DETERMINANTS OF THE DEVELOPMENT OF ENTERPRISES' INNOVATIVENESS IN THE ASPECT OF COMPETITIVENESS OF THE ECONOMY*

Jolanta Brodowska-Szewczuk

*Faculty of Social Sciences, Siedlce University of Natural Sciences and Humanities,
Konarskiego 2, 08-110 Siedlce, Poland*

E-mail: jolanta.brodowska-szewczuk@uph.edu.pl

Abstract. The article presents determinants pertaining to the development of enterprise innovativeness in the aspect of competitiveness of the economy. This article presents definitions, and following on from there, the research indicates the results of performed investments depending on the type of implemented innovation: product innovations, process innovations, or non-technological innovations. In assessing the innovativeness of the surveyed companies, I took into account the following: instruments of competitiveness; the new products or services implementation, the improvement of the product and services' quality, improvement in customer relations; potential for innovation: increased productivity or production capacity, modern methods of production and services, cost reductions, improved work flows, innovations in management; effects: higher numbers of customers, an augmentation in market share, better brand awareness, extended market coverage, higher profitability of production and services, revenue growth, higher net profit. The work involves statistical analysis on the reliance between features. It proposes the hypothesis about the independence of these same features. Person's chi-squared test and Fisher's exact test for all mentioned issues were carried out. The one synthetic feature was created and the Wilcoxon rank – sum test (Mann – Whitney U test) was performed.

Keywords: EU funds; innovativeness; competitiveness; enterprises

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1. Introduction

In 1934, J. Schumpeter, an Austrian economist, conceptualized the notion of innovation in the wider economic sense. He emphasized that innovation allows a company to keeping a high position on the market. According to Schumpeter, a nurturing of innovation results in the following situations: an emergence of a new product on the market, making a decision about introducing the new methods in production, creating new markets for the products, using new sources of raw materials, supporting sales processes with uncharted formulas, creating new structure in the company organization (Croitoru, 2012).

In the opinion of P. F. Drucker, innovation is an action that permeates all realms of a company's activity. An innovation can apply to products, marketing; likewise actions involving improvement in the methods of a company's management processes. Drucker perceives innovation in system-wide operations as consisting of the active identification of changes that take place in an organisation, and also using those operations in the process of creating further innovations (Drucker 1998). P. Kotler, an American theoretician of marketing, defines innovation as something perceived in the category of novelty (Kotler 1999). According to J. Tidd, innovation is a process of changes when opportunities are remoulded in new ideas; and further on they are used in practice (Tidd, Bessant 2009). P. Hildreth and C. Kimble perceive innovation as the effect of exchanges between different areas of knowledge; and later on, as the integration of knowledge in a completely new and different way. As a result of such integration, new products are produced as well as services, not to mention processes in the organization (Hildreth, Kimble 2004).

The Oslo Manual concerns the methods of collecting and interpreting indexes related to innovation. The manual perceives innovation as the implementation of completely new or relevantly changed products; as well as the processes and solutions connected to management and the organizing of a company. Innovative processes are connected to academic, research, technical, financial or trading activities. Those activities aim to develop and implement innovations to common use. According to the authors of the Manual, in an economic sense, innovation is the ability of an economic entity to do systematic research, use their results in practice and also the ability to practise published academic research, research-and-development works, inventions and patents.

The definition of innovation underlines the fact that that essence of innovation is production and realization of a new product, alternatively application of a new process during manufacturing already known products (OECD 2005).

Another definition perceives innovation as the final stage of creating a new material reality; or simply the implementation of new ideas (Bogdanienko et al. 2004; Prodani et al. 2019; Orynbassarova et al. 2019).

The last mentioned definition places an emphasis on innovation as a process and considers it as those actions which lead to the creation, development and introduction of new values (Niedzielski, Rychlik 2006).
Using the quoted definitions we can delineate most important features of innovation.

They are:
- innovation is interactive and multidisciplinary;
- it is one of the most important integrated processes in the enterprise,it outstands by novelty and uniqueness,
- it forces employees of an organization to continuously learn,
- it has the attributes of social phenomenon,
- it can be perceived as the forerunner of changes in the company (creative destruction),
- it brings the risk of expending high costs,
- it has features typical for processes (Niedzielski, Rychlik 2006).

There are many criteria that are used to classify innovation. The most important are: the introduction of a new product, process or service, applying changes in the organisation, range of changes, steadiness of the process of changes, uniqueness, novelty and range of influence, a range of induced effects, and a degree of complexity.

2. Innovativeness and Economy Growth

Technology as a product of innovative activities cannot be the reason for rivalry between economic entities (non-rivalry of ideas). So it is a source of growing incomes. In the macroeconomic scale, in order to for the non-rivalry of ideas could be translated into long-term dynamic of economic growth, it is necessarily that reliance between general expenditures on research-and-development in economy and the tempo of the technological progress is enough strong.

According to Schumpeter's model of growth, in which the pace of long-term growth in developed countries is proportional to the intensity of research-and-development activities, measured by a percentage of expenses on innovative activities in GDP, alternatively by percentage of employees in research and the development sector. In consequence, according to that kind of model it translates into the dynamic of GDP per capita. From the perspective of the company, the non-rivalry of ideas means that the first inducement to start innovative activity is the possibility of obtaining additional revenues in the future.

The most popular means for saving innovator rent is intellectual property protection (IPP). According to recent literature the reliance between the strength of IPP and the innovativeness of economies has the shape of the diverted curve U. This means that too strict or to weak protection reduces innovative activity; the most beneficial is a moderate level of intellectual property protection (Narodowy Bank Polski, 2016).

The growth of productivity in countries which go through real convergence, like Poland, usually depends in small degree on expenditures on research-and-development. In this case, much more important are innovations from abroad (diffusion of innovations). Diffusion of innovations is necessary for economic growth in less developed economies.

The factors favouring the diffusion of innovations can be analyzed on the company or state levels. In the first instance, the conditions which effect the tempo of diffusion of innovations are: innovations' prevalence over old solutions, experience of potential clients, simplicity of innovations, possibility to test new solutions and success of the companies which implemented innovation earlier (Narodowy Bank Polski, 2016).

Direct foreign investment can be an important source of growth and restructuring of economy via knowledge, technology and innovations diffusion. The ability to gain benefits from direct foreign investment does not depends on just macroeconomic environment but also on the characteristic of the company based on material and intangible resources (Gammeltoft, Kokko 2013; Tvaronavičienė 2019; Zeibote et al. 2019; Baltgailis 2019).

3. The factors, which determine the development of innovativeness of companies

There are many factors which determine the development of companies' innovativeness. According to one of the classification they are as follow:
-   resources of academic and technical knowledge; research-and-development abilities in the organisation (decide about bases of innovative activity, they are the important source of innovation),
-   innovativeness policy preferred by the organisation (sets out the directions of innovativeness, and decides about spendings on research and development),

- structure of the state economy (it influences the innovative mechanisms and determines how much the economy depends on technical achievements),
- system in which the economy operates (determines the specification of innovative mechanism as well as its effectiveness),
- psychological and cultural factors (they condition the presence of prestige and ambition as the motives for introducing innovation) (Szopik-Depczyńska 2009).
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The idea that innovations in a company depend on external factors (exogenous) and also internal factors (endogenous) has a lot of supporters in the literature concerning management. The external factors are created outside of the company but latter are formed by the organization.

According to M. Kolarz, the most important external factors of enterprise's innovativeness are:
- conducting research-and-development works outside of the company,
- realization mutual research-and-development works with close external entities,
- deputing specific research-and-development works to external entities,
- sending employees for internship or practice outside of the company,
- employment of outside workers,
- exchanging technical knowledge and experience with other companies,
- processes of contracting out production,
- co-production – taking collaborative production tasks,
- building complete facilities outside of the company,
- services for the outside entities; but also accepting services from outside (management contract, franchising),
- export and import of licenses,
- international trade,
- creating venture companies and overseas investment (Kolarz 2006).

There are factors conditioning innovativeness in a company, like:
- all kinds of service processes like academic research, technical and scientific information and also economic and management information,
- social and political state situation,
- law standards and administrative warrants,
- general market conditions (market mechanisms, economic calculations, prices),
- systematic education about innovativeness in the economy,
- conducting trainings about innovativeness in the economy,
- market and outside market interactions between partners who are a source of information and technology (strategic alliances, possibility to share the research-and-development activities on few entities, less risk and more competitiveness),
- technical infrastructure (particularly important for companies from energy-related sector).

It is easy to note that many of outside factors may indicate state interventionism. We have to mention political situations, and legislative policies; so a *de facto* state policy towards innovativeness. State interventionism should aim to support enterprises of high technology, the takeover of responsibility for the transfer of technology; as well as creating research-and-development works, that also means organizing the research, creating and financing research centers, and supporting companies, which aim to introduce technicolgical and scientific progress. Adequate state policy relevantly determines the progress of innovativeness of companies. This way it also minimizes the risk of destabilization and deterioration of of the economic situation and stimulates high-tech changes in the economy.

The internal factors existing within a company define the company's innovative needs and means that can be used for innovations; human resources in innovative processes and the importance of innovation for the further development of the company.

The one essential condition for the right course of innovative processes in the company is to employ the person responsible for organizing these processes (a coordinator).

The basic variable that is a part of expenditure indices is the amount of expenditure on research-and-development. One of the basic indexes in this group is GERD (Gross Domestic Expenditure on Research and Development), whichis the amount of state spending on research-and-development, presented as a percentage of GDP.

The basic variables, parts of the resultative indices of innovativeness, are selected effects of expenditure on research-and-development, numbers of academic publications, patents applications, patents, and above all the number of innovative products. The countries, which bear high costs of research-and-development activity are able to create new knowledge and invent patents and implement innovations (Nowak 2012).

„Technological product and process (TPP) innovations comprise technologically implemented new products and processes; and lead to significant technological improvements in products and processes. TPP innovation has been implemented if it has been introduced on the market (product innovation) or used within a production process (process innovation). TPP innovations involve a series of scientific, technological, organisational, financial and commercial activities. A TPP innovating firm is one that has implemented technologically new or significantly technologically improved products or processes during the period under review" (OECD 2005).

Nowadays, the definition proposed by OECD is commonly used; it distinguishes the kinds of innovations implemented by enterprises. It is named the Oslo Methodology, which determines innovation as the application of completely new or significantly improved goods or services, processes, marketing and organizational methods.
This definition figures out the following types of innovations:
- product innovations – those implement the product or service on the market, which are new or significantly improved in matters of their features or purposes,
- process innovations – implementation of new or considerably improved method of production or delivery,
- organizational innovations – implementation of new methods of management in the company, that concern the changes in organizing work places or relations with surroundings,
- marketing innovations – implementation of the new marketing method concerning significant changes in project/construction of product, packaging, distribution, promotion or price strategy (OECD 2005).

4. The Results of Research

In the process of implementation and researching the investments financed from EU funds the following definitions were used:
1. Product innovations – implementation of the products or services, which are new or significantly improved on the market.
2. Process innovations – implementation of new or considerably improved methods of production or systems of delivery products.
3. Non-technological innovations – mainly organizational and management innovations like: implementation of the advanced management technics (e.g. Total Quality Management), introduction of improved organizational structures, and implementation of new or significantly changed strategy of the company. Besides we can also consider essential change in marketing concept or strategy of the company.

In 2018, I conducted my own research in Poland, where 210 small and medium enterprises were examined for in terms of their use of UE funds for new investments. In the research I tried to check if the enterprises implemented innovations (product, process or non-technological).

In assessing innovativeness of the surveyed companies, I took into account:
-instruments of competitiveness: the new products or services implementation, the improvement of the products' and services' quality, the improvement in relations with the customers,
-potential for innovativeness: increased productivity or production capacity, modern methods of production and services, cost reduction, better organization of work, innovations in the management processes,
-effects: higher number of customers, the augmentation in market share, better brand awareness, extended market coverage, higher profitability of production and services, revenue growth, higher net profit.
A statistical analysis of dependences between the features was performed. In order to test if there is statistical reliance between the responses and intances of innovation I used Pearson's chi – squared test and Fisher's exact test.

Two types of variables were created for answers to questions:
pi_3 - nominal variable with 3 variants with values: 1 for "no" answers, 2 for "difficult to say", 3 for "yes",
pi_2 - nominal variable with 2 variants with values: 0 for "no" and "difficult to say", 1 for "yes",
Hypotheses Pearson's chi-squared test and Fisher's exact test in the tests are:
H0: features are independent
H1: features are not independent
The obtained p-value <0.05 indicates the rejection of H0.

Fisher's exact test is recommended when there are not many categories. Its results coincide in most cases with the results of the Pearson's chi-squared test.
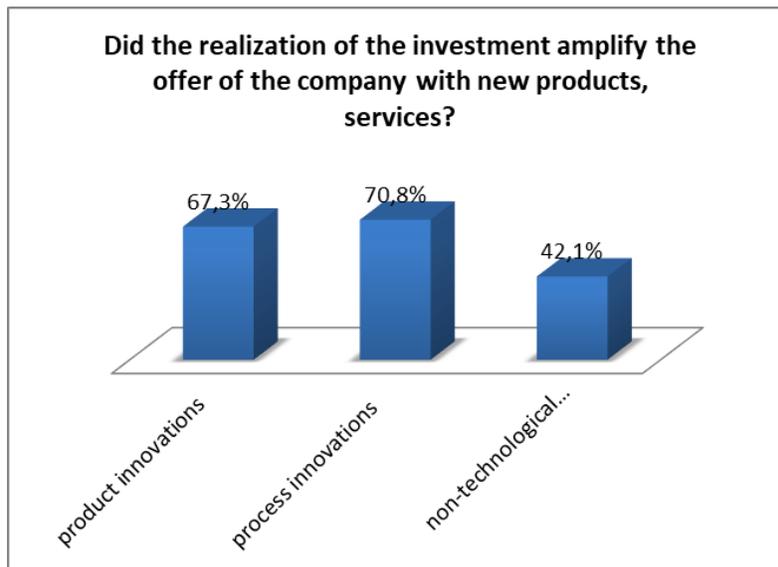
Fig. 1. Influence of investments on the introduction of new products or services
Source: own research

Companies by introducing product or process innovations achieved the effect of an innovative or modernized product offer (product innovations 67,3% and process innovations 70,8%). 42% of non-technological innovations extended their product offer (see Figure 1).

The performed statistical tests Pearson's chi-squared test and Fisher's exact test mostly confirm the independence of tested features. There is no dependence between the answers and the kind of introduced innovation product, innovation process.

Chi-squared test for product innovations

3 variants of the feature product innovations: Pearson chi2(2) = 1.3037; p-value = 0.521; Fisher's exact = 0.552

2 variants of the feature product innovations: Pearson chi2(1) = 0.7811; p-value = 0.3

Fisher's exact = 0.506; 1-sided Fisher's exact = 0.255

Chi-squared test for process innovations

3 variants of feature process innovations: Pearson chi2(2) = 1.0841; p-value = 0.582; Fisher's exact = 0.553 2 variants of the feature process innovations: Pearson chi2(1) = 1.0088; p-value = 0.315; Fisher's exact = 0.379; 1-sided Fisher's exact = 0.218

The dependence occurred with non-technological innovations.

3 variants of the feature non-technological innovations: Pearson chi2(2) = 11.0369; p-value = 0.004; Fisher's exact = 0.006

2 variants of the feature non-technological innovation: Pearson chi2(1) = 8.2882; p-value = 0.004; Fisher's exact = 0.008; 1-sided Fisher's exact = 0.006
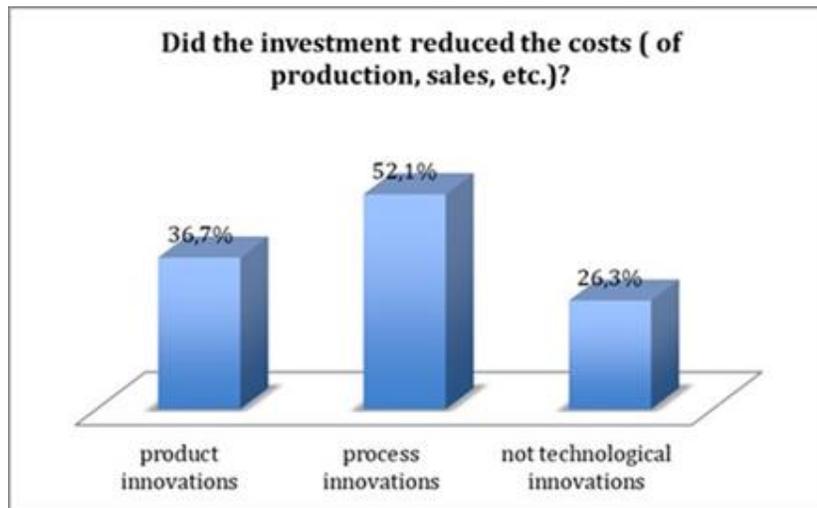
Fig. 2. Influence of investments on costs' reduction
Source: own research

Over 50% of examined companies after the realization of process innovations achieved cost reductions. Over 30% of companies, which introduced the product innovations, presented the cost reduction. Only 26% of companies that implemented non-technological innovations reduced the costs (see Figure 2).

The performed statistical tests Pearson's chi-squared test and Fisher's exact test mostly confirm the independence of tested features. There is no dependence between the answers and the kind of introduced innovation product, innovation process, non-technological innovations.

Chi-squared test for product innovations

3 variants of the feature product innovations: Pearson chi2(2) = 0.5784; p-value = 0.749; Fisher's exact = 0.766

2 variants of the feature product innovations: Pearson chi2(1) = 0.5438; p-value= 0.461; Fisher's exact = 0.550; 1-sided Fisher's exact = 0.296
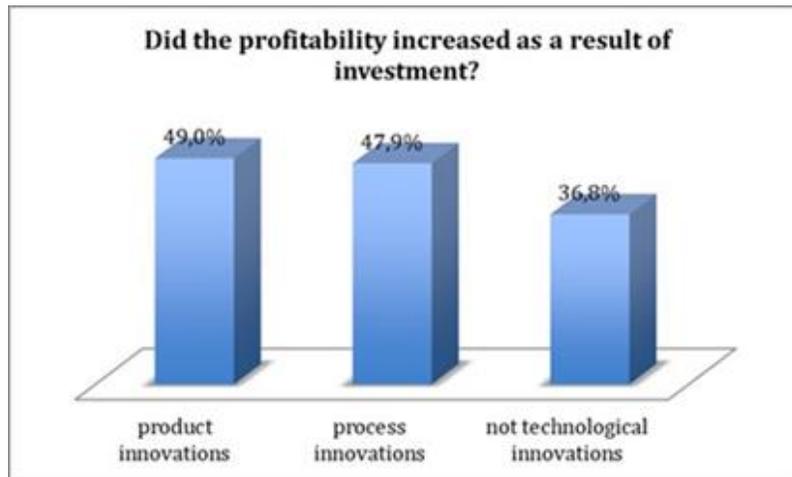
Chi-squared test for process innovations

3 variants of the feature process innovations: Pearson chi2(2) = 3.7995; p-value = 0.150 ; Fisher's exact = 0.149

2 variants of the feature process innovations: Pearson chi2(1) = 3.4901; p-value = 0.062 Fisher's exact = 0.075; 1-sided Fisher's exact = 0.047

3 variants of the feature non-technological innovations: Pearson chi2(2) =   4.3553;
p-value = 0.113; Fisher's exact = 0.122
2 variants of the feature non-technological innovations: Pearson chi2(1) =   2.9577;
p-value = 0.085; Fisher's exact = 0.119; 1-sided Fisher's exact = 0.071

Fig. 3. Impact of investments on profitability
Source: own research

The performed statistical tests: Pearson's chi-squared test and Fisher's exact test mostly confirm the independence of tested features. There is no dependence between the answers and the kind of introduced innovation product, innovation process (see Figure 3).
Chi-squared test for product innovations
3 variants of feature product innovations: Pearson chi2(2) = 0.4470; p-value = 0.800;
Fisher's exact = 0.825
2 variants of feature product innovations: Pearson chi2(1) = 0.4446; p-value= 0.505; Fisher's exact = 0.554; 1-sided Fisher's exact = 0.320;
Chi-squared test for process innovations
3 variants of the feature process innovations: Pearson chi2(2) = 2.7897; p-value = 0.248; Fisher's exact = 0.244
2 variants of the feature process innovations : Pearson chi2(1) =   0.0037;   p-value = 0.951;
Fisher's exact = 1.000; 1-sided Fisher's exact = 0.555
The dependence occurred with non-technological innovations.
3 variants of the feature non-technological innovations: Pearson chi2(2) = 9.2587; p-value = 0.010; Fisher's exact = 0.019;
2 variants of the feature non-technological innovation: Pearson chi2(1) = 1.4814; p-value = 0.224, Fisher's exact = 0.301; 1-sided Fisher's exact = 0.169;
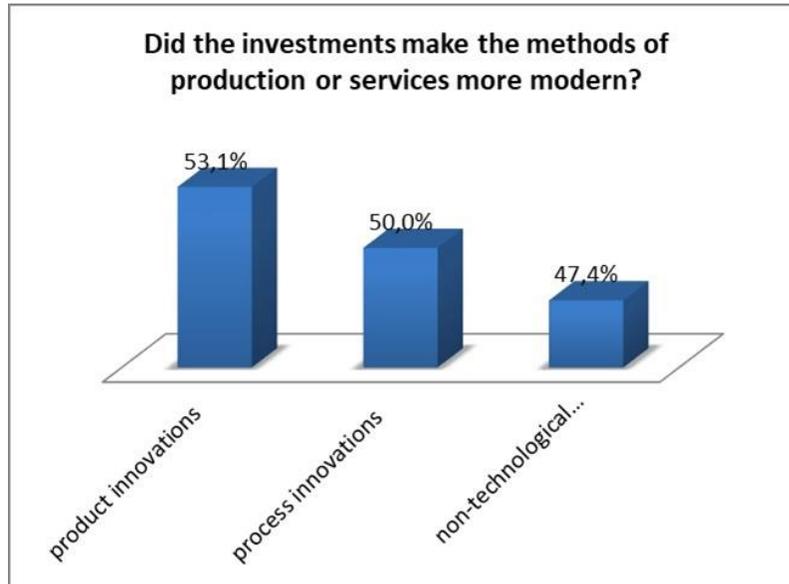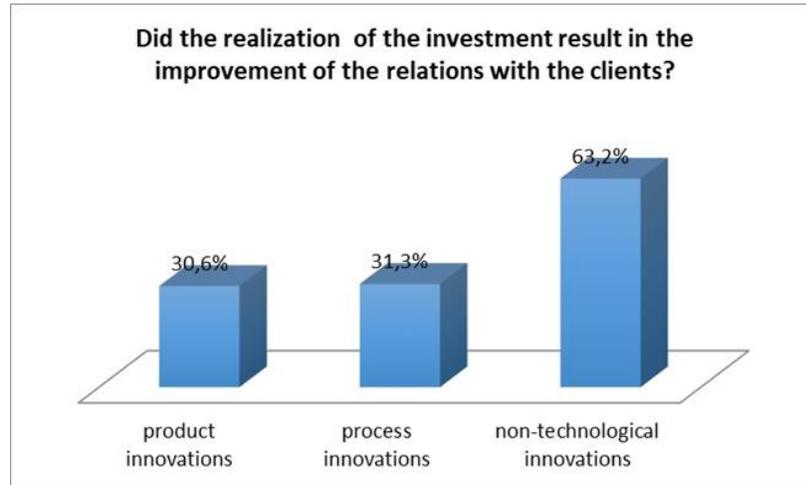
Fig. 4. Impact of investments on methods of production or services
Source: own research

The performed statistical tests: Pearson's chi-squared test and Fisher's exact test, mostly confirm the independence of tested features. There is no dependence between the answers and the kinds of introduced innovation product, innovation process, and non-technological innovations (see Figure 4).
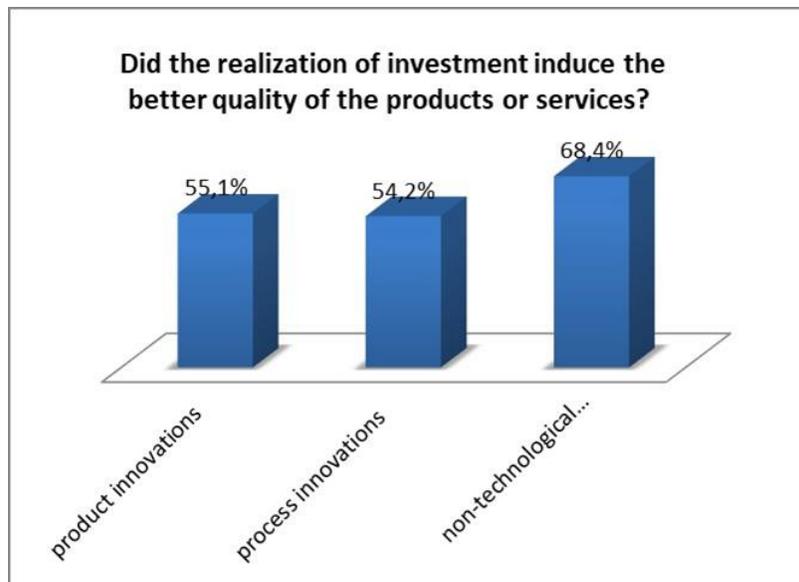
Fig. 5. Impact of investments on the quality of products or services
Source: own research

The performed statistical tests: Pearson's chi-squared test and Fisher's exact test, mostly confirm the independence of tested features. There is no dependence between the answers and the kind of introduced innovation product, innovation process or non-technological innovations (see Figure 5).

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Fig. 6. Influence of investment on customers relations' improvement
Source: own research

The performed statistical tests: Pearson's chi-squared test and Fisher's exact test, mostly confirm the independence of tested features. There is no dependence between the answers and the kind of introduced innovation product or innovation process (see Figure 6 amd Figure 7).

Chi-squared test for product innovations

3 variants of the feature product innovations: Pearson chi2(2) = 1.8117; p-value = 0.404; Fisher's exact = 0.371;

2 variants of the feature product innovations: Pearson chi2(1) = 0.6326; p-value = 0.42; Fisher's exact = 0.541; 1-sided Fisher's exact = 0.278;
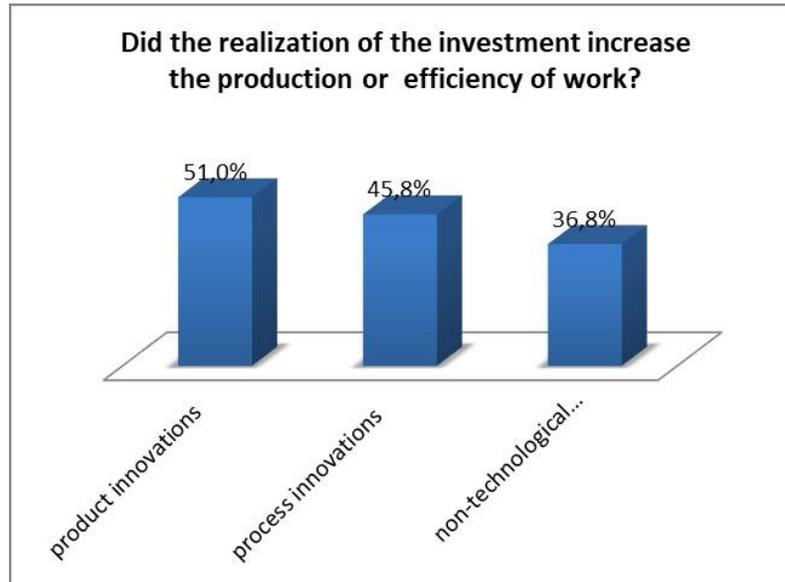
Chi-squared test for process innovations

3 variants of the feature process innovations: Pearson chi2(2) = 3.5944; p-value= 0.166; Fisher's exact = 0.193;

2 variants of the feature process innovations: Pearson chi2(1) = 0.9080; p-value= 0.341; Fisher's exact = 0.418; 1-sided Fisher's exact = 0.227;

The dependence occurred with non-technological innovations.

3 variants of the feature non-technological innovations: Pearson chi2(2) = 7.2936; p-value = 0.026; Fisher's exact = 0.020;

2 variants of the feature non-technological innovation: Pearson chi2(1) = 6.7652; Pr = 0.009; Fisher's exact = 0.015; 1-sided Fisher's exact = 0.010;

Fig. 7. Impact of investments on increase of production or work efficiency
Source: own research

The performed statistical tests: Pearson's chi-squared test and Fisher's exact test, mostly confirm the independence of tested features. There is no dependence between the answers and the kind of introduced innovation product orinnovation process.
Chi-squared test for product innovations
3 variants of the feature product innovations: Pearson chi2(2) = 1.2763; p-value= 0.528; Fisher's exact = 0.518;

2 variants of the feature product innovations: Pearson chi2(1) = 1.1349; p-value= 0.287; Fisher's exact = 0.323; 1-sided Fisher's exact = 0.193;
Chi-squared test for process innovations
3 variants of the feature process innovations: Pearson chi2(2) = 2.7507; p-value = 0.253; Fisher's exact = 0.257;

2 variants of the feature process innovations: Pearson chi2(1) = 0.1130; p-value = 0.737;
Fisher's exact = 0.843; 1-sided Fisher's exact = 0.445;
The dependence occurred with non-technological innovations.
3 variants of the feature non-technological innovations: Pearson chi2(2) = 6.3325; p-value= 0.042; Fisher's exact = 0.061
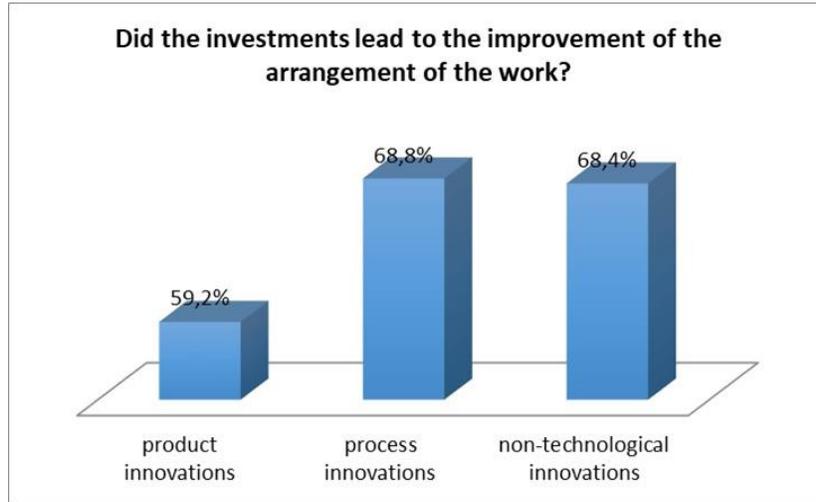
Fig.8. Impact of investments on better organization of work
Source: own research

The best results in the improvement of work flow– over 68% of the companies were achieved by introducing process innovations and non-technological innovations (see Figure 8).
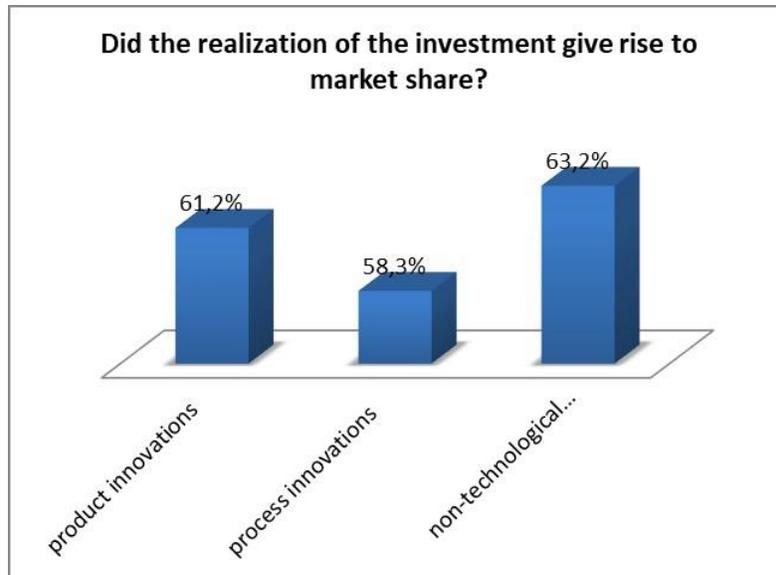
The performed statistical tests: Pearson's chi-squared test and Fisher's exact test, mostly confirm the independence of tested features. There is no dependence between the answers and the kind of introduced innovation product, innovation process, or non-technological innovations.
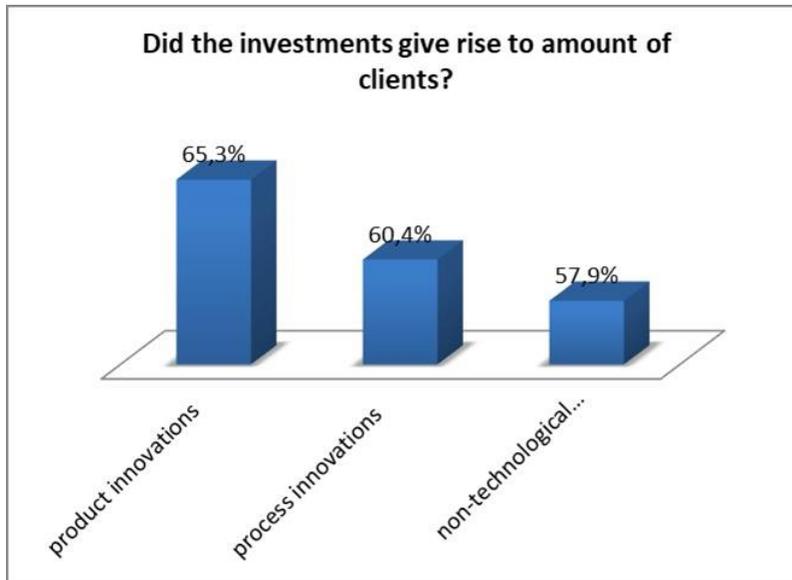
Fig.9. Impact of investments on increase in the number of customers
Source: own research

The companies, which introduced product innovations performed in 65% cases increased the number clients, for process or non –technological innovations the result was achived by 60% or less cases (see Figure 9).

The performed statistical tests Pearson's chi-squared test and Fisher's exact test mostly confirm the independence of tested features. There is no dependence between the answers and the kind of introduced innovation product, innovation process, or non-technological innovations.

Fig.10. Impact of investments on market share
Source: own research

In the companies, where the non-technological innovations were introduced, the investment gave the rise to market share in 63% of surveyed cases, for product innovations over 60% of the enterprises. The performed statistical tests Pearson's chi-squared test and Fisher's exact test mostly confirm the independence of tested features. There is no dependence between the answers and the kind of introduced innovation product, innovation process, or non-technological innovations (see Figure 10).
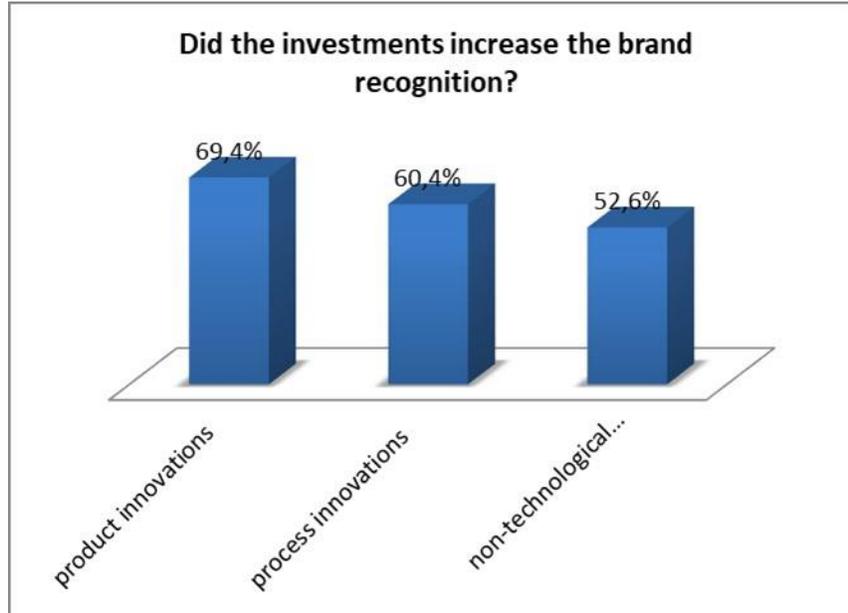
Fig. 11. Impact of investments on brand recognition
Source: own research

Brand recognition increased in nearly 70% of the companies, which introduced product innovations. The performed statistical tests Pearson's chi-squared test and Fisher's exact test mostly confirm the independence of tested features. There is no dependence between the answers and the kind of introduced innovation product, innovation process or non-technological innovations (see Figure 11).
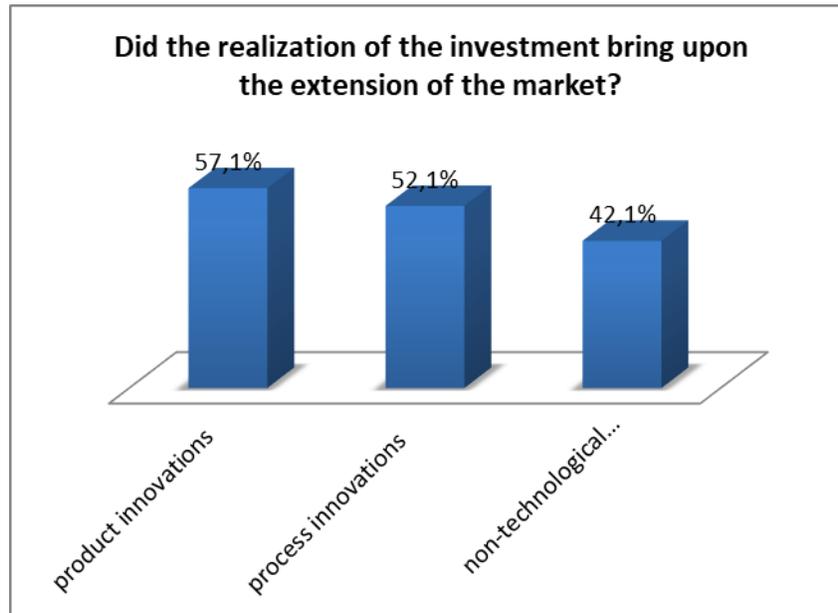

Fig. 12. Impact of investment on market expansion
Source: own research

The realization of product innovation investment increased market share in 57% of cases. The performed statistical tests: Pearson's chi-squared test and Fisher's exact test, mostly confirm the independence of the tested features. There is no dependence between the answers and the kind of introduced innovation product, innovation process, or non-technological innovations (see Figure 12).

Wilcoxon rank-sum test:

The one synthetic feature was created to present the level of the company's satisfaction from the introduced innovation. The feature was created on the basis of the answers to 16 questions.

The Wilcoxon rank-sum test verifies the hypothesis H0 (two independent samples derive from the population with the same dispersion).

Conclusions

The research presented here shows that as a result of introducing innovations, particularly product and process innovations, companies modernised methods of the production which caused reduction of the costs and the companies achieved higher profitability of production or services.

Flexible, modern technologies enable to prepare diversified products offer adjusted to needs and expectations of clients. The companies expanded their offers of products or services and at the same time the high quality of their products was provided.

The research presented here shows that the introduced non-technological innovations influenced relations with clients and better workflow much more than product and process innovations.

The investments in the companies, regardless of these kinds of innovations: product, process or non-technological, influenced many instruments of competitiveness.

The companies presented here displayed better methods of production, higher quality of services, better management of work and the same reduction of costs.

With regard to the introduced innovations, the companies noted an increase in the number of clients, an increase in market share and reinforcement of the brand. The financial result indicated by more than half of the amount of companies was increase of sales incomes and net profit.

The performed statistical tests Pearson's chi-squared test and Fisher's exact test mostly confirm the independence of the tested features. There is no dependence between the answers and the kind of introduced innovation (product, process or non-technological). In a number of cases, dependence occurred with non-technological innovations.

The one synthetic feature was created to present the level of the company's satisfaction from introduced innovation. The feature was created on the basis of answers to 16 questions. Wilcoxon rank-sum test verifies the hypothesis H0 (two independent samples derive from the population with the same dispersion). H0 indicates a similar dispersion for the synthetic variable presenting the level of company satisfaction pertaining to to the introduced innovation. There is no argument for denying H0 in all kinds of innovations (product, process and non-technological). Therefore there is no dependence between a general level of satisfaction (represented by synthetic variable) and the fact of introducing a specific kind of innovation.

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Aknowledgements

Jolanta BRODOWSKA-SZEWCZUK is the Doctor of Economic Sciences - Faculty of Economic Sciences at the University of Warsaw. In 2016, she was awarded the title of "The Best Young Scientist of the Siedlce University of Natural Sciences and Humanities". She was the Vice Dean for Research at the Faculty of Economic and Legal Sciences of the University of Natural Sciences and Humanities. She is Associate Professor at the University of Natural Sciences and Humanities, she is a Program Member of the Transdisciplinary Center for the Study of Security Problems in Poland and Member of the Editorial Board Management Dynamics in the Knowledge Economy, Romania. Research interests: absorption of EU funds, competitiveness and innovativeness of enterprises, the sector of small and medium enterprises, financial risk.
ORCID ID: orcid.org/0000-0002-8629-3064

Register for an ORCID ID:
https://orcid.org/register