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Research Article

Impact of Innovative Information Technologies and Systems on Achieving Financial and Process Effects of a Company

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Abstract

In the last decade, measuring the effectiveness and the effects of information and communication technologies has become a very important issue for companies. Company managers often argue over the effects achieved by integrating innovative information technologies and systems. It is a general consensus that innovative pervasive technologies, information and communication technologies and information systems can help companies succeed in competition, simplify their work and make effective use of the opportunities offered, as well as identify potential threats. The integration of these technologies and systems into business processes brings several financial and process effects/benefits. This scientific article talks about the integration of innovative information and communication technologies and systems into business processes. It identifies the most significant financial and process effects/benefits achieved by companies in the Slovak Republic. It examines the differences in achieving these effects depending on the company size measured by the number of employees and the company's activities.

Keywords: information and communication technologies, innovative pervasive technologies, information systems, benefits, process management.

Introduction

In proportion to the pace of digitization, companies implement and use new, innovative information and communication technologies and systems in the implementation of their business activities. Their origin was also stimulated by

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scientific and technical progress and the onset of the fourth industrial revolution. In the last twenty years, the world has witnessed a major revolution in the area of information and communication technologies, which has affected all areas of the economic and social life. After the digitization and automation of processes, industries began to integrate the virtual world with the physical world, namely, the cooperation between information and communication technologies and the human factor. Robotics has an important position in product standardization and standardized business processes. The human factor makes each product/series unique, which is increasingly looked for and preferred by customers of today. Industry 4.0 has introduced digitization, automation, innovative technologies and virtualization. Businesses achieve higher productivity by integrating these technologies and digitizing.

Currently, in connection with the global pandemic caused by the COVID-19 virus, it can be said that the pandemic is also a strong accelerator of the digitization of business processes and the implementation of new information and communication technologies (ICTs) in all spheres of the economic and social life. Some companies even reported that COVID-19 has led to the informatization and digitization of their business activities.

This scientific article points out innovative ICTs building the company's ambient intelligence. It defines the properties of these technologies and systems. The article presents the results of a research aimed at achieving financial and process benefits from the integration of innovative ICTs and systems in companies. The empirical research was conducted among companies in the Slovak Republic (N = 206). The construction of variables (financial and process effects of integration) is based on a detailed analysis of a theoretical background and interviews with respondents (company managers). It summarizes the most significant benefits achieved in the field of financial and process management of the company. It also identifies statistically significant differences in achieving these benefits in companies in the Slovak Republic depending on their size and activity.

Theoretical background

Innovative ICTs are characterized by their ubiquity (pervasiveness). The ubiquitous computational power was defined by Chun and Kai (2003), who spoke of a new homologous computational paradigm. They predicted developments in the field of computer technology, which will be characterized by an ever-closer integration of ICTs in everyday life. The main idea of ubiquitous calculations was to insert a computer into the environment, or to integrate it as a human tool so that it is invisible from the user's point of view, and so that users focus on their work and task without realising that they are working with a computer. It was about integrating the physical world with the virtual world into the information space as a whole. Such technologies are referred to as pervasive technologies.

Individual innovative pervasive technologies in interaction with information systems and the human factor create an intelligent, ambient environment. Ambient intelligence (Bolek and Romanová, 2020) represents a multidisciplinary approach, integrating innovative pervasive technologies and systems that form an ecosystem, which, based on collected, transformed, analysed and evaluated data, responds to users' requirements in an intelligent way. Ambient intelligence represents a multidisciplinary approach which focuses on the integration of innovative pervasive technologies that support user activities through specific environmental services that are provided with minimal user interference. Essentially, the system of ambient intelligence should be aware of a person's presence, understand the person's needs and be able to adapt to them. Ambient intelligence brings new findings about the environment for software development and implementation, where there are large quantities of various devices and sensors that need to be integrated, creating a programmable and auto-configurable infrastructure of

information systems. The centre of attention is no longer in hardware, neither in computer, nor network, but in providing intelligence in an everyday environment.
Aarts and Marzano (2003) summarize five key technological features that characterize the system of ambient intelligence:

- Integration - network devices are integrated into the environment,
- Situation context - the system recognizes people,
- Personalization - the system can be adapted to people's needs,
- Adaptability - the system can change in response to human requirements,
- Predictability - the system predicts without conscious mediation.

However, it is important to remember that the acceptance of ambient intelligence by a company, and thus also by the company's management, is mainly influenced by its properties (Riva, Vatalaro & Davide, 2005) which are: usability, technical feasibility and credibility.

Usability - the interaction with the surrounding intelligence should be unobtrusive, non-intrusive and user-friendly. In practice, this is often encountered especially when technological products do not contain detailed operating instructions. According to manufacturers, the technologies will work intuitively as soon as they log into the ambient environment.

Technical feasibility - ambient intelligence has to work reliably within the constraints of state-of-the-art technologies. Factors such as accuracy, capacity, and measures to prevent the failure of all hardware and software components need to be considered. Lee (2017) emphasizes building trust in ambient intelligence. Users must build a relationship with it and trust it before it is widely accepted.

Interesting is the view of Marr (2016), who defined four features that a company must have in order to be considered smart and to be part of the concept of ambient intelligence in relation to Industry 4.0. Those features are: interoperability, information transparency, technical support, and decentralized decision-making processes.
It is important for companies that individual machines and sensors communicate with each other. The system must be able to permanently create a virtual copy of the physical world and provide contextualization of information. Cybernetic systems are also included, supporting people in performing work and demanding tasks. At the same time, they must be able to make elementary decisions and be independent.

Smit et al. (2016) complement the requirements for a smart enterprise and ambient intelligence with features of virtualization, real-time changes and modularity. Gams et al. (2019) point to the field of ambient intelligence, which is very closely related to pervasive technologies, as well as to the awareness of context and the design of interaction between people. The most important features of ambient intelligence systems include:

- Built-in: devices are integrated into the environment; they are "invisible";
- Contextual: they recognize the user, possibly also the current state of the user and the situational context;
- Personalized: they are often tailored to user needs;
- Adaptive: ambient intelligence systems change their performance in response to changes in the user's physical or mental state;
- Anticipating: they can anticipate the user's wishes without conscious mediation;
- Subtle: discreet, providing nothing but the necessary information about the user to other devices and people;
- Non-invasive: they do not require any action from the user, but act independently.

The integration of innovative pervasive technologies and the development of ambitious intelligence bring several effects/benefits to companies that can help

them succeed in competition, improve their competitiveness and market position, simplify work, optimize business processes and effectively seize opportunities, as well as identify potential threats. Based on the analysis of the theoretical basis, the achievement of effects and benefits can be divided into three groups: financial, customer and process effects. This scientific article presents partial results from the achieved financial and process effects.

Brynjolfsson and Hitt (1996) published a study demonstrating the positive effect of information and communication technologies on productivity, however, they also pointed out, in this study, that information and communication technologies did not have a direct impact on profit.

However, in another study, Prasad and Harker (1997) did not find a statistically significant impact of ICTs on productivity, but rather pointed to their positive impact on increasing business performance and profitability.

In order to achieve multiple effects and benefits for individual business areas, companies spend significant funds on information and communication technologies and information systems (Chou, Seng-chou & Tzeng, 2006). In some companies, these investments represent the largest percentage of the company's total investments, and their management expects to benefit from these investments. Although expenditures on IS/IT are huge, they do not always bring the expected benefits (Odusanya, Coombs & Doherty, 2015).

Koelinger's research (2006) emphasizes that information and communication technologies are a key factor in increasing a company's competitiveness and productivity, which contributes to positive changes in the economic growth. The company's innovation in the field of information and communication technologies and technological leadership contributes to significantly strengthening its market position, brand, competitive advantage and identification of business opportunities (Xu, Thong & Venkatesh, 2014). Innovative pervasive technologies take into account the diversity of technological requirements in business practices. From the point of view of the achieved effects/benefits for companies, they bring effects in the following areas:

- The market value of a company or an organization;
- Applications for a wide range of markets (financial, insurance, industrial, commercial);
- Seizing start-up and spin-off opportunities to identify potential service requirements and service connections in order to meet new needs;
- Low input costs in order to achieve economies of scale (the position of cost leader);
- Grabbing the customer's attention. The basis is considered to be the so-called "free" services, additional services, advertising...,
- Evaluation of the company, product, or service through social networks and user communities at almost zero costs.

The integration of innovative pervasive technologies is changing and has a major impact on several business areas. Recently, these technologies have significantly affected company marketing (advertising, digital campaigns, communications and their targeting, distribution channels). Hope (2019) anticipates that these technologies will have an even greater and more vigorous impact on individual business areas in the coming years, which will be reflected in their modification.

Research results (Bayo-Moriones, Billón & Lera-López, 2013) reveal a wide range of effects and benefits from the introduction of information and communication technologies and point to the need for their continuous use to achieve better results. According to the authors, the computerization of individual processes may not bring results immediately, but in the longer run. Information and communication technologies are a key factor in modifying processes in order to increase the quality of services and products (Kowalkowski, Kindström & Gebauer, 2013). Innovative pervasive

technologies have significant effects/benefits on the innovation of products, processes and management functions.
The development of innovative technologies and their integration into entrepreneurial or business models and their processes will manifest itself in the form of modification of business processes, modification and creation of new partnerships, and a combination of different business models. Leasing and franchising models are expected to be much more important in achieving a rapid turnover of technological investments.

Innovative pervasive technologies can also significantly influence the processes of social interaction of all participants in the corporate environment as follows:

- Facilitate contact between people,
- Focus on improving the community and culture,
- Help build knowledge and skills for working with information and communication technologies,
- Improve the quality of work, inspire creativity and build trust,
- Be consistent with long-term sustainability - personal, social and environmental,
- Be part of lifelong learning,
- Be accessible to management and employees and be controlled easily and intuitively.

Methodology

Research model

The work procedure in the implementation of research and the formulation of relevant conclusions is shown in the research model (Figure 1). From a detailed analysis of the theoretical basis and consultations with companies, two groups of effects of integrating information technologies and information systems were identified, which was the basis for determining individual variables: financial effects (Brynjolfsson & Hitt, 1996; Prasad & Harker, 1997; Chou, Seng-chou & Tzeng, 2006; Odusanya, Coombs & Doherty, 2015) and process effects (Bayo-Moriones, Billón & Lera-López, 2013; Kowalkowski, Kindström & Gebauer, 2013), which are achieved by integrating innovative pervasive technologies, digitization and virtualization.

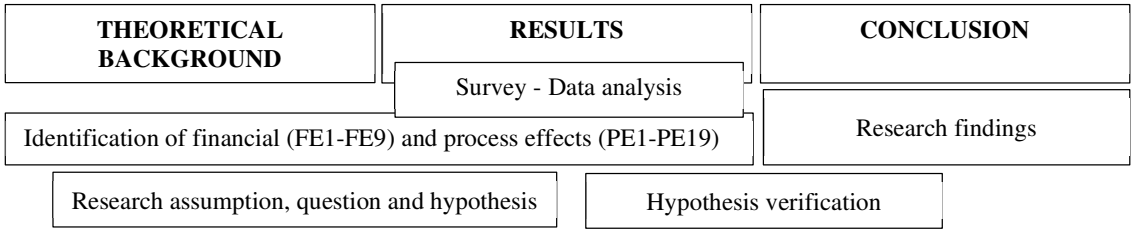

Figure 1: Research model

Source: Authors' calculations

Based on the study's findings, the authors of this paper have established a **research assumption** that companies differ in achieving effects/benefits of integrating information technologies and systems depending on their size. At the same time, they assume that this is not the case in the most significant effects, and that the company size will not affect the achievement of the most significant financial and process effects.

From the research assumption, a **research question was formulated:**
What financial and process effects/benefits do most companies achieve depending on their size?

In order to provide an exact answer to the research question, the following **research hypothesis was set:**

H_0: depending on the size (micro, small, medium, large), companies do not differ in

achieving the most significant financial and process effect.

H_1: depending on the size (micro, small, medium, large), companies differ in achieving the most significant financial and process effect.

Data structure and Methodology

The object of the investigation was enterprises in the Slovak Republic. The relevant respondents whose responses were included in the analysis were 206. The survey structure consisted of 79% of commercial companies, 6% of self-employed persons and 15% of other companies. The representativeness of the sample was ensured by regional equilibrium, while the sample was from all regions of Slovakia. The structure of the sample by sectors approximates the distribution of enterprises in the national economy (statistical classification of economic activities - SK NACE).

The biggest share belonged to enterprises from industrial production (24%), other activities (13%) and wholesale and retail (12%). Enterprises were also segmented by manufacturing/non-manufacturing activity. The survey sample of enterprises segmented by activity consisted of 40% of manufacturing and 60% of non-manufacturing enterprises. Enterprises were segmented by size based on the European Commission's Recommendation 2003/361/EC, based on the number of employees (micro 1-9 (17.49%), small 10-49 (19.42%), medium 50-249 (24.76%), large enterprise >= 250 (38.35%)).

Subsequently, a questionnaire survey was conducted among companies in the Slovak Republic through occasional selection. The degree of achievement of individual effects/benefits was recorded by the respondents on a point scale of 0 - did not achieve, up to 100 - achieved in full extent. The data obtained were subjected by the questionnaire survey to a detailed statistical analysis using the application MS Excel and IBM SPSS.

The data were analysed in detail through descriptive statistics to obtain a detailed picture of the current state of the achieved financial and process benefits as a result of integrating innovative information technologies and systems. The normality of the data distribution was determined using the Levene's test. Then, the parametric T-test, the Anova or non-parametric Mann-Whitney (U) test and the Kruskal-Wallis test were used to determine the differences depending on the company size and activity.

Results

Innovative pervasive technologies and information systems can help companies succeed in competition, simplify their work and make effective use of the opportunities offered, as well as identify potential threats. The integration of these technologies and systems brings several significant effects/benefits for companies in the field of financial and process management. The results of the analysis, the answer to the research question and the verification of the research hypothesis are presented in the following part of the research results.

Table 1: Financial and process effects

Variable FE - financial effects/PE - process effects	Size	M	SD	Std. Error	95% Confidence Interval for Mean		Skew	Kurt	Parametric/non-parametric test	
					Lower Bound	Upper Bound				
FE1- Direct financial revenues from separate ICT products and services	Micro	24.72	28.709	4.785	15.01	34.44	0.68	-0.92		
	Small	30.78	33.918	5.363	19.93	41.62			χ^2	p
	Medium - sized	28.73	33.939	4.752	19.18	38.27			6.201	0.102
	Large	42.19	38.447	4.326	33.58	50.80				
	Total	33.59	35.394	2.466	28.73	38.45				
FE2 - Direct financial revenues from ICT products and services as added value to basic products and services	Micro	21.17	28.036	4.673	11.68	30.65	0.61	-0.97		
	Small	31.48	33.431	5.286	20.78	42.17			F	p
	Medium - sized	32.06	32.081	4.492	23.04	41.08			4.842**	0.003
	Large	45.23	36.014	4.052	37.16	53.29				
	Total	35.09	34.203	2.383	30.39	39.79				
FE3 - Increase in market value	Micro	25.64	25.469	4.245	17.02	34.26	0.42	-1.13		
	Small	28.88	28.159	4.452	19.87	37.88			χ^2	p
	Medium - sized	47.45	31.959	4.475	38.46	56.44			21.054**	0.000
	Large	52.30	36.856	4.147	44.05	60.56				
	Total	41.89	34.007	2.369	37.22	46.56				
FE4 - Improvement in profitability indicators	Micro	29.25	30.875	5.146	18.80	39.70	0.22	-1.34		
	Small	33.35	29.651	4.688	23.87	42.83			F	p
	Medium - sized	51.43	31.998	4.481	42.43	60.43			7.146**	0.000
	Large	54.42	36.212	4.074	46.31	62.53				
	Total	45.19	34.542	2.407	40.44	49.93				
FE5 - Improvement in sales indicators	Micro	33.92	32.662	5.444	22.87	44.97	0.30	-1.24		
	Small	36.25	32.576	5.151	25.83	46.67			F	p

	Medium - sized	45.88	32.904	4.608	36.63	55.14				
	Large	51.01	35.180	3.958	43.13	58.89			2.972*	0.033
	Total	43.89	34.182	2.382	39.19	48.58				
FE6 - Cost reduction	Micro	25.64	30.329	5.055	15.38	35.90	0.34	-1.21		
	Small	26.20	30.220	4.778	16.54	35.86			**F**	**p**
	Medium - sized	46.78	35.625	4.989	36.76	56.80			10.699**	0.000
	Large	54.37	31.136	3.503	47.39	61.34				
	Total	42.00	34.199	2.383	37.30	46.70				
FE7 - Cost increase	Micro	20.31	18.957	3.159	13.89	26.72	1.03	0.17		
	Small	22.38	26.875	4.249	13.78	30.97			χ^2	**p**
	Medium - sized	18.73	23.320	3.266	12.17	25.28			10.513*	0.015
	Large	33.87	31.117	3.501	26.90	40.84				
	Total	25.52	27.293	1.902	21.77	29.27				
FE8 - Productivity increase	Micro	38.25	31.158	5.193	27.71	48.79	-0.08	-1.29		
	Small	38.38	30.996	4.901	28.46	48.29			**F**	**p**
	Medium - sized	55.59	34.083	4.773	46.00	65.17			8.161**	0.000
	Large	63.49	31.890	3.588	56.35	70.64				
	Total	52.25	33.797	2.355	47.60	56.89				
FE9 - Productivity increase in relation to lower costs	Micro	30.64	29.019	4.837	20.82	40.46	0.35	-1.24		
	Small	28.75	31.577	4.993	18.65	38.85			**F**	**p**
	Medium - sized	48.53	34.312	4.805	38.88	58.18			6.142**	0.001
	Large	51.32	35.594	4.005	43.34	59.29				
	Total	42.63	34.688	2.417	37.87	47.40				
PE1 – Increase in the company process performance	Micro	36.86	32.366	5.394	25.91	47.81	0.02	-1.28		
	Small	37.15	33.094	5.233	26.57	47.73			**F**	**p**
	Medium - sized	49.12	33.267	4.658	39.76	58.47				0.003

	Large	56.99	32.929	3.705	49.61	64.36			4.789**	
	Total	47.67	33.850	2.358	43.02	52.32				
PE2 - Reduction of customer requirements response time	Micro	44.94	33.475	5.579	33.62	56.27	-0.11	-1.27		
	Small	44.38	34.829	5.507	33.24	55.51			**F**	**p**
	Medium - sized	51.18	33.594	4.704	41.73	60.63			3.082*	0.028
	Large	60.97	33.118	3.726	53.56	68.39				
	Total	52.52	34.142	2.379	47.83	57.21				
PE3 - Reduction of order processing time	Micro	39.25	30.397	5.066	28.97	49.53	-0.10	-1.31		
	Small	45.68	35.874	5.672	34.20	57.15			F	p
	Medium - sized	43.73	33.149	4.642	34.40	53.05			5.697**	0.001
	Large	62.13	32.268	3.630	54.90	69.35				
	Total	50.38	34.015	2.370	45.71	55.05				
PE4 - Reduction of manufacturing time	Micro	19.61	22.546	3.758	11.98	27.24	0.65	-0.95		
	Small	28.73	34.843	5.509	17.58	39.87			χ^2	**p**
	Medium - sized	29.12	34.113	4.777	19.52	38.71			9.371*	0.025
	Large	40.91	34.935	3.931	33.09	48.74				
	Total	31.90	33.581	2.340	27.29	36.52				
PE5 – Improvement in the quality of production	Micro	22.36	27.131	4.522	13.18	31.54	0.53	-1.09		
	Small	33.53	37.373	5.909	21.57	45.48			χ^2	**p**
	Medium - sized	33.14	34.727	4.863	23.37	42.90			7.897*	0.048
	Large	43.14	35.474	3.991	35.19	51.08				
	Total	35.17	34.917	2.433	30.37	39.96				
PE6 - Improving the quality of management processes in the company	Micro	30.31	28.629	4.772	20.62	39.99	0.17	-1.12		
	Small	38.25	35.772	5.656	26.81	49.69			**F**	**p**
	Medium - sized	46.96	31.954	4.474	37.97	55.95				0.000

	Large	56.11	30.468	3.428	49.29	62.94			6.463**	
	Total	45.87	32.867	2.290	41.35	50.38				
PE7 –Improvement in the level of communication of the company	Micro	48.97	31.808	5.301	38.21	59.73	-0.27	-0.98		
	Small	51.00	35.159	5.559	39.76	62.24			**F**	**p**
	Medium - sized	55.88	29.660	4.153	47.54	64.22			3.153*	0.026
	Large	65.13	28.902	3.252	58.65	71.60				
	Total	57.27	31.374	2.186	52.96	61.58				
PE8 –Improvement in the quality of decision-making processes	Micro	36.00	25.088	4.181	27.51	44.49	-0.04	-0.99		
	Small	44.95	33.121	5.237	34.36	55.54			**F**	**p**
	Medium - sized	51.57	30.422	4.260	43.01	60.12			4.708**	0.003
	Large	57.29	29.108	3.275	50.77	63.81				
	Total	49.76	30.409	2.119	45.58	53.93				
PE9 – Improvement in the quality of planning processes	Micro	29.61	27.019	4.503	20.47	38.75	-0.09	-1.15		
	Small	43.73	33.587	5.311	32.98	54.47			**F**	**p**
	Medium - sized	53.73	29.645	4.151	45.39	62.06			10.892**	0.000
	Large	62.52	29.646	3.335	55.88	69.16				
	Total	50.94	32.119	2.238	46.53	55.35				
PE10 –Improvement in performance through better monitoring	Micro	33.33	27.965	4.661	23.87	42.80	-0.08	-1.07		
	Small	45.50	33.470	5.292	34.80	56.20			**F**	**p**
	Medium - sized	54.16	30.907	4.328	45.46	62.85			5.755**	0.001
	Large	57.65	30.363	3.416	50.84	64.45				
	Total	50.17	31.779	2.214	45.81	54.54				
PE11 – Improvement in performance through better data evaluation	Micro	36.00	31.596	5.266	25.31	46.69	-0.21	-1.16		
	Small	46.88	35.036	5.540	35.67	58.08			**F**	**p**
	Medium - sized	56.08	31.974	4.477	47.09	65.07			5.729**	0.001
	Large	61.22	30.841	3.470	54.31	68.12				

	Total	52.75	33.190	2.312	48.19	57.31				
PE12 - Product and service innovation	Micro	37.50	31.993	5.332	26.68	48.32	0.10	-1.30		
	Small	43.08	33.214	5.252	32.45	53.70			**F**	**p**
	Medium - sized	48.24	35.942	5.033	38.13	58.34			1.509	0.213
	Large	51.42	35.744	4.022	43.41	59.42				
	Total	46.58	34.820	2.426	41.79	51.36				
PE13 - Process innovation	Micro	41.75	33.948	5.658	30.26	53.24	-0.01	-1.28		
	Small	39.38	32.565	5.149	28.96	49.79			**F**	**p**
	Medium - sized	48.65	32.468	4.546	39.52	57.78			2.486	0.062
	Large	54.91	33.405	3.758	47.43	62.39				
	Total	48.04	33.468	2.332	43.45	52.64				
PE14 - Benefits due to changes in the organizational structure	Micro	17.92	24.183	4.031	9.73	26.10	0.58	-0.74		
	Small	26.63	26.297	4.158	18.21	35.04			**F**	**p**
	Medium - sized	31.27	30.722	4.302	22.63	39.92			5.322**	0.002
	Large	39.61	29.304	3.297	33.04	46.17				
	Total	31.23	29.166	2.032	27.23	35.24				
PE15 - Benefits caused by changes in processes as a result of information system implementation	Micro	26.25	24.470	4.078	17.97	34.53	0.23	-1.11		
	Small	34.80	29.992	4.742	25.21	44.39			**F**	**p**
	Medium - sized	47.43	33.593	4.704	37.98	56.88			7.574**	0.000
	Large	53.16	32.478	3.654	45.89	60.44				
	Total	43.48	32.509	2.265	39.01	47.94				
PE16 - Improving the support of internal customers of the IS/IT unit	Micro	30.00	31.623	5.270	19.30	40.70	0.44	-1.10		
	Small	25.75	29.495	4.664	16.32	35.18			**F**	**p**
	Medium - sized	37.20	34.085	4.773	27.61	46.78			5.430**	0.001
	Large	48.68	33.621	3.783	41.15	56.21				
	Total	38.12	33.680	2.347	33.49	42.75				

PE17 - Better coordination of business activities	Micro	38.11	31.285	5.214	27.53	48.70	0.10	-1.15		
	Small	40.08	30.525	4.826	30.31	49.84			**F**	**p**
	Medium - sized	47.45	34.977	4.898	37.61	57.29			3.301*	0.021
	Large	55.47	32.076	3.609	48.28	62.65				
	Total	47.46	32.938	2.295	42.94	51.99				
PE18-Significant changes in the manner of doing business in the area	Micro	22.97	29.116	4.853	13.12	32.82	0.76	-0.57		
	Small	26.28	27.055	4.278	17.62	34.93			χ^2	**p**
	Medium - sized	28.82	31.695	4.438	19.91	37.74			6.753	0.080
	Large	38.32	33.829	3.806	30.74	45.89				
	Total	30.95	31.653	2.205	26.60	35.29				
PE19 - Support for the expansion of business areas	Micro	24.44	24.547	4.091	16.14	32.75	0.55	-0.76		
	Small	30.28	27.643	4.371	21.43	39.12			**F**	**p**
	Medium - sized	35.76	29.248	4.095	27.54	43.99			1.909	0.129
	Large	37.65	32.459	3.652	30.38	44.92				
	Total	33.44	29.700	2.069	29.36	37.52				

*Note: N = 206, min = 0; max = 100; *p=0,05; **p=0,01; df = 3, 202 Source: Authors' calculations*

In terms of the financial effects (FE) listed in table 1, as a result of the integration of innovative pervasive technologies, information systems and digitization, the analysed companies achieved the biggest increase in productivity (FE8) M = 52.25, SD = 33.80, followed by improvement in profitability indicators (FE4) M = 45.19, SD = 34.54, improvement in sales indicators (FE5) M = 43.89, SD = 34.18, productivity increase in relation to lower costs (FE9) M = 42.63, SD = 34.69, and cost reduction (FE7) M = 42.00, SD = 34.20.

Based on the results of the analysis of differences in mean values, it is observed that companies segmented into groups according to size (micro, small, medium, large) differ significantly in achieving these financial effects: FE2 - Direct financial revenues from ICT products and services as added value to basic products and services; FE3 - Increase in market value; FE4 - Improvement in profitability indicators; FE5 - Improvement in sales indicators; FE6 - Cost reduction; FE7 - Cost increase; FE8 - Productivity increase, FE9 - Productivity increase in relation to lower costs. Higher values in achieving individual financial effects are achieved by large and medium-sized enterprises, where the average figure of individual financial effects is often above the level of 50.00. In achieving the remaining financial effects, the authors did not identify a statistically significant effect between the individual groups segmented by size.

In the next part of the testing, the authors compared between the average values of the achieved financial effects of manufacturing and non-manufacturing companies. They did not identify a statistical significance for any of the aforementioned financial effects.

Every company strives to manage its processes so that they are implemented with the greatest possible efficiency. The integration of innovative pervasive technologies changes the existing processes in the company.

The implementation of innovative pervasive technologies and elements of ambient intelligence is closely related to individual processes of the company. By implementing these elements, companies achieve several process effects (PE) listed in Table 1.

The highest value was reached by the indicator of improvement of the level of communication of the company (PE7) M= 57.27, SD = 31.37, followed by an increase in performance based on better evaluation of data (PE11) M = 52.75, SD = 33.19, shortening the customer requirements response time M = 52.52, SD = 34.14, increasing the quality of planning processes M = 50.94, SD = 32.12, and shortening of order handling time M = 50.38, SD = 34.02.

The last part of testing process effects was analysing the comparison of the mean values of the three most significant achieved effects depending on the size of the company (Table 1). From the results of the analysis, it was observe that companies segmented into groups according to size (micro, small, medium, large) differ significantly in achieving individual process effects: PE1 - Increase in the company process performance; PE2 - Reduction of response time to customer requirements; PE3 - Reduction of order processing time; PE4 - Reduction of production time; PE5 - Improvement in the quality of production; PE6 - Improvement of the quality of management processes in the company; PE7 - Improvement of the level of communication of the company; PE8 - Improvement of the quality of decision-making processes; PE9 - Improvement of the quality of planning processes; PE10 - Improvement of the performance through better monitoring; PE11 - Improvement of performance through better data evaluation; PE14 - Benefits due to changes in the organizational structure; PE15 - Benefits caused by process changes due to the implementation of an information system; PE16 - Improvement in the support of internal customers of the IS/IT department; and PE17 - Better coordination of business activities. The authors did not identify statistically significant differences between the groups of companies in achieving the following effects: PE12 - Product and service innovation, PE13 -

Process innovation, PE18 - Significant change in the way of doing business in a given area, and PE19 - Support in expanding business areas.

From the results of testing the difference of mean values in non-manufacturing and manufacturing enterprises, it is observed that non-manufacturing enterprises (M = 46.41, SD 33.224) differ significantly, in terms of statistics, from manufacturing enterprises (M = 57.65, SD = 29.335) in achieving the effect of PE9 - Increase in the quality of planning processes by integrating ICTs and introducing elements of digitization and virtualization t (204) = - 2.494, p = 0.013. Non-manufacturing enterprises (M = 46.25, SD 33.141) statistically significantly differ from manufacturing enterprises (M = 55.99, SD = 28.870) in achieving the PE10 effect - Increase in performance through better monitoring by integrating innovative pervasive technologies and introducing digitization and virtualization t (204) = - 2.176, p = 0.031. Non-manufacturing enterprises (M = 24.91, SD 32.785) statistically significantly differ from manufacturing enterprises (M = 42.27, SD = 32.218) in achieving the PE4 effect - Reducing production time by integrating ICTs and introducing elements of digitization and virtualization Z = - 4.535, p <0.000. Non-manufacturing enterprises (M = 29.28, SD 35.630) statistically significantly differ from manufacturing enterprises (M = 43.88, SD = 32.100) in achieving the PE5 effect - Improving the quality of production by integrating innovative pervasive technologies and introducing elements of digitization and virtualization Z = - 3,780, p <0.000.

Non-manufacturing companies use innovative ICTs in the provision of services. The production activity of manufacturing companies is demonstrably more efficient by integrating innovative pervasive technologies into individual processes and introducing elements of digitization and virtualization. It is observed that innovative pervasive technologies have a positive effect on the company's performance, whether from a macroeconomic or microeconomic point of view.

In terms of the research model, a research question was defined, which was based on the research assumption. A research hypothesis was also formulated (Section: Methodology). The most significant effects from the integration of innovative information technologies and information systems come from the group of financial effects FE8 - productivity increase, and from the group of process effects PE7 - Improvement in the level of company communication.

The increase in the economic indicator of productivity is mainly recorded by large enterprises (M = 63.49; SD = 31.89) and medium-sized enterprises (M = 55.59; SD = 34.08). Also, on the basis of interviews with respondents, companies can deduce that with the growing size of a company, this effect is more noticeable. Large and medium-sized enterprises implement several processes in which the integration of information technologies and information systems will increase labour productivity. In this case, it does not have to be only an increase in productivity by digitization and automation of production output, but also process management, production management, the implementation of auxiliary tasks as well as the work of managers and employees. Enterprises, depending on size (micro, small, medium, large), differ significantly in achieving the most significant financial effect of productivity (M = 52.25; SD = 33.80; F = 8.161; p < 0.000).

An interesting observation is provided by Table 1 (effect PE7), which clearly shows that companies of all sizes have most often seen benefits in improving the level of communication, both internally and externally. The implementation of innovative ICTs and systems has a significant benefit for business communication processes. For medium-sized enterprises measured by the number of employees, this benefit is secondary. The results of testing the difference of mean values depending on the size of enterprises show that medium enterprises (M = 55.88; SD = 29.66) statistically significantly differ from large (M = 65.13; SD = 28.90), small (M = 51.00, SD = 35.16) and micro enterprises

(M = 48.97; SD = 31.81) in the most frequently achieved process effect PE7 - Improving the level of enterprise communication (M = 57.27; SD = 31.37; F = 3.153, p = 0.026). Medium-sized companies identified the most significant benefit as performance gains based on better data evaluation.

Based on the aforementioned test results, it is observed that the size of the company measured by the number of employees has a statistically significant impact on achieving the most important financial and process effects from the integration of innovative ICTs and systems. The authors reject the hypothesis H_0 and accept the hypothesis H_1: depending on the size (micro, small, medium, large), companies significantly differ in achieving the most significant financial and process effect.

Discussion

Businesses and organizations spend significant financial resources on information systems (Chou et al., 2006). The relationship between information and communication technologies and the competitiveness of enterprises is a long-term topic of several researches, which confirms the significant impact of information and communication technologies on the competitiveness of enterprises. The effects of ICTs on business performance are constantly the subject of scientific research, since not all studies demonstrate a clear return on investment in ICTs. The effects have also been studied from a macro and micro perspective (Chan, 2000; Kohli & Devaraj, 2003).

Innovative pervasive technologies and information systems can help companies succeed in competition, simplify their work and make effective use of the opportunities offered, as well as identify potential threats. Their integration in business processes provides the company/organisation with several effects/benefits in individual business areas. In the last decade, measuring the effectiveness and effects of IS/IT, information and communication technologies have become a very important issue for companies. The quantification of effects and benefits of IS/IT and information and communication technologies is the main issue that the company's management needs to address. The exact methods to be used depend on the nature of the business. The authors of this paper agree with Silka's (1990) statement that keeping a detailed overview of all types of IT investments and quantifying the benefits of individual investments, in the context of general management, is not a trivial task. In some companies, these investments represent the largest percentage of the company's total investments. Although IS/IT expenditures are large, they do not always bring the expected benefits (Odusanya et al., 2015; Černý, Bodiš & Töröková, 2017).

Lycett and Giaglis (2000) claim that managers must first understand the impact of IS/IT investments in relation to the overall business productivity. They suggest that the evaluation of the success of IS/IT projects provides a simple feedback for the management as well as benchmarking possibilities. By investing in new technologies, a company can achieve a significant competitive advantage with the help of good management and an appropriately chosen technical implementation (Ward & Elvin, 1999). According to Doherty (2014), it often happens in business practice that the return on investment in IS/IT is achieved later than the IS/IT life cycle.

Business owners and managers deal with the efficiency of IS/IT implementation and operation in the company. The reason is the fact that IS/IT can affect not only the value of the company, its competitiveness and relationships with interest groups, but also a product or a service.

The research showed that companies achieve several financial and process effects/benefits from the integration of innovative information technologies and systems. From the group of financial effects, the highest importance is given to increasing productivity, then improving profitability indicators, improving sales indicators, increasing productivity in relation to lower costs, and finally reducing costs. From the group of process effects,

companies consider that the most significant effect is the improvement in the level of communication between individual technologies and information systems of the company, then the increase in performance through better data evaluation, shortening response time to customer requirements, and finally the increase in the quality of planning processes and shortening order processing time.

Depending on the size of the company, there are statistically significant differences between individual companies in achieving individual financial and process effects/benefits. Large and medium-sized enterprises mostly reached the highest level. Higher figures in achieving individual financial effects are achieved by large and medium-sized enterprises, where the average figure of individual financial effects is often above the level of 50.00 (scale of 0 did not achieve - 100 achieved in full extent). The authors have identified significant differences in: direct financial revenues from ICT products and services as added value to basic products and services, increase in market value, improvement in profitability indicators, improvement in sales indicators, cost reduction, cost increase, productivity increase, and productivity increase in relation to lower costs. In the case of the segmentation of enterprises by activity (manufacturing/non-manufacturing), the authors did not identify statistically significant differences in achieving financial effects. Based on further testing, according to the activity of the company (manufacturing/non-manufacturing), the authors accept the result that in case of manufacturing companies, the integration of innovative pervasive technologies into processes, their digitization and virtualization demonstrably streamline the production activities of these companies, and in case of non-manufacturing companies, they streamline service provision. The authors have reached a general consensus that ICTs have a positive effect on the company's performance, whether from a macroeconomic or microeconomic point of view.

The integration of innovative pervasive technologies, digitization and virtualization brings new digital functions, innovates products, and digitizes customer services. In addition, the availability of real-time data allows companies to offer more customized products and solutions, which usually generate significantly higher margins than massively produced items.

Achieving process effects by integrating innovative pervasive technologies is also confirmed by Bayo-Moriones, Billón and Lera-López (2013). Kowalkowski, Kindstrőm and Gebauer (2013) point, in particular, to the change in processes that ultimately leads to an increase in the quality of services and products. Digital transformation (Szabo et al., 2020) is inherently a non-linear organizational change process and is very much influenced by the position of the organization in the value chain. The value chain itself generates a demand for the member organizations, perceived by top managers perceive as the customer driver, and after which they start planning the implementation. Consequently, they learn from other members of their value chain, and they trust universities and research organizations' recommendations regarding the right technology and management practices.

Conclusion

Digitization, process virtualization and new technologies brought about by scientific and technological progress as well as the Fourth Industrial Revolution are creating the surrounding intelligence. These technologies are characterized by their ubiquity. Their integration and use in business processes brings many effects/benefits for companies in several areas. An example for this is the findings from this research carried out among companies in Slovakia. By integrating these innovative information and communication technologies and systems, companies achieve significant financial and process effects/benefits. The most significant financial benefits from the integration of these technologies into business processes include increased productivity, subsequently improved profitability

indicators, improved sales indicators, increased productivity in relation to lower costs, and cost reduction. These new, innovative technologies bring the most significant changes in the area of process management, namely in improving the level of business communication, increasing performance through better data evaluation and shortening the response time to customer requirements. These effects are most significantly achieved by large and medium-sized enterprises. Positive findings can also be observed in small and micro enterprises. Micro businesses are even reporting significant improvements in terms of reducing response times to customer requirements by using these innovative information technologies and systems. Significant shifts can also be seen in medium-sized companies, which, thanks to these technologies, evaluate data more accurately and in more detail, which makes it possible to improve subsequent business processes and business management decisions. These effects can also be observed in manufacturing and non-manufacturing companies, which confirms the importance of the integration of these innovative technologies and systems. The benefits and positive effects of the integration of innovative ICTs and systems provide companies with opportunities for better market penetration, competitiveness and, ultimately, economic indicators.

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