
Determinants of Innovation Activities in Small Enterprises: A Model Approach

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Abstract:

Purpose: The article aims to develop a model explaining the undertaking of Polish small enterprises' innovation activities.

Design/Methodology/Approach: There are many classifications of the factors that stimulate or inhibit small enterprises' innovation activity. Generally, they are considered in two domains – as external and internal determinants. Empirical studies were conducted in 2015 on a representative sample of 202 Polish small enterprises using the CAPI method. Analysis of the significance of the impact of key internal and external factors on small enterprises' innovation activity was based on a logit regression model.

Findings: The results indicate the significance of seven of the 25 key factors included in the model. These statistically significant determinants of Polish small enterprises' innovation activity exhibited both positive and negative impacts on undertaking innovative undertakings.

Practical Implications: The identified determinants of innovation activity may guide managers of such companies. The presented model shows which factors stimulate the process of implementing innovations and which inhibit it.

Originality/value: The research identifies the external and internal determinants of innovation activity in Polish small companies. These results can be compared with results in other countries, where the conditions for conducting innovation activities are often completely different.

Keywords: Innovation, determinants of innovation, small business.

JEL classification: D22, M20, O30.

Paper Type: Research study.

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1. Introduction

Global economic rivalry forces countries, regions, and entrepreneurs to seek new sources of competitive advantage. The effects of the sub-prime mortgage crisis and the EU's weakening international market position indicate that difficulties in meeting the present economic challenges are increasing. The prevailing view in the literature is that, in addition to international and national authorities or enterprises' diverse actions, the essential factor in overcoming difficulties is greater innovation (Mizgajska, 2013; Kuś, 2020). Innovation in Business innovation a key determinant to determine advantage (Deffains-Crapsky and Sudolska, 2014). However, only a systemic approach to introducing changes can improve the position of any (Havlíček, Thalassinos, and Berezkinova, 2013). Innovative activity is understood as the entirety of activities intended to lead to new or significantly improved solutions being implemented in a business. This activity may take various forms, ranging from advanced projects that will result in a new product, to the continuous improvement of existing products or processes. Regardless of the type of innovation, however, it should be understood as an organisationally complex learning process that depends on many internal and external factors (Zastempowski *et al.*, 2020). This article focuses on small Polish entities' conditions for conducting innovation activities.

The small and medium-sized enterprise (SME) sector is seen as an important feature of the economic landscape in most countries: in Poland, it accounts for 99.8% of all enterprises, generates almost half of the gross domestic product, and provides employment for 69% of society (Zakrzewski and Skowrońska, 2019). In our present age of globalization and internationalization, these entities play a heightened social and economic role. Speaking about SMEs in his position as European Commission Vice-President, responsible for Enterprise and Industry, put it simply: "Entrepreneurs are the economic DNA which we need to build competitiveness and innovation in Europe" (Pach and Solińska, 2010).

It is worth emphasizing that small enterprises constitute 129,862 entities within the SME sector in the Polish national economy. The high innovation potential of small enterprises results from the combination of possibilities and the need to support innovation's rapid development. Although small enterprises are the subject of many studies, they are most often lumped together with medium-sized entities in analyses of the SME sector as a whole (European Union, 2018a; Hvolkova *et al.*, 2019; Grego-Planer and Glabiszewski, 2016). However, the results of the present study show that these entities are closer to micro-enterprises than to medium-sized enterprises. The specificity of small business activities prompted us to make them the subject of our research. The article's main aim is to develop a model that indicates the essential conditions for Polish small enterprises to undertake innovation activities.

2. Theoretical Background

“Failure to innovate means failure for a company in the long run” (Freeman, 1982). Although spoken several decades ago, these words of Christopher Freeman still directly reflect how important innovation is in the functioning of each enterprise. Innovative enterprises are those that have the ability to create or copy new products. They are characterized by the ability to constantly revise their portfolio, adapting to changes in the environment. They can efficiently introduce new technologies and organizational methods to achieve changing development goals (Bogdanienko, 2004). Damanpour and Wischnovsky (2006) identify an innovative organization as one that simultaneously generates and adopt innovative solutions. In turn, OECD specialists indicate in the Oslo Manual that an innovating firm is one that in the period under review “implemented at least one product or process innovation, or carried out at least one innovative project that was interrupted or abandoned during the period under review (not completed) or was not completed by the end of the period” (OECD, 2008).

Innovation activity is identified as:

all those scientific, technological, organisational, financial and commercial steps which actually, or are intended to, lead to the implementation of technologically new or improved products or processes. Some may be innovative in their own right; others are not novel but are necessary for implementation [...] Innovative activities also include research and development (R&D) activities that are not directly related to the creation of a specific innovation. (OECD, 2008)

Seeing innovation through the prism of a coupled process that includes many different activities, from a new idea's emergence to its adoption in the enterprise, requires a broader look at the elements that determine how modern businesses conduct innovation activity. The emergence of innovations in small enterprises may be influenced both by external conditions (Drews, 2018a) related to the environment in which the enterprise develops and operates and by internal conditions (Drews, 2018b) related to the company's potential for innovation. However, at this point, it should be emphasized that a company's level of innovativeness results from many diverse external and internal factors that change over time, rather than individual determinants of a given type. Identifying these conditions makes it possible, in a sense, to identify what determines the conduct of innovation activity, and thus the effective implementation of innovation.

The literature provides many typologies of determinants of business innovation activity. First of all, analyzing the organization's external environmental conditions, as early as 1979, Whitfield (1979) pointed out that they are related to the macro-economic system. Romijn and Albaladejo (2002), in turn, point out that the external conditions include the intensity of cooperation and advantages related to creating networks with customers, suppliers, competitors, financial institutions, training,

research and development, service providers, and industry associations, as well as institutional factors in the form of the British innovation awards and EU innovation subsidies. Assink (2006) believes that the external factors influencing innovation include demographic, ecological, political, economic, social, technological factors, as well as competition and consumers. According to Romero and Martinez-Roman (2012), the important external determinants include aspects such as the spread of knowledge, the university system, and research and development institutions, as well as regulations and public support measures. Romanowska (2016), meanwhile, indicates that the factors are of either direct impact (e.g., tax breaks), or indirect impact (e.g., education, law), or are sectoral (e.g., the intensity of competition). Based on a detailed analysis of the issues encompassing numerous global studies in the field, we can divide the external conditions influencing the innovation of Polish small companies into seven groups: economic, political and legal, socio-cultural and demographic, international, technical, geographical, and sectoral (industry).

Alongside the factors deriving from the organization's immediate and more remote environment, the company's innovation activity's endogenous determinants are equally important. Identifying them is directly relevant to distinguishing the resources necessary to build an economic entity's innovation potential. This potential is perceived as a multidimensional construct that includes the product, process, market, strategic, and behavioral innovation (Wang and Ahmed, 2004). Dobni (2008) has a slightly different view of innovation potential that distinguishes the intention to innovate, the innovation infrastructure, market orientation, and the environment for implementing innovations. Poznańska (1998) defines it as the company's ability to implement innovative solutions effectively.

Innovation potential is shaped by four main components: financial potential, human potential, material potential, and knowledge. As Zastempowski (2010) writes, "innovation potential is those resources that small and medium-sized enterprises should have at their disposal in order "to create and commercialize innovations effectively. The ability to innovate is undoubtedly built mainly on specific resources at the enterprise's disposal (Zastempowski, 2019). According to Saunila, Ukko, and Rantanen (2014), it is based on such intangible resources as supporting culture, employee skills and innovativeness, employee welfare, leadership practices, processes and tools for managing ideas, the development of individual knowledge, external sources of knowledge, and links to strategic goals.

Lambrou (2016) believes that the components of innovation capacity are strategy, organizational intelligence, and culture. In turn, Donate, Pena, and Sanchez (2016) claim that a personalized and cooperative human resources system, social capital, and human capital have the greatest impact on innovation capacity. All interpretations of the company's innovation potential indicate that it is determined by material and non-material resources that build an intra-organizational basis for selecting a specific innovation strategy and the internal conditions in which it is implemented.

Therefore, what specific external and internal conditions imply that Polish small enterprises engage in innovation activities? Identifying these conditions was the subject of the authors' research, and the results will be presented in the next part of the work.

3. Research Methodology

The main quantitative analyses were based on direct interviews conducted with Polish SME owners using the CAPI method. Ultimately, the interviews with a representative sample of Polish SMEs were completed in Q2 of 2015. The research sample was selected at random from the REGON register by the Statistical Informatics Centre of Statistics Poland (GUS) in Warsaw in September 2014.

The representativeness of the sample was based on four indicators: the size of the enterprise, type of activity according to the sections and divisions of the Polish Classification of Activities (PKD), province (voivodeship) of the business headquarters, and a minimum period of operation of the entity in the market economy (5 years).

The size of the research sample was established on the assumption that:

- the research population was 176,276 enterprises in 2012: 146,489 small (excluding micro-enterprises) and 29,787 medium-sized, respectively,
- the confidence level is $p=0.95$,
- fraction size – the percentage share of the phenomenon of innovation in the studied population is 20%,
- the maximum error is 0.05.

With criteria thus defined, the research sample should contain 246 enterprises (Kaczmarczyk, 2011). Ultimately, 250 randomly selected entities from the SME sector took part in the study. For this study, only responses from small companies, constituting 80.8% of the surveyed sample, were used for further analysis. Apart from the traditional logical inference methods, the work uses statistical tools based on the STATA 16 program to develop a logit model.

In the attempt to examine the influence of independent variables on the dichotomous dependent variable, the logit regression method was used, based upon which a logit model was built that takes the form (Gruszczynski, 2012):

$$\text{logit}(p_i) = Z_i = x'_i \beta = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_k X_{ki} \quad (1)$$

where:

- $\text{logit}(p_i)$ is denoted as $\ln = \frac{p_i}{1-p_i}$.

In an attempt to answer the question, “Which factors significantly affect small enterprises’ conduct of innovation activities?” a list of potential variables that might

imply that these entities conducted innovation activities was first prepared. Exogenous factors influencing small enterprises' innovation activity were assessed by respondents on an ordinal scale (1–5), where: 1 – very bad; 2 – bad; 3 – neither good nor bad (neutral); 4 – good; 5 – very good. Meanwhile, endogenous factors influencing small enterprises' innovation activity were assessed on an ordinal scale (0–3), where: 0 – no resource, 1 – low impact, 2 – moderate impact, 3 – high impact.

To estimate the logit model, 25 external and internal factors were adopted that respondents had indicated as being of key importance in the process of generating innovation (hereinafter referred to as “explanatory variables” [X1–X25]). Most come from inside the organization, and the remaining 40% of its environment. Innovation activity, understood as implementing at least one type of innovation activity in the analyzed period, was selected as the main explained variable (Y1). The characteristics of the variables used in the general model are presented below in Table 1.

Table 1. *Characteristics of model variables*

Variable	Meaning
Explanatory variables from the external environment (ordinal scale 1–5)	
X ₁	Workforce mobility
X ₂	Individual customer expectations of innovation
X ₃	Populational level of education
X ₄	Availability of bank loans
X ₅	Work ethic
X ₆	Speed of technology and technology transfer
X ₇	Availability of natural resources
X ₈	Pace of technology and technological development
X ₉	Sectoral competition for quality
X ₁₀	Support for small and medium-sized enterprises (e.g. advisory, training, financial)
Intra-organisational explanatory variables (ordinal scale 0–3)	
X ₁₁	Management leadership ability (owner)
X ₁₂	Management attitude to change (owner)
X ₁₃	Employee creativity
X ₁₄	Employee productivity
X ₁₅	Management attitude towards innovation (owner)
X ₁₆	Employee readiness to cooperate
X ₁₇	Knowledge, experience and skills of management (owner)
X ₁₈	Corporate image and reputation
X ₁₉	Employee technical culture
X ₂₀	Employee loyalty to the enterprise
X ₂₁	Enterprise's ability to learn
X ₂₂	Employee openness to changes
X ₂₃	Organisational culture of the enterprise
X ₂₄	Employee readiness to improve qualifications
X ₂₅	Educational level of employees
Explained variable (dichotomous scale 0:1)	
Y ₁	Innovative activity of the enterprise

Source: Own research.

4. Results and Discussion

To investigate the significant determinants that translate into innovation activity conducted by small enterprises, a logit regression model was estimated. However, to create a model that best reflects the studied phenomenon, it was decided to eliminate a few more of the variables with the highest p values. Seven variables were thus deleted, i.e., X14, X17, X12, X10, X22, X24, X25, to yield the final form of the model (Table 2). Next, the likelihood test was conducted on the final model (LR chi-square [18] = 41.6112; Prob>chi-square 0.0013), which indicates the significance of the model and is thus a reliable basis for further interpretation of the results. The McFadden pseudo-R2 coefficient was chosen to measure the quality of the model fit to the data. In the analyzed case, it is 0.352003, which indicates the relative degree of the explanatory power of a dependent variable.

Table 2. Logistic model for innovation operations

Var.	Coeff.	Std. Err.	z	P> z	95% conf. interval	
Constan	0.2740365	1.899738	0.1442	0.88530	-3.449381	3.997454
X ₁	-1.28483	0.5268015	-2.4389	0.01473**	-2.317342	-0.2523184
X ₂	-0.2193767	0.4706175	-0.4661	0.64111	-1.14177	0.7030168
X ₃	1.086875	0.5144227	2.1128	0.03462**	0.0786245	2.095125
X ₄	0.6982205	0.5211961	1.3397	0.18036	-0.3233051	1.719746
X ₅	-1.111256	0.5467419	-2.0325	0.04210**	-2.18285	-0.396612
X ₆	-0.7432191	0.4927762	-1.5082	0.13150	-1.709043	0.2226046
X ₇	0.3402549	0.4575386	0.7437	0.45708	-0.5565043	1.237014
X ₈	0.9421433	0.515875	1.8263	0.06780*	-0.0689531	1.95324
X ₉	-0.3098034	0.4324908	-0.7163	0.47379	-1.15747	0.5378631
X ₁₁	0.6995542	0.4364925	1.6027	0.10901	-0.1559553	1.555064
X ₁₃	0.394537	0.5582451	0.7067	0.47972	-0.6996034	1.488677
X ₁₅	1.060806	0.5416354	1.9585	0.05017*	-0.0007801	2.122392
X ₁₆	-0.8514958	0.5250615	-1.6217	0.10487	-1.880597	0.1776057
X ₁₈	1.255665	0.656307	1.9132	0.05572*	-0.0306726	2.542004
X ₁₉	-0.9581411	0.5432414	-1.7637	0.07777*	-2.022875	-0.1065926
X ₂₀	0.6772702	0.6148168	1.1016	0.27064	-0.5277485	1.882289
X ₂₁	-0.735107	0.599909	-1.2254	0.22044	-1.910907	0.440693
X ₂₃	0.742744	0.6162954	1.2052	0.22814	-0.4651729	1.950661
N				130		
LRchi2(18)				41.6112		
Prob >chi-sq.				0.0013		
Pseudo R ²				0.352003		

Source: Own research.

In the above model, the estimated parameters take positive and negative values, which means that the impact of independent variables on the dependent variable translates into an increase or decrease, respectively, in the chances of small enterprises conducting innovation activities. The model was calculated for 130 observations because this corresponds to the number of companies that could implement the given innovation activities due to implemented product or process innovations.

In the analysed general model, the following variables turned out to be statistically significant: X1 – workforce mobility; X3 – the populational level of education; X5 – work ethic; X8 – the pace of technology and technological development; X15 – management attitude towards innovation (owner); X18 – corporate image and reputation; X19 – employee technical culture.

Of the 130 small enterprises, 112 were correctly diagnosed as conducting innovation activity. This means that the logit function predicts the event with an accuracy of 86.2%. In the general model, the odds ratio is 14:17, which means that the model forecasts at better than random. The estimated model was interpreted using the *i*th variable's odds ratio, assuming the remaining model variables (Table 3).

Table 3. Evaluation results for the logit model of innovation activity: odds ratios

Var.	Odds. ratio	Std. Err.	z	P > z	95% conf. interval	
Constant						
X ₁	1.315263	2.498655	0.14	0.885	0.0317653	54.45933
X ₂	0.2766975	0.1457647	-2.44	0.015**	0.0985351	0.7769973
X ₃	0.8030192	0.3779149	-0.47	0.641	0.3192534	2.0119837
X ₄	2.964993	1.52526	2.11	0.035**	1.081798	8.126453
X ₅	2.010173	1.047694	1.34	0.180	0.723753	5.583111
X ₆	0.3291454	0.1799576	-2.03	0.042**	0.1127198	0.961115
X ₇	0.4577805	0.2343548	-1.51	0.131	0.181039	1.249326
X ₈	1.405306	0.6429817	0.74	0.457	0.5732093	3.445311
X ₉	2.565474	1.323464	1.83	0.068*	0.9333704	7.051496
X ₁₁	0.7335912	0.3172715	-0.72	0.474	0.3142804	1.712344
X ₁₃	2.012855	0.8785961	1.60	0.109	0.8555974	4.735388
X ₁₅	1.483697	0.8282666	0.71	0.480	0.4967823	4.43123
X ₁₆	2.888698	1.564621	1.96	0.050**	0.9992202	8.351088
X ₁₈	0.4267761	0.2240837	-1.62	0.105	0.152499	1.194354
X ₁₉	3.510174	2.303751	1.91	0.056*	0.9697931	12.7051
X ₂₀	0.3836053	0.2083903	-1.76	0.078*	0.1322747	1.112481
X ₂₁	1.968497	1.210265	1.10	0.271	0.5899317	6.568522
X ₂₃	0.4794541	0.2876289	-1.23	0.220	0.1479461	1.553784
	2.101695	1.295265	1.21	0.228	0.6280265	7.033334

Source: Own research.

Based on the data presented above, it can be stated that:

- greater workforce mobility reduces the chance that small enterprises conduct innovation activities by an average of 72.4%;
- a higher level of populational education multiplies the chance of conducting innovation activities an average by 2.964;
- higher assessment of the work ethic reduces the chance of small enterprises conducting innovation activities by an average of 67.1%;
- a higher pace of technical and technological development multiplies the chance of conducting innovation activities an average by 2.565;
- higher assessment of management's (the owner's) attitude to innovation multiplies

- the chances of conducting innovation activities an average by 2.888;
- higher assessment of the company's reputation and image multiplies the chance of conducting innovation activities an average by 3.510;
 - a higher assessment of employees' technical culture reduces the chance of small enterprises conducting innovation activities by an average of 61.7%.

As part of the estimation of the logit regression model, the obtained results indicate several important themes for discussion.

Firstly, statistically significant external factors in conducting innovation activity are mainly socio-cultural and demographic conditions. It is not surprising that the populational level of education increases smaller economic entities' chances of carrying out innovation activities. It is confirmed that the knowledge, skills, and predispositions acquired during learning essential to implementing particular stages of the innovation process play a key role in small enterprises (Mariz-Perez *et al.*, 2012; Munjal and Kundu, 2017). Therefore, actions should be taken to stimulate employee activity and constantly seek the best way to solve emerging organizational problems.

It seems that in smaller companies, there is a higher attachment to the workplace and sense of responsibility for ones entrusted tasks, as well as the perception that work is the most important duty, and this can significantly disturb the work-life balance. Both workaholism and the related phenomenon of professional burnout affect an increasing proportion of Polish society at various career levels. Moreover, smaller companies often conduct innovation activities of an imitative nature, which negatively correlates with work ethic. For this reason, work ethic turned out to be a statistically significant factor that reduces the chance of conducting innovation activities.

Secondly, the expanding consequences of globalization in modern market economies have both positive and negative impacts on small enterprises' implementation of innovative undertakings. When analyzing the present results from this perspective, it is clearly visible that the ubiquitous development of techniques and technologies increases Polish small companies' chance of conducting innovation activities. It has the decided effect of activating small company owners to take up ever newer challenges that correspond to reported needs and result from the pace of new technological solutions. The high flexibility of operation allows smaller enterprises to reorganize and modernize their current products and services more quickly. This, in turn, enables them to achieve sustainable competitive advantage and to expand new markets. Conversely, however, unlimited flow of resources, capital, and workforce affect how domestic organizations function: this is painful predominantly for smaller companies, whose limited financial possibilities often do not allow them to keep many outstanding specialists in the company. This state of affairs drains them of valued employees, thereby reducing their possibilities for conducting innovation activities.

Thirdly, aside from employees' significant role in increasing novelty in the organization, and undeniably important role is played by management and owner

attitudes to innovation, which is the most statistically significant internal factor in small companies conducting innovation activities. There have been many studies on the owner (manager) role in the broadly understood development of the enterprise (De Jong and Hartog, 2007; Szczepańska-Woszczyzna, 2014), emphasizing leadership, organizational, motivational and managerial qualities. The organization leader's right attitude depends largely on successfully implementing new solutions or consistently conducting innovation projects. Similar associations obtain for company reputation and image. Systematically developing the organization using new solutions is an effective way to create a positive company image.

Fourthly, the only identified internal factor in reducing the chances of small enterprises conducting innovation activities was employees' technical culture. Moreover, as indicated by Zastempowski (2018), this factor influences innovation operations and the innovative activities in the surveyed companies, i.e., it also reduces the probability of small companies reducing innovations. However, as has rightly been noted, this result is directly related to the characteristics of the surveyed companies' activities and the dominance of services in this area. The technical culture of employees, i.e. their engineering education or technical skills, did not play such a significant role in the surveyed companies' conduct of innovation activities.

5. Conclusion

The article's main aim was to develop a model explaining the Polish small enterprises' undertaking of innovation activities. Identifying the key determinants has produced interesting results. Seven of the 25 key factors, both external and internal, turned out to be statistically significant. While it is not surprising that factors such as populational level of education, the pace of technological development, or the owner's attitude to innovation have a stimulating effect on the implementation of innovation activities, it is certainly a puzzle that work ethics and the technical culture of employees are determinants that reduce the chance of conducting innovation activities. The proposed model of innovation activity of Polish small enterprises reveals the impact of individual variables on the scope of implemented innovative projects.

The presented model includes a relatively holistic list of factors that may become important from the point of view of identifying a novelty in Polish small companies. There is no doubt that increasing innovation and its determinants in enterprises is particularly important among small companies, which are central to the expansion of many modern economies, including Poland's. The authors are aware that the presented considerations have their limitations, while the presented conclusions relate to only a narrow part of the innovativeness of modern economic entities. However, the research may constitute the basis for determining future directions for exploring this field of knowledge.

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