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ADOPTION OF INFORMATION SYSTEMS BY TRADE AND MANUFACTURING ENTERPRISES

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The article discusses the ability of enterprises to adopt and use information systems.

The analysis of scientific literature published by Oxford University Press, Cambridge University Press, Harvard University Press, Springer, M. E. Sharpe, Routledge, etc. show that 5.39 mln. authors are talking about information systems. 4.0 thousand authors mention the role of trade and manufacturing enterprises in this area. Most of these authors pay attention to manufacturing enterprises (it is mentioned by 2.3 thousand authors), others – to trade enterprises (it is mentioned by 911 authors), some of them pay attention to both.

In addition, it is important to mention that such topic is not very popular among authors who dedicated books to information systems. Most of them are analysing individual technology adoption or individual organizations' adoption decisions. Therefore, it is important to reveal the ability of enterprises to adopt and use information systems in the current challenging conditions; to compare enterprises, which have activity in different countries, to evaluate, if enterprises, taking into account the new circumstances, are able to respond and adapt to these challenges adequately.

One of the challenges is the adoption of information system is when it is multi-functional. In the literature it's mentioned that enterprise easily adopt dual-function information system, but not multi-functional, which increases confusion, frustration and indecision thinking about adoption of new information system.

The ability of enterprise to adopt information system depends on industry structure, enterprises' size, environmental factors and information system itself. That's why the analysis by company size is not included into this study. As in European Union small and medium size enterprises take the largest part (their share is 99.8% among all enterprises).

So, the paper presents the results of investigations about the adoption of different information system in two industries located in 32 European countries. National level of 32 European countries is used to seeking to describe environmental factors on country level.

The research is aiming to propose framework helpful to compare enterprises by geographic location and their ability to adopt information systems. In literature different factors that influence the adoption of information systems are suggested for benchmarking. Therefore the classical adoption theories are tending to neglect market and industry characteristics as important factors in the adoption decision, in the paper the set of factors are used to explore complex organizations and industry adoption patterns.

The study presented in the paper contains three different aspects. First, the adoption of information systems is disclosed from different perspectives. Second, a theoretical framework that incorporates factors determining the ability of companies to adopt information systems is presented. Third, the application of framework for manufacturing and trade enterprises, located in 32 European countries, is given.

The article is based on comparative and multiple criteria analysis. For the suggested framework, the set of criteria and the multiple criteria evaluation method (COPRAS) is used.

The proposed approach can be useful for decision-making practitioners who analyse the perspectives and adoption of information systems.

Keywords: *Manufacturing, trade, enterprises, comparison, information systems, COPRAS.*

Introduction

The analysis of literature shows that it is important to reveal the ability of enterprises to adopt information systems in the current challenging conditions; to evaluate, if enterprises, taking into account the new circumstances, are able to respond and adapt to these challenges adequately. The classical adoption theories are tending to neglect market and industry characteristics as important factors in the adoption decision. In literature different factors that influence the adoption of IS are suggested for benchmarking. These factors alone, or in combination, may influence the adoption effects for various industries differently. The set of factors are used in paper to explore complex organizations and industry adoption patterns.

The research is aiming to propose framework, which incorporates factors determining the complex ability of enterprises to adopt information systems. To eliminate environmental factors two industries, located at the same country, are compared.

The research tasks are defined as follow: 1) the adoption of information systems is disclosed from different perspectives,

2) to present theoretical framework that incorporates factors determining the ability of enterprises to adopt information systems, and 3) to apply suggested framework for the comparison of manufacturing and trade enterprises located in 32 European countries.

Research objective is the framework that incorporates factors determining the ability of enterprises to adopt information systems.

The article is based on comparative and multiple criteria analysis. The scientific novelty of the study – presented the formulated framework, which incorporates factors determining the ability of enterprises to adopt information systems.

The proposed approach can be useful for decision-making practitioners, which analyze the perspectives and adoption of information systems.

The adoption of information systems

Information systems (IS) are defined as the complementary networks of hardware and software that organizations use to collect, filter, process, create, and distribute data. Each specific **IS** aims to support operations, management and decision making. In a broad sense, the term is used to refer not only to the information and communication technologies (ICT) that organizations use, but also to the way in which employees interact with them seeking to support business processes. Some authors make a clear distinction between IS, ICT, and business processes. IS typically include an ICT component but are not purely concerned with ICT, which focus on the end use of technology. IS are also different from business processes. So, IS help to control the performance of business processes.

Information systems (IS) adoption is a process during which a problem is solved through the assessment and evaluation of alternative solutions. IS adoption models recognize both organizational and extra-organizational factors (Del Aguila-Obra and Padilla-Melendez, 2006). A brief review of literature provided below discusses some of the most important factors that affect IS adoption decisions.

In this section IS adoption models are quickly reviewed. First, Rogers' innovation adoption model (1995), where capable of adopting organization to apply the technology is a secondary consideration in the model. Rogers suggests that novelties adoption can be the result of the effects of five groups of determinants. The first group focuses on the perceived attributes of novelty. These include relative advantage (how much better the technology is comparing to it supersedes), compatibility (how well it meets needs), and simplicity (how easy the technology is). Second, it is MOA (MOA: motivation, opportunity, ability) model, where the extent of innovation adoption is primarily determined by individual organization rather than the technology. Borrowing from individual level adoption models, theorists have attempted to describe technology adoption by placing their emphasis on organizational factors (Azadegan and Teich, 2010). The underlying factors for these models can be categorized into such groups: the organization's motivational factors; the organization's ability factors; and other external factors.

A criticism of classical adoption theories is that they tend to neglect market and industry characteristics as important factors in the adoption decision. An exception is that of the TOE (TOE: Technology, organisation, environment) model. It distinguishes how the industry, competitors, government and other near and far institutions can influence the adoption decision (Azadegan and Teich, 2010).

Technology Acceptance Model TAM2 was developed specifically to predict who is most likely to accept new information system in a workplace environment. It is an adaptation of the theory of reasoned action, in that the model posits that beliefs determine behavioural intentions, which determine behaviour. TAM2 differs from the theory of planned behaviour in that it accounts for the fact that in organizational settings the adoption of new information system is not determined solely by the employees' beliefs.

Even when employees use the information system supplied to them, human error is a large component of the success or failure of any adoption initiative. Rarely organizations remain competitive because they make large investments in information systems. Most of the system performance shortfalls are the result of behavioural errors rather than hardware or software deficiencies (King and He, 2006). These shortfalls often stem from users failing to use the new information system the way the decision-makers envisioned. In most cases, employees would increase their performance if they would fully utilize information system that has already been adopted by their organization. Besides justifying the sizable investment in information system that has been adopted, organization leaders must justify the downtime that occurs as a result of implementing that change.

There has been some discussion regarding the most appropriate measure of information system acceptance (Sun and Zhang, 2006). TAM2 can predict both behavioural intention to use the technology and also actual use after adoption. These two indications of acceptance are conceptually different. The alternative measure of future usage depends on a number of adoptions and history factors that may or may not be directly associated with characteristics of the information system itself.

Abrahamson (1991) discusses the adoption of inefficient information systems that are expensive to implement and don't add value to the enterprise. The justification of any information system in economic terms is problematic, however, in part due to unknown implementation costs, which can be much greater than the cost of the information system itself. Fichman (2004) presents a framework used to evaluate the economic value of new information system.

In literature authors Thatcher et al. (2006) are describing the degree to which various organizational, industrial, governmental and cultural factors influence IS adoption decisions. Governmental factors include government regulations and industrial factors – industry cycles. Cultural factors are the main driver of adoption decisions but it is clear that cultural factors can help us better understand how the confluence of organizational, industry and governmental factors do indeed influence decision making. In the individualistic culture of the United States, a "technology champion" often drives the IS adoption. This is very different from Chinese cultures where IS adoption is more of a collective effort driven by a confluence of government, industry, and management initiatives.

In other words, the role of culture in IS adoption decisions inside countries may find no effects of culture until one differentiates between different industries at national level.

Thatcher et al. (2006) find out that the adoption of business-to-business (B2B) information systems by large customers has driven the adoption of these by their suppliers. In the United States, the electronics industry has also been more advanced than the textile industry in terms of linking enterprise resource planning (ERP) systems between organizations. Firms also are increasingly deploying open source information systems due to their advantages such as flexibility, knowledge creation, performance, and cost-saving (Qu et al. 2011). Qu et al. (2011) expand the literature by distinguishing information systems adoption experience at two levels – company level and industry level and show such necessity.

Lee et al. (2010) provides a framework through which technology adoption behaviour can be examined systematically at the dyadic level of B2B relationships. This framework includes the multi-level characteristics of buyer-seller information system adoption. Lee et al. (2010) argue that a buyer-seller information system adoption can serve as a resource that promotes cooperation and collective actions between current or potential suppliers and customers. Competitive pressure for adopting a buyer-seller information system refers to the capabilities of their competitors (Lee et al. 2010). In addition, the adoption of buyer-seller information system has positive externalities: the obtainment of potential benefits depends on the collective actions of other companies. This means that potential benefits increase if more companies adopt the same or compatible information systems (Lee et al. 2010).

Successful technology adoption depends on multi-dimensional perspective, including those related to the adopter, to the information systems, to the provider and the network within which they operate. Without careful consideration of these factors, effectiveness of benchmarking of information systems adoptions may be remiss of predictable outcomes (Azadegan and Teich, 2010). How organizations assess the benefits (and risks) associated with technology adoptions is dependent on the type of technology and its lifecycle.

Sääksjärvi et al. (2011) raise question about adoption of IS with dual-functionality and multiple-functionality. Authors mention that high-tech IS are increasingly becoming multifunctional. They increase confusion, frustration and indecision thinking about new IS adoption. Organization's readiness which includes its resistance to innovation, technology sophistication and the availability of finances in adopting new technologies should be less influential. The theoretical arguments made by systems theorists with those suggested from adoption theories to note three key factors to affect technology adoption: network size; network inter-connection; and technological infrastructure. For example, network factors are technological infrastructure and the level of collaboration between network members.

At the same time, the relations between network partners play a role as a social control mechanism that governs partnership behaviours at the dyadic level, whereas a low level of relations is characterized by weak ties. Weak ties are more likely to be not stable bridges for possessing unique information compared to strong ties. However, enterprises connected with weak ties are exposed to the risk of opportunistic behaviours by their partners. For instance, they are more likely to exit the relationship in order to solve problems than to seek solutions within the current partner relationship. Such interactions between buyers and sellers are very important in the process of a new technology adoption (Lee et al. 2010).

The need to adopt new technology can also occur due to competitive reasons. The competitive pressure for adopting a buyer-seller technology refers to the level of buyer-seller technology capability of its competitors. Studies show that despite the lack of internal needs concerning new technology adoption, many firms actively adopt automated data exchange solutions or ERP software packages to respond to the various forms of competitive pressures. The firms are evaluating between the risk of losing competitive advantage and opportunities in case they are late with new technology adoption (Lee et al. 2010).

Strüker et al. (2010) suggest discussing the innovation-push (IP) and need-pull (NP) concepts to explain behaviour in the adoption of new information systems. The smaller organizational size can be an advantage for the adoption of information systems. A crucial prerequisite is that the adoption of information systems significantly affects business processes and organizational structure. Small and medium size enterprises have a relative advantage because of lower complexity of organizations. But comparing with large enterprises small and medium size (SMEs) enterprises typically exhibit lower financial resources and the lower number of cooperating suppliers and customers.

Potential barriers concerning the adoption and application of information systems:

- Costs and benefits. It could be situations then benefits derived from adoption exceed costs to implement information system. In order to reap the full benefits information system has to be integrated into the company's existing technological infrastructure, internal business processes and cross-company processes as well;
- Security. For the prevention of unauthorized executions of sensitive information in the case of cross-company information exchange e-signature or other security tools could be implemented.
- Functionality. Technical functionality of information systems is an important potential barrier. For example, the management of large amounts of data can impose a burden which is too high for implemented information system (Strüker et al. 2010).

As a result, factors that influence the adoption of different IS may enhance the understanding of relationships and therefore allow for more effective benchmarking. Furthermore, organizations may follow industry expectations to adopt a technology. These factors alone, or in combination, may influence the adoption effects for various technologies differently.

Through literature review, two groups of different studies are established.

A) First group of studies, which focus on environmental factors.

Studies under this category focus on general factors that are valid across countries. The gap of IS adoption among countries is widening. Some researches suggest framework, which integrate factors driving IS adoption and are important to decision-making practitioners (Li et al., 2012).

Researches often neglect some important factors, such as technology related and company related factors. They think that environmental factors (government policy, telecommunication infrastructure, etc.) are more influential then organisational factors.

B) Second group of studies, which focus on factors describing IS adoption.

Authors analyse managerial attitude, external pressure company strategy, and technological IS strength. Strategic orientation of company is divided into two categories: orientation to business partners and orientation to innovation. Enterprises, which are oriented to innovations, are willing to adopt IS. They will be frontiers in the market and ready to meet high risks during implementation.

Enterprises, which are oriented to business partners, are willing to adopt IS, if they face great pressure of business partners, or they are planning to internationalise their activity.

There are enterprises which adopt IS seeking to build their own competitive advantage. Of course, not all of them achieve expected performance, some of them fail. Authors are analysing reasons. First, they highlight enterprise' size. They think that small and medium enterprises (SMEs) are seeking to get competitive outcomes, while large enterprises tend to simplify operations and achieve lower costs. Second, authors highlight industry structure. Some of them analyse mechanisms of IS adoption among different industries. But there is limited amount of such studies.

Finally, the analysis of various studies shows that factors driving IS adoption can be integrated into theoretical framework, which is important to decision-making practitioners. The analysis of different studies shows that there is lack of attention to different industries and orientation to IS itself. There is also a need to revise issues related to enterprises' size, but it's not a part of this study. It's strongly recommended to dedicate research to this topic in the futureTalking about IS adoption, the set of factors are used to explore complex organizations and industry behaviour (Pathak et al, 2007 and Wycisk et al, 2008). So, bellow is provided theoretical framework that incorporates industry and organizational adoption patterns.

A framework that incorporates factors determining the ability of companies to adopt information systems

1. Relevance of research

Talking about information systems the usage of them between European Union enterprises increased considerably: 95% of enterprises have Internet access, 87% of enterprises have fixed broadband connection, and 70% of enterprises have Website. Enterprises made intensive use of the Internet to interact with public authorities (around 70% of enterprises reported that they submit completed forms electronically using Internet), but automated data exchanged solutions with public authorities are not yet highly implemented. Also talking about B2B solutions, for example, only 5% of companies received orders in a format that allowed automated processing of e-invoices (Eurostat, 2011). In addition, talking about security for Internet transactions there are reasonable proportion of Internet users who say they have not been able to access online services because of cyber-attacks is considerably high (Eurobarometer, 2012).

2. Suggested framework

There are two groups of factors that are presented in the literature:

- General factors, which are characterizing national environment (legislation, telecommunications infrastructure, government policy, transparent and trust financial system). The analysis of such indicators is not a part of this study.
- Specific factors, which characterizing ability of enterprise to meet higher risk, make business changes, and overcome difficulties arising from adoption of different information systems. These will be analysed on industry level.

For the framework, that incorporates factors determining the ability of enterprises to adopt information systems, the set of nine criteria is used. So, this set consists of such criteria, which characterize enterprises:

1. Enterprises using open source operating systems;
2. Enterprises using LAN and Intranet or extranet in reference year;
3. Enterprises sending and/or receiving e-invoices;
4. Enterprises who have ERP software package to share data on sales/purchases with other internal functional areas;
5. Enterprises whose business processes are automatically linked to those of their suppliers and/or customers;
6. Enterprises using automated data exchange for sending or receiving data to / from public authorities;
7. Enterprises using automated data exchange for sending payment instructions to financial institutions;
8. Enterprises, which are not using advanced e-signatures in relations with suppliers / clients;
9. Enterprises, which are not offering secure transactions when receiving orders over Internet.

The author thinks that the aforementioned set of criteria can describe the ability of enterprises to adopt various information systems. For the comparison of enterprises from different countries multiple criteria method COPRAS is used. In quantitative comparison each alternative is described by nine criteria. Some of these criteria have different direction (Turskis et al, 2009). Maximising and minimising criteria are with different directions. Bellow (see Table 1), the criteria and their direction – maximizing or minimizing (i.e. max or min in column 3), is defined.

For long time managers are dealing with multiple criteria issues (Zavadskas and Turskis, 2011; Antucheviciene et al, 2010). Numerous methods have been developed for the analysis of such problems (Peldschus, 2009). One multiple criteria method is the method of COmplex PRoportional Assessment of alternatives (COPRAS). During the application of method direct and proportional dependences are assumed and the alternatives, values and weights of criteria are adequately described (Turskis et al., 2009). Among Lithuania scientists COPRAS method is used widely (for example, by Kildiene et al, 2011; Ginevicius and Podvezko, 2009; Ginevicius and Podvezko, 2008; Andruskevicius, 2005; Malinauskas and Kalibatas, 2005). Based on such type of methods, the multiple criteria problem is represented by a matrix. In our case the matrix contains of 32 alternatives (rows) and 9 criteria (columns).

In order to avoid the difficulties caused by different dimensions of nine criteria, normalization is used (Ginevicius, 2008). The transformed values of nine criteria of thirty two countries are given in Table 2 and Table 3. The criteria weights (in Table 1) are determined by the experienced experts from ICT companies and home University. The number of experts is limited to ten. Calculations are more accurate and more objective when number of experts is higher.

The application of multiple criteria methods depends on the calculation of criteria weights. Usually experts are used for the estimation of weights. In our case study 10 experts were used (see Table 1).

The consistency of experts' judgments is checked using the coefficient of concordance. The sum of scores, presented by experts:

$$c = \sum_{j=1}^{r} c_j \ (i = 1,...,m) = 450,$$

here m is the number of alternatives; r – the number of experts.

The coefficient of concordance W is calculated according such formula:

$$W = \frac{S}{S_{\max}}, when\ S = \sum_{i=1}^{m} (c_i - \bar{c})^2,$$

here S is the sum of deviations, which shows difference from average squared, S_{max} – the sum of deviations in ideally agreed case, $\bar{c}$ – overall average is calculated:

$$\bar{c} = \frac{1}{2} r(m+1) = \frac{1}{2} \cdot 10 \cdot (9+1) = 50, \text{ when } S = 273.$$

The sum of deviations in ideally agreed case:

$$S_{\max} = \frac{r^2 m(m^2-1)}{12} = \frac{100 \cdot 9 \cdot (81-1)}{12} = 6000,$$

after $$W = \frac{S}{S_{\max}} = \frac{2732}{6000} = 0.46.$$

The significance x^2 for the coefficient of concordance is calculated as follows:

$$x^2 = Wr(m-1) = 0.46 \cdot 10 \cdot (9-1) = 36.42.$$

Random number x^2 is distributed under x^2 with $v=m-1$ the degrees of freedom of the chosen significance level α (in practice α is usually equal to the value of 0.05 or 0.01).

The assessments of experts are aligned calculated x^2 value is greater than the x_{kr} (which is taken from tables of distribution with ν=9−1=8 the degrees of freedom and significance level α=0,05and is equal to 14.79). The coefficient of concordance is equal to 0.46 (its significance is equal to 36.42 and is greater than the critical value – equal to 14.79) and shows that experts' judgments are in a good agreement. This means that the weights of criteria (estimated by experts) can be used for analysis (Podvezko, 2005).

Finally, the weights of criteria are placed into framework. The criterion, which represents the usage of open source operating system, received the highest experts' interest. After this the matrix is normalized. The sum of normalized values is equal as always to one (Turskis et al, 2009).

The developed framework is applied for two sectors: manufacturing and distributive trade. In European Union 27 countries small and medium size enterprises take 99.8% share of all enterprises. There are some countries where large enterprises take biggest share such as Slovakia (with 0.9% share) and Denmark and Luxembourg (with 0.5% share). Talking about different industries, the share of large enterprises in distributive trade is lowest – 0.1% and the share in manufacturing is among the highest – 0.8%. These industries are among ones, which stand for the highest number of enterprises, persons employed and value added. Therefore, they also stand among ones, which have the lowest labour productivity. This might be resulted due to not satisfactory usage of information systems for linking business processes and sharing data with business partners and other bodies.

The comparisons of manufacturing and trade enterprises from different countries

This part of the paper is dedicated to the application of developed framework. For the comparisons of manufacturing and trade enterprises Eurostat (2010) data, which is collected using questionnaire, is taken.

Table 1. The estimation of weights by experts

No	Criterion	The direction of criterion	Experts										The sum of scores	Deviations from the average	The significance of criterion	The average
			1	2	3	4	5	6	7	8	9	10				
1	Enterprises using open source operating systems, %	Max	1.5	1	1.5	1	2.5	1	1.5	7.5	7.5	6	31	361	0.172	8.948
2	Enterprises using LAN and Intranet or extranet in reference year, %	Max	4	2	6	2	1	2.5	3.5	4	3	3	31	361	0.157	8.181
3	Enterprises sending and/or receiving e-invoices, %	Max	1.5	3	1.5	3	2.5	2.5	1.5	2.5	2	2	22	784	0.157	8.162
4	Enterprises who have ERP software package to share information on sales/purchases with other internal functional areas, %	Max	8.5	9	8.5	6.5	8	8.0	8	2.5	1	4	64	196	0.067	3.469
5	Enterprises whose business processes are automatically linked to those of their suppliers and/or customers, %	Max	5.0	8	5.5	5	7	4.5	5.5	5.5	4	9	59	81	0.076	3.945
6	Enterprises using automated data exchange for sending or receiving data to / from public authorities, %	Max	4	4.5	4	6.5	5.5	5.0	5.5	9	6	5	55	25	0.102	5.328
7	Enterprises using automated data exchange for sending payment instructions to financial institutions, %	Max	8.0	6.5	5.5	6.5	5.5	8.5	8	5.5	9	8	71	441	0.085	4.399
8	Enterprises, which are not using advanced e-signatures in relations with suppliers / clients, %	Min	8.5	6.5	7	8	9	8.5	8	7.5	7.5	1	72	462	0.073	3.797
9	Enterprises, which are not offering secure transactions when receiving orders over Internet, %	Min	4	4.5	5.5	6.5	4	4.5	3.5	1	5	7	46	20	0.111	5.771
Suma			45	45	45	45	45	45	45	45	45	45	450	2732	1.000	52.000
Average													50.0			

The sample size is determined by statistical analysis. The results of the analysis of survey sample show that it is sufficient. In order to ensure 95% reliability of statistical data and 4% of allowable inaccuracy 1.22% manufacturing and 1.20% trade enterprises have to be questioned. During Eurostat survey 3.31% manufacturing and 2.92% trade enterprises have been interviewed.

The results of the comparisons show that Belgium manufacturing and Germany trade enterprises are the most active in adopting IS: these enterprises have received the highest score (Table 2 and Table 3).

It is noted that 45% of Belgium manufacturing enterprises are using LAN and Intranet or extranet in reference year; 41% of them are sending and/or receiving e-invoices; 34% of them – enterprises whose business processes are automatically linked to those of their suppliers and/or customers; 48% of them – using automated data exchange for sending or receiving data to/ from public authorities. The results of the comparison of manufacturing enterprises show that Belgium manufacturing enterprises are leading with IS adoption (Table 2).

In general, from all researched manufacturing enterprises 16.5% enterprises are using open source operating systems; 37.8 % of them – using LAN and Intranet or extranet in reference year, 32.8% of them are sending and/or receiving e-invoices, 20% of them – enterprises whose business processes are automatically linked to those of their suppliers and/or customers; 37.8% of them – using automated data exchange for sending or receiving data to/ from public authorities.

It is clarified that 31% of Germany trade enterprises using open source operating systems; 51 % of them – using LAN and Intranet or extranet in reference year; 31% of them – enterprises whose business processes are automatically linked to those of their suppliers and/or customers; 45% of them are sending and/or receiving e-invoices. The results of the comparison of trade enterprises show that among trade enterprises, enterprises from Germany are leading ones (Table 3).

In general, from all researched trade enterprises 14.7% enterprises are using open source operating systems; 48.4 % of them – using LAN and Intranet or extranet in reference year; 24.4% of them – enterprises whose business processes are automatically linked to those of their suppliers and/or customers; 38.4% of them are sending and/or receiving e-invoices; 36.8% of them – using automated data exchange for sending or receiving data to/ from public authorities.

The results of research show that manufacturing enterprises are more active in adoption of information systems. Trade companies are more passive, especially with applying security tools.

The comparison of manufacturing and trade enterprises shows that IS adoption have imbalances between enterprises, located in Netherlands, Austria, Finland, Portugal, Greece, Czech Republic and Iceland. Especially differences are seen in Iceland, where manufacturing enterprises are behind trade enterprises by 13 places, and Czech Republic, where manufacturing enterprises are above trade enterprises by 10 places.

The study results also show that IS which received low adoption attention by enterprises (IS helping business processes are automatically linked to those of their suppliers and/or customers) could be treated as multifunctional.

The result of the study show that the framework, which incorporates factors determining the ability of companies to adopt information systems, is important to decision-making practitioners, analyzing IS adoption perspectives.

Conclusions

The analysis of literature shows that it is important to reveal the ability of enterprises to adopt information systems in the current challenging conditions; to compare enterprises from different countries; to evaluate, if enterprises are able to respond and adapt to these challenges adequately taking into account the new circumstances.

Different factors, influencing the adoption of information systems, are suggested in literature. Most of them are used for analyzing adoption of individual information system or individual organizations' adoption decisions. But topic oriented for adoption in different industries is not very popular among authors dedicated books for to information systems. Talking about enterprises attention to the adoption of information systems, authors give more attention to manufacturing ones.

For the comparison of trade and manufacturing enterprises different criteria are used, including specific factors, which characterizing ability of enterprise to use security tools.

The results of the study show that Belgium manufacturing and Germany trade enterprises are the most active in adopting information systems. Comparing Belgium manufacturing enterprises with other manufacturing enterprises, it is noted that there are more active enterprises in Belgium (the number of active enterprises is 0.82-1.69 times greater than industry average). This means that it is necessary to improve the ability of other manufacturing enterprises to adopt information systems. Comparing Germany trade enterprises with other trade enterprises, it is noted that there are more active enterprises in Germany (the number of active enterprises is 1-2.1 times greater than industry average). This shows that for trade enterprises it is big opportunity concerning IS adoption, but on the other hand, it is necessary to improve the ability of enterprises in other European countries to amend their adoption of information systems.

Finally, the set of criteria is tested by using data of enterprises located in 32 countries. The survey is conducted to reveal the ability of enterprises for the adoption of information systems. The comparison of manufacturing and trade enterprises shows that adoption have imbalances between enterprises, located in Netherlands, Austria, Finland, Portugal, Greece, Czech Republic and Iceland. Especially differences are seen in Iceland and Czech Republic.

The study results also show that IS which received low adoption attention by enterprises could be treated as multifunctional.

In Addition, it is noted that suggested profile helps to compare enterprises from different countries and their ability to adopt information systems and might be useful for authors analyzing current adoption of information systems by enterprises and future perspectives and decision-making practitioners. The analyses by company size were not a part of this study. In future studies it is recommended to analyze the experience of different size enterprises in related information systems adoption since different size companies may have different experience in such systems adoption and usage.

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Table 2. The comparison of manufacturing enterprises

By country	Enterprises using open source operating systems, %	Enterprises using LAN and Intranet or extranet in reference year, %	Enterprises sending and/or receiving e-invoices, %	Enterprises who have ERP software package to share information on sales/purchases with other internal functional areas, %	Enterprises whose business processes are automatically linked to those of their suppliers and/or customers, %	Enterprises using automated data exchange for sending or receiving data to / from public authorities, %	Enterprises using automated data exchange for sending payment instructions to financial institutions, %	Enterprises, which are not using advanced e-signatures in relations with suppliers / clients, %	Enterprises, which are not offering secure transactions when receiving orders over Internet, %
Significance of criteria	0.17	0.16	0.16	0.07	0.08	0.10	0.08	0.07	0.11
Belgium	14	45	41	37	34	48	56	60	93
Germany	22	43	33	37	29	38	54	79	92
Lithuania	16	31	50	6	35	52	39	31	93
Luxembourg	20	46	30	25	25	40	57	61	94
Italy	17	30	62	12	22	30	55	76	99
Sweden	13	48	33	48	28	37	39	65	89
Slovenia	17	36	10	30	17	60	53	3	90
Latvia	19	30	43	5	35	44	38	56	99
Finland	19	45	33	37	18	36	33	84	96
Slovakia	20	39	31	18	26	38	39	74	98
France	15	46	33	32	13	32	35	71	95
Netherlands	14	32	32	40	6	57	35	75	92
Poland	18	41	16	13	16	44	34	51	97
Austria	22	36	19	35	13	28	26	87	93
Ireland	13	43	29	29	16	28	27	81	88
Denmark	9	39	33	32	13	23	37	75	92
Czech Republic	24	32	18	19	14	16	26	56	94
Malta	8	41	32	23	19	30	34	87	93
Norway	7	33	37	21	17	41	30	88	91
Estonia	18	26	36	9	12	36	13	76	97
Portugal	10	26	24	16	42	35	27	92	97
Croatia	12	25	20	14	53	17	27	70	96
Spain	9	30	25	24	15	25	33	46	95
United Kingdom	8	29	14	14	7	74	45	85	92
Bulgaria	12	30	27	7	18	31	14	50	100
Iceland	16	37	19	24	6	21	18	84	96
Turkey	13	39	15	12	17	21	20	88	97
Hungary	19	19	6	9	9	41	33	86	98
Greece	10	30	10	36	14	11	25	91	99
Romania	11	23	18	12	13	19	16	92	99
Former Yugoslav R	7	18	8	13	13	8	15	81	99
Cyprus	6	11	4	12	4	3	4	98	100
Sum	458	1079	841	701	619	1064	1037	2299	3043
Sum multiplied from the significance of criteria	79	170	132	47	47	109	88	168	338
	Sum equal to 1246								

By country	Matrix: Enterprises using open source operating systems, %	Enterprises using LAN and Intranet or extranet in reference year, %	Enterprises sending and/or receiving e-invoices, %	Enterprises who have ERP software package to share information on sales/purchases with other internal functional areas, %	Enterprises whose business processes are automatically linked to those of their suppliers and/or customers, %	Enterprises using automated data exchange for sending or receiving data to / from public authorities, %	Enterprises using automated data exchange for sending payment instructions to financial institutions, %	Enterprises, which are not using advanced e-signatures in relations with suppliers / clients, %	Enterprises, which are not offering secure transactions when receiving orders over Internet, %	The sum of the matrix values	Sum of maximizing values	Sum of minimizing values	Minimizing values by the country, which has the least minimizing value	The relative importance of comparative options	Priority row
Belgium	0.005	0.007	0.008	0.004	0.004	0.005	0.005	0.002	0.003	0.042	0.0364	0.0053	0.638	0.04248	1
Germany	0.008	0.006	0.006	0.004	0.004	0.004	0.004	0.003	0.003	0.042	0.0358	0.0059	0.576	0.04137	2
Lithuania	0.006	0.005	0.009	0.001	0.004	0.005	0.003	0.001	0.003	0.037	0.0329	0.0044	0.772	0.04034	3
Luxembourg	0.008	0.007	0.006	0.002	0.003	0.004	0.005	0.002	0.003	0.039	0.0338	0.0054	0.629	0.03982	4
Italy	0.006	0.004	0.012	0.001	0.003	0.003	0.004	0.002	0.004	0.040	0.0335	0.0060	0.561	0.03894	5
Sweden	0.005	0.007	0.006	0.005	0.003	0.004	0.003	0.002	0.003	0.038	0.0328	0.0053	0.636	0.03890	6
Slovenia	0.006	0.005	0.002	0.003	0.002	0.006	0.004	0.000	0.003	0.032	0.0285	0.0034	1.000	0.03816	7
Latvia	0.007	0.004	0.008	0.000	0.004	0.004	0.003	0.002	0.004	0.037	0.0316	0.0054	0.627	0.03767	8
Finland	0.007	0.007	0.006	0.004	0.002	0.003	0.003	0.003	0.004	0.038	0.0317	0.0062	0.547	0.03701	9
Slovakia	0.008	0.006	0.006	0.002	0.003	0.004	0.003	0.002	0.004	0.037	0.0307	0.0059	0.570	0.03621	10
France	0.006	0.007	0.006	0.003	0.002	0.003	0.003	0.002	0.003	0.035	0.0291	0.0057	0.591	0.03476	11
Netherlands	0.005	0.005	0.006	0.004	0.001	0.005	0.003	0.002	0.003	0.035	0.0288	0.0057	0.589	0.03445	12
Poland	0.007	0.006	0.003	0.001	0.002	0.004	0.003	0.002	0.004	0.031	0.0259	0.0052	0.655	0.03224	13
Austria	0.008	0.005	0.004	0.003	0.002	0.003	0.002	0.003	0.003	0.033	0.0268	0.0062	0.549	0.03208	14
Ireland	0.005	0.006	0.005	0.003	0.002	0.003	0.002	0.003	0.003	0.032	0.0262	0.0058	0.584	0.03180	15
Denmark	0.003	0.006	0.006	0.003	0.002	0.002	0.003	0.002	0.003	0.031	0.0251	0.0057	0.589	0.03076	16
Czech Republic	0.009	0.005	0.003	0.002	0.002	0.002	0.002	0.002	0.003	0.029	0.0242	0.0052	0.649	0.03047	17
Malta	0.003	0.006	0.006	0.002	0.002	0.003	0.003	0.003	0.003	0.031	0.0251	0.0062	0.549	0.03041	18
Norway	0.003	0.005	0.007	0.002	0.002	0.004	0.002	0.003	0.003	0.031	0.0248	0.0061	0.552	0.03014	19
Estonia	0.007	0.004	0.007	0.001	0.001	0.003	0.001	0.002	0.004	0.030	0.0241	0.0060	0.568	0.02959	20
Portugal	0.004	0.004	0.004	0.002	0.005	0.003	0.002	0.003	0.004	0.031	0.0243	0.0065	0.523	0.02930	21
Croatia	0.005	0.004	0.004	0.001	0.006	0.002	0.002	0.002	0.004	0.029	0.0236	0.0057	0.590	0.02923	22
Spain	0.003	0.004	0.005	0.002	0.002	0.002	0.003	0.001	0.003	0.027	0.0216	0.0049	0.686	0.02824	23
United Kingdom	0.003	0.004	0.003	0.001	0.001	0.007	0.004	0.003	0.003	0.029	0.0228	0.0061	0.558	0.02820	24
Bulgaria	0.005	0.004	0.005	0.001	0.002	0.003	0.001	0.002	0.004	0.026	0.0209	0.0052	0.645	0.02713	25
Iceland	0.006	0.005	0.004	0.002	0.001	0.002	0.001	0.003	0.004	0.028	0.0215	0.0062	0.547	0.02673	26
Turkey	0.005	0.006	0.003	0.001	0.002	0.002	0.002	0.003	0.004	0.027	0.0202	0.0063	0.533	0.02538	27
Hungary	0.007	0.003	0.001	0.001	0.001	0.004	0.003	0.003	0.004	0.026	0.0196	0.0063	0.536	0.02478	28
Greece	0.004	0.004	0.002	0.003	0.002	0.001	0.002	0.003	0.004	0.025	0.0182	0.0065	0.520	0.02324	29
Romania	0.004	0.003	0.003	0.001	0.002	0.002	0.001	0.003	0.004	0.023	0.0167	0.0065	0.517	0.02169	30
Former Yugoslav R	0.003	0.003	0.001	0.001	0.002	0.001	0.001	0.003	0.004	0.018	0.0116	0.0062	0.546	0.01683	31
Cyprus	0.002	0.002	0.001	0.001	0.000	0.000	0.000	0.003	0.004	0.014	0.0069	0.0068	0.500	0.01166	32
Sum	0.172	0.157	0.157	0.067	0.076	0.102	0.085	0.073	0.111	1.000	0.8160	0.1840	19.129	1.0000	

Table 3. The comparison of trade enterprises

By country	Enterprises using open source operating systems, %	Enterprises using LAN and Intranet or extranet in reference year, %	Enterprises sending and/or receiving e-invoices, %	Enterprises who have ERP software package to share information on sales/purchases with other internal functional areas, %	Enterprises whose business processes are automatically linked to those of their suppliers and/or customers, %	Enterprises using automated data exchange for sending or receiving data to / from public authorities, %	Enterprises using automated data exchange for sending payment instructions to financial institutions, %	Enterprises, which are not using advanced e-signatures in relations with suppliers / clients, %	Enterprises, which are not offering secure transactions when receiving orders over Internet, %
Significance of criteria	0.17	0.16	0.16	0.07	0.08	0.10	0.08	0.07	0.11
Germany	31	51	45	32	31	39	58	82	88
Belgium	15	56	42	40	41	47	52	55	88
Finland	19	65	50	27	31	42	49	84	92
Luxembourg	21	52	42	27	40	35	57	58	92
Slovakia	22	51	44	22	39	44	42	70	94
Latvia	26	39	48	6	40	44	41	52	97
Lithuania	14	39	56	7	42	54	43	30	93
Slovenia	13	39	14	27	36	65	62	2	86
France	18	61	44	23	23	35	40	69	91
Sweden	11	59	39	44	35	38	39	70	86
Italy	17	37	62	13	30	27	54	77	98
Norway	6	48	61	13	40	50	38	85	85
Iceland	20	47	40	26	12	43	30	88	92
Poland	20	46	20	13	25	49	38	38	96
Portugal	12	40	31	35	42	46	43	91	97
Denmark	6	51	48	36	27	28	45	78	83
Malta	11	39	42	26	29	41	43	84	93
Netherlands	13	40	40	29	7	48	37	75	90
Austria	18	37	28	30	25	36	32	86	89
Estonia	17	34	52	8	18	42	19	75	94
Spain	11	34	34	30	28	30	39	45	93
Croatia	14	32	27	13	59	20	32	67	94
Greece	15	30	23	40	29	23	24	79	96
United King	9	28	21	8	13	72	46	87	84
Ireland	10	35	34	24	18	29	29	82	89
Bulgaria	14	39	29	11	23	28	14	52	98
Czech Repul	19	33	18	16	20	15	29	66	91
Hungary	18	26	11	8	20	44	38	85	96
Romania	12	27	19	17	15	19	20	91	100
Turkey	11	36	15	12	18	16	17	91	95
Former Yug	11	20	10	13	14	9	18	80	99
Cyprus	11	16	9	22	9	5	12	98	97
Sum	485	1287	1098	698	879	1163	1180	2272	2956
Sum multiplied from the significance of criteria	83	202	172	47	67	119	100	166	328
	Sum equal to 1284								

By country	Matrix: Enterprises using open source operating systems, %	Enterprises using LAN and Intranet or extranet in reference year, %	Enterprises sending and/or receiving e-invoices, %	Enterprises who have ERP software package to share information on sales/purchases with other internal functional areas, %	Enterprises whose business processes are automatically linked to those of their suppliers and/or customers, %	Enterprises using automated data exchange for sending or receiving data to / from public authorities, %	Enterprises using automated data exchange for sending payment instructions to financial institutions, %	Enterprises, which are not using advanced e-signatures in relations with suppliers / clients, %	Enterprises, which are not offering secure transactions when receiving orders over Internet, %	The sum of the matrix values	Sum of maximizing values	Sum of minimizing values	Minimizing values by the country, which has the least minimizing value	The relative importance of comparative options	Priority row
Germany	0.011	0.006	0.006	0.003	0.003	0.003	0.004	0.003	0.003	0.043	0.0370	0.0059	0.554	0.04246	1
Belgium	0.005	0.007	0.006	0.004	0.004	0.004	0.004	0.002	0.003	0.038	0.0334	0.0051	0.649	0.03980	2
Finland	0.007	0.008	0.007	0.003	0.003	0.004	0.004	0.003	0.003	0.040	0.0343	0.0062	0.535	0.03958	3
Luxembourg	0.007	0.006	0.006	0.003	0.003	0.003	0.004	0.002	0.003	0.038	0.0330	0.0053	0.619	0.03911	4
Slovakia	0.008	0.006	0.006	0.002	0.003	0.004	0.003	0.002	0.004	0.038	0.0327	0.0058	0.570	0.03830	5
Latvia	0.009	0.005	0.007	0.001	0.003	0.004	0.003	0.002	0.004	0.037	0.0317	0.0053	0.620	0.03780	6
Lithuania	0.005	0.005	0.008	0.001	0.004	0.005	0.003	0.001	0.003	0.034	0.0299	0.0045	0.739	0.03716	7
Slovenia	0.005	0.005	0.002	0.003	0.003	0.006	0.004	0.000	0.003	0.031	0.0272	0.0033	1.000	0.03709	8
France	0.006	0.007	0.006	0.002	0.002	0.003	0.003	0.002	0.003	0.036	0.0303	0.0056	0.584	0.03603	9
Sweden	0.004	0.007	0.006	0.004	0.003	0.003	0.003	0.002	0.003	0.036	0.0301	0.0055	0.601	0.03598	10
Italy	0.006	0.005	0.009	0.001	0.003	0.002	0.004	0.002	0.004	0.036	0.0295	0.0062	0.535	0.03477	11
Norway	0.002	0.006	0.009	0.001	0.003	0.004	0.003	0.003	0.003	0.034	0.0285	0.0059	0.556	0.03402	12
Iceland	0.007	0.006	0.006	0.002	0.001	0.004	0.002	0.003	0.003	0.034	0.0280	0.0063	0.524	0.03318	13
Poland	0.007	0.006	0.003	0.001	0.002	0.004	0.003	0.001	0.004	0.031	0.0260	0.0048	0.682	0.03274	14
Portugal	0.004	0.005	0.004	0.003	0.004	0.004	0.003	0.003	0.004	0.034	0.0277	0.0066	0.501	0.03262	15
Denmark	0.002	0.006	0.007	0.003	0.002	0.002	0.003	0.003	0.003	0.032	0.0267	0.0056	0.586	0.03246	16
Malta	0.004	0.005	0.006	0.002	0.003	0.004	0.003	0.003	0.003	0.033	0.0264	0.0062	0.532	0.03160	17
Netherlands	0.005	0.005	0.006	0.003	0.001	0.004	0.003	0.002	0.003	0.031	0.0255	0.0058	0.569	0.03108	18
Austria	0.006	0.005	0.004	0.003	0.002	0.003	0.002	0.003	0.003	0.032	0.0254	0.0061	0.539	0.03072	19
Estonia	0.006	0.004	0.007	0.001	0.002	0.004	0.001	0.002	0.004	0.031	0.0250	0.0059	0.554	0.03046	20
Spain	0.004	0.004	0.005	0.003	0.002	0.003	0.003	0.001	0.003	0.029	0.0236	0.0049	0.667	0.03021	21
Croatia	0.005	0.004	0.004	0.001	0.005	0.002	0.002	0.002	0.004	0.029	0.0231	0.0057	0.579	0.02884	22
Greece	0.005	0.004	0.003	0.004	0.003	0.002	0.002	0.003	0.004	0.028	0.0223	0.0061	0.536	0.02763	23
United King	0.003	0.003	0.003	0.001	0.001	0.006	0.003	0.003	0.003	0.027	0.0211	0.0060	0.553	0.02660	24
Ireland	0.004	0.004	0.005	0.002	0.002	0.003	0.002	0.003	0.003	0.027	0.0212	0.0060	0.551	0.02660	25
Bulgaria	0.005	0.005	0.004	0.001	0.002	0.002	0.001	0.002	0.004	0.026	0.0204	0.0054	0.615	0.02645	26
Czech Repul	0.007	0.004	0.003	0.002	0.002	0.001	0.002	0.002	0.003	0.026	0.0200	0.0055	0.595	0.02586	27
Hungary	0.006	0.003	0.002	0.001	0.002	0.004	0.003	0.003	0.004	0.027	0.0202	0.0063	0.520	0.02535	28
Romania	0.004	0.003	0.003	0.002	0.001	0.002	0.001	0.003	0.004	0.023	0.0163	0.0067	0.493	0.02116	29
Turkey	0.004	0.004	0.002	0.001	0.002	0.001	0.001	0.003	0.004	0.022	0.0158	0.0065	0.507	0.02077	30
Former Yug	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.003	0.004	0.019	0.0123	0.0063	0.524	0.01747	31
Cyprus	0.004	0.002	0.001	0.002	0.001	0.000	0.001	0.003	0.004	0.018	0.0113	0.0068	0.485	0.01610	32
Sum	0.172	0.157	0.157	0.067	0.076	0.102	0.085	0.073	0.111	1.000	0.8160	0.1840	18.677	1.0000	

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