

Innovation in Selected European Countries and Position of Czech Businesses

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Abstract: Innovation and the introduction of new processes are an essential part of the functioning of enterprises. The main aim of this paper is to evaluate the position of enterprises from the Czech Republic within Central Europe in terms of innovation and the introduction of new business processes, and to identify whether there are significant differences between enterprises from individual countries. To achieve this aim, harmonized secondary data from the CIS 2022 survey and descriptive statistics, together with the chi-square test of independence, are used. The Oslo Manual is used to classify particular types of innovation. The results show the dominance of Germany, both in absolute terms and in intensity. Slovakia lags significantly behind other Central European countries. Process innovations are most often represented in all countries, while Czech enterprises are well above average in marketing innovations, and they also stand out in product innovations. It is recommended to strengthen organizational and process innovations, in particular in order to create a suitable innovation mix leading to increased competitiveness.

Keywords: innovation, business process, improving, Oslo manual

JEL Classification: M21, O31, O32

1 Introduction

Improving business processes in companies is based mainly on two levels, namely (a) strategic innovation management and (b) Business Process Management (BPM), which helps to introduce innovations into an operational and, above all, measurable state (Mendling et al., 2020). We also recognize the term Business Process Innovation (BPI), which refers to changes in the design and operation of processes (Qerimi et al., 2024). BPM then offers support in the form of process models, analytics, and further improvement options, which help not only to create innovations themselves, but also to implement and maintain them in practice (van der Aalst, 2013).

In terms of basic concepts in the field of types of innovation, the most widely used OECD methodology, called the Oslo Manual, can be used. It distinguishes four basic types of innovation. First, there are product innovations (new or significant product improvements), process innovations (e.g., new methods, procedures), organizational innovations (innovations of structures, knowledge), and finally marketing innovations (innovations of positioning, design, or pricing) (Gunday et al., 2011). Progress within individual innovations is captured using both quantitative and qualitative indicators (Dzialis & Blind, 2019). In addition, a strong theme in the current literature is the complementarity between the particular types of innovation. Those organizations that can align product and process innovations are better able to achieve sustainable improvement (Camisón & Villar-López, 2014). However, the goal of an organization should be a balanced portfolio of innovations, which will include not only process and product innovations, but also other types of innovations (Polder et al., 2020).

Within the framework of innovation and business processes, there is a number of specificities for Central and Eastern Europe. These are summarized in the Community Innovation Survey. It was found that companies in this region are more oriented towards incremental and gradual innovations than radical product innovations (Hashi & Stojčić, 2013). The fact that companies in the Central European region – specifically ones from the Czech Republic – are strongly focused on product and marketing innovations is also confirmed by Vokoun & Píchová (2020). It is also interesting that, in general,

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for Central European countries, internal R&D has a positive impact on product innovations, while a negative impact on process innovations, applies. Moreover, external R&D is significant only in the case of the Czech Republic. In the framework of innovation, funding from EU sources appears to be crucial (Vávra et al., 2021). Likewise, for companies in this region, knowledge and membership in various associations and groups are important internal sources of innovation. It was also found that the source of external knowledge is usually not technology transfer from abroad or foreign technology (Prokop et al., 2021). Based on these differences, the research question was formulated as follows: “Are there differences between countries in terms of individual types of innovation?”

2 Methods

The main aim of this paper is to evaluate the position of enterprises from the Czech Republic within Central Europe and Germany in terms of innovation and the introduction of new business processes, and to identify whether there are significant differences between enterprises from individual countries. To achieve this aim, the latest available secondary data from the Eurostat database was used. (Eurostat, 2022a; 2022b).

The geographical area was selected based on several scholarly publications dealing with a similar topic in Central or Central and Eastern Europe and Germany, often with a specific focus on one country, as will be the case in this paper, and the topic has been discussed cross-sectionally for many years (Hashi & Stojčić, 2013; Lewandowska et al., 2016; Radosevic, 2002; Vokoun & Píchová, 2020). The analysis is based on the latest complete wave of harmonized Eurostat data available at the time of processing in the form of the Community Innovation Survey 2022, abbreviated CIS 2022. CIS is a survey with a reference period of 2020–2022; the results of this wave were published in 2024, and the next wave (CIS 2024) will not be published until 2026 (Eurostat, 2024). For structural business statistics, the standard lag is in the order of several months or lower tens of months (Eurostat, n.d.); therefore, 2022 is the last year with final and internationally comparable data for all monitored indicators. The choice of 2022 thus ensures the replicability of the analysis. Research dealing with Central Europe with data from the Community Innovation Survey is no exception (Makrevska Disoska et al., 2024; Vokoun & Dvouletý, 2022).

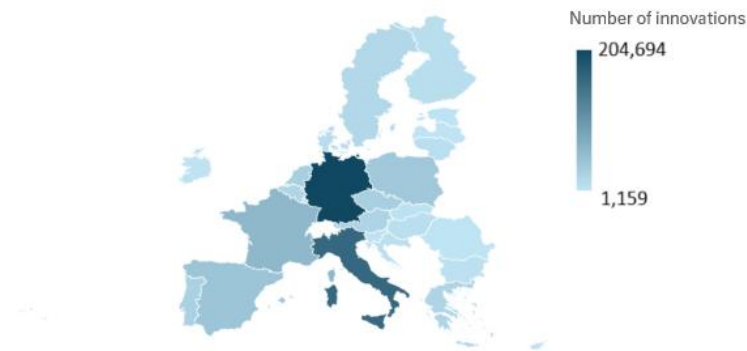
To enable cross-country comparability, absolute numbers of innovations were recalculated into relative indicators. First, innovation intensity was computed as the ratio of the number of new or improved business processes to the total number of enterprises in the country ($\text{Innovation intensity} = \text{Number of innovations} \div \text{Number of enterprises}$). Second, the indicator “companies per one innovation” was derived as the inverse of innovation intensity ($\text{Companies per innovation} = \text{Number of enterprises} \div \text{Number of innovations}$). For Figure 3, the number of innovations by type was normalized per company using the same approach, i.e., dividing the absolute count of each innovation type by the total number of enterprises in the respective country. Finally, the process/product ratio in Table 3 was calculated as $(\text{Process innovations} + \text{Organizational innovations}) \div (\text{Product innovations} + \text{Marketing innovations})$. These recalculations ensure that differences are not driven by country size but reflect relative innovation activity.

In order to answer the research question with statistical significance, it was necessary to use statistical analyses. First, basic descriptive statistics were used in the form of tables and graphs (Byrne, 2007). Subsequently, the chi-square test of independence was used, which answers the question of whether there is a statistically significant relationship between the individual variables (Franke et al., 2011). The calculation of standardized residuals was also used to observe whether companies in individual countries implement fewer or more specific types of innovations than the expected average (Ahad et al., 2023). If the residual value is > 0 , then this is a statistically significant positive deviation. If the residual is < 0 , then the value is smaller than the expected average and there is statistically significant negative deviation (Bewick et al., 2004). The initial significance level was chosen as $\alpha = 0.05$ (Wasserstein & Lazar, 2016). MS Excel and the statistical tool R Studio were used for all calculations and analyses.

3 Research results

Before looking at Central Europe and Germany, a look at all EU member states is offered in Figure 1. The total number of activities related to the implementation of innovations in existing business processes or introducing new ones was monitored.

Figure 1 Number of new or improved business processes in EU

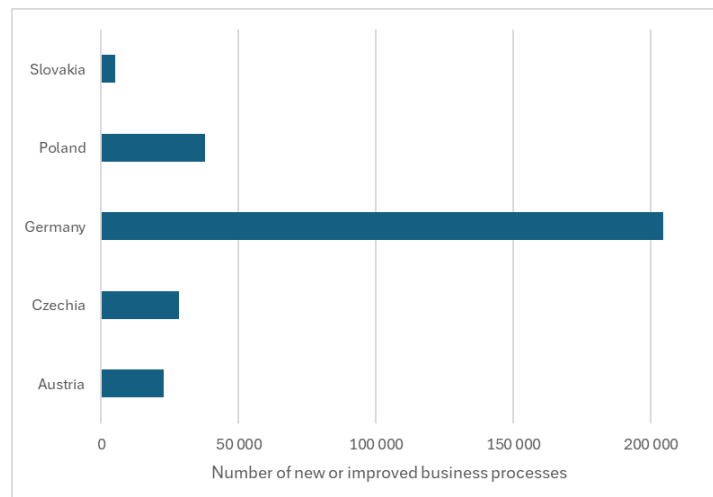


Source: Own processing according to Eurostat (2022b)

As can be seen, in the context of the entire EU, Germany is the leader in the number of innovations, followed by Italy. Companies in France, Spain, and Poland are also significantly active. The Czech Republic is located approximately in the middle of the color spectrum. Companies in the Baltic States or the Balkan Peninsula are significantly less active.

A simple comparison overview is now offered within the individual Central European countries. Figure 2 shows the total number of new and improved business processes in the individual countries.

Figure 2 Number of new or improved business processes in Central Europe and Germany



Source: Own processing according to Eurostat (2022b)

As can be seen from Figure 2, in absolute terms, Germany is clearly dominant, and very significantly so, as the total number of new or innovated business processes here reaches 204,694. Polish companies appear to be the second best (37,668), followed by the Czech Republic (28,300), Austria (22,716), and Slovakia (5,280). From this simple perspective, the situation of the Czech Republic appears to be significantly lagging Germany, but Czech companies are keeping pace with other Central European countries. However, looking at absolute numbers can distort reality, because each country has a different number of companies. More telling indicators are offered in Table 1, in the form of innovation intensity per company, or how many companies are involved in one innovation.

Table 1 The intensity of innovations per company in Central Europe and Germany

	Number of new or improved processes	Number of businesses	Innovation intensity	Companies to one innovation
Austria	22,716	583,947	0.039	25.71
Czechia	28,300	1,292,436	0.022	45.67
Germany	204,694	3,159,716	0.065	15.44
Poland	37,668	2,675,865	0.014	71.04
Slovakia	5,280	635,781	0.008	120.41

Source: Own processing according to Eurostat (2022a; 2022b)

If we focus on the characteristics of countries according to the innovation intensity of enterprises, we can observe slightly different conclusions. Germany also dominates Central Europe within this indicator, where its innovation intensity reaches a value of 0.065, i.e., 6.5% of enterprises here implement innovations. Austria appears to be the second best within this indicator (0.039), followed by the Czech Republic (0.022), Poland (0.014), and Slovakia (0.008). Within this indicator, it can be stated that 2.2% of Czech enterprises work with set business processes, implement new ones, or innovate existing ones. The situation in Slovakia is alarming, as not even 1% of enterprises here revise and improve processes. The situation is also completely identical in terms of the number of enterprises per one new process or its innovation, with Germany achieving the best values, while Slovakia, on the contrary, having the worst.

The numbers of individual business processes according to the type of innovation that was implemented are also interesting. These are the four basic types of innovations, namely process, product, organizational, and marketing. A basic overview in absolute terms can be seen in Table 2; a graphical representation can be seen after calculating the number of companies per innovation in Figure 3.

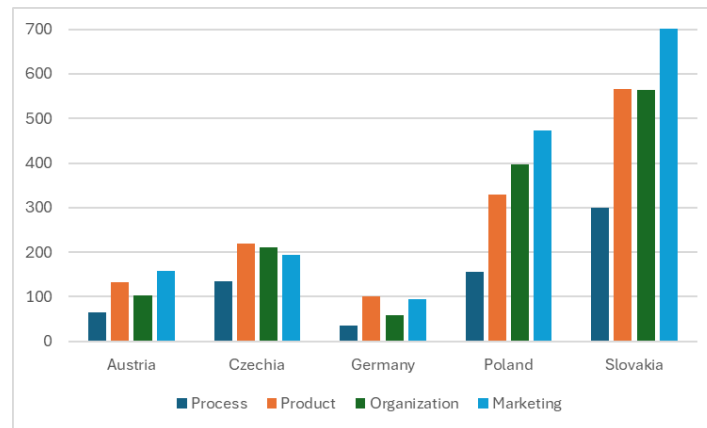
As can be seen, process innovations are implemented most often. Moreover, in all the countries studied, the “per business” number is the smallest. The second highest number represent organizational innovations is implemented, with two countries, namely the Czech Republic and Slovakia, having approximately the same “per business” frequency as for product innovations, and the number is even higher in Poland. Although fewer organizational innovations are implemented in total, in these countries, the differences between organizational and product innovations are negligible or very small. However, there is a significant departure from Germany, as here enterprises implement almost twice as many organizational innovations than product innovations, which are at the marketing level. These are implemented in total by far the least, and this is the case in all countries except the Czech Republic, where the marketing innovations account for the second-highest share. This significantly differentiates Czech enterprises from the rest of Central Europe.

Table 2 Number of new or improved business processes according to the kind of Innovation in Central Europe and Germany

	Process innovation	Product innovation	Organization innovation	Marketing innovation
Austria	9,002	4,375	5,643	3,696
Czechia	9,613	5,890	6,159	6,638
Germany	86,549	31,269	53,831	33,045
Poland	17,164	8,126	6,729	5,649
Slovakia	2,124	1,142	1,126	906
Sum	124,452	50,784	73,488	49,934

Source: Own processing according to Eurostat (2022b)

Figure 3 Relative intensity of innovation per company in Central Europe and Germany



Source: Own processing according to Eurostat (2022a; 2022b)

It was also investigated what proportion of process and product innovations there is in individual countries. Process innovations can be defined as process and organizational innovations alone, while product innovations can be defined as product innovations alone combined with marketing innovations. The results are presented in Table 3.

Table 3 Process/Product ratio

Austria	1.815
Czechia	1.259
Germany	2.183
Poland	1.735
Slovakia	1.601

Source: Own processing according to Eurostat (2022a; 2022b)

There can be drawn several conclusions from Table 3. The first is that Czech companies have the index closest to zero of all the countries monitored. This means that they focus on marketing and product innovations significantly more than neighboring countries. In contrast, Germany is significantly oriented towards process and organizational innovations. The same is true for Austria.

It was also investigated whether the differences between individual countries in terms of individual types of business process innovations are statistically significant. For this observation, the chi-square test of independence was used. The results of the test are presented in Table 4.

Table 4 Chi-square test of independence

χ^2 statistics	3,701.612
Df	12
p-value	<0.001

Source: Own processing according to Eurostat (2022a; 2022b)

The χ^2 test statistic reaches high values, indicating significant differences. Moreover, these are statistically significant, since the p-value is well below the significance level of 0.05. To determine which countries are more active or passive in innovating individual business processes according to the type of innovation, standardized residuals were calculated. The results are shown in Table 5.

Table 5 Standardized residuals

	Process innovation	Product innovation	Organization innovation	Marketing innovation
Austria	-6.494	9.414	0.857	-1.887
Czechia	-27.623	17.926	-11.670	31.919
Germany	10.008	-37.104	31.690	-12.448
Poland	16.407	25.249	-32.499	-9.585
Slovakia	-2.146	8.360	-5.584	0.864

Source: Own processing according to Eurostat (2022a; 2022b)

Table 5 shows significant differences in all countries. In the case of Czech companies, a higher number of process and organizational innovations of business processes is expected, while in the case of marketing and product innovations, Czech companies are above average. In process innovations, all countries are lagging, except Poland and Germany, while in product innovations, organizations from all countries except Germany are above expectations. In organizational innovations, German and Austrian companies are significantly above expectations, and in marketing innovations, Czech and Slovak companies are. In summary, it can be said that companies from the Czech Republic are very strong in product and marketing innovations of business processes, but they are lagging in process and organizational innovations. The closest to the value of 0 are Slovakia and Austria, in the case of marketing and organizational innovations, respectively. The stated research question can also be answered. Yes, there are a number of significant differences between individual countries in terms of individual types of innovations.

4 Conclusions

The main aim of this paper was to evaluate the position of enterprises from the Czech Republic within Central Europe and Germany in terms of innovation and the introduction of new business processes, and to identify whether there are significant differences between enterprises from individual countries. This aim was achieved thanks to secondary data from the Eurostat database, the identified descriptive characteristics, and the statistical examination of the data, using the chi-square test and standardized residuals.

The results show that in absolute terms and in the intensity of introducing new or innovating existing business processes, Germany clearly dominates, which is significantly different from other Central European countries. The Czech Republic, Poland, and Austria occupy approximately the same, let's say, middle position. Slovakia is significantly the worst country of all observed, lagging significantly behind in the overall assessment, not only in the number of innovations, but also in their intensity, with less than one percent of organizations innovating their processes or coming up with new ones. Descriptive statistics confirmed that process innovations are the most frequently implemented type in all countries; however, the other structure differs. The Czech Republic achieves above-average numbers of marketing and product innovations, but lags in process and organizational innovations. On the contrary, Germany has an unshakable strong position in process and organizational innovations, while Poland benefits mainly from process and product innovations. The results of the chi-square test clearly confirmed the statistical significance of the differences found between companies from different countries.

Based on these findings, several practical recommendations can be formulated. First, Czech companies should focus on strengthening process and organizational innovations, as these areas currently represent a weak point. The underlying cause may be the historical emphasis on product and marketing innovations, which has led to an imbalance in the innovation portfolio. To address this, companies should implement structured process management systems, invest in employee training for operational excellence, and adopt digital tools that support workflow optimization. Second, Slovak companies require more systematic support for innovation. This could include targeted government subsidies for process improvement projects, knowledge transfer programs from advanced economies, and partnerships with research institutions to foster organizational innovation. Finally, policymakers should consider creating incentives for collaborative innovation networks, which can help firms share best practices and reduce barriers to adopting process innovations. These concrete steps go beyond generic recommendations and aim to address the root causes of the observed disparities, thereby improving competitiveness in the region.

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