Learning and Development Tools and the Innovative Potential of Artificial Intelligence Companies

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Abstract:

Purpose: The aim of the article is to examine the relationship between the use of learning and development tools in building the innovation potential of enterprises in the artificial intelligence sector.

Design/Methodology/Approach: The study is based on a survey on companies from the artificial intelligence sector (n=127) located in Poland. The regression model defines the relationship between learning and development tools and innovations measured by the number of obtained patents. In addition, the analysis was expanded to include the results of a survey conducted among employees of the surveyed enterprises. As a result, an assessment of the usefulness of knowledge management tools was obtained.

Findings: The findings indicate that modern tools of knowledge management in the form of knowledge bases and knowledge pills, or gamifications and business simulations affects the level of innovativeness. These tools are positive assessed by employees (i.e. programmers) that are directly involved in creating solutions in the field of artificial intelligence.

Practical implications: The results of the analysis may indicate the directions of development of HR departments in companies of the artificial intelligence sector. It turns out that modern forms of learning stimulate the level of company innovation.

Originality/Value: The artificial intelligence sector is perceived as the one that will have the greatest impact on technological progress in the coming years. Solutions in the field of artificial intelligence will have their impact on other industries, such as medicine or the IT sector. The study drew attention to factors determining the level of innovativeness of companies related to learning and development tools.

Keywords: Artificial intelligence, learning and development, knowledge management.

JEL classification: 034, M12, M53, D83.

Paper Type: Research study.

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1. Introduction

Every technological revolution has been a consequence or a dynamic development of a specific sector. This was the case for the combustion engine, the electricity or the internet. Scientists, including economists, considering what sector will drive economic development and set new trends in technological development in the forthcoming years, agree on this matter. Artificial intelligence is forecast to exert the biggest influence on the competitiveness of economy in the nearest future. During the European Forum for Science, Research and Innovation in Dresden, which took place on 24th June 2019, the Polish Prime Minister was heard to say a European Innovation Strategy needed to be created. He described a few strategic branches which need to be drawn attention to and they were a hydrogen storage technology, the Internet of Things, cybersecurity, the 5G technology, space technologies, 3D printing and 3D technologies and artificial intelligence.

Most countries in the world, those of the most developed in particular, have implemented the development of the artificial intelligence industry in multi-annual development strategies. The following countries are worth mentioning here: Canada, China, Denmark, the EU, Finland, France, India, Italy, Japan, Mexico, the Nordic-Baltic region, Singapore, South Korea, Sweden, Taiwan, the UAE, and the UK. Other countries intend to do it soon (Barron *et al.,* 2018). Therefore, the importance of this industry is not only an invention resulting from fascination with new technologies, but it is a serious approach to the influence of this sector on a number of other sectors of economy. The IT sector is undoubtedly the one which will benefit from the solutions described as artificial intelligence. Great hopes are also pinned on implementing such solutions in medicine, which should contribute to improving the comfort and quality of life. Apart from enthusiasts of the development of artificial intelligence, also sceptics voice their opinions indicating the threat to lose control over the technological progress.

Artificial intelligence started to develop after the Second World War. Breaking codes of the German Enigma cipher machine by Polish mathematicians was one of the events that led to the defeat of the Allies. The cipher machine itself and cryptography can also be considered to be the beginnings of the development of the artificial intelligence sector. It was in the 1940s that the first electronic computer was created. Translating a text from Russian to English done by a machine, about which IBM informed at a press conference on 8th January 1954, constituted an important breakthrough in interpersonal communication (Lupu, 2018). The first conference on artificial intelligence organised by John McCarthy in 1956 is also considered to be a breakthrough moment. As far as today's world is concerned, the spectacular victory of a machine over the world chess champion Garry Kasparov in 1997 should be mentioned here.

What exactly is artificial intelligence? This concept should be understood as devices and software that mimic cognitive functions of the human mind. Artificial

intelligence is connected with the processes of learning, making decisions, inference, speech and gesture recognition, solving problems or identification of objects. Artificial intelligence is also compared with the development of neuron networks, so called fuzzy logic or artificial life forms – robotics (Russel and Norvig, 2016).

The companies that are providing artificial intelligence solutions operates in computer systems design and related services industry. Innovation in this sector often takes the form of novel and useful code and, by inference, the creation of new software functionality. This led to the creation of a wide range of software systems, including corporate tools, end-user applications, operating systems, communication protocols, mobile applications and embedded software (Rose, 2010). Software development often has to go hand in hand with hardware development. Particularly concerned embedded software. In addition, hardware and software for devices such as mobile phones are often developed in parallel, so that the two components are quite interdependent.

Similarly, the traditional distinction between product and service is often observed in software innovation, as the term service is widely used to mean various forms of software. Various new forms of software are considered services. Carlo *et al.* hold a similar position (Carlo *et al.,* 2011) for which all software products are considered services. Other researchers consider certain types of software to be services, such as network services (Xu *et al.,* 2005) or mobile services (Kristensson *et al.,* 2002). In addition to software development, companies in the sector often provide related services, which include installation, end user support, platform management, web hosting and consultations.

The software service may be part of a wider offer, such as a banking service, in which the combined offer may constitute an innovation (Aaen, 2008; Nambisan et *al.,* 1999; Oliveira and Von Hippel, 2011). Innovations in the programming process should be broadly understood. Software processes include tasks, standards, and formal and informal procedures that support software development efforts. These processes are expressed in methods, tools and techniques that organize the work of a programmer and describe how to create software (Rose, 2010). Researchers perceive innovations in the programming process as including innovations in ways of predicting, designing and implementing software (Aerts, 2004; Boudreau, 2010; Carlo *et al.,* 2011). All significant improvements in design techniques, team organization and management processes can therefore be considered as process innovations. Software process innovation is one of the key form of innovation in the software development context and important driver of product innovation.

Therefore, innovativeness constitutes a natural element of the artificial intelligence sector, which bases on creating new solutions, which subsequently can be adopted also in other sectors. Companies creating solutions from the area of artificial intelligence provide their services to such sectors as: data analysis and business intelligence, sales, marketing and advertising, FinTech and InsurTech or robotics.

Innovativeness is one of the fundamental factors determining the level of competitiveness with respect to individual sectors, enterprises or on the level of general economy. Referring to its classical approach, an innovation means introducing a new product, a new production method, creating a new market, finding a new source of raw materials or conducting new organisation of business processes (Schumpeter, 1934). Therefore, it seems that the artificial intelligence industry can be a perfect source of creating innovations, which, on the other hand, should be its integral part (Cockburn *et al.,* 2018). In contrast, Peter Drucker (Drucker, 1996) assumes that innovation constitutes a tool for entrepreneurs owing to which a change can lead to starting new economic activities or providing new services. It should be emphasised that innovation does not need to be something material or technical in the narrow sense of the word. We can define innovation as introducing a new or significantly improved solution in a product (a good or service), process, marketing or organisation (OECD/Eurostat, 2019). Therefore, the following can be listed: product innovations, process innovations, organisational innovations and marketing innovations. Innovativeness can be understood in a very broad context – on the level of a singular enterprise, sector, country or even of the whole world.

The experts draw attention to the problem of the measurement of innovativeness seen in the light of resources, factors leading to creating innovation (so called innovation inputs). An example of an innovation input can be research and development (R&D) expenditure. A different approach concentrate on effects in the form of created product, process, organisational or marketing innovations. In the latter approach, a dummy variable indicating creating or not creating a given type of innovation can be assumed. It is also reasonable to use more reliable categories such as the number of obtained patents or registered utility models (Crossan and Apaydin, 2010; Schmiedeberg, 2008).

Returning to the concept of artificial intelligence, the definition of intelligence is worth mentioning. According to the Oxford Advanced Learner's Dictionary, intelligence is the ability to learn, understand and think in a logical way about things, the ability to do this well (Oxford Advanced Learner's Dictionary). The Cambridge Dictionary defines it as the ability to learn, understand, and make judgments or have opinions that are based on reason (Cambridge Advanced Learner's Dictionary & Thesaurus, 4th Edition). Both definitions draw attention to the process of learning, which is connected with gaining knowledge.

In the context of innovativeness of enterprises, increasing attention is given to non-material resources, including knowledge in particular (De Geus, 1988; Drewniak and Karaszewski, 2019). Knowledge for an enterprise is inseparable from intellectual capital and human resources. Therefore, as early as at the recruitment and selection stage, companies search for creative, developing, ambitious and creative individuals who add considerable value to the intellectual capital of an enterprise. It is essential to create appropriate conditions facilitating using knowledge and turning it toward an enterprise's increased competitiveness. The

literature concerning the issue of knowledge management is incredibly rich. Specific solutions which help enterprises to manage knowledge have been developed.

Learning and development (L&D) activities constitute one of the areas of interest for practitioners and theoreticians dealing with corporate knowledge management. It turns out that knowledge itself does not guarantee success. The ability to apply this knowledge in an economic process and so called knowledge diffusion within a company is of key importance. Such an approach to the meaning of knowledge in an enterprise has led to the transformation of some departments in the corporate organizational structure. It concerns especially the Human Resources department, which is now not only responsible for basic staff-related matters such as recruitment or documentation, but it also helps to identify problems and limitations in individual entities. Any knowledge or skill deficits can be wiped out by using specific tools.

Among typical solutions necessary to gain knowledge - trainings and workshops should be mentioned. They are classic tools, most of which are used by enterprises systematically. Workshops are dedicated to small groups, in which special emphasis is placed on the practical part. They aim at using specific knowledge, skills or tools in practice. Trainings are a broader concept, as they combine a workshop form with a theoretical part, frequently in the form of a lecture or a seminar. Both forms of providing knowledge are tailored to the needs of an organization or individual employees. Trainings should aim particularly at the improvement of knowledge and skills, therefore verifying the gained knowledge and skills confirmed by a certificate comes frequently as their element.

Online learning platforms are also an interesting solution commonly used in companies. The development of IT technologies and knowledge management systems contributed to their development. An online learning platform enables complex management of a training process in a company from sending an employee to a training, conducting a training, its evaluation and reporting. Online learning platforms can be implemented in a company in various types of models. Basic models of platform implementation as IT systems of knowledge management can operate independently or with other systems (Dąbrowski and Gierszewska, 2005; Galwas *et al.,* 2010; Łobejko, 2005; Plebańska, 2011).

Knowledge bases and so called knowledge pills are also used in knowledge management. Knowledge pills are small units of knowledge in a multimedia format, created by an expert on a given field, possible to use in a convenient time. Knowledge bases are a more complex tool which collects knowledge on a wider scale. A knowledge base constitutes a complex collection of documents and articles concerning a given field.

Business simulations and so called gamifications are also an attractive form of knowledge acquisition. A gamification consists in using the mechanisms of well-known computer games or role-play games in business in order to boost

participation among participants. Situational processes and behaviors are transferred into the virtual reality and thus enable solving typical problems through making decisions and experiencing their consequences. Gamifications are considered to be one of the most promising tools in the scope of knowledge management in an enterprise (Meister, 2013).

2. Methodology

The aim of the article is to identify the factors influencing innovativeness of enterprises belonging to the artificial intelligence industry. The 300 biggest entities operating in this sector in Poland were examined. In the sectoral classification, companies dealing with artificial intelligence belong to the computer systems design and related services industry. The information on the examined enterprises was received from the EMIS (the Emerging Markets Information Service) database. The required data were received from 262 enterprises. Data for 38 enterprises were incomplete and therefore not included in the further analysis. The enterprises in the examined group were asked a question in order to gain information in relation to used tools in the scope of learning and development. 86 entities responded to the question, additional 41 responses were obtained thanks to a telephone interview. The surveyed companies were asked to answer whether they used the following tools in the process of knowledge management: trainings and workshops, online learning, knowledge bases and knowledge pills, and gamifications and business simulations. As a result, complete information was received from 127 entities. The next stage consisted in gathering information on obtained patents and/or registered utility models with the use of the European Patent Register and the Espacenet service. The following hypotheses were proposed in the article:

H1: Modern tools of knowledge management contribute to the increase of the level of innovativeness of an enterprise.
H2: The longer an enterprise operates, the higher the level of its innovativeness is.
H3: The higher the level of employment in an enterprise, the higher the level of its innovativeness.

The innovativeness level was evaluated on the basis of the number of obtained patents. The dependent variable INNOV was given the following values:

- 0, in the case of no patents or registered utility models,
- 1, in the case of 1 registered patent or utility model,
- 2, in the case of at least 2 but no more than 9 registered patents or utility models,
- 3, in the case of at least 10 registered patents or utility models.

The structure of examined enterprises according to the number of registered patents or utility models is presented in Table 1.

Table 1. *The structure of examined enterprises according to the number of obtained patents or utility models*

Number of patents	Number of enterprises
0	77
1	22
From 2 to 9	20
10 and more	8
In total	127

Source: Authors' own elaboration.

The independent variables were divided into two groups:

1. The variables characterising using of knowledge management tools as:
- TW – a variable with a value of 1 in the case of using trainings and workshops and with a value of 0 when those tools are not used,
- eL – a variable with a value of 1 when e-learning is used and with a value of 0 when this tool is not used,
- KBKP – a variable with a value of 1 when knowledge bases or knowledge pills are used and with a value of 0 when those tools are not used,
- GS - a variable with a value of 1 when gamification or business simulations are used and with a value of 0 when those tools are not used.

2. The variables characterising the size and financial situation of an enterprise as:
- EMPL – the employment level (in the number of employees),
- PUBL – a variable with a value of 1 when a company is listed on the stock exchange and with the value of 0 in the case of private companies,
- AGE – number of years of activity,
- ROA – profitability (as a percentage),
- BV – the book value (in PLN millions),
- REV - total revenue (in PLN millions),
- EBIT – operating profit (in PLN millions).

In order to examine the dependence between the dependent variable and the independent variables, the multiple regression model was used. Two models were constructed. The first one examined the influence of the variables characterising the knowledge management tools, the other one examined the impact of the variables characterising companies from the point of view of their size or financial situation.

In addition, apart from analysing data on individual enterprises, the usefulness of individual learning and development tools was assessed. To this end, employees of the surveyed enterprises were asked to answer the questions which forms of L&D they used and how they assess their usefulness in carrying out their tasks. The five-point Likert scale was used as the rating scale ranging from 1 (very useless) to 5 (very useful). The target group was those enterprises in which at least one of the

tools considered universal (training, e-learning) and at least one of the tools considered modern (knowledge pills, gamification) were used. As a result, out of 23 enterprises meeting this condition, responses were received from employees of 10 enterprises.

The division of employees into administrative and office employees as well as employees responsible for creating AI solutions was made. This second group was defined as programmers. In 10 enterprises whose employees responded, there were a total of 546 office employees and 1639 employees directly related to the creation of AI solutions. The questions asked were answered by 373 office workers (68%) and 1,465 (89%) programmers.

3. Results

Table 2 presents basic descriptive statistics of the analysed variables and the VIF coefficient to examine the multicollinearity of the independent variables. As a result, the REV, EBIT and BV variables, which were correlated, were dropped. The theoretical form of regression models is as follows:

$$INNOV = \alpha_0 + \alpha_1 TW + \alpha_2 eL + \alpha_3 KBKP + \alpha_4 GS \tag{1}$$
$$INNOV = \beta_0 + \beta_1 EMPL + \beta_2 PUBL + \beta_3 AGE + \beta_4 ROA \tag{2}$$

The results of the multiple regression parameters estimation are shown in Tables 3 and 4.

Table 2. *Descriptive statistics and correlation matrix*

	mean	Std. Dev.	1	2	3	4	5	6	7	8	9	10	11	12
TW	0.64	0.04	1											
eL	0.46	0.04	-0.05	1										
KBKP	0.29	0.04	-0.06	0.24	1									
GS	0.17	0.03	0.03	0.05	0.09	1								
EMPL	630.86	209.59	-0.01	-0.14	0.18	-0.07	1							
PUBL	0.21	0.04	-0.05	-0.1	0.05	0.08	0.18	1						
AGE	12.69	0.43	0.18	-0.01	0.19	0.03	0.08	-0.11	1					
ROA	21.06	15.4	0.07	0.1	0.13	-0.04	-0.02	0.19	-0.13	1				
REV	263.08	85.07	0.08	-0.12	-0.12	0.08	0.04	-0.1	0.09	-0.02	1			
EBIT	14.45	6.53	0.04	-0.16	-0.12	0.03	0.03	-0.06	0.07	-0.02	0.84	1		
BV	46.41	16.65	0.02	-0.24	-0.13	-0.06	-0.03	-0.09	0.06	-0.02	0.57	0.8	1	

INNOV	0.69	0.09		0.05	0.1	0.19	0.18	-0.06	-0.07	0.22	0.11	-0.06	-0.1	-0.1	1
VIF			1.07	1.19	1.21	1.06	1.11	1.13	1.13	1.11	4.13	7.48	3.23		

Source: Authors' own elaboration.

Table 3. *Multiple regression parameters estimation results – model 1a and 1b*

	Model 1a				Model 1b			
	INNOV				INNOV			
	coeff		std err	t stat	p-value	coeff		std err	t stat	p-value
Intercept	0.39839	**	0.1716	2.32167	0.02191	0.51379	***	0.10522	4.88299	0,000003
TW	0.11371		0.1765	0.64425	0.52062					
eL	0.10855		0.17478	0.62107	0.53571					
KBKP	0.34281	*	0.19237	1.782	0.07724	0.3634	*	0.18592	1.95465	0.05287
GS	0.43359	*	0.22878	1.89518	0.06043	0.44301	*	0.22739	1.94824	0.05365
Adj R2	0.0384					0.048				
F	2.25865	*				4.1746	**			

*Note: * Significant at 10% level, ** Significant at 5% level, *** Significant at 1% level*
Source: Authors' own elaboration.

In the 1a and 2a models, all independent variables were taken into account, and in the 1b and 2b models, the structural parameters were estimated for the relevant variables. As a result of the estimation of the structural parameters of the model with the independent variables characterising the use of the tools of corporate knowledge management, the KPKB and GS variables turned out to be statistically important. The parameter values indicate a positive influence of those variables on the level of corporate innovativeness.

The AGE and ROA variables turned out to be statistically important as the estimation of the structural parameters in the second model shows. The parameter values also indicate a positive impact of those variables on the level of innovativeness in the surveyed companies.

Table 4. *Multiple regression parameters estimation results – model 2a and 2b*

	Model 2a				Model 2b			
	INNOV				INNOV			
	coeff		std err	t stat	p-value	coeff		std err	t stat	p-value
Intercept	0.1353		0.24588	0.55027	0.58314	0.08488		0.23709	0.35799	0.72096
EMPL	-0.00003		0.00004	-0.72398	0.47046					
PUBL	-0.15543		0.21453	-0.72451	0.47014					
AGE	0.04642	***	0.01754	2.64617	0.00921	0.04657	***	0.01735	2.68473	0.00825

ROA	0.00086	*	0.0005	1.72559	0.08695	0.0008	+	0.00049	1.63671	0.10423
Adj R2	0.0467					0.0521				
F	2.54452	**				4.46222	**			

Note: *Significant at 10% level, ** Significant at 5% level, *** Significant at 1% level*
*+ accepted at 10% level*
Source: *Authors' own elaboration.*

The final form of the models 1b and 2b is expressed by the formulas:

$$INNOV = 0.51379 + 0.3634\ KBKP + 0.44301\ GS \tag{3}$$
$$INNOV = 0.08488 + 0.04657\ AGE + 0.0008\ ROA \tag{4}$$

Next, the results of estimating the parameters of multiple regression models are compared with the opinions of employees regarding the suitability of individual tools. A similar tendency is visible in both groups of surveyed employees. All employees had access and benefited from workshops and training (TW). Slightly less had the opportunity to use e-learning solutions (eL), even less used the knowledge bases and knowledge pills (KBKP), and the least often employees used business simulations and gamifications - GS (Figure 1).

Figure 1. *The number of employees using specific learning and development tools*
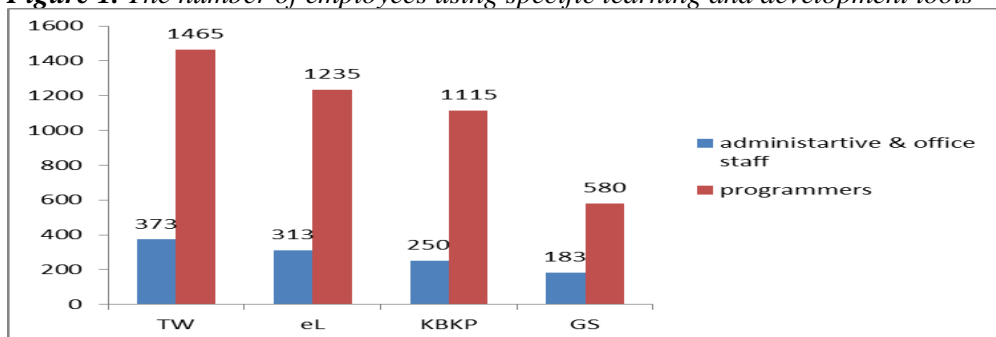
Tools in the form of workshops and trainings were highly rated in terms of their usefulness by administrative and office employees. Programmers were more neutral about the suitability of this type of tool (Figure 2). It is worth noting that the subject of training is often better suited to the current needs of administrative employees in terms of supplementing their knowledge and skills. Programmers often use this type of tools to develop their own competencies not necessarily applicable in their current work (e.g. learning new programming languages).

Another commonly used tool, which is e-learning, was again assessed rather neutrally in terms of usefulness by programmers (Figure 3). Employees who are in contact with programming or application development often treat IT tools as solutions that should be commonplace, without regard for excessive usability. In

turn, for administrative employees they can be an innovation and improvement of everyday work.

Figure 2. *Assessment of the usefulness of workshops and training by employees (1 - very useless to 5 - very useful (percentage of indications)*
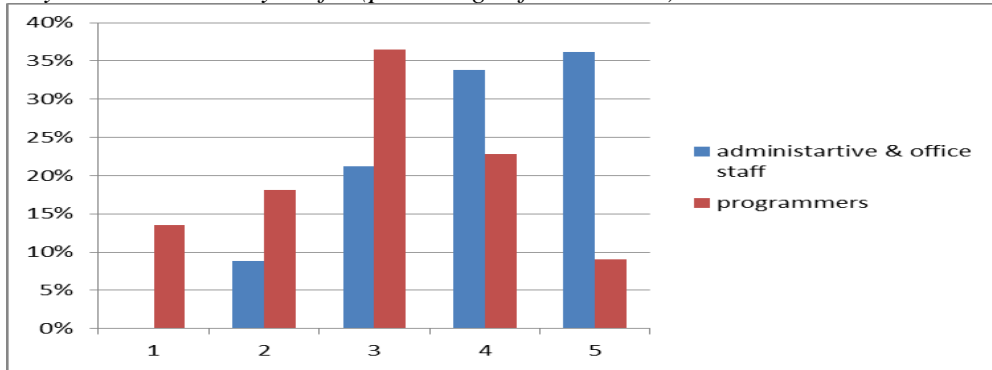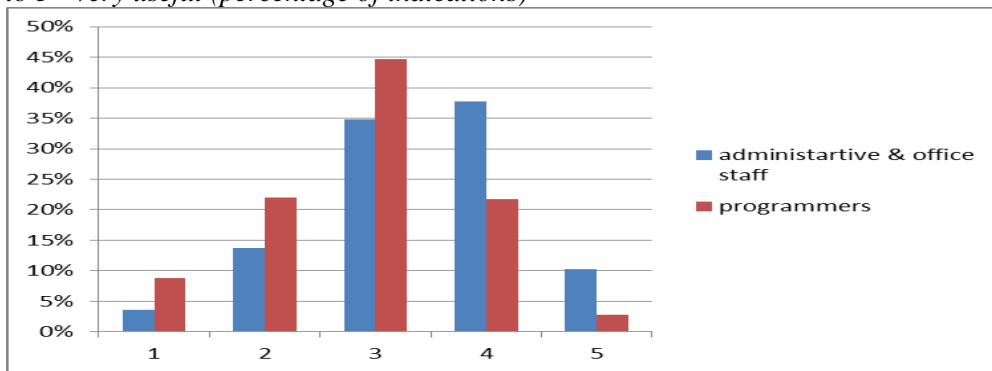

Figure 3. *Assessment of the usefulness of e- learning by employees (1 - very useless to 5 - very useful (percentage of indications)*

Analyzing the usefulness of more innovative solutions such as knowledge bases and knowledge pills, as well as gamification and business simulations, one can notice a clear discrepancy in the assessment of the usefulness of these tools by 2 groups of analyzed employees (Figure 4 and Figure 5). Programmers rate the usefulness of this type of tool very highly. Important in this regard is the large autonomy of users, because they decide what knowledge they need at a given moment and are able to independently find the appropriate source of this knowledge. Similarly, in the case of gamification or simulation, developers appreciate the opportunity to test their own decisions and observe their effects.

Figure 4. *Assessment of the usefulness of knowledge bases and knowledge pills by employees (1 - very useless to 5 - very useful (percentage of indications)*
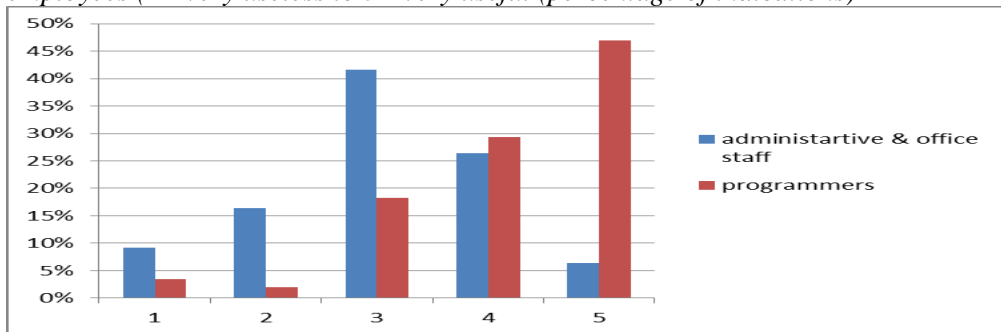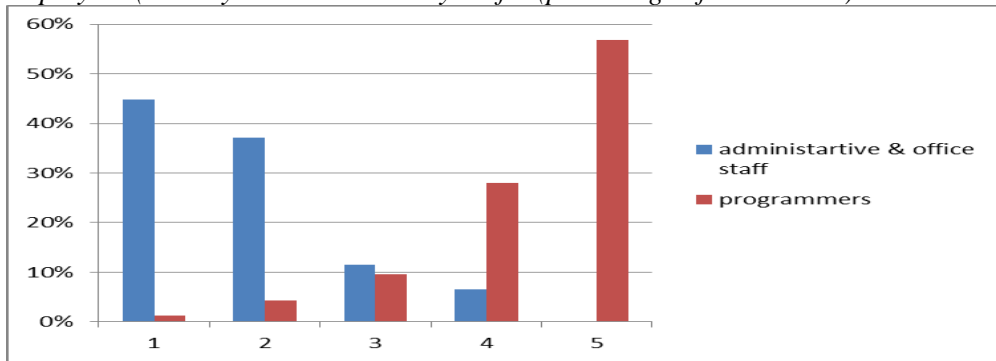

Figure 5. *Assessment of the usefulness of business simulations and gamification by employees (1 - very useless to 5 - very useful (percentage of indications)*

4. Discussion

Classic forms of knowledge management in an enterprise such as trainings or workshops are now widely used. This is confirmed by the data received from the enterprises. 64% of the surveyed companies belonging to the artificial intelligence industry use this type of tools for improving their employees' qualifications. Another analysed tool, namely online learning, is also commonly used in today's reality. Over 46% of the surveyed companies use e-learning as a platform for communication and transferring knowledge to their employees. Although the above mentioned tools are crucial in the process of corporate knowledge management, questions should be raised whether they enable building a competitive advantage and whether the constitute an impulse for creating innovations in a company. An easy access to those tools, the ability to tailor them to the individual needs of an organisation or an employee are their advantage.

However, it needs to be noted that their universality and thus an easy access result in the fact that they are used mostly to transferring knowledge which is the result of the experience of other people. Trainings and workshops can complete competency gaps

of employees. The increase of creativity, which seems important in the process of creating innovations, should not be expected as their result.

The two groups of other tools, that is knowledge bases and knowledge pills, gamifications and business simulations, constitute non-standard ways of the development of employees. They are not always found in the offer of companies responsible for introducing solutions in the scope of learning and development (L&D). Among the surveyed enterprises, about 29% confirmed the use of tools in the forms of knowledge bases or knowledge pills, and only just under 17% used gamifications or business simulations. Attention should be drawn to the fact that in the case of classic tools, that is trainings and workshops, the process of gaining knowledge is to a large extend moderated by one person or a few people (a lecturer, a mentor).

The role of an employee is to listen and absorb knowledge without using own initiative of any particular kind. An employee has no choice and can either use transferred knowledge for developing skills or consider a training or workshop not very useful in everyday work. In the case of knowledge pills or knowledge bases, it is an employee that decides what knowledge to gain. An employee needs to identify a problem and think where to find a solution. A knowledge base enables an employee to explore the accessible resources more deeply, but the whole process depends exclusively on the ability to collect appropriate information. Using knowledge pills also requires initiative from an employee. In his mind the need to search for answers to a question or a solution to a problem which he has encountered must appear. The process creates the abilities to think logically, it depends on intelligence and the capability of recognising facts, and contributes to the increase of an employee's creativity. An employee who can identify a problem and find a solution independently can be a potential creator of new solutions with the potential of an innovation.

The situation with gamifications and business simulations is similar. Although it requires the presence of a moderator, who follows the case, but this role is much more passive than in the case of trainings or workshops and it is participants that create the reality they find themselves in. It is often possible to find more than one way to achieve a goal, and the choice of the correct one depends on a participant of a game or a simulation. Participating in a gamification or a simulation meets with a favourable response of employees. It requires their involvement and concentration, and after a task is completed, they do not feel the time was wasted. It is no accident that those forms of acquiring knowledge are considered by participants a pleasant way of spending time.

The analysis of the structural parameters of the model indicates the importance of the variables connected with the tools in the form of knowledge bases and knowledge pills, and gamifications and business simulations. Using such tools can

lead to the increased creativity of a team and thus contribute to creating new products or solutions with the process and organisational character.

When analysing the other characteristics of the surveyed enterprises demonstrated in the second model, statistical importance of variables describing the age and profitability of the companies was confirmed. Both variables have a positive impact on the level of innovativeness.

Companies that operate on the market longer have richer experience and organisational support at their disposal. Formed relationships with partners enable them to enjoy additional benefits. Enterprises frequently cooperate in view of creating new solutions in the form of products or processes enabling them to build a competitive advantage over other entities. More experienced enterprises have already gone through initial stages of development, at which a company normally tries to adjust to the market conditions and formulate the rules of operating. It is not until some time goes by and its position is stable that a company stops being a follower and starts to be a creator with a considerable impact on the development of its sector. A longer period of existence is usually accompanied by an improved financial situation and organisational development, which in turn open new possibilities in the scope of gaining capital. An access to additional sources of capital, often not easy accessible for newer companies, constitutes an additional stimulus for the development of innovation.

It was also proved that the higher the profitability of an enterprise, the higher the level of innovativeness in the form of patents or utility models. It is not an obvious situation as far as innovative enterprises are concerned. Reversed situations can often be observed. Enterprises create innovations, however, benefits in the form of the improvement of their profitability come later. It results partly from the capital-intensive nature of investment processes leading to creating innovations and a relatively longer time horizon when it comes to commercialisation of new solutions. However, in the case of the leading sectors, and the artificial intelligence industry belongs to this group, the period of commercialisation can be significantly shortened. It is crucial to bear in mind that the enterprises of this sector do not create those solutions just for themselves, but they are able to sell ready-made solutions to other entities, which can also improve their profitability.

It was interesting to see that the variable displaying the level of employment did not prove to be as important as far as the level of innovativeness is concerned. Therefore, human capital understood in terms of the number of employees does not guarantee success in creating new products or process improvements. It seems that the quality of a team and the ability to find the most talented individuals, which can become value added for an enterprise, are the most powerful factors. It is thus necessary to refer again to the tools supporting the process of gaining knowledge, which regardless of the number of employees can improve the innovative potential of a team.

Obtaining access to the public stock market is not of key importance, either. Although it does bring new abilities to gain capital for an enterprise, it turns out that this form of financing is not essential. A situation on the market can also be observed when companies are afraid to enter a stock exchange because, in accordance with regulatory requirements of a stock exchange, they must inform the market about essential for a company undertakings, and innovative activities do belong to this group. In the case of such processes, enterprises try to keep their plans to develop in secret as long as possible in order not to be overtaken by competitors in the scope of concepts for new products. On the other hand, enterprises operating in high technologies like the artificial intelligence sector can expect interest from institutional investors including risk capital funds. Such investors are eager to invest in even risky ventures, which can bring above-average profits.

5. Conclusion

Referring to the hypotheses presented in the paper, it can be stated that there is no reason for rejecting hypothesis H1. The results of the estimation of the structural parameters of the models 1a and 1b make it possible to conclude that when enterprises use modern tools of knowledge management in the form of knowledge bases and knowledge pills, or gamifications and business simulations, it has a positive impact on the innovativeness of an enterprise estimated with the number of patents or utility models. There is no reason for rejecting hypothesis H2, which assumes a positive influence of company age on the level of innovativeness, either. This variable proved statistically important taking into account the structural parameters of the model 2a and 2b. However, there are reasons for rejecting hypothesis H3. No important dependence between the variable characterising the number of employees in an enterprise and the number of obtained patents or utility models was confirmed.

The results of the survey supplement the conclusions of the regression analysis. It can be clearly seen that employees directly involved in creating solutions in the field of artificial intelligence rate the usefulness of such learning and development tools as knowledge bases and knowledge pills as well as gamification and simulations higher, which would confirm that these tools should support the process of creating innovation in artificial intelligence sector enterprises. Office and administrative employees, i.e. those who are not directly involved in the process of creating specific products or services, attach more importance to traditional learning and development tools such as workshops and trainings or e-learning.

Undoubtedly, we are on the verge of a technological revolution, and the changes it brings are happening before our very eyes. It is enough to look at the new solutions in banking and mobile payments, in the IT sector, in media or the internet, in the car industry or in medicine. Many activities, like advertisements, aimed at attracting the attention of consumers use artificial intelligence solutions. Every day devices equipped with complex algorithms analyse our data and they are able to make

decisions what product will satisfy our tastes. This revolution seems unstoppable and we can only hope that the development of artificial intelligence sector will result in innovations used in many industries and aiming at improving the quality and comfort of life and thus solving numerous problems of today's world.

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