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Conference Paper

An inside look into a problem of innovation in selected Priority Axis of Innovative Economy Operational Programme 2007 - 2013 for Lower Silesia Region

54th Congress of the European Regional Science Association: "Regional development & globalisation: Best practices", 26-29 August 2014, St. Petersburg, Russia

Provided in Cooperation with:

European Regional Science Association (ERSA)

Suggested Citation: Zaleska, Marta; Mogiła, Zbigniew; Knap, Joanna (2014) : An inside look into a problem of innovation in selected Priority Axis of Innovative Economy Operational Programme 2007 - 2013 for Lower Silesia Region, 54th Congress of the European Regional Science Association: "Regional development & globalisation: Best practices", 26-29 August 2014, St. Petersburg, Russia

This Version is available at:

<http://hdl.handle.net/10419/124486>

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An inside look into a problem of innovation in selected Priority Axis of Innovative Economy Operational Programme 2007 – 2013 for Lower Silesia, Poland.

The economic crisis and the declining competitiveness of Europe, led to the orientation of cohesion policy for smart growth based on knowledge and innovation. Poland and its regions are in a specific socio-economical position characterized by a low share of higher value-added products and high technology-intensive ones in total export. They still need to bridge the gap towards the more developed EU countries and regions by shaping their competitive advantage. The main way to develop and maintain a competitive advantage is to trigger knowledge- and innovation-based entrepreneurship. Cohesion policy funds open up great opportunities for innovation. Nowadays, when the programming period 2007 – 2013 came to an end, it is increasingly important to assess effectiveness of the EU intervention in the context of innovation. The paper is the first part of the presentation of a method that allows to assess the role of the EU operational programs in determining the long-term development based on pro-innovative business sector. Due to the wide scope of the research, this paper presents the general characteristics of the typologies of innovations introduced through the implementation of EU projects within a region. The second stage of the study will be to determine how the various types of innovations are translated into a region's long-term development and the results of this research will be outlined in the next paper. The method is presented on the example of Measures 1.4, 4.1 and 4.4 of the Innovative Economy Operational Programme 2007 – 2013 (IE OP) for Lower Silesia (NUTS-2 region) in Poland. The detailed analysis of more than 81 pro-innovative-by definition- projects under the IE OP in Lower Silesia was carried out to assess their long-term effectiveness. In this paper the projects were classified to created categories of innovation (e.g. imitative, product-oriented, process-oriented etc.) which made basis for an analysis of the effects of the EU support in terms of innovations. The preliminary results imply that imitative innovations do not play a dominant role within the EU supported projects. What is more, the EU funding stimulates endogenous potentials of the region to implement innovations which allows to omit an “average income trap”. The results of the study may be used in future analyses as a contribution to the macroeconomic quantitative studies of the cohesion policy impact.

1. Introduction

In the modern world of business, innovation is a necessary condition for the survival and development of a firm. The concept of innovation is highlighted as the main factor of success and functioning in the market. However, when analysing the market realities, it is worth considering whether unreflective orientation towards innovations and research and development (R&D) is indeed a universal success factor in the context of the development of individual regions. In a situation when about 50% of GDP and 70% of employment in Poland are an effect of the activities of the sector of small and medium enterprises (SMEs) and also taking into account that, due to the scale of their operations, SMEs do not often have sufficient resources for innovation activities, external support is an extremely important aspect. Funds assigned under the EU Cohesion Policy have played a major role in this regard in Poland since 2004.

The paper is the first part of the presentation of a method that allows to assess the role of the EU operational programs in determining the long-term development based on pro-innovative business sector. Due to the wide scope of the research, this paper presents the general characteristics of the typologies of innovations introduced through the implementation of EU projects within a region. The second stage of the study will be to determine how the various types of innovations are translated into a region's long-term development and the results of this research will be outlined in the next paper. The method is presented on the example of Measures 1.4, 4.1 and 4.4 of the Innovative Economy Operational Programme 2007 – 2013 (IE OP) for Lower Silesia (NUTS-2 region)¹ in Poland. The detailed analysis of more than 81 pro-innovative²- by definition- projects under the IE OP in Lower Silesia was carried out to assess their long-term effectiveness. In this paper the projects were classified to created categories of innovation (e.g. imitative, product-oriented, process-oriented etc.) which made basis for an analysis of the effects of the EU support in terms of innovations.

The paper has the following structure. In the introduction, the concept of innovation is presented as well as different (classical and modern) interpretations of innovation term. Then, the typology of innovation is highlighted that forms the basis of the methodology used in this research. The following parts are devoted to the description of database and the presentation of project assignment to the innovation categories. The paper ends with the main conclusions.

2. The concept of innovation.

Today, innovation is not associated anymore with the concept of “invention”. In the scientific literature, the first distinction between these concepts was made already at the beginning of the 20th century. This distinction was developed by Schumpeter, according to whom innovation is an act of intellectual creativity, whereas an invention “*is without importance to economic analysis*”. Innovation

¹ Lower Silesia is one of Poland's better developed regions. It is situated in western Poland, on the border with Germany. In 2011 its GDP per capita (in current prices) was 113.4% of the national average, which means that it ranked second in Poland after Mazowieckie Voivodeship.

² Under this research authors focused on projects dedicated to the SMEs. These are projects mainly from 1st and 4th Priority Axis of the Programme. Due to the lack of detailed data on regions, it was estimated that 81 analyzed projects were about 50% of projects from 1st and 4th Priority implemented in Lower Silesia region.

is more a continuation of an invention, an act of its adaptation and implementation to the economic and social reality. Other distinctions between these concepts are based on the practical application of innovations. Innovation is defined as technical and economic success in the implementation of a certain idea (Heunks 1998), while others perceive innovation (unlike an invention) as not only the creation of something new, but also the incorporation of added value that consumers receive thanks to a new product (O'Sullivan Dooley 2009).

The basic definitions and types of innovation have been established by the OECD. This organisation defines innovation *“as the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations”*. The earlier applicable definition (OECD 1981) described innovations as *“all those scientific, technical, commercial and financial steps necessary for the successful development and marketing of new or improved manufactured products, the commercial use of new or improved processes or equipment or the introduction of a new approach to a social service. R&D is only one of these steps”*.

In the classical approach (Schumpeter 1960), innovation means the introduction of a new solution into practice. Technical innovations and their impact on the economy were primarily the subject of discussion. Any dissemination of innovations is a separate type of change termed imitation. Schumpeter is the author of the concept of creative destruction which is based on the constant destruction of old structures and the continuous creation of new more effective structures, which is innovation activity.

It is characteristic that this definition relates innovation to large-scale radical changes or small-scale changes which have a significant impact on changes in the structures of markets and industries. In this approach, new production methods are not necessarily based on new inventions. The first use of existing technologies in new industries can also be regarded as new methods. This type of approach to this problem results from the linking of innovation to the product manufacturing process.

However, in reality the definition of “radical change” indicated by Schumpeter poses serious difficulties. In his theory, there is no clear distinction between innovation as a radical change and other types of innovativeness. This author states that the “creative destruction” leads to the replacement of an old technology and introduces new opportunities, but the perception of these opportunities can be subjective and depend on the point of view and measurement method.

The approaches of other authors emphasise the importance of “novelty” in the perception of innovation. Innovation is interpreted as “the first use of an invention” (Mansfield 1968), “an innovation refers to any good, service, or idea that is perceived by someone as new” (Kotler 1999), “innovation is anything that is perceived as new, regardless of the objective newness of a given idea or object” (Rogers 1962), or “the first commercial introduction (application) of a new product, process, system or device” (Freeman 1982). At the same time, however, the literature stresses that the criterion of “novelty” may not be the main determinant of innovation, but it relates more to inventions or ideas that are subsequently transformed and implemented for use in practice.

Certain changes in the perception of the concept of innovation can be observed. While in the 1960's innovation was primarily considered in conceptual terms, by referring it to the situation of individual markets, in the 80's an interest developed in the relativity of this concept, referring it to particular dimensions and levels of functioning (innovation at the level of an enterprise, market, industry or at the global economy level). The criterion of "novelty" relates more and more frequently to such perception of a given idea, object or practice by the unit of adoption, that is, a specific group of their adapters. A summary of this approach is the definition (Walker 2008) in which innovation is perceived as "*a process through which new ideas, objects and practices are created, developed or reinvented and which are new and novel to the unit of adoption*".

In one of the most comprehensive reviews of the literature (Kotsemir Abroskin) devoted to the innovation definitions, it is said that the definition of innovation is linked not only to the concept of "novelty" but also to the concept of change as well as effectiveness in terms of market game and quick introduction of new products. These authors emphasise that the concept of innovation cannot be contained in one definition due to its complex and complicated nature as well as on account of the variability of the environment in which it functions. Therefore, in various scientific fields innovation is often perceived as a concept depending on the investigated aspect. In economic theory, it is thus perceived to be closer to the concept of "novelty", while in management theory it is more perceived in terms of the creation of competitive advantage.

In the literature, innovation is also classified according to its particular aspects (Ram 2010). The following aspects of innovation have been distinguished: innovation as something new, a reason for change, a process, a value added medium, or an invention. Each of these aspects of innovation can be expressed by the definitions contained in the literature (Barnett 1953; Drucker 1985; Aiken 1971; Wang & Kafouros 2009; Zaltman Duncan and Holbek 1973). Innovation is therefore something more than the introduction of completely new products or services, while an invention is only one of elements of innovation. Hence, innovations should be considered at least from two points of view; firstly, as a novelty, that is, something that did not previously exist, and secondly, as a novelty within the meaning that something was not previously made by the industries or the enterprise which now manufacture it.

3. *The typology of innovation.*

With the evolution of this concept, the typology of innovation has also evolved. The classification of innovation adopted by the OECD distinguishes 4 types of innovation: product, process, marketing and organisational innovation. Product innovation relates to goods and services and means significant improvements in technical specifications, components and materials in developed products and services in terms of their user friendliness and other functionality characteristics. Process innovation relates to new or significantly improved production or delivery method. It means significant changes in techniques, production, equipment and/or software. Marketing innovation relates to the area of new marketing methods and involves significant changes in product packaging or

design, product placement or promotion. It means greater customer satisfaction from the product, the creation of new markets or a better market position for the one introducing an innovation. Organisational innovation relates to the implementation of a new organisational forms and methods in an enterprise and means the introduction of business practices in workplace organisation or external relations of the enterprise. A similar typology distinguishes product, process, positional and paradigm innovation (Bessant Tidd 2007). This latter type is undoubtedly a much wider concept than organisational innovation, since it includes all changes in the behaviour of a firm and its strategy in relation to the definition. The typologies consisting of process, product and information innovations are found in a number of literature references on the typologies of innovation. They can be included in classical typologies which are largely based on Schumpeter's theory and established in relation to the object of innovation.

There are also more exotic typologies; in recent years, a number of new types of innovation have been defined and the following can be included in them, among others: frugal innovation (Tiwari and Herstatt 2011), organic innovation (Moore 2005), blue ocean innovation (Kim and Mauborgne 2005), and open innovation (Chesbrough 2003). These types are primarily developed with a view to innovation management models and business models. Their characteristic feature is that they are described more attractively for the recipients and their definitions are simpler than those of strictly scientific typologies, but in the realities of Cohesion Policy implementation it is difficult to use them in relation to projects co-financed from European funds.

Typologies based on the degree of innovation are also commonly used. In these classifications, radical, breakthrough, revolutionary innovations can be described as innovations with a high degree of "novelty", while incremental innovations are characterised by a low degree of "novelty" (Garcia and Catalone 2002; Coccia, 2006).

Dichotomous typologies are yet another type of classification. The first of these dichotomy-based models (Henderson and Clark 1990) distinguishes four elements: incremental and radical innovations as well as architectural and modular innovations. In this model, incremental innovations are created based on the existing components and knowledge architecture. In turn, when a certain innovation revolutionises both the components and the whole knowledge architecture, we have to do with a radical innovation. Modular innovations require new knowledge with regard to the components, but the knowledge architecture does not change. Architectural innovations are the opposite of modular innovations, that is, they have a huge impact on the knowledge architecture (on the relationships between the individual knowledge components), whereas the knowledge within the individual components does not change. A second model that is worth mentioning (Abernathy and Clark 1985) includes regular – revolutionary innovation and market niche – architectural innovation. Yet another example of the dichotomous classification can be disruptive – evolutionary innovation (Christensen 1997) where the essence is the dichotomy of two types of innovation – sustaining/evolutionary innovation and disruptive innovation. An evolutionary innovation improves the functioning of existing products in terms of their importance/functionality for the customer. In turn, a disruptive innovation

helps create new needs, markets and networks or disrupts the functioning of existing markets, displacing an earlier technology.

In terms of the role of innovation in the development of a firm (Penc 1999), strategic innovation and tactical innovation are distinguished. Strategic innovations are long-term changes that have a significant impact on the firm's development and are important for its future. Tactical innovations, in turn, relate to minor changes in production techniques, technologies or manufacturing methods and organisation which take place in the day-to-day activities of enterprises and are designed to improve their operation, thereby introducing improved products and enhancing the quality but also meeting better the needs of the society.

For the needs of this paper, a typology was created based on a review of the literature on innovation activities; this typology is shown in Table 1. The criteria and dimensions were selected in a way that allowed the characteristics of innovation to be presented in a comprehensive and broadest possible manner.

Table 1. The proposed typology of innovation to be used in the studies on innovation activities.

Criterion	Dimension	
	Objective perspective	Enterprise perspective
Object	1. Product innovation 2. Process innovation 3. Marketing innovation 4. Organisational innovation	
Novelty	1. Radical innovation 2. Incremental innovation 3. Imitative innovation	1. An innovation to the firm 2. An innovation that improves existing technologies, processes, products of the firm
Spatial scale of innovation	1. International 2. European 3. National 4. Regional 5. At enterprise level	
Role of innovation in the firm's development	-	1. Tactical innovation 2. Strategic innovation
Source of knowledge/innovation origin	1. Endogenous sources (region) 2. Mixed sources (know-how originating from interregional and/or foreign cooperation) 3. External sources (outside the region)	1. An innovation based on own research 2. An innovation based on research commissioned externally 3. An innovation purchased from the outside 4. Cooperation
Supported industry	1. An innovation supporting the current economic structure in the region 2. An innovation supporting new industries (e.g. infant ones)	-

Source: Authors' own compilation.

This typology is based on the literature research and largely refers to the most frequently used divisions of innovation discussed earlier. The analysis of the type of innovations introduced through the implementation of the EU projects is made through the prism of 6 criteria, including the criteria that are commonly cited in the literature such as the object of innovation, the degree of novelty, and the scale of innovation. They allow us to determine the basic parameters of innovations. The criterion of the object of innovation refers to the OECD's classical typology, referring in turn to the classical typology according to Schumpeter, which does not require extensive justification. The criterion of

“novelty” refers to the model of Henderson and Clark (1990), with creative (radical and incremental) innovations being complemented with imitative innovations (which involve the implementation of innovations that have already been used in practice in order to achieve specific benefits); this allows innovations to be characterised exhaustively in terms of their contribution to the global development of goods and services. In turn, the selection of the criterion “role of innovation in the firm’s development” is driven by an attempt to determine the weight of an introduced innovation in shaping the specificity and dynamics of the firm’s development. Therefore, this criterion is strictly subjective and the determination whether a particular product, service or production process is tactical or strategic for the firm is dependent, among others, on the firm’s production structure, cost structure and development vision that its management has. Assignment according to this criterion should be, in principle, based on interviews with beneficiaries. In the case of the criterion of innovation scale, the main goal is to obtain information whether a particular product, service, etc., is innovative only at the regional level or its qualities also allow the enterprise to be distinguished at the European or even international/global level.

The above criteria were expanded by adding the criterion of source of innovation origin, i.e. the place where the R&D activities were carried out, and the criterion of supported industry. Taking into account the place of innovation creation (the source of knowledge), from the point of view of the beneficiary, innovations can be divided into external and internal research. External sources of innovation are concentrated in domestic and foreign research institutions, organisations involved in the transfer of technologies, purchased licences and services. Internal sources of innovation include the results of work of the R&D department of the firm, its managerial personnel, quality circles, cooperation with suppliers, customers and employees who should be considered to be the main source of innovation. In turn, cooperation allows us to distinguish the cooperation of the beneficiary enterprises with their external sources. As far as the objective perspective is concerned, we can distinguish innovations of endogenous origin (the knowledge and know-how on the basis of which innovations are developed are created within the region), innovations of mixed origin (innovations created in cooperation with institutions from outside the region and foreign entities), and innovations of external/exogenous origin where the phenomenon of “creative application” sometimes occurs (the knowledge and know-how are transferred from outside the region and are locally applied within the region). This criterion will allow us to identify whether introduced innovations are predominantly based on knowledge created within the region or rather on knowledge that is applied from the outside as well as whether the enterprises are based on their own research or on external knowledge. The criterion of the type of supported industry will enable us to carry out an analysis taking into account the region’s economic structure. In other words, it will be possible to analyse to what extent supported innovations relate to the economic industries already developed within the region and to what extent they apply to the industries of little importance to the economy. On the one hand, this may allow us to identify new growth potentials emerging in the region, while on the other hand, it can be an element of

evaluation of the EU programme in terms of its effectiveness in supporting business specialisations and in terms of the correctness of selection of projects.

It should be underlined that the above criteria are considered in 2 dimensions – from the objective perspective and from the point of view of the beneficiary, i.e. the enterprise introducing innovations. Due to their nature, the criteria of the object, novelty and scale of innovation are common for the two above-mentioned dimensions of the analysis. A combination of several criteria and dimensions will allow providing more eclectic analysis and characteristics of innovations developed under the operational programmes. The review of the literature on innovation typologies shows that analyses of innovation in one established typology is insufficient to capture its complete and complex nature. In other words, it does not allow to form the basis for comprehensive evaluation of innovation in the context of its contribution to the region's development.

4. Database description.

Projects implemented by entrepreneurs in Lower Silesia under the 1st and 4th priority axis, Investment in innovative projects, of the Innovative Economy Operational Programme were analysed. From the mentioned priority axis, projects carried out as part of the following measures were selected:

- Measure 1.4 & 4.1³ Support for R&D and implementation of R&D results; and
- Measure 4.4 New investments of highly innovative potential.

Data on the a.m. projects were acquired from the Regional Financing Institution (RFI) for Lower Silesia – the Wrocław Regional Development Agency. They were obtained on 10 May 2014. Only projects supported by the RFI were reviewed. Because the RFI supported the a.m. projects only in some years of the 2007-2013 financial framework, the study of projects implemented under Measures 1.4 & 4.1 finally included 50 projects selected by calls for proposals over the period 2009-2011 and 31 projects under Measure 4.4 which were recommended for financial support during the period 2008-2009 and in 2013. Due to the lack of access to information on projects that received funding in the other years (projects supported by the Polish Agency for Enterprise Development (PARP) and institutions mandated by PARP to perform certain tasks), other projects were not included in this analysis.

The Measure 1.4 projects involved research and development, including technical, technological and organisational projects which were carried out by the entrepreneurs on their own or with the participation of external entities and which led to the creation of a prototype/service/technology. Positive results of R&D work carried out during stage I provided the possibility of carrying out the second stage of a particular project, i.e. the implementation of the outcomes of R&D financed under the first stage through investments (the purchase of fixed and intangible assets).

³ One project from Measures 1.4 & 4.1 was not taken into account due to the absence of documentation in the Wrocław-based RFI.

Under Measure 1.4, funding agreements for the implementation of stage I and stage II were signed with 33 beneficiaries, while in the case of 17 beneficiaries agreements were signed only for stage I of the projects. The total value of 50 projects is PLN 728,318,684.96, including the amount of eligible expenditure of PLN 583,669,262.52 and the amount of co-financing of PLN 271,536,733.37. Out of these 33 above-mentioned agreements for the implementation of stages I and II, 6 agreements were terminated, 15 were completed (both stage I and stage II), in 3 cases stage I of the project is approved as of today, in 5 cases R&D work is ongoing, while in 4 cases R&D work was completed with negative results of the research and in consequence the R&D outcomes were not implemented. Among the 17 agreements signed for the implementation of stage I of the project, 5 agreements were terminated, 10 are still under implementation, whereas in the case of one agreement the R&D results were negative. There is no information on the progress in the implementation of one of the 17 a.m. agreements, since it is now supported by the RFI for Opolskie Voivodeship.

The analysed Measure 4.4 projects involve the application of new technological, product, service or organisational solutions (technological and organisational solutions applied for no longer than 3 years in the world). The total value of the projects was PLN 1,315,617,919.51, while the amount of eligible expenditure was PLN 1,058,691,305.36. Funding valued at PLN 491,634,741.47 was awarded to the projects included in the study. As of today, 14 projects are under implementation, 12 projects were completed, whereas in 5 cases the agreements were terminated.

Most of the projects under Measures 1.4 & 4.1 and 4.4 are carried out by medium enterprises (37%), followed by large enterprises (26%) and small enterprises (23%). The lowest number of projects is implemented by micro-enterprises (14%).

A vast majority of the projects related to an unspecified manufacturing industry (more than 50%). The other projects were implemented as part of the following divisions of the economy: environment related activities, health care, postal services and telecommunications, retail and wholesale trade, building and construction, manufacture of food products, manufacture of transport equipment, and other unspecified services.

5. Results.

In an analysis of the support of innovative projects, the attention should be focused on the assignment of projects to different innovation types both in qualitative and quantitative terms. The analysis of the number of projects classified in a particular innovation category allow us to determine the number of potential economic impulses which - depending on the innovation dimension of a project, the potential demand for its effects, and the life cycle of a product - can stimulate qualitative changes in the economy regardless of the value of such projects. On the other hand, the analysis of the amount of funding allocated to particular types of innovation, compared to the number of supported projects, enable one to estimate the average cost intensity of a given project category. However, taking into account the fact that a low-value project may revolutionise the market, whereas a high-value project may have an

insignificant effect on the innovativeness of the economy, in this paper the authors are primarily focused on the quantitative issue.

The assignment of 81 projects implemented under Measures 1.4 & 4.1 and 4.4 of the Innovative Economy Operational Programme (IE OP) in Lower Silesia to the particular categories according to the **criterion of the object of innovation** shows that projects connected with both product and process innovation were most frequently co-financed (38 projects). The largest portion of funding was allocated to this type of projects (67.67%). Product innovations were the second group in terms of the size and number of projects (34 projects to which 15.35% of the amount of co-financing was allocated).

Table 1. Overall results for the assignment of 81 projects implemented under Measures 1.4 & 4.1 and 4.4 IE OP to the particular categories of the innovation typology according to 6 criteria and 2 dimensions.

OVERALL RESULTS for Measures 1.4 & 4.1 and 4.4	Number of projects	Percentage of projects (%)	Value of projects	Value of projects in percentage (%)	Amount of co-financing	Amount of co-financing in percentage terms (%)	Share of co-financing in the project value
<i>Criterion of the object of innovation</i>							
Process	5	6.17%	365 897 631	17.90%	103 324 370	13.54%	28.24%
Product	34	41.98%	246 745 975	12.07%	117 115 313	15.35%	47.46%
Process + product	38	46.91%	1 351 311 936	66.12%	516 408 241	67.67%	38.22%
Process + organisational	1	1.23%	25 947 943	1.27%	9 429 456	1.24%	36.34%
Process + product + organisational	1	1.23%	34 171 020	1.67%	10 000 000	1.31%	29.26%
Process + product + marketing	2	2.47%	19 862 100	0.97%	6 894 095	0.90%	34.71%
	81	100.00%	2 043 936 605	100.00%	763 171 475	100.00%	37.34%
<i>Criterion of novelty (from the objective perspective)</i>							
Imitative	33	40.74%	885 330 175	43.32%	351 840 937	46.10%	39.74%
Incremental	39	48.15%	866 916 943	42.41%	324 443 663	42.51%	37.42%
Radical	9	11.11%	291 689 487	14.27%	86 886 875	11.38%	29.79%
	81	100.00%	2 043 936 605	100.00%	763 171 475	100.00%	37.34%
<i>Criterion of novelty (from the point of view of the enterprise)</i>							
New to the firm	39	48.15%	1 252 130 456	61.26%	465 925 311	61.05%	37.21%
Improvement	42	51.85%	791 806 149	38.74%	297 246 164	38.95%	37.54%
	81	100.00%	2 043 936 605	100.00%	763 171 475	100.00%	37.34%
<i>Criterion of innovation scale</i>							
European	4	4.94%	85 680 955	4.19%	34 178 008	4.48%	39.89%
National	18	22.22%	288 222 934	14.10%	127 123 048	16.66%	44.11%
International	48	59.26%	1 111 349 728	54.37%	396 278 538	51.93%	35.66%
Enterprise level	10	12.35%	548 351 084	26.83%	200 694 851	26.30%	36.60%
Regional	1	1.23%	10 331 904	0.51%	4 897 030	0.64%	0.00%
	81	100.00%	2 043 936 605	100.00%	763 171 475	100.00%	37.34%
<i>Criterion of knowledge source (from the objective perspective)</i>							

External	11	13.58%	599 286 371	29.32%	191 899 993	25.15%	32.02%
Mixed	37	45.68%	1 049 793 043	51.36%	426 834 296	55.93%	40.66%
Endogenous	33	40.74%	394 857 191	19.32%	144 437 186	18.93%	36.58%
	81	100.00%	2 043 936 605	100.00%	763 171 4745	100.00%	37.34%
<i>Criterion of knowledge source (from the point of view of the beneficiary)</i>							
Own research	28	34.57%	493 042 648	24.13%	172 349 643	22.58%	34.96%
Commissioned research	10	12.35%	322 632 494	15.78%	146 077 709	19.14%	45.28%
Cooperation	29	35.80%	660 460 153	32.32%	260 817 016	34.18%	39.49%
Purchased from the outside	7	8.64%	429 937 162	21.03%	126 747 188	16.61%	29.48%
Purchased from the outside and own research	6	7.41%	126 536 954	6.19%	53 989 101	7.07%	42.67%
Own research + commissioned research	1	1.23%	11 327 194	0.55%	3 190 819	0.42%	28.17%
	81	100.00%	2 043 936 605	100.00%	763 171 475	100.00%	37.34%

Source: Authors' own calculations.

Taking into account the **criterion of novelty from the objective perspective**, the largest number of projects (39 out of 81) was assigned to the group of incremental innovations, whereas imitative innovations were the second largest group (33 projects). This means that projects that transfer already existing solutions to the region or consist in adding new unique properties to these solutions were mainly selected for financing. Radical innovations, i.e. revolutionary innovations involving the introduction of something that has not existed before and thereby creating new demand or markets, are relatively few.

Analysing in greater detail the group of imitative innovation projects, we notice that they mostly introduce product innovations. Imitative innovation projects are primarily projects that are innovations at the national level, whereas innovation projects at the enterprise level are the second largest groups. Imitative innovation projects are most often based on own research (39.39%), but slightly less frequently on cooperation and commissioned research. It can therefore be said that projects which can be described as active imitation are predominant in this group; these are projects that seek and introduce solutions hitherto non-existent in the Polish market, which creates competitive advantage and may initiate this type of activity in competitors, thereby leading in the long run to a higher quality of services and products offered and to increased effectiveness. To a large extent, these projects result from the cooperation with institutions abroad. A second numerous group comprises projects involving the introduction of solutions that are new to the enterprise, but which are already in common use – also in the region – and which are only an element enhancing the competitiveness of the enterprise or create the opportunity for the firm to enter new markets by introducing modern technologies and products that enable it to compete successfully within the region. Most frequently, the source of knowledge for this type of innovation is the firm's cooperation with

institutions from outside the region or its own research that allows the firm to reproduce particular solutions for its own use. This group of projects can be termed as passive imitation where the main motive is to ensure equal competitive opportunities in the market.

Figure 1. The number of imitative innovation projects by innovation category according to 5 criteria and 2 dimension – IMITATIVE INNOVATION (33 projects out of 81)

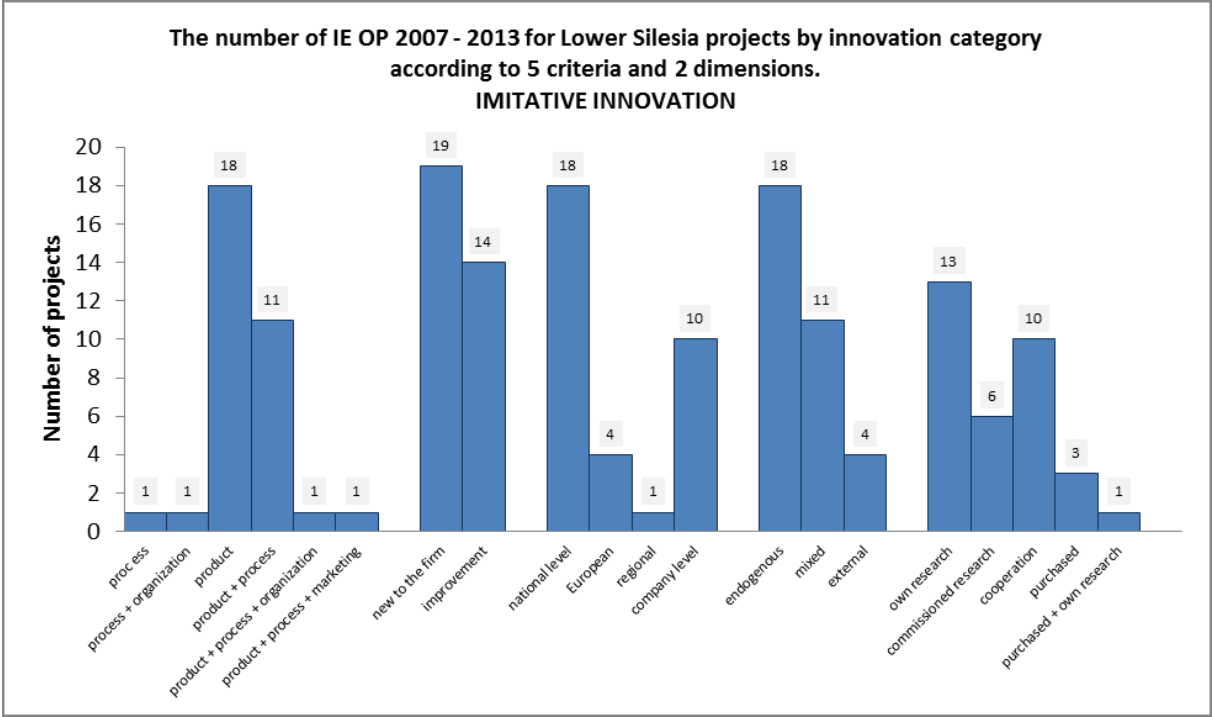
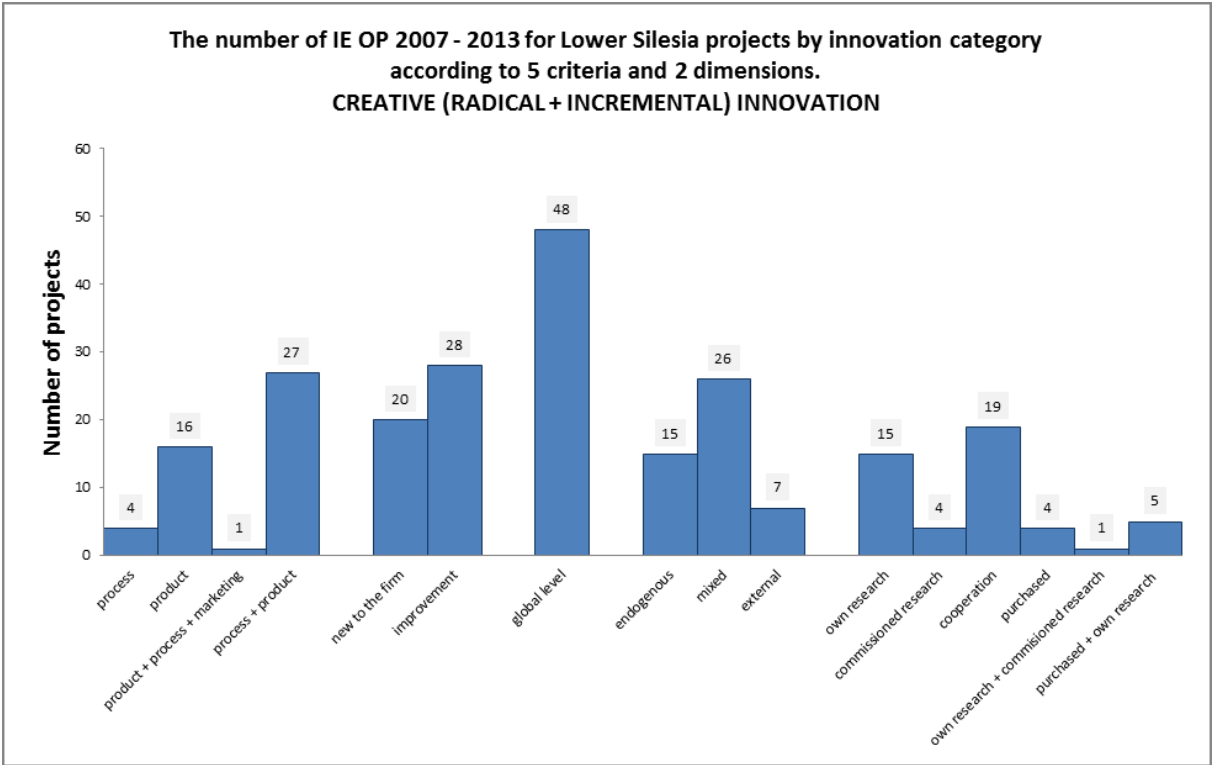


Figure 2. The number of creative (radical and incremental) innovation projects by innovation category according to 5 criteria and 2 dimensions – CREATIVE INNOVATION (48 projects out of 81)



Source: author’s calculations.

When we go over to the group of creative (incremental and radical) innovations, it can be seen that they are most often process and product innovation or product innovation, most frequently designed to improve the firm's existing business operations. Improvements most often arise from the firm's cooperation with research institutions. In other words, projects producing creative innovations are most often the effect of the beneficiary's experience enriched with the knowledge gained as a result of the cooperation with its partners from outside the region. On the other hand, about 40% of the projects in this group are those that are associated with the entry into a new area of activity for the beneficiary. The firms develop solutions enriched with new properties which are a novelty at the international level. Thus, they enter new markets offering an improved product relative to their competitors. Both the conclusions concerning active imitators and the above findings may suggest relatively high activity and creativity of the Lower Silesian beneficiaries of the IE OP associated with the skill to undertake difficult tasks – which undoubtedly is the entry into areas that are new to the enterprise, often with an improved product compared to its competitors (at the same time, not being based only on the cost advantage) or through the application of improved processes as well as by seeking and implementing solutions that enable the firm to gain competitive advantage.

Analysing the overall results according to the **criterion of novelty from the point of view of the beneficiary**, 39 out of 81 projects are new innovations to the firm, that is, the developed solutions relate to areas that have been unknown before to the enterprise, which entails the need to gather new knowledge and resources. This is usually associated with the launch of new business activities or the expansion of the offer and thus the entry into new markets. 42 projects relate to an improvement, i.e. solutions in the areas in which that the firm currently operates and where the beneficiary uses its existing experience.

Moving to the **criterion of innovation scale**, the predominance of creative innovation projects determines their predominance in quantitative and value terms at the international level (48 projects). Adding new, hitherto unknown, utility properties to already existing solutions or products cause them to be a novelty at the international level, despite that they do not produce revolutionary changes in the markets or industries. On the other hand, projects with innovation at the enterprise level make up a large group. This means that although a large portion of the amount of co-financing is allocated to projects whose effects are a novelty at the global level, innovations being a novelty only at the enterprise level are also a significant part. Innovations at the national level are also numerous, but given their relatively low average project value, it can be concluded that they are predominantly based on the transfer of solutions not used in the country before, which does not require substantial R&D

expenditure and most frequently comes down to the reproduction of a solution and its application.

Taking into account the **criterion of innovation source**, that is, the place of creation of the knowledge on which an innovation being introduced is based, mixed projects are predominant (37), i.e. the source of knowledge is research conducted in Lower Silesia in cooperation with research institutions from outside the region – located in other Poland's regions or abroad. 33 projects are based on knowledge originating from the region. The analysis of the projects in which the sources of knowledge forming the basis for innovations are endogenous undoubtedly provides the most interesting conclusions from the point of view of the concept of the present study.

Analysing the **criterion of innovation source from the point of view of the enterprise**, projects involving cooperation, i.e. the firm's cooperation with research centres, institutions, firms within the region and outside of it, slightly predominate; projects whose innovation is based on the beneficiaries' own research are also numerous. The next noticeable groups are projects based on research commissioned by the beneficiaries and involving the purchase of knowledge from the outside - i.e. the purchase of knowledge outside the firm and introducing it as a ready solution. Projects based on mixed sources where the beneficiary uses both own and commissioned research or uses knowledge purchased from the outside as an element of know-how are of lesser importance.

Taking into account the **criterion of supported industry**, in the first place it should be noted that a major part of projects relate to the manufacturing section. These projects account for as much as 63% of the projects analysed. Definitely fewer projects were implemented within the information and communication section (15%) and the professional, scientific and technical activity section (11%) of the Polish Classification of Activities. The remaining small part of projects fits into the sections of mining and quarrying, construction, water supply, sewerage, and waste management as well as wholesale and retail trade. Taking into consideration the divisions of activities, the highest percentage of projects was implemented in the division of manufacture of chemicals and chemical products (almost 14%), slightly less (about 10%) in the non-manufacturing sections, in research and development, software related activities, computer consultancy activities and related activities as well as manufacture of machinery and equipment not elsewhere classified. It is worth noting that only less than half of the projects (37) were implemented in the manufacturing divisions that play a certain role in sold production, that is, their role in the region's development is noticeable⁴; among them,

⁴ Understood as divisions that are 2-17% of total sold production in Lower Silesia in 2012.

the largest number (11 projects) related to manufacture of chemicals and chemical products, 6 to manufacture of other non-metallic mineral products, and 4 to manufacture of other products.

6. *Summary.*

This paper is the first part of a study showing a method for estimating the role of the operational programmes in stimulating innovation-based regional development in the enterprise sector. Due to the wide scope of the research, the paper presents a typology of innovation created by the authors of the present study and its application for the analysis of Measures 1.4, 4.1 and 4.4 of the Innovative Economy Operational Programme 2007 – 2013 for Lower Silesian Voivodeship. The next stage of this study will be to analyse the various types of innovation in the context of the region's long-term development. Its results will form the basis for the second part of this research which will be included in a separate paper.

Due to the specificity of the programme and a complicated management and implementation system of the IE OP (a multitude of managing and implementing authorities), access to the lists of projects is limited. Therefore, the proposed methodology is presented based on a relatively limited base of projects (81). However, this research was focused on projects dedicated to SMEs, those are generally from 1st and 4th Priority Axis of IE OP for Lower Silesian Voivodship. It was estimated that the base of 81 projects is about 50% of projects from 1st and 4th Priority Axis of IE OP, implemented on Lower Silesian region.

The typology of innovation proposed in this paper refers to 6 criteria (object of innovation, degree of innovation, scale of innovation, role of innovation in the firm's development, sources of innovation origin, and type of supported industry). The above criteria are considered in 2 dimensions – considering the innovation (objective) perspective and from the point of view of the beneficiary, i.e. the enterprise introducing innovations. The application of the above-mentioned typology in the analysis of Measures 1.4, 4.1 and 4.4 of the Innovative Economy Operational Programme 2007 – 2013 allows us to make the following conclusions:

- It can be noted that about 60% of the projects qualified for financial support are not imitative. They include investments based on the creativity and invention of the entrepreneurs or institutions cooperating with them. It is worth stressing that 11% of all projects are undertakings whose effect involves radical innovations creating a completely new product, process, marketing and/or organisational quality. In turn,

48% of the projects fit into the category of incremental innovations oriented towards a creative original improvement of existing tangible and intangible elements of the production process or service provision. 46% of the analysed projects represent global- or European-level innovations. Due to the fact that the value of all the projects analysed is at a level similar to the total annual expenditure on innovation activities in Lower Silesia (about €500 million in 2011), the above results do not entitle us to formulate a definitive conclusion about the predominance of creative innovations over imitative innovations in Lower Silesia during the period 2007-2013. Nevertheless, they provide a clear incentive for conducting a bottom-up study oriented to individuals firms implementing innovations within the region. This is particularly important in view of the frequently drawn conclusions that the development of Poland and its regions to a large extent has the character of "imitative diffusion" (Hausner 2011), with an implication that our country may find itself in the middle income trap. The analysis results contained in this paper make us treat the above thesis concerning the imitation-based development model with caution;

- The results do not allow us to make unambiguous conclusions with respect to the sectoral structure of the regional economy. 37 projects fitted into the manufacturing divisions that play a certain role in sold production of industry in the region (2-17% of total sold production in Lower Silesia in 2012). The other 44 projects were carried out within the divisions whose importance in sold production is marginal (16 projects) or within other NACE sections, primarily the information and communication section. Whether infant industries will emerge or the economic structure of the region will be petrified will depend upon the ultimate effects of the projects. Hence, only an ex post analysis will show us the real market power of creative innovations to generate higher value added as well as new branches and markets;
- The transfer of high investment risks from the enterprise sector to the public sector is a *sine qua non* condition for effective innovation-oriented policy. It should be expected that a more significant shift of the risk in the direction of public institutions will stimulate an increase in the importance of creative innovations. This relates in particular to work on radical innovations which are by definition characterised by a significant level of uncertainty and which might generate the most valuable effects on the whole regional economy;

- The long-term development of the economy and its dependence on external factors should be associated with the identification, stimulation and support of the region's endogenous potentials. Therefore, the fact that the implementation of 41% of the analysed projects involves the exclusive use of regional resources should be considered to be positive. Only 14% of the innovations studied are a result of exploiting extra-regional factors (of exogenous nature). In considering the study results from the point of view of the supported enterprises, it is worth noting that a major part of innovations are created by their own research or through the cooperation between the firms (in total about 70%). This confirms the dominant role of regional resources in generating new or improved solutions using EU support and also shows another important factor promoting more dynamic development, which is networking cooperation of the firms;
- New or modified products (42%) as well as products and processes together (47%) are the dominant effect of the analysed projects. It can therefore be concluded that the EU support of the Lower Silesia-based enterprises is predominantly oriented towards the direct characteristics of a product (among others, its features, functionality as well as the cost and time of production resulting from the adopted technology). Financial support related to marketing or organisational issues is secondary. This fact can be interpreted as an attempt of regional entrepreneurs to build in the first place a competitive (in terms of cost and quality) manufacturing capacity. It can be expected that the market success of these measures will stimulate in the future an increased interest in marketing and organisational innovations. It is also worth mentioning that the high percentage of projects oriented towards product innovation corresponds to the relatively low average project value within this group. This shows a relatively low level of cost intensity of this category of projects.

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