CHAPTER 5

Methodological Aspects of Innovation of Project and Production Businesses

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Summary. In this chapter the authors present a proposal of selected aspects of methodology for improving individual and team innovation in enterprises. Methodological aspects were reasoned with measurements of the level of innovation by GUS and its causes in Poland. The reasons for the low level of innovation are justified by historical roots, as the seven main points formulated by PTI in 1980, similarly to the 21 postulates of "Solidarity", accurately reflect the main reasons for Poland's backwardness in development and, unfortunately, most of them are still valid. These reasons require action on the part of the Polish state, but they should also be used in bottom-up activities of each enterprise after minor interpretation corrections. The chapter focuses on industrial enterprises, because the realities of creativity of engineers and technicians are different from workers in other sectors of the economy. An important determinant of creativity in industrial enterprises with aspirations to design their products and production processes is the set of instruments, in particular CAD/CAM/CAE. Three methodological proposals guarantee a faster and more effective way to creativity and innovativeness of enterprises, although their implementation requires a lot of effort on the part of both employees and their employers. At the same time, they are a prerequisite for acquiring the ability to make strategic innovations in the enterprise. The developed methodological solutions have been tested in practice and constitute an institutional recommendation.

Keywords: innovativeness in Polish industry, methodological aspects, innovative creativity of employees

1. Introduction

The authors of this chapter have dedicated more than 30 years of work to applications of information technology in education and practice of social and economic life. Undoubtedly, the use of information technology still means innovation, and the whole process of creating information systems and their implementation requires creativity, not only individual from employees but also from the entire community.

Recently, innovativeness has reached the rank of innovation policy in some countries, as well as in the EU. Therefore, public statistics, also in Poland, carries out measurements of innovation in services and industrial companies. The period 2010–2021 of the studies carried out by the authors was focused on innovation of engineering and technical workers and innovation of project and production businesses located in the Pomorskie Voivodship.

The aim of this study is to highlight the methodological aspects related to the improvement of industrial innovation, because the authors concluded that they constitute a necessary condition for taking up directly related topics, i.e.:

- contemporary dilemmas of entrepreneurship,
- use of ICT in transforming the organization,
- virtual enterprise,
- digital business strategy,
- the future of digital innovation in business,
- business computing and digital society.

2. Diagnosis of state of innovation and research results

The state of innovativeness of Polish enterprises has been monitored and the data have been published by Statistics Poland (GUS). The methodology of this monitoring is standardized by the OECD and Eurostat. It refers to:

- innovation activities of companies,
- economic aspects of innovation activities,
- cooperation in innovation activities, such as technology transfer and intellectual property protection.

Monitoring is focused on enterprises which are active in innovation and are innovative in the following areas: product innovations, process innovations and other innovations. The situation of innovative enterprises in 2011–2019 in Poland is shown in Figure 1.

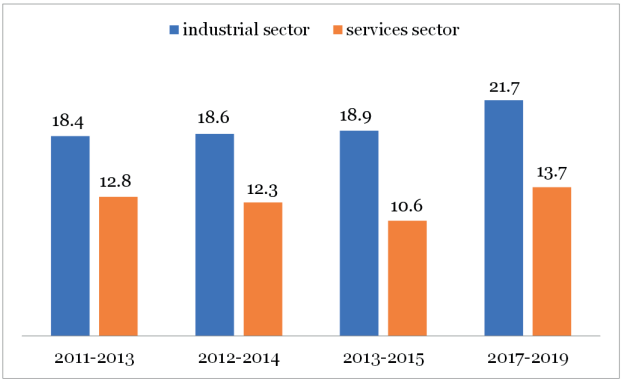

Fig. 1. The percentage of innovation-active enterprises in Poland in 2011–2019

Source: own research based on GUS (2015, 2016, 2020b)

Unfortunately, the percentage of innovation-active enterprises in Poland is very low and even lower is the percentage of innovative enterprises, which in the years 2017–2019 amounted to 18.9% of industrial enterprises and 11.9% of services enterprises – out of the total number of such businesses. There is a large variation between voivodships, e.g. innovative activity of industrial enterprises in the Pomorskie Voivodship (where the authors conducted research).

A situation of industrial enterprises in 2008–2019, product innovations which are typical for them (indicating minor importance of these innovations for the market) are shown in Figure 2.

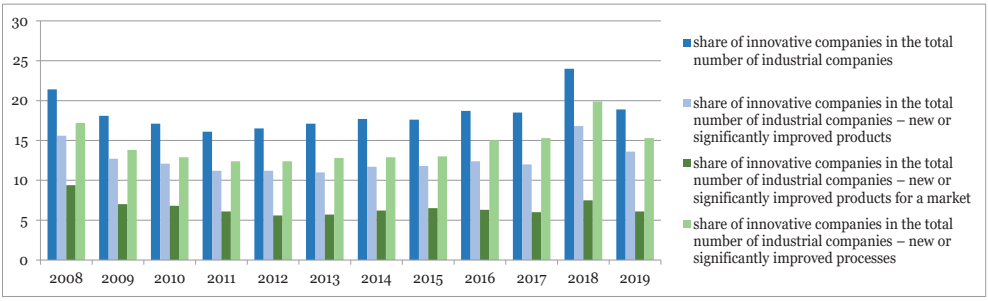

Fig. 2. Percentage of innovative, industrial companies in Poland in the years 2008–2019

Source: own research based on GUS (2015, 2016, 2020b, p. 18)

In the ranking of EU countries, in the case of introducing product innovations by industrial enterprises, four levels of the indicator were distinguished (i.e. 40.0–50.8; 30.0–39.9; 20.0–29.9; 12.5–19.9) and, unfortunately, Polish enterprises are at the lowest level (GUS, 2020b, p. 48). The share of net revenues from sales of new or significantly improved products launched to the market in terms of the total sales revenue in 2019 amounted to 9.3% for industrial companies. The largest share of revenues from sales of new or significantly improved products in total revenues was reached by industrial enterprises (12.1%) which employed 250 people and more. The percentage of industrial companies which made expenditures on innovative activities in 2019 amounted to 14.4%. It should be emphasized that the lowest expenditure in the area of innovative activities within industrial enterprises was made on staff training directly related to the introduction of product or process innovations.

The first author's diagnosis of the state of innovation in 2012–2013 was carried out by the authors as part of the project "Road to professional excellence" and its synthesis was published in the article (Sala, Tańska, 2013a). As a result of the analysis of experiences of the British government and self-government, which referred to moderating and stimulating innovation of businesses in the UK, authors took part in the development of the model dedicated to the companies from the Pomorskie Voivodship. The authors have published an essence of the model in the article (Sala, Tańska, 2015) exposing its initiating part connected with the transfer of ICT knowledge and the first edition of the model implementation. This implementing clarification has been focused on the technical and engineering staff, and the

choice of ICT tools has been addressed to integrated computer systems CAD/CAM/CAE. The elaboration of a model is a methodology for reaching the versatility, professional project and production flexibility, which consists of three paths (Fig. 3):

1) for engineering and technical staff,
2) for project and production businesses,
3) for strategic innovation partnerships.

In Figure 3 the path 2 is presented, for which the path 1 is a necessary condition, what has been explained in the article (Sala, Tańska, 2015).

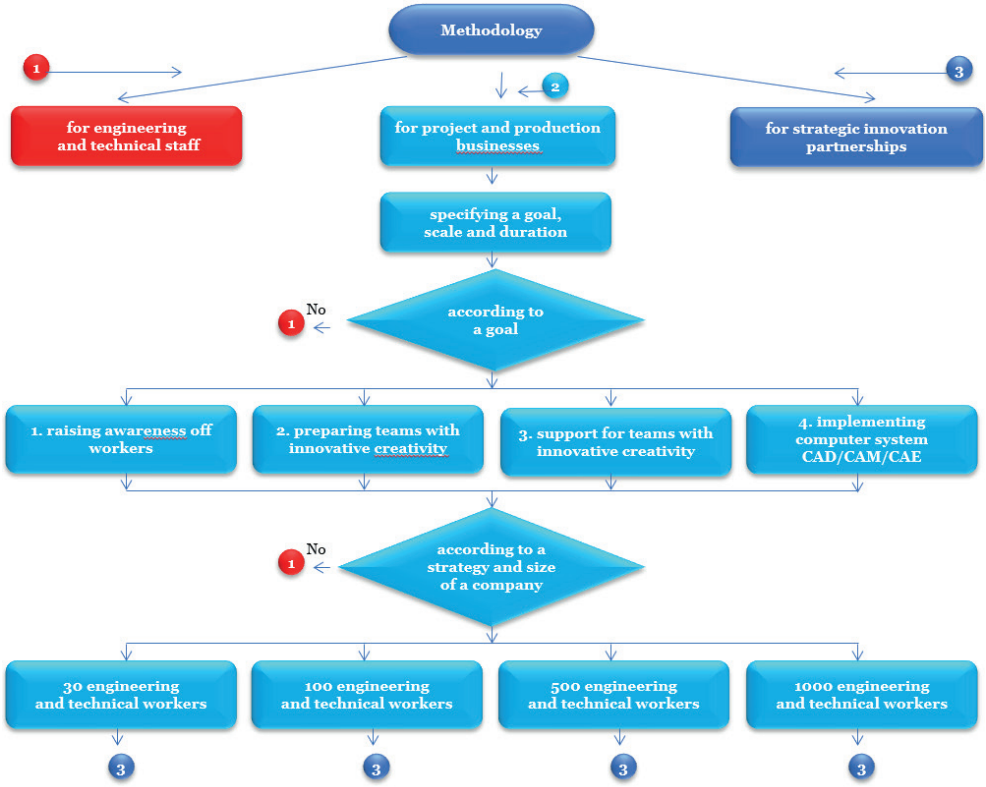

Fig. 3. Methodology of reaching the versatility, professional project and production flexibility to obtain the ability to make strategic innovation

The main objective of methodology is to acquire the individual and institutional ability of making strategic innovation by the employees and the company through the implementation of the path no. 3 shown in Figure 3. The path no. 3 is an adaptation of the British model of innovation which has been carried out for over 35 years, under which approximately 1000 strategic innovations were moderated and stimulated annually after the year 2000. However, in the case of Polish enterprises the execution of path no. 3 would not be effective without

taking a necessary condition in the form of path no. 2. The purpose of taking into account methodological differences between the British and Polish companies has its historical roots, and a lack of understanding them will lead to incidental, not permanent, understanding of the innovativeness of Polish enterprises.

3. Historical roots of a lack of understanding

In order to verify the methodological assumptions, it is worth considering the causes of the current state and determining how deeply these causes are rooted in the culture of socio-economic life. To do this, one should diagnose the past by taking into account sufficiently distant future. It can be assumed that the proper reference point is the year 1980, in which professional awareness of IT specialists in Poland was strongly visible and their activities to stop the chaos were integrated. The most emphasized and consequent manifestation of this phenomenon is the creation and activity of the professional association of the Polskie Towarzystwo Informatyczne (PTI) [Polish Information Technology Society], which celebrated 35 years of its existence in 2016. It can be assumed that the following main theses formulated by the founders of the PTI can be a reference point for identifying the initial state:

1) a lack of rational attitude of authorities towards computer sciences and its applications in all sectors of economic and social life;
2) allowing the extreme underdevelopment of computer services in software development, as well as assistance and consulting, which is an important factor contributing to the low efficiency of using computer sciences in Poland;
3) Polish society is uninformed about the real possibilities and the benefits of using computer sciences;
4) it is necessary to maintain a high level of basic research in computer sciences, so that it keeps up with the world-class developments in this field;
5) education of specialists at universities should be developed and the saturation of information techniques at all educational programs of higher education ought to be increased;
6) one should strive for the gradual introduction of computer sciences into secondary schools by providing opportunities for using computer sciences (hardware and software) in the teaching process;
7) specialists are not rewarded well enough and their salaries do not reflect the amount of work needed to acquire and maintain the qualifications or the value of qualified computer scientists on global labour markets.

Seven main points formulated by PTI in 1980, like the 21 demands of "Solidarity", accurately reflect the major causes of underdevelopment in Poland, and unfortunately most of them are still valid. The thesis no. 3 should also comprise the need of informing Polish society of the real risks connected with using computer sciences. However, in the comment to the thesis no. 6 it should be emphasized that this one can only be considered as completed together with the second part of the thesis no. 5, because secondary schools (as well as primary schools) and all the educational programs of higher education have been saturated with information technology, but unfortunately, in the authors' opinions the execution requires the qualitative verification. Thus, over 40 years, only one and a half of the PTI theses can

be regarded as completed (Szyjewski, 2016). Other causes of underdevelopment and their consequences have deepened.

The timeliness of thesis no. 7 and the first part of the thesis no. 5 is underlined in (Iszkowski, 2016, p. 11), (Greniewski, 2016, p. 16; Kisielnicki, 2016, p. 36) and others. They note, among others:

- lack of official and proper recognition of the profession of computer scientist and computer engineer, through entry in the polish classification of professions and specializations (*Obwieszczenie…*, 2018), which makes it difficult to manage professional IT staff;
- the challenge is to overcome the barriers that will allow the effective and efficient use of information technology;
- significant barriers are problems: economic, legal, technical, and the inefficiency of our Polish educational system in educating appropriately qualified personnel; lack of them means not taking advantage of the possibilities offered by modern computer science.

4. Methodology and institutional basis for implementation

In Polish, the word "methodology" has more than 60 synonyms and dictionary (synonim.net, 2016) distinguishes four main groups of the meaning of synonyms "methodology": as a remedy, as a part of the procedure, as a course of action, as arts and crafts. In the context of methodology aimed at reaching versatility and professional project and production flexibility (see Fig. 3) its meaning is best reflected by synonyms from the group "as a remedy", though synonyms from the group "as a course of action" are useful as well. There are also many definitions of methodics, and it should be definitely distinguished from methodology. Colloquially speaking, it is assumed that methodology focuses on the answer to the question "What to do?", whereas methodics focuses on finding the answer to the question How it should be done?

Therefore, it can be assumed that the developed methodology can be a remedy to problems caused by the lack of completion of the obligations of the Polish state from the 1970s and their effects and abandonments ongoing to this day. On the synthetic diagram presented in Figure 3 the path no. 1 is a prerequisite for the success of the initial implementation of this methodology in each company. It is necessary to overcome the shortcomings resulting from theses no. 3, 5 and 6, provided that the company has the correct proportion of solutions regarding also theses no. 2, 4 and 7. Path no. 1 of methodology has been positively tested on a group of 60 employees of the Pomeranian project and production businesses and has been applied successfully since 2014. Path no. 1 of the methodology had been developed with public funds. It is recommended by the KIW (Krajowa Instytucja Wspomagająca) and is subject to a free license, which is operated by Organizacja Międzyzakładowa NSZZ "Solidarność" in Gdansk Shipyard. It should be stressed that without a transfer of tool knowledge from ICT there is no appropriate basis for innovation activity.

The implementation of the path no. 2 of methodology shown in Figure 3 can be started only after the completion of the condition on the path no. 1, at least for key engineering and technical staff in a company. The path no. 2 has been verified and validated, it has been tested in several project and production businesses. First, a company must define the purpose, scale and duration of reaching the versatility and professional project and production flexibility.

The methodology distinguishes four different specific objectives:

1) raising the awareness of employees,
2) preparing teams with innovative creativity,
3) supporting teams with innovative creativity,
4) implementing a computer system CAD/CAM/CAE.

These objectives can be pursued simultaneously or sequentially, depending on the scale and duration of the systematic effort of achieving a higher level of innovation in the industrial enterprise. The shorter time is needed to prepare a selected group of employees, e.g. 30% of the crew, but much more favourable is to involve all employees in an implemented methodology. Goals no. 1 and 3 were tested in practice. After determining the purpose, scale and duration actions should be elaborated in accordance with the strategy and size of a company. Unfortunately, a significant obstacle to SME enterprises is the lack of plans and strategies. Making up for this increases the costs of coming to permanent innovation and prolongs the time of its reach. The research shows that companies employing over 250 employees cope better in terms of the innovation activity (in 2017–2019 product or process innovations were introduced by 47.0% of industrial companies and by 24.4% of services companies), but even they have a lot to improve so that innovation activity was not limited to the purchase of new solutions, but was based on the achievements of their own employees. Thus, the implementation of methodology should be a particular challenge for small and medium-sized enterprises, which should not delay its implementation because in the years 2017–2019 the innovative activity was undertaken only by 7.7% of industrial companies employing 10–49 people.

Finally, after reaching a certain level of preparation for internal innovation an enterprise can start the implementation of the path no. 3 for strategic innovation partnerships. Thus, it is important to follow the order of implementation of paths no. 1, 2, 3, and to anticipate a gradual return to the previous paths depending on the situation.

Undoubtedly, without the institutional foundations (Sala, Tańska, 2013b) the implementation of methodology will not be possible. It is worth noting that modern management is carried out in the following conditions: extremely high complexity of actions, turbulent environment, globalization, increasing competitiveness. This situation requires a project approach in the implementation of innovative processes and development will not be possible without the use of: modern management methods, high organizational culture, the use of ultramodern technology and modern information technology, such as BI systems and knowledge base. It is worth assuming that the real challenge are activities aimed at reversing the trend of increasing the difference between organizations using modern IT solutions and organizations that do not have them (Sala, Tańska, 2014a; 2014b).

5. Conclusion

The proposal of selected aspects of the methodology is dedicated primarily to the previously revised target audience, i.e. staff occupying engineering and technical positions and employed by industrial enterprises, in particular SMEs. In part, they constitute the implementation of ICT knowledge transfer model, presented more thoroughly in (Sala, Tańska, 2015) and oriented mainly on the effectiveness of the path no. 1 (for employees), and so on

individual creativity. On the other hand, path no. 2 of methodology, synthetically presented in Figure 3, is oriented mainly on the creativity of a team (for project and production businesses).

Both methodological proposals guarantee a faster and more effective way to creativity and innovation of enterprises, although their implementation requires a lot of effort from both employees and their employers. Concurrently, they are a necessary condition to acquire the ability to make strategic innovations in the enterprise (path no. 3).

Seven socio-economic (macroeconomic) PTI's theses of 1980, which require action from the Polish state, due to their timeliness can be used in the bottom-up activities of any company after the introduction of the following minor editing and interpretation adjustments:

1) rational approach of a company's managers towards using information technology in all its departments;
2) raising the level of computer services in software, assistance and consulting in order to improve the low efficiency of using information technology in a company;
3) informing all employees about company's real capabilities and benefits of IT application;
4) monitoring research regarding an application of information technology in enterprises selected sections of PKD and introducing periodic benchmarking to keep up with the leading companies in this field in the world (GUS, 2020a);
5) investing in education of already employed IT specialists and other employees of a company;
6) striving for a gradual implementation of solutions for internal communication process, exchange of experiences and learning in the enterprise;
7) paying attention to the decent financial rewarding of specialists, as at present salaries do not reflect the amount of work needed to acquire and maintain qualifications, or value of a qualified computer scientist on global labour markets.

The authors can assure that enterprise management, taking into account the methodology and the above seven theses, will undoubtedly improve the innovativeness of enterprises and lead to the ability to undertake strategic innovations, which was tested in industrial enterprises of the Pomorskie Voivodship.

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