THE ASSESSMENT OF ENGINEERS CONTRIBUTION TO BUSINESS SECTOR INNOVATION IN UPPER SILESIA REGION

Agata MESJASZ-LECH, Tomasz NITKIEWICZ, Iwona OTOLA, Aneta PACHURA, Janusz GRABARA

Abstract: The paper presents the results of research realized in the field of engineers contribution to innovation in region of Upper Silesia in Poland. The results of the assessment show that the region has a good potential of innovation and should concentrate on using it in a full scale. Secondly, the analysis of companies and their approach towards innovation is made on the basis of their surveyed opinions. Finally, the assessment of the engineers role in innovation creation and implementation process is investigated. The results show that their role is crucial and should be regarded as one of innovation dynamo factors. On the other hand, their potential role should be increased and fostered by policy-driven actions in order to contribute more to the competitiveness of Upper Silesia business sector.

Keywords: Upper Silesia, engineering education, engineers contribution to innovation, regional innovation strategy

1. Introduction

The recent years of implementing knowledge economy rules to business activities have proved to be fruitful in way of bringing out new decision models, instruments to foster the creation of innovation or catalyzing the effects of their implementation. It seems that mechanism of starting efficient innovation strategies have been already identified and well described. But still, there is great number of issues that should be addressed and investigated in order to have the knowledge economy picture clear and complete. Examples of such an issue could be investigating such mechanisms for specific areas or discovering the role of given factors in fostering innovation in business sector. The paper tries to explore these two areas simultaneously. The focus is on (1) Upper Silesia region on (2) the contribution of engineers to innovativity of local business.

2. Upper Silesia and its innovation potential

The topic of engineers contributing to innovations in Upper Silesia region has not been fully covered so far. Nevertheless, some research has been made on more general issues, e.g. innovation in Upper Silesian industry or educational system functioning. One of the big scale research has been performed within the project "Diagnosis of education and labor market in Upper Silesia" [1]. The research activities of the project consisted of multiple surveys made with several groups of respondents such as students, university and high school management staff, business representatives and employment public service workers.

Within the project 3201 business representatives have been surveyed. Respondents group consisted of company owners, management boards members, specialists on personnel issues or directors of personnel departments. The survey took place between

January the 1st 2009 and June the 30th 2010. Some results are strongly related to the problems discussed here. One of the investigated issues was the educational structure of employed graduates. The structure of newly employed engineers education is presented in Fig 1.

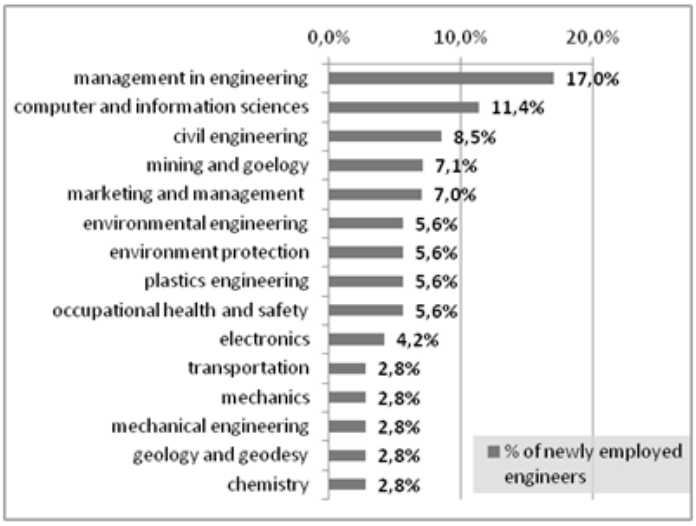

Fig. 1. The structure of newly employed engineers education [1]

The employers representatives have also judged higher education system and its effect on their employees. Their opinion indicates the major problem of higher education that is lack of practical courses, workshops and practical use of knowledge. More than 50% of surveyed representatives indicates that it is the major lack in education system that should be addressed and adjusted to the needs of labor market. Moreover, more than 30% thinks the education system should focus more on practical skills and knowledge because right know the system does not include these kind of education at all [1, pp. 158-159].

Evidently, the situation of innovations, creativity and reasonable thinking among graduates skills is judged more graciously. Only 2,1% of respondents indicates that educational system has some lacks in this field. 8,6% of respondents claims that the education system serves outdated knowledge and omits technological innovations. Concerning the expectations on educational system 9,7% of respondents thinks that it should be more focused on creativity, independence and will of action. 6,3% of respondents wants the educational system to be more adjusted to the labor market by including more courses and exercises that are developing creativity, innovativeness and reasonable thinking [1, pp. 158-159].

In order to have review of literature on business innovation in Upper Silesia complete the number of studies exploring the issue should be mentioned. First of all, all the studies made within the framework of Regional Innovation Strategy (RIS) should be mentioned collectively. RIS and its implementation is monitored institutionally by Innobservator Silesia, and number of occasional and periodical studies and analyses is realized there. The result of one of such study is the expertise titled *Identification and assessment of current trends in RIS* [2]. The document collects views and opinions on regional innovation system in Upper Silesia from different actors and anticipates its development and possible

measures to foster it. RIS also outsources analytical tasks and some external institutions can propose and eventually realize their assessments.

Some more innovative approaches are used in smaller scale projects and publications. M. Kozak [3] proposes his own model for assessment of intellectual capital in regions, with a special focus on social capital and its influences and on network projects. P. Pachura [4] focuses his investigation on network structures and identifies its role and potential in shaping the innovativeness of Upper Silesia with a reference to innovation leading regions from Finland and Belgium.

Important source of information on labor market in Upper Silesia is the Regional Employment Office (REO) and its analytical activities. REO publishes on yearly basis a report on Upper Silesian labor market situation. The focus of the report is on unemployed and their structure and the efficiency of labor market instruments. But its content does not include analyses specific for given graduates group (like engineers) and their performance after employment. Certainly, it does not give any information on employed engineers contribution to the innovations [5].

On the other hand national Statistical Office and its regional offices gather statistics on companies performance, their employment policies and trends and their approach to innovation. These kind of statistical data is very useful for cross-regional comparisons in respect of innovations, its financing or innovation-oriented employment.

Country-wide analysis of innovation potential with regard to regional differences is quite popular topic for different types of research projects. Most of them are using the same statistical data based on European Innovation Scoreboard (EIS) methodology. One example of the results of such a project is the expertise titled EIS methodology-based comparative analysis of regional innovation in Poland [6]. The situation of innovation in Upper Silesia, in relation to other regions in Poland, is presented there in a similar manner as here above. Since the dataset is similar for merely all of the studies the results are similar too and there is no need to explore them all.

3. The structure of surveyed companies

In order to investigate the contribution of engineers to innovations 250 companies have been surveyed. A survey has been made by ASM Centrum Badań i Analiz Ltd. in the period of 16-20.11.2009 in a form of Computer Assisted Telephone Interview (CATI). The survey was one of the stages of "Engineer of the Future – research on the directions of development of engineer staff in the context of changing structure of śląskie voivodship economy".

All the investigated companies are located in Upper Silesia region. Employees of different management levels have responded the survey. Mostly, they have been positioned as directors, managers, personnel officers, production managers and in some cases company owners. The structure of surveyed companies concerning their size and their affiliation to medium- and hi-tech sectors and high-growth sector is presented in tab. 1 below.

More than 30% of surveyed companies belong to high-growth sector which in Upper Silesia region includes such sectors as: biotechnology, energy technologies, environmental and waste technologies, ITC technologies, materials production and transformation, machinery industry, car industry, aircraft industry, miniaturization and precise engineering, mechatronics and nanotechnologies, simulation and production processes modeling, and

decision-supporting intelligent systems. The definition of high-growth sectors in Upper Silesia has been derived within Engineer of the Future project.

Tab. 1. The structure of surveyed population [7]

Characteristics of population	Quantity / %
Number of companies surveyed	250
Micro-sized enterprises (less than 5 employees)	13,2%
Small-sized enterprises (from 6 to 50)	46,4%
Medium-sized enterprises (from 51 to 250)	31,6%
Big-sized enterprises (above 250)	8,8%
Companies from high-growth sector	33,2%
Companies from medium- and hi-tech sectors	31,2%

In contrary, the definitions of medium- and hi-tech sectors are officially derived and constitute separate statistical categories. Hi-tech category includes such sectors as: aircraft and spacecraft production, pharmaceutical production, office devices and computers production, ITC, TV and radio devices production, medical, optical and precise instruments production, production of clocks and watches. Medium-tech category includes such sectors as: production of machinery and electric instruments, production of mechanical vehicles, trailers and semitrailers, production of chemicals, production of trains and trams, production of motorbikes and bicycles, and production of other transport equipment.

The composition of the surveyed population is purposeful and consists of companies that have high potential of (1) getting engaged into innovation-related activities and (2) employing engineers for the purpose as well as for running their businesses. Therefore, the results presented here should be referred to as the evidence of some trends and phenomena in well developed and technically-oriented branches and sectors. Their responsibility for innovation driving forces in the region is very important, but on the other hand, does not release less technology-oriented companies from their responsibilities for regional innovation level and their own competitiveness.

4. Engineers and their competences

To compare the results of two surveys presented here ("Diagnosis of education and labor market in Upper Silesia" and "Engineer of the Future") the most wanted specializations of engineers are presented below Fig. 2. The difference between the data on Fig. 1 and Fig. 2 is that the first one presents the structure of newly acquired engineers by companies and the latter shows the structure of the demand on engineers with given specialization. It is clear that these two aspects differs significantly. The most wanted mechanics and electromechanics engineers are only the 13th group as far as the number of newly acquired staff is concerned. Of course, there are some similarities, like for example 2nd position of computer science engineers on both figures. Comparing the data shows to incremental phenomena: (1) the dynamics of current engineers engagements are far behind the anticipated needs of companies and (2) further hiring plans are supposed to suit companies' visions and development strategies but not necessarily their current possibilities.

There is also one technical difference between two surveys that could explain the discrepancy of the results. The "Diagnosis of education and labor market in Upper Silesia" survey was made on the big population of companies (over 3000) and therefore, it is more

representative for their qauntitive structure while “Engineer of the Future” survey was made on the small population (250 companies only) of some specific structure (certain presence of high-growth, high- and medium-tech companies included) to be reached. As shown on Fig. 2 the most wanted are highly specialized engineers with the purpose of engaging them in well developed sectors.

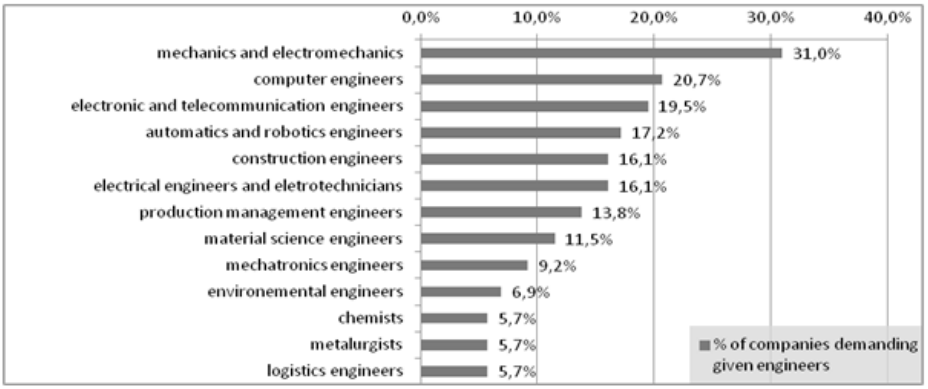

Fig. 2. Companies’ demand on engineers with respect to their specialization [7]

It is not yet clear what are the benefits for company’s innovation activities from engineers education but one more issue, concerning the expectations of their supplementary education, is investigated here. The most desirable additional education fields for engineers already employed in responding companies are presented on Fig. 3. Again, the most wanted education is highly specialized one serving well developed sectors. High position of management and production engineering specialization probably represents the desire of making the engineers more competitive in administrative functions as well.

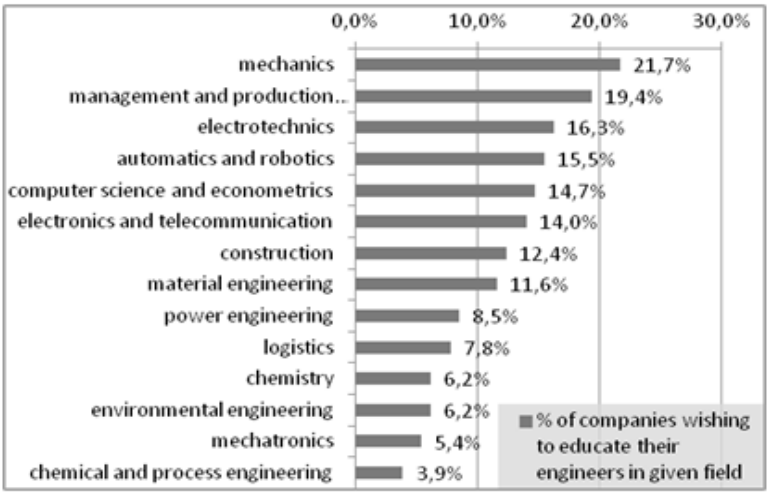

Fig. 3. Companies’ plans and expectations for continuing education by employed engineers [7]

Focusing on the present competences of currently employed engineers companies responded to the questions concerning their evaluation of knowledge and practical skills gained by them in their education process. As shown on Fig. 4 and Fig. 5 engineers' theoretical knowledge and practical skills are highly valued by their employers.

The data presented on Fig. 4 shows that almost 80% of employers find theoretical knowledge of engineers very or at least quite useful. The percentage of evidently unsatisfied employers with this knowledge is only 8% of the entire population of companies.

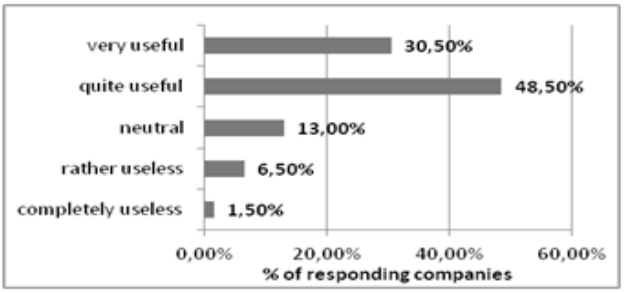

Fig. 4. The extent of usefulness of engineers' theoretical knowledge gained during studies to their work [7]

The situation is quite similar in the area of engineers' practical skills. As shown on Fig. 5 altogether 73% of employers find engineers' practical skills very useful or quite useful. The percentage of unsatisfied employers with engineers education is slightly higher here and is beyond 15%. The conclusion of these results is that companies are quite satisfied with the education of their engineers. Despite this positive evaluation of its work, high education system in the field of engineering should be alerted by relatively high percentage of companies complaining on the practical skills and their build-up during education.

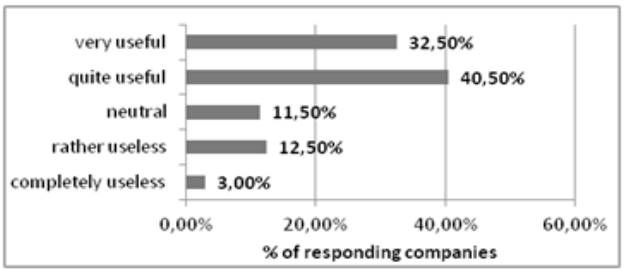

Fig. 5. The extent of usefulness of engineers' practical skills gained during studies to their work [7]

Some more complaints about education of engineers could be found in exploring the topic of demand on additional education. Most of the companies (almost 80%) prefers to educate their employees in a form of courses, trainings and workshops that last for some weeks only. The group of employers accepting other forms of education (studies or post-graduation studies) are rather small. The conclusion is that higher education institutions in Upper Silesia are rather unprepared to meet that demand from the business sector. Technical universities have some extra courses in their offers but these refers only to few

directions of education. On the other hand, training institutions are mostly oriented on more common, non-technical courses.

The possible solution is changing the scope of higher education offer in technical fields or to develop training and lifelong learning institutions in order to equip them in some more technical competences. Unfortunately, none of the possible solutions proposed above is probable to happen. First of all, the higher education sector has rather low ability to change quickly responding to market needs. Secondly, training and lifelong learning institutions have no interest in changing because they are well of satisfying current demand for different kinds of knowledge and very often mange to get some financial support from EU structural funds to make their offer even more competitive.

5. The contribution of engineers to innovation

Another questions used in "Engineer of the Future" survey could bring some light to the issue of engineers contribution to innovation. The questions investigate engineers engagement in innovation and the usefulness of engineers technical competences in the process of creation and implementation of innovation. Majority of the companies, namely 93,5% of those implementing any innovation recently, have admitted that their engineers are involved in the process.

Most of the companies appreciate the usefulness of engineers technical competences in the process of creation and implementation of innovation. Half of the respondents finds them very useful, barely another half finds them quite useful. Only 2% of responding companies does not value their contribution to the innovation finding technical competences neutral or rather useless. These results show that the education of engineers serves well to the companies and their objectives in the field of their innovation-related activities.

In order to investigate the issue of engineers competences and their usefulness the following two questions are used. The focus of these questions is on the categories of competences needed by companies. As presented on Fig. 6 and Fig. 7 the competences are grouped into technical and non-technical categories.

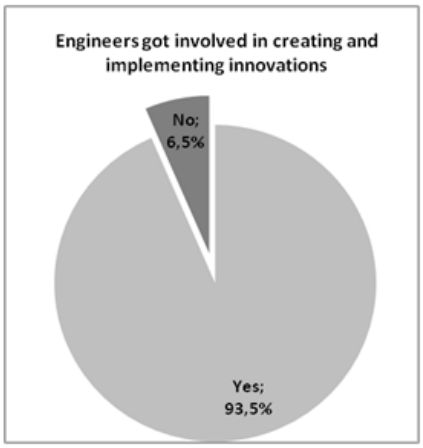

Fig. 6. The engagement of engineers to the process of innovation creation and implementation [7]

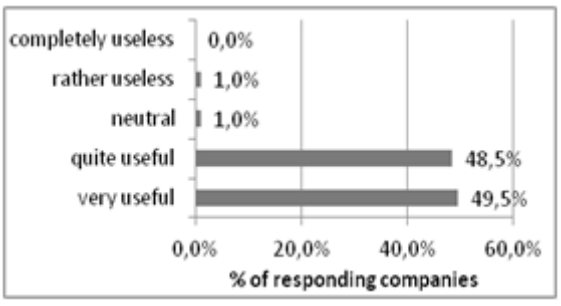

Fig. 7. Usefulness of engineers technical competences in creation and implementation of innovation [7]

The results of the survey shows that the most desirable technical competence is the knowledge on materials used in production processes realized in companies. The 2nd most desirable competence is understanding and modeling the processes and phenomena used in the companies. The next two most desirable competences are related to handling hi-tech equipment, technologies and software. As shown on Fig. 8 there is no single technical competence that is dominating the whole population of surveyed companies. The preferences in this matter are distributed in rather sustainable way and companies desire competences that are the most appropriate for their operational profiles [8].

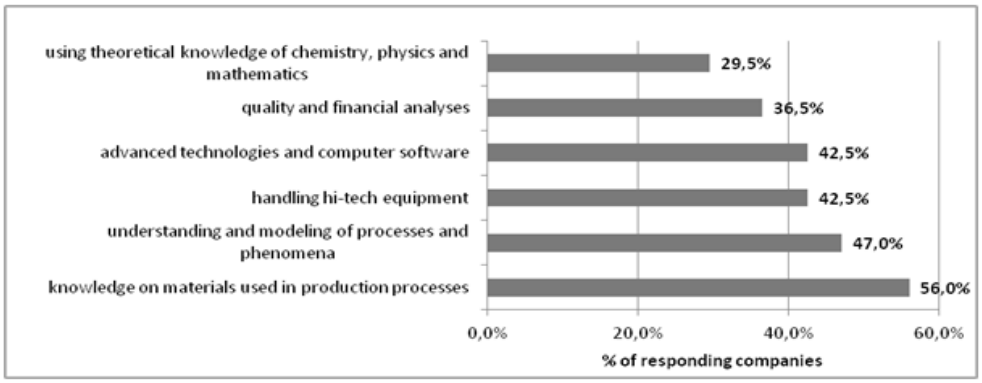

Fig.8. The most desirable technical competences of engineers [7]

As for non-technical competences, the dominance of some competences is quite clear. The 1st spot is taken by creativity, the 2nd by team work competences, both achieving the results of 80% indications or more (Fig. 9). If the 3rd competence that is communication skills is added to the first two, the picture of engineer perfectly suited for the challenge of innovation is drawn. The challenge could be set for the engineers individually (the competence of creativity) or for the group under their leadership or with their participation (team work and communication skills). Only the 4th competence, that is knowledge of norms and regulations, does not relate to the process of creation and implementation of innovation.

Fig. 9. The most desirable non-technical competences of engineers [7]

6. Intersecting analysis of companies responses

The first issue that is investigated here is the relationship between employing any engineer and implementing innovation in last 3 years. As shown on Fig. 10 almost a half of the companies that are employing any engineers have implemented any innovation recently. In the group of companies that are not employing any engineers at all the percentage of those implementing innovation is 20% only. It does not determine that employing engineers is a prerequisite for implementing innovation but shows that it certainly helps the process.

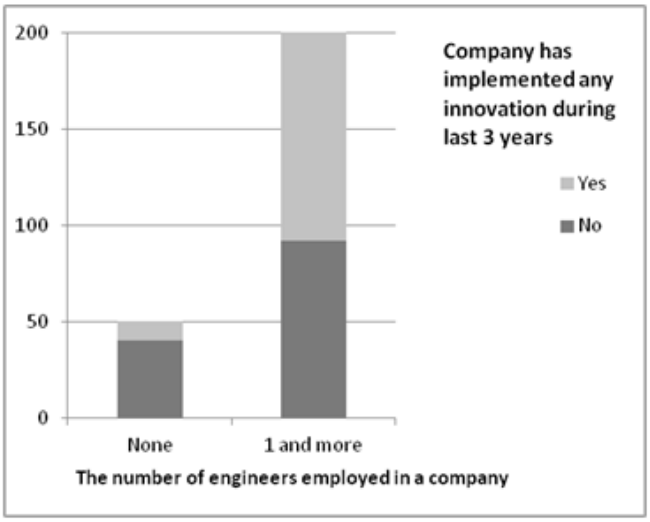

Fig.10. The relationship between the employment of engineers and implementation of innovation [7]

Similar comparison is made for company's engagement in R&D activities while engineers employment is taken into account. As shown on Fig. 11 also similar proportions could be observed. Less than 5% of companies not employing engineers got involved into R&D activities while in the group of those who employed at least 1 engineer this percentage is almost 35%. The conclusion is that employing any engineers gives some potential, capabilities and competences to get involved into R&D activities. There are number of additional conditions to be met in order to run own R&D departments, like i.e. having financial resources or following certain innovation goals, but employing engineers could significantly foster the process.

There are no specific findings in the field of the structure of innovation effects in which engineers got involved. As shown on Fig. 12 the most often result of innovation implementation in observed companies is new or modified product, and it is the same for engineer employing and non-employing companies. It is similar with new processes that is the 2nd most popular indication for innovation implementation effect. As expected there is slightly bigger share of non-employing engineers companies in organization and management innovation that are implemented much less often.

Finally the financial issues of running R&D activities are investigated. As shown on Fig. 13 among the companies non-employing engineers there is none to have own financial resources for performing its own R&D activities. Almost 1/3 of those companies that employs engineers have their own resources to finance R&D activities.

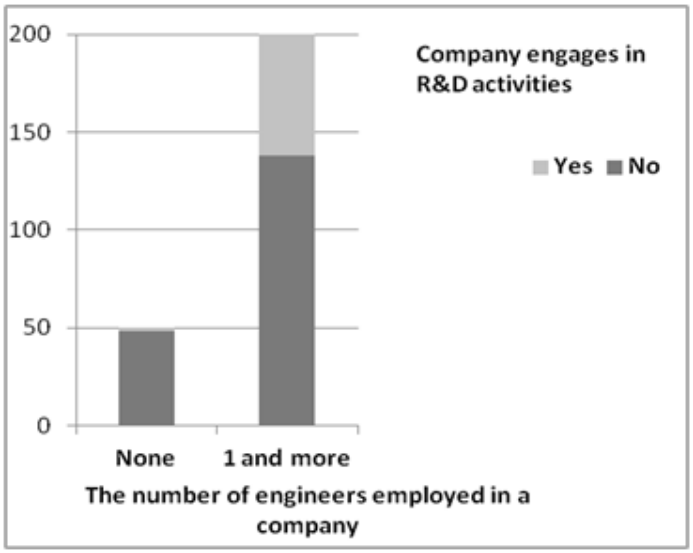

Fig. 11. The relationship between the employment of engineers and company's engagement in R&D activities [7]

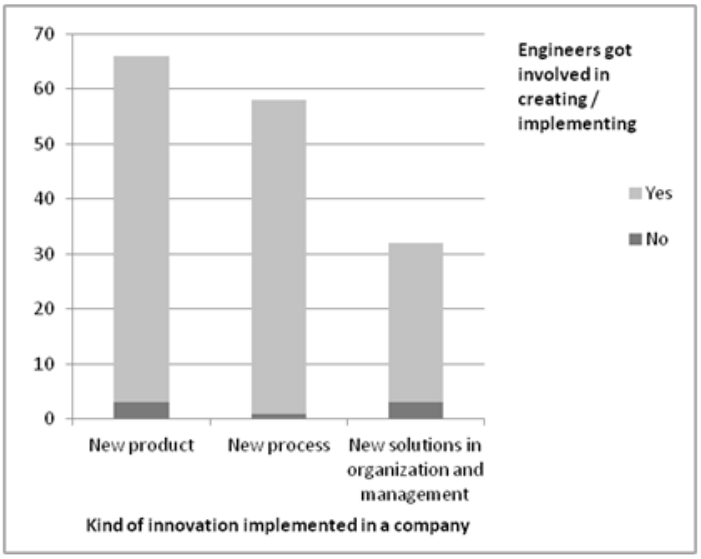

Fig.12. The relationship between the involvement of engineers in creation and implementation of innovation and kinds of innovation produced [7]

Perhaps, due to low rate of responses on that question (only 25% of companies have responded the question on having financial resources) these results should not be brought out here but on the other hand given responses showed some trends already. Of course, it is not possible to make any claims that engineers contribute also to produce financial resources for R&D purposes basing on these results, but the conclusion that employing engineers makes such an effort is justified by the data.

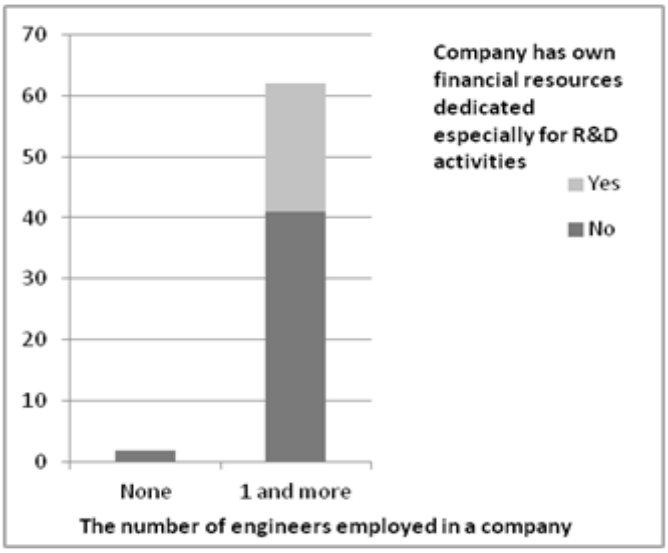

Fig. 13. The relationship between the employment of engineers and company's capability of financing innovation on its own [7]

7. Innovation policy issues concerning engineers and their contribution

The results presented above are quite satisfactory as the engineers contribution is concerned. In order to concentrate the efforts to increase the potential of engineers as the most innovation oriented labor force some policy-determining issues are proposed. The proposition is based on four general policy domains identified in Oslo manual. The outline ***map*** in Fig. 14 labels four general domains of the engineers oriented ***innovation policy terrain*** as follows:

- the broader *framework conditions* of regional institutional and structural factors setting the rules and range of opportunities for engineers to get proper education and get involved into innovation;
- the *science and engineering base* – underpinning business innovation by providing technological training and scientific knowledge for engineers, with a high access to practical courses and self-developing opportunities for funded research in science and technology institutions;
- *transfer factors* that are mostly affected by engineers' capabilities to influence the effectiveness of the linkages, flows of information and skills, and absorption of learning which are essential to business innovation;
- the *innovation dynamo* is the domain most central to business innovation – it covers mostly engineers engagement in innovation building activities, orientation on competitiveness and supportive climate for innovation-oriented actions.

Concerning the results of the survey, some of these conditions are already met, some other, mostly within framework conditions and transfer factors terrains, are still slowing the innovation dynamo and should be addressed by efficient innovation policies and actions soon.

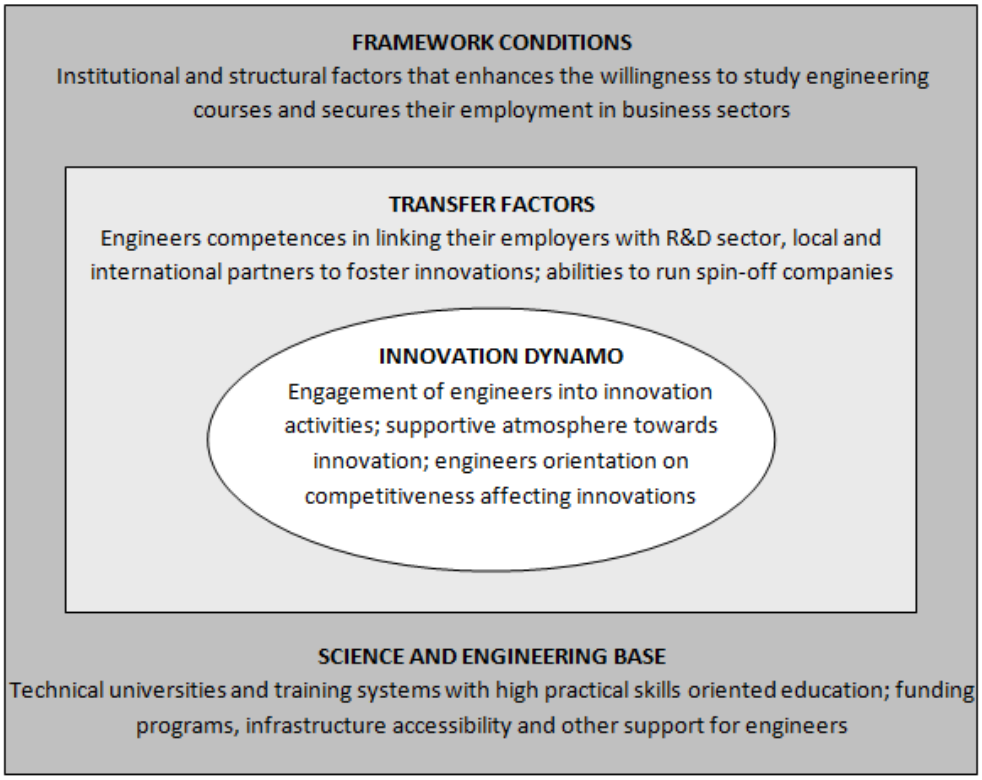

Fig. 14. Map of engineers-oriented innovation policy terrain [9]

Conclusions

To conclude the topic of engineers contribution to the creation and implementation of innovation in Upper Silesia it is important to mention that surveyed population of companies has a big share of well developed and technology oriented ones. Therefore, the results should not be treated as a mean value for whole business in Upper Silesia, but rather general observation for potentially well growing business.

The role of engineers seem to be crucial in the process of running any innovation activities. Their theoretical knowledge and practical skills are valued high enough to assure their contribution to innovation. On the other hand, employing engineers very often relates to some designing and modeling job duties that are natural steps to create and implement innovations. But the presence of engineers gives some noticeable pace to innovation issues in a company including their engagement in R&D activities, implementing their effects, organizing its finances and keeping up with the technological development.

The competences of engineers are good enough to serve innovation creation and implementation purposes. It seems that higher education in the field of engineering is maintaining the acceptable level of their services. Some observed drawbacks relates to relatively smaller share of practical skills in education process as compared to theoretical knowledge.

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