understood by the innovation agents of the region. It will also facilitate an easily implemented process for the comparison of innovation policies in different regions.

The crucial element for this system is the availability and coherence of data. That is the reason there are so many different methods of gathering of information that could be suitable for regions.

To ensure the long-term success of the presented model, the model should be used for the supervision of the use of public funds for increasing innovative abilities of enterprises.

For practical use of the model, we would have to establish a system of permanent gathering and processing data. On the other side, the government would have to establish a system of regulation of innovative improvement of enterprises.

One of the most problematic points in such system is the assessment of weights. Therefore, one suggestion for further research is to find more optimal way to assess these weights.

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Jože Jesenko passed away in July 2009, a few days after sending the final version of the paper to the editor.

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Učinkovitost javnih finančnih sredstev pri razvoju inovativne dejavnosti v malih in srednjih podjetjih na primeru Slovenije

V članku smo avtorji prikazali postopek merjenja učinkovitosti izrabe javnih sredstev državnih in evropskih za pospeševanje inovativne dejavnosti v podjetjih od zasnove ideje do plasiranja izdelka ali storitve na trg. Sam postopek merjenja smo speljali z sistemom matrik s katerimi smo prikazali porazdelitev javnih sredstev med posredniki storitev, ki nudijo podjetjem za dvig njihove inovativne sposobnosti. Sistem matrik vključuje tudi matriko vpliva storitev posrednikov na podporne elemente inovativnosti. Na podlagi zgrajenih matrik smo zgradili mero učinkovitosti, ki lahko služi nosilcem politike za usmerjanje in nadzor nad javnimi sredstvi.

Ključne besede: Inovativnost, učinkovitost, javna sredstva, sistem matrik.