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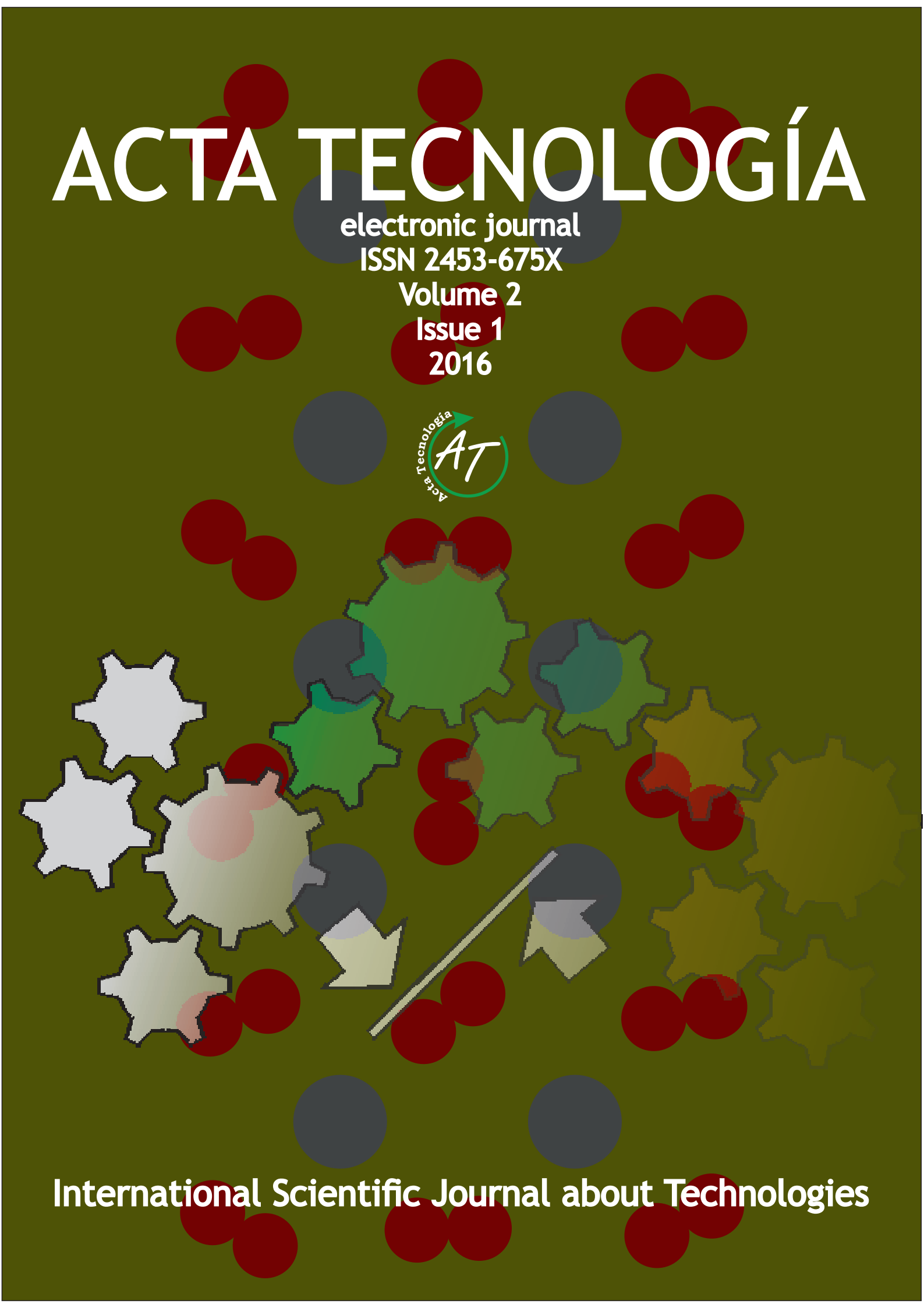

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EXPLOITATION OF ECONOMIC INFORMATION SYSTEMS FOR COST MANAGEMENT IN SLOVAK CONSTRUCTION COMPANIES

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Keywords: exploitation of economic information systems, cost management, Slovak construction companies
Abstract: Planning and cost management is one of the criteria how to successfully manage the company. This contributes several instruments. One of them are information systems and economic information systems. Several studies indicate that their use have a lot of benefits. Article discusses the issue of exploitation level of economic information systems for cost management in Slovak construction companies. The main objective of this article is to confirm the hypothesis that answers to the following questions: Does the size of the construction enterprise impact on the exploitation level of information systems in the cost management of construction enterprises? What is overall the exploitation level of economic information systems for cost management in Slovak construction companies?

1 Introduction and theoretical backround

Civil engineering industry is characterized by fragmentation that exists both within individual phases as well as across project phases [1]. Participants from various organizations who are involved in a project phase or in different project phases are facing ineffectiveness and inefficiency in their coordination, collaboration and communication [2]. Cost management is important issue of construction company management [3]. Economic information systems has become a prerequisite to manage companies more efficiently and effectively [4].

Progress of information and communication technologies (ICT) is undeniable in every sector of industry. Economic information system is a complex economic and accounting software for businesses in any area. It allows for a simple and double-entry bookkeeping, and also includes other modules for managing economic agenda [5]. Information economic system (IES) can be defined as a set of people, processes, hardware and software ensuring the collection, transmission, storage and processing of economic data with a view to distribution and presentation of information to users operating in the management system for the needs of their decision-making. This general definition of IES is the basis for different types of IS, in particular, the enterprise information system [6]. It is a system for collecting, receiving, selected and information exchange. Economic information systems usually include some modules, as: bookkeeping, invoicing, warehouse management, cost management and so on [7].

2 Methodology

According to several studies the exploitation of economic systems leading to cut off overall company costs. As already stated in the introductory part of the article, abroad there are several studies confirming the assumption that large companies use of economic systems at a higher rate. Based on these statements, it was setting objectives of this aticle, which are described in the section "research sample." Before it is necessary to formulate the basic research problems.

2.1 Problem formulation

In recent years, our environments are driven by changes in society, fast growth by science, technology and knowledge development [8], [9]. Implementation of information systems in enterprises is relatively difficult process. Many studies, which are also mentioned in the introductory part of the article, it appears that larger businesses increasingly using information and communication (ICT) systems in general [9]. ICT is a general term for all systems. Economic systems are one of the ICT. For managing economic agenda they are being used to a greater extent. This includes activities such as:

- Bookkeeping,
- Invoicing,
- Warehousing management,

- Payroll and human resources,
- Quality Assurance and Control,
- Cot management.

2.2 Research objectives and methods

The issue and the objecitve of this article are closely related to the issue of the use of economic systems in cost management of construction companies. Theoretical analysis and detection of exploitation level of the different technologies is one of the objectives of my dissertation. Between these ICT include economic systems such as carrier and comprehensive solution of information systems for the management of construction companies and construction project management. The main objective of this article is to confirm the hypothesis that answers to the following:

- Does the size of the construction enterprise impact on the exploitation level of economic information systems in the cost management of construction enterprises?
- What is overall the exploitation level of economic information systems for cost management in Slovak construction companies?

The article also describes the use of economic systems in various economic activities. Based on the above arguments were set as follows hypotheses:

HA1: Company size has a positive impact on the exploitation level of economic systems in the cost management of Slovak construction companies.

H01: Company size has not a positive impact on the exploitation level of economic systems in the cost management of Slovak construction companies.

In other words we can say that large companies will use economic systems to a greater extent. Another hypothesis concerns the overall exploitation level of economic systems for cost management in Slovak construction enterprises.

HA2: The overall exploitation level of economic systems for cost management in Slovak construction companies is good.

H02: The overall exploitation level of economic systems for cost management in Slovak construction companies is not good.

What does it mean good. Exploitation level measured at the 5 level Likert scale. Values above 4, we consider to be very good. Values above 3, we consider to be good, All values below 3 we consider to be not good. This means that overall exploitation level of economic systems for const management in Slovak construction companies will be more than 3. Due to the nature of the problem and the main objective of the article they were selected appropriate statistical methods that can detect and analyze relationships between variables of interest – correlation and regression analysis. The objective of correlation and regression analysis is a description of the statistical properties of the relationship between two variables.

Within inductive statistics were performed statistical hypothesis tests (tests of statistical significance). Statistical hypothesis testing is a process of verifying the correctness or incorrectness hypothesis using the results obtained at random. When testing the statistical hypothesis of the research have been observed following, generally known steps (www.rimarcik.com).

1. Formulation of the null hypothesis (H0), which expresses the independence of variables, i.e. absence of a relationship between variables.

2. The formulation of the alternative hypothesis (HA), which shows statistical dependence variables, namely the existence of a statistically significant relationship between variables.

3. Determining the level of significance (α).

The significance level α is the probability of error of the first kind, which we do, if we reject the null hypothesis (H0) that actually pays. Was determined significance level $\alpha = 0.05$ (5%).

4. Calculation of test statistics and probability.

The test statistic was calculated from the sample, which has provided the veracity of the null hypothesis (H0) the probability distribution. P-value is the lowest level of significance, leading to the rejection of the null hypothesis (H0) - the lower, the more we are convinced that the null hypothesis (H0) is not true and should be rejected.

5. The decision - reject or not to reject the hypothesis.

It formulated a conclusion statistical test. If $p < \alpha$, i.e. if $p < 0,05$ null hypothesis (H0) was against the relevant alternative hypothesis (HA) rejected, which means between variables exists relationship, if $p \geq \alpha$, that is, if $p \geq 0,05$ zero hypothesis (H0) has been rejected. We did not have sufficient evidence to have argued that there is a relationship between variables. There have been used three degrees values of significance p:

*** $p < 0.001$ - very highly statistically significant relationship

** $p < 0.01$ - statistically highly significant relationship

* $p < 0.05$ - significant relationship

2.3 Research sample and data obtaining

The questionnaire survey featured data collection using the online questionnaire. Link to the online questionnaire was together with an explanatory covering letter sent to respondents in electronic form. The questionnaire titled was created as a system of targeted questions designed for contractor and sub-contractor of construction processes, planners and architects. In order to verify the questionnaire, mainly to test the formulation of clarity of individual items, it was a sample of 42 companies and projects, realized within pre-research. The pre-research is the basis for verification of selected research sample for research in the realization of a dissertation thesis.

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Based on this group of companies, it was subsequently randomized defined research sample. Choice of subjects in the research sample was not limited by other criteria such as occupation of the enterprise, region or company size etc. It can be concluded that the fundamental requirement of ensuring representativeness, the survey sample was complied with.

Main characteristics of research subjects in terms of the size of the company we can see down. Participated in the survey and a questionnaire completed by 5 micro-companies, 10 small companies, what constitutes 23.81% of the research sample, 15 medium-sized companies, what constitutes 35.71% of the research sample and 12 large enterprises, representing 28.57% of the sample (Figure 1).

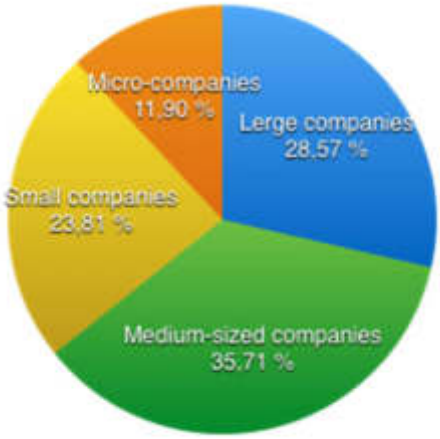

Figure 1 Characteristics of the research sample by size of construction company

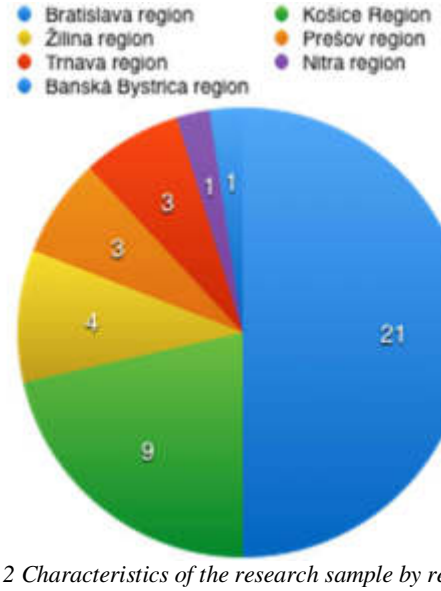

Figure 2 Characteristics of the research sample by region

3 Results

The aim of this survey was to understand and verify the effect of size on the use of economic systems. Endpoints are compared between companies. It is expected that large companies behave differently in ICT investment as small and medium sized companies (SMEs). The results of the use can be seen in figure 3.

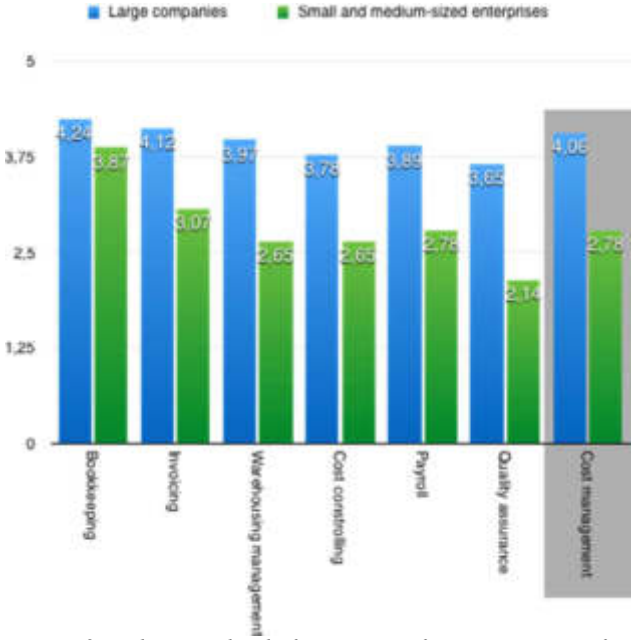

Figure 3 Exploitation level of economic information systems for cost management

As regards the use of economic information systems is the most used bookkepeeing module. This is true for both enterprise groups. The trend of using in individual modules of economic information system is very similar. The difference is mainly in the utilization rate. Large companies used each module a greater extent. The most significant difference is in the module of Quality assurance and cost management module. The exploitation level of economic information systems for cost management in large enterprises is 4.06. The exploitation level of economic information systems for cost management in small and medium-sized enterprises is only 2.78. Based on the descriptive statistics we can say that company size has an impact on exploitation of economic information systems for cost management.

Correlation analysis was carried out in the form of correlation matrix, prepared for all variables. To express the degree of correlation dependence between variables in the correlation matrix was used so-called The Pearson correlation coefficient pairwise. Using a two-sided t - test within T - distribution of the test statistic tests were performed statistical significance correlation coefficients.

The hypothesis H1 assumes that company size has a positive impact on the exploitation level of economic information systems in the cost management of Slovak construction companies.. The results of correlation analysis have confirmed the hypothesis H1. For variable was calculated correlation coefficient r = + 0.407. Using

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the statistical significance test of the correlation coefficient using two-sided t - test, we have demonstrated a highly statistically significant relationship with the corresponding value of p = 0.002, where we note that p <α, that is, p <0.05.

To verify another hypothesis is necessary to evaluate the overall scores for the use of economic information systems for cost management. To verify another hypothesis is necessary to evaluate the overall scores for the use of economic information systems for cost management. It is also very interesting to see the relative share of enterprises that exceed a value of 3, which represents good exploitation level.

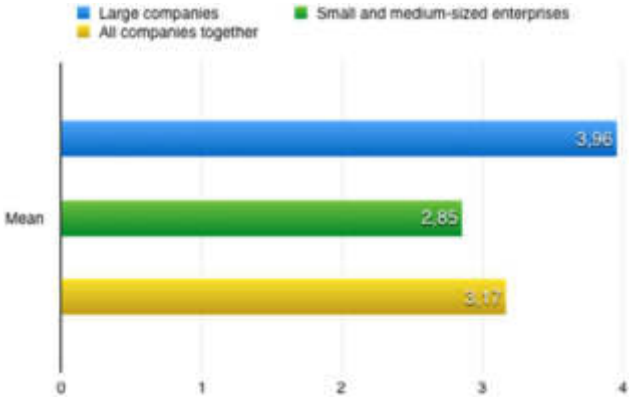

Figure 4 Exploitation level of economic information systems for cost management

Large companies have reached the exploitation level of economic information systems for cost management 3.96. Small and medium-sized achieved the exploitation level of economic information systems for cost management only 2.65. The overall exploitation level of economic systems for cost management represents a value of 3.17. This value is greater than 3. Based on this indicator, we can conclude that the exploitation level of economic information systems for cost management in the Slovak construction companies achieves good level. Relative frequency at individual enterprises is shown in Figure 5.

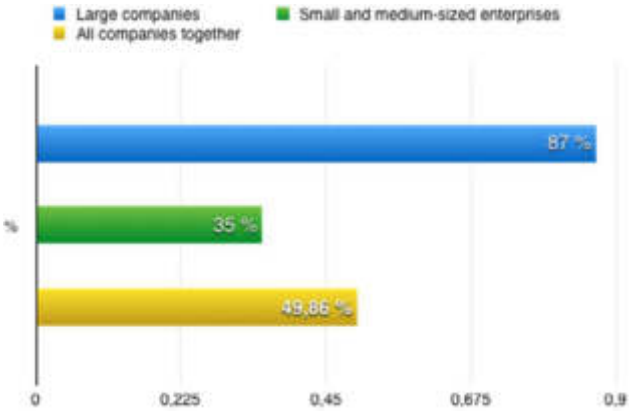

Figure 5 Relative frequency at individual companies

Hypothesis H2 assumes that The overall exploitation level of economic information systems for cost management in Slovak construction companies is good. Based on the research it can be confirmed.

Conclusions

Economic information systems can be seen as a smaller group of information systems used for management of companies in each field. Their benefits are described in various literature. These benefits are indisputable. There are several surveys and studies that address the benefits of using economic information systems. Important it is to monitor the level of use of these systems in various industrial sectors. It is equally important to monitor this parameter in different markets. Both hypotheses in Slovak construction companies were confirmed. Here and opens the way to other markets, and industrial areas. It is necessary to compare these results with other countries. There is also space to move this research, such as the V4 countries that are very similar in some parameters.

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"The paper presented a partial research result of project "Identification of key competencies of university students for the needs of knowledge society development in Slovakia", which is supported by the Ministry of Education, Science, Research and Sport of the Slovak Republic in supplying incentives for research and development from the state budget in accordance with Act no. 185/2009 Z.

References

[1] HOWARD, C. et al.: Computer integration: reducing fragmentation in AEC industry, *Journal of computing inp.* 1989, p. 18-32.

[2] NITITHAMYONG. P., SKIBNIEWSKI. M..: WEba-based construction project management systems: how to make them successful, *Automation in construction*, 2004, Vol. 3, pp. 491-506

[3] SELÍN, J.: *Možnosti optimalizácie stavebných dodávok,* In: Inovatívny prístup k modelovaniu inteligentných konštrukčných prvkov v stavebníctve: zborník vedeckých prác : 14. december 2009, Košice. - Košice : VÚSI, 2009, p. 137-144. (Original in Slovak)

[4] LEE. S., YU. J.H.: *Success model of project management information system in construction.* In: Automation in construction. 2012, pp. 82-93

[5] KRŠÁK, B., TOBISOVÁ, A., SEHNÁLKOVÁ, M.: Information technologies and their using during firm´s financial health modelling. in: *Transactions of the Universities of Košice*. 2011, Vol. 4., pp. 35-40.
[6] ONDREJKA, R., MORAVČÍKOVÁ, L.: Mathematical modelling within the road safety management, *Acta Tecnología*. 2015, Vol. 1., No. 2, pp. 5-8.
[7] ČARNICKÝ, Š.: Manažérske informačné systémy podnikov. Bratislava: Ekonóm, 2004. (Original in Slovak)
[8] KRŠÁK, B., TOBISOVÁ, A., SEHNÁLKOVÁ, M.: Education in information technology as a tool for tourism development. In: *Procedia - Social and Behavioral Sciences 116*: WCES 2013, Elsevier, 2014, pp. 1096-1100. Available at: http://ac.els-cdn.com/S1877042814003681/1-s2.0-S1877042814003681-main.pdf?_tid=4ff845f8-adb4-11e3-9f...
[9] ONDREJKA, R., KAJÁNEK, P., MORAVČÍKOVÁ, L.: Empirical approaches of road infrastructure safety management, *Acta Tecnología*, 2015, Vol. 1., No. 1, pp. 1-4.

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TECHNICAL MEASUREMENT AND ANALYSIS OF THE IMPACT OF MAGNESITE DEPOSIT OF DUST ON THE READABILITY OF RFID TRANSPONDERS

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Keywords: RFID transponder, magnesite dust, measuremnt
Abstract: The present paper deals with experimental testing of the readability of RFID transponders in the sputtered magnesite dust layer under different conditions. In the first part of the article describes the measurement and the used.equipment. The second part includes the creation of experimental model with a subsequent evaluation of measurements for the purposes of carrying out verification of the applicability of the selected RFID transponders in the circumstances. In conclusion, the publication is evaluated the progress of the experiment and the results of measurements determining the environmental conditions and meets the requirements of the application.

1 Introduction

Meaning applications of RFID technology in the monitoring of material flows is to ensure optimal flow of information about the production and traceability of individual items monitored in real time. Monitoring the material flow at the production plant in real time would create ideal conditions for enhancing the quality of production but also the safety of their operation. The application provides a solution for increasing the quality of service and production. Its essence is to monitor the motion of transport batch through the application of RFID technology. Since no one has so far to address the impacts of magnesite functionality RFID systems, yet. It was necessary to to make measurements and choose the right transponder for applications of RFID technology in terms of magnesite mine [1], [2].

2 Identification of external factors with measure of their impact on the readability of RFID transponders

In the real environment of operation magnesite mines affect the quality parameters of the RFID technology products especially magnesite external factors such as dust and weather conditions such as cold water and that alter the structure sputtered layer of magnesite. The impact of these factors was verified experimentally in laboratory conditions in expert laboratory of identification technologies at the Department of Manufacturing Management, Technical University of Kosice. Measurements were carried out, which were intended to verify the readability of RFID transponders under the influence of external factors, which were found at the premises of the mine.

2.1 Description of experiments

The experiment was set up to generate real operating conditions to ensure the testing of selected RFID transponders [3]. Realization was subject to the creation of a model simulating real conditions of operation in magnesite mines which are magnesite dust and weather conditions. The required magnesite layer on the surface of the RFID transponder in the range of 10-20 mm was formed by sputtering the magnesite powder to the surface of the RFID transponder. Furthermore, magnesite was added to the water in the described proportions and was also exposed to low temperatures due to external simulation imaginatively.

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2.1.1 Used equipment

To ensure the required outputs of each measuring of the impact of the magnesite dusty layer on the readability of the selected RFID transponders were used elements listed in Table 1.

Table 1 The inventory of the equipment used for the implementation of measurement

	Manufacturer	Model
UHF RFID reader	Impinj	Speedway Revolution
UHF RFID antenna	Alien	ALR-8696
RFID middleware	Impinj	Speedway
UHF RFID transponder	Confidex	Ironside™ Gen II
Surface termometer	TESTO	905

Configuration of the elements involved in the measurements:
RFID antenna located at a distance of 1 m from the RFID transponder.

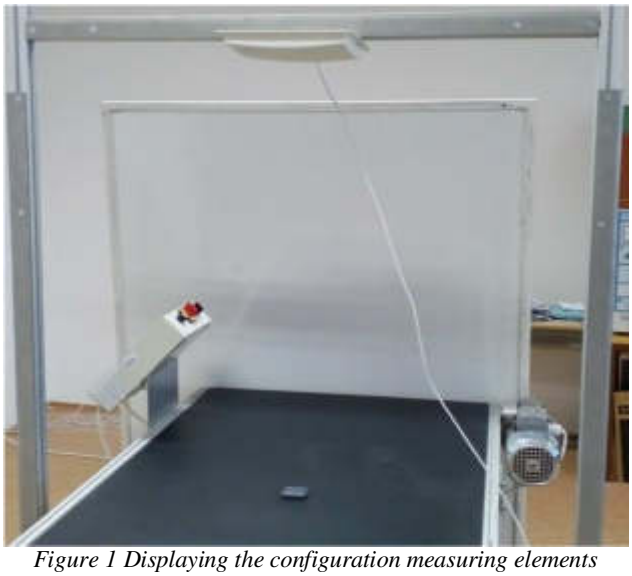

Figure 1 Displaying the configuration measuring elements

A.1 - applying a layer of the magnesite powder to the surface of the RFID transponder of thickness 10 mm.
A.2 - applying a layer of the magnesite powder to the surface of the RFID transponder of thickness 20 mm.
A.3 - applying a layer of the magnesite powder to the surface of the RFID transponder of thickness 10 mm with the addition of water in a 1: 1 (g / ml).
A.4 - applying a layer of the magnesite powder to the surface of the RFID transponder 20 mm thick with the addition of water in a 1: 1 (g / ml).

Figure 2 Displaying the the magnesite powder coating layer on the surface of the RFID transponder 20 mm thick with the addition of water in a 1: 1 (g / ml)

A.5 - applying a layer of the magnesite powder to the surface of the RFID transponder of thickness 10 mm with the addition of water in a 1: 1 (g / ml), followed by freezing at -3.5 ° C.
A.6 - applying a layer of the magnesite powder to the surface of the RFID transponder 20 mm thick with the addition of water in a 1: 1 (g / ml), followed by freezing at -3.5 ° C.

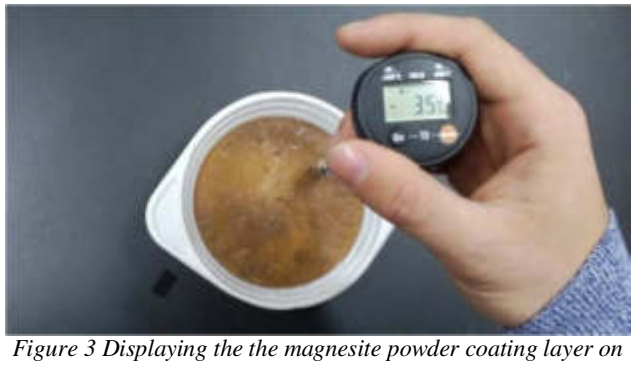

Figure 3 Displaying the the magnesite powder coating layer on the surface of the RFID transponder 20 mm thick with the addition of water in a ratio of 1: 1 (g / ml), followed by freezing at -3.5 ° C

3 Measurement results

The evaluation software was a product of Impinj and basic readability endpoint was selected parameter number of readings in a single measurement.

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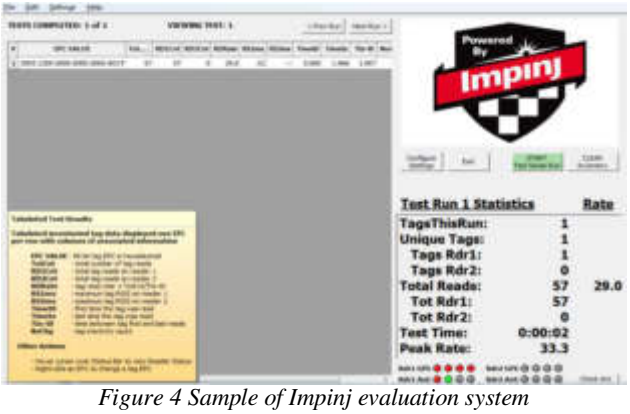

Figure 4 Sample of Impinj evaluation system

The values of the measurements of the readability of the RFID transponder are listed in Table 2. The number of measurements in a single configuration element has been established and implemented in the number of 500 measurements. To ensure the possibility of comparison of the values of the quality parameters were then calculated the arithmetic mean [4], [5].

Table 2 Table of measurement parameters and final results

Sign	Thickness of the magnesite material layer [mm]	Temperature of the magnesite material layer [°C]	Admixture	Average number of loading within a given test	The occurrence of unreadability in a single test
A.1	10	20	-	56,4	0
A.2	20	20	-	56,3	0
A.3	10	20	H_2O, 50 %	55,7	0
A.4	20	20	H_2O, 50 %	55,7	0
A.5	10	-3,5	H_2O, 50 %	54,1	0
A.6	20	-3,5	H_2O, 50 %	53,8	0

A.0 - average number of loading for testing the readability cue direct manner without adding external factors reached 57.0 loading. Said value is found to be a fundamental and is then compared with the values in the individual tested. The comparison of these values can be determined by inference from measures.

A.1 - average number of loading for testing the readability when applying magnesite layer of dust on the surface of the RFID transponder with a thickness of 10 mm reached 56.4. Decline in the value of the average number of load from baseline (set in A.0) is negligible within the testing and implementation of reading the RFID transponder is in these conditions without problems.

A.2 - average number of loading for testing the readability at application layer magnesite dust on the surface of the RFID transponder thickness 20mm reached 56.3. Decline in the value of the average number of load from baseline (set in A.0) is negligible within the testing and implementation of reading the RFID transponder is in these conditions for seamless ..

A.3 - average number of load for testing the readability of the application of a layer of magnesite powder to the surface of the RFID transponder of thickness 10 mm with the addition of water in a 1: 1 (g / ml) reached 55.7 loaded. Decline in the value of the average number of load from baseline (set in A.0) is negligible within the testing and implementation of reading the RFID transponder is in these conditions without problems.

A.4 - average number of load for testing the readability of the application of a layer of magnesite powder to the surface of the RFID transponder of thickness 10 mm with the addition of water in a 1: 1 (g / ml) reached 55.7 loaded. Decline in the value of the average number of load from baseline (set in A.0) is negligible within the testing and implementation of reading the RFID transponder is in these conditions without problems.

A.5 - average number of load for testing the readability of the application of a layer of magnesite powder to the surface of the RFID transponder of thickness 10 mm with the addition of water in a 1: 1 (g / ml), followed by freezing at -3.5 ° C reached 54.1 loading. Decline in the value of the average number of load from baseline (set in A.0) is negligible within the testing and implementation of reading the RFID transponder is in these conditions without problems.

A.6 - average number of load for testing the readability of the application of a layer of magnesite powder to the surface of the RFID transponder of thickness 10 mm with the addition of water in a 1: 1 (g / ml), followed by freezing at -3.5 ° C reached 53.8 loading. Decline in the value of the average number of load from baseline (set in A.0) is negligible within the testing and implementation of reading the RFID transponder is in these conditions without problems.

Conclusion

From previous data measuring of the impact of the magnesite dust layer on the readability of RFID transponders can be reported following that zhr magnesite found on the surface of the selected RFID transponder does not affect its readability, even under the influence of external factors such as the presence of water and in that the measurement range or freezing temperatures. It is possible to implement the right RFID technology in an environment with a high concentration of magnesite by finding does not affect the functionality of UHF RFID technology.

References

[1] BALOG, M., STRAKA, M.: *Logistické informačné systémy*, Košice, EPOS, 2005. (Original in Slovak)
[2] BROWN, D.: *RFID Implementation*, New York, McGraw-Hill Osborne Media, 2006.
[3] BANKS, J., HANNY, D., PACHANO, M. A., THOMPSON, L. G.: *RFID Applied*, London, Wiley Press, 2007.

[4] SWEENEY, P.: *RFID For Dummies*, Indianapolis, Indiana, WileyPublishing, 2005.
[5] BHUPTAMI, M., MORADPOUR, S.: *RFID FieldGuide: Deploying Radio Frequency Identification Systems*, Michigan, PrenticeHall, 2005.

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RFID AS A TOOL OF COMPETITIVENESS INCREASE OF RAIL FREIGHT

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Keywords: RFID, RFID tag, freight transport, wagon
Abstract: Nowadays huge of goods is transported by road although there is requirement to greener logistic. Unfortunately if rail freight transport wants to be competitive to road transport, many changes must be done. Slovak railways freight transport has many barriers and bottlenecks and although private carriers are not real competition right now, later situation can change. So there must be new ways how to improve goods transport while anticipating resource and environmental constraints. From that point of view, implementation of RFID technology sounds as good solution for increase of competitiveness of rail freight.

1 Introduction

Railway transport depends on the amount of rail infrastructure, and railway capacity is a function of three basic areas which influence it. Firstly, it is the management of flows and operations, secondly, how efficiently resources and assets are used, and finally overall basic track structure. Railway transport is a core topic to nation economies, as it supports employment as well as economic growth. And also because of its global character, actions must be more effective which asks for stronger international cooperation. Transport is at its crossroad in Europe nowadays. European western and eastern parts are not united and that is the reason why they do not fully reflect the transport needs. To keep transport greener means to use more of railway transport and intermodal transport for freight, which has many advantages in comparison with "traditional" transport, for example:

- relatively low costs on medium and long distances,
- safety,
- less emissions,
- low agricultural land is occupied by railway transport,
- in comparison with road carriers there is lower traffic restriction … etc.

2 Situation of the Slovak Republic

Nowadays there are many various economical opportunities for Slovakia thanks to transport corridors, for example access to new markets or increase potential of logistic functions. New TEN-T corridors help to produce very positive impacts not only on the economies of big cities but also for local urban systems. The main reason is that investments become more attractive and also the increase of local opportunities for innovative systems and new services are predictable. Plus bigger using of communication and information technologies should provide new opportunities for increasing availability in an intelligent way.

2.1 Characteristic of the Slovak railway freight transport

There are more than 30 different freight transport operators in the Slovak Republic, but Železničná spoločnosť Cargo Slovakia is still the biggest one. The main business of ZSSK Cargo Slovakia, a.s. is the provision of rail freight transport services, and the company performs transport and commercial activities on the basis of valid license to provide transport services issued by the Transport authority. The market share of the company in the rail freight transport in the Slovak Republic in 2014 amounted to about 80 percent. In addition to the ancillary services directly related to the implementation of freight and combined transport, its second main product is services related to leasing rolling stock, maintenance and repair [1]. National freight transport together with international freight transport was more than 36 million tons of goods in 2014 [2]. Thanks to its solid market position, other private carriers are not real competition right now. On the other hand, huge competition can be felt from the road freight transport which still dominates in the Slovak Republic. Although there are many disadvantages beginning with the customs control (still carried out on Slovakia-Ukraine border) thru differences in technical standards between countries to the different level of infrastructure finally, two biggest advantages – costs and speed – overtrumped disadvantages of the road transport. Another very topical problem is lack of information about containers. It is the reason why it is necessary to focus on automatization on freight railway transport.

Nowadays the registration and numbering train sets out manually. Automatization will bring many positive factors to the train controls. To the main advantages belong for example:

- increasing of service quality,
- possibility to monitor shipment by customers,
- shortening the journey time,
- lower rate of error due to human factors,
- higher efficiently transport thru monitoring,

- elimination of paper documents, etc.

But there are also other areas where automatization could be useful, for example:

- monitoring of the wagon technical conditions,
- date of last repairs or maintenance, etc.

The system which fits into the required concept of transport telematics is very successfully developed. The system is RFID - Radio-Frequency IDentification based on radio frequency technology.

3 The usage of RFID technology

Some experts believe that RFID is able to replace barcodes in future. Truth is that both technologies have advantages and disadvantages [4]. Among main RFID disadvantages in comparison with barcode belong:

- higher price especially infrastructure components as sensors, terminals and RFID antennas,
- higher demands on data throughput of IS as mass reading of tags could during a short-term overloaded the information system,
- higher price of information carriers,
- it is impossible to read information by eyes (but in this case printable smart labels can be used),
- physical properties of signal spread (for example metal or liquid) and RF devices give restriction,
- the need of a pilot solution to validate the technology parameters.

On the other hand there are more advantages, for example:

- automatic identification can be done without direct sight,
- huge data capacity,
- information is given in real time which will improve the quality of production,
- it is possible to not only read information but also write (if necessary),
- increasing the quality of inventory management by reduction of losses and inventories,
- as it is contactless technology, the identification of the object requires neither precise positioning nor visibility,
- at the same time hundreds of tags can be identified,
- during the process the information could be added ad hoc,
- reducing the operation costs by unattended operation,
- encryption possibility,
- counterfeiting is difficult.

RFID has many ways of use in freight traffic, especially by rail. For example:

- exact location of the consignment is clear,
- cargo is protected against thefts or losses,
- information is topical and in-time,
- information can be collected on consignment.

Because of that, the RFID tag must be placed at the designated place to prevent thefts, losses or consignment damages during the transport.

There are many countries where wagons tracking is carried out by barcodes. But they are not suitable in bad or dusty weather as reading can be distorted. But RFID tags are readable as well. Also reading distance is several times bigger in comparison with bar codes.

4 RFID technology in the Slovakian railway transport

Freight wagons marking composed of letters and numbers system. The system is the same for all railways, members of International Union of Railways (UIC) and Organisation for Co-operation between Railways (OSJD).

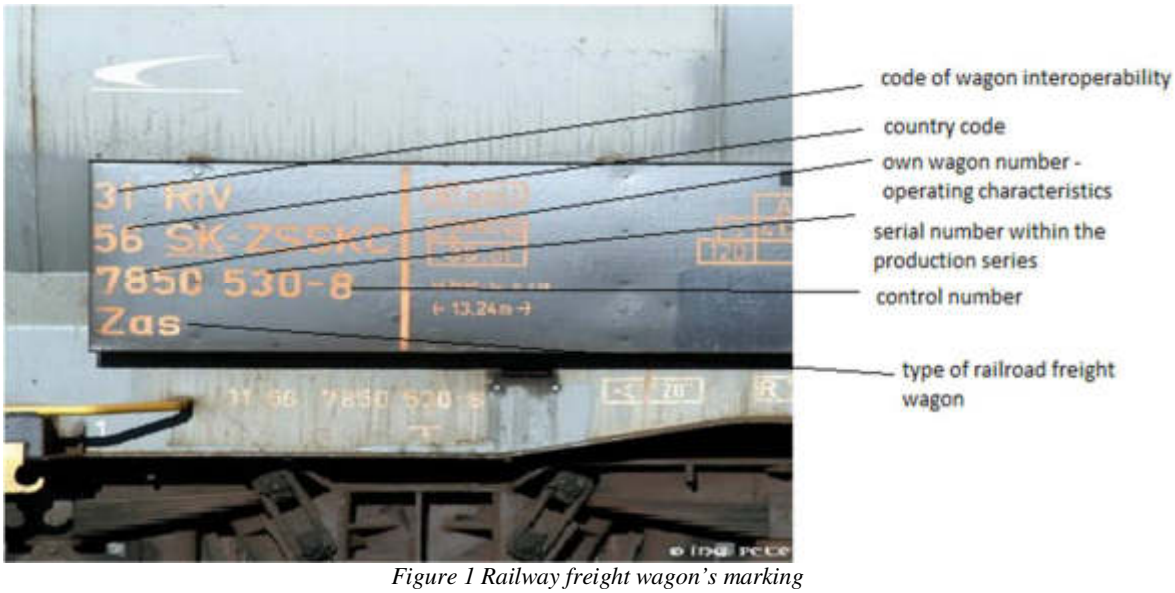

Figure 1 Railway freight wagon's marking

The identification of wagons (currently in the Slovak Republic) is carried out by hand, railway stations employees identify a train set or wagons. Employees personally come over to a wagon and write back numbers to the consignment note. After that the numbers are put into the information system in the computer unit by another employee. Such wagon identification brings risk of errors.

Applied RFID technology allows to read a wagon's number automatically after passing through the gate [5], [6]. Then transmitting signal from an active RFID tag is transmitted to the computer unit. It is managed by an employee, who detects the change of state of the wagon. Important information is that RFID tags contains huge amount of information about wagons. That means more than only 12 digit-wagon-numbers but also the date of the technical inspection, the condition of the wagon, the type of goods, goods quantity carried in wagons and lots of other information.

RFID technology implementation brings:
- correct shifting of wagons which brings correct trains forming,
- detection of wagons downtime,
- train speed monitoring,
- statistical evidence of wagons,
- monitoring of the wagons movement on the railway system.

Lacking in information system is adequate to mentioned conveniences in Slovak railway stations. It means that detection of wagons number is hand done, and then database is creating by manual register the wagon in the system. If RFID technology will be applied, such database will be accomplished automatically. Slovak Railways, which missing electronic documents and records about the date and time of arrival and departure of the train set now, will be fully informed just in time. Information from the RFID tag will be transmitted in to the information system, in which will be possible to locate a particular wagon, records of dangerous goods, identified individual consignment and other features.

5 Proposition of tracking system for loading units and train set

The identification of the exact trains and cargo units positions, further collection of information about the consignment and safety of transported cargo are the main role of the RFID technology in railway transport.

RFID identification has many advantages, especially:
- increase the safety of the cargo unit,
- reducing of operating costs for printing documents,
- easier and quicker reporting of the cargo unit,
- operation cost savings (for example mailing costs, archiving, office supplies..)
- labour saving and labour costs savings,
- maximizing effectiveness,
- saving work of employees,
- location tracking,...etc.

But also railway companies use RFID will bring many benefits such as:
- better evidence of train sets and individual wagons,
- check trains arrivals and departures to and from the stations of destination for consignments,
- monitoring of the shipments,
- in case RFID are with sensors, there is possibility to have additional information about temperature, acceleration of moisture, grade or pressure.

6 Selection of suitable RFID tags under specific conditions and its methodology

Lots of different RFID tags are on the market nowadays. User selection is because of it difficult and good methodology will facilitate RFID selection [7]. Specification of parameters in the program displays a best result or results.

Step 1 is defining supplies of different producers and choosing a right system. Depends on requirements, the system can be passive, semi-passive or active.

Step 2 is defining objects of transport that are wagons and loading units from various producers.

Step 3 is selecting of suitable tag. Important is material, where RFID tags will be placed but also distance, because by then is possible to select the frame rate. Frame rate may be low, high, ultra high, microwave frequency or the latest frequency is the ultra-wideband. Requirements for registration of the RFID tag can be divided into read-only tag, tags on one write or rewritable tags.

Step 4 is necessity to solve the problem how big internal memory is required. Standard is 96 bit memory, but the memory tag can be programmed 96 bit + 1 or even the possibility to program the tag memory with integrated sensors 96 bit + 1 + sensor (acceleration, thermal, pressure, moisture, sensitive to chemicals, ...)

Step 5 the RFID tag is well defined, but the contractor may still consider the use of active, semi-active or passive tag. During making a decision, into account is taken a need of own power supply. Last question is, if there is possibility of using own resources to communicate with the sensor.

Step 6 is selection of suitable RFID tag is finished.

7 The concept of placing and data reading by RFID technology

Figure 2 shows possible placement of RFID tag should meet the required functions plus reached maximum uptime. Simultaneously must not be threatened by environmental influences. It is important that the tag is placed on the wagon in a manner best suited to the location of the reading device on a railway line. Even when train speed is high, location of tag must meet criteria, especially that reader was able to thoroughly and

quickly read information from the RFID tag. Design of reading device and its construction must be resist to the climate changes and external environment as changes of temperature, wind, solar radiation, humidity would damage a device designed to read the RFID tags contents which are placed on wagons. Construction equipment, as well, must be adapted to mention various conditions. The construction must be fixed to the ground on a concrete foundation, which, in case of bad weather, to avoid damage or destruction.

Figure 2 Possible placement of RFID tag in real conditions [3]

Conclusions

Nowadays shows, that way, how to improve railways services in Slovakia is to implement RFID technology. It brings benefits to all involved partners – for railway companies, carriers and customers as well. The main benefits are:

- possibilities to optimize logistics ways and processes,
- quick information among all partners which are involved and government offices,
- reduction of costs,
- higher efficiency of supply chain...

RFID is modern technology which significantly can change the capabilities of involved company to acquire data about the properties and location of any entity that can be physically tagged and wirelessly scanned within certain technical limitations.

References

[1] http://www.zscargo.sk/en/ (available: 12, March, 2016)
[2] http://www.zscargo.sk/files/dokumenty/2015/vyrocna_sprava_sk.pdf (available: 9, March, 2016)
[3] BALOG, M., HUSÁR, J., KNAPČÍKOVÁ, L., ŠOLTYSOVÁ, Z.: Automation monitoring of railway transit by using RFID technology, *Acta Tecnología*, International Scientific Journal about Technologies. Volume: I., No. 1, 2015, pp. 9-12.
[4] http://www.copperspiralrfid.com/ (available: 10, March, 2016)
[5] BALOG, M., STRAKA, M.: *Logistické informačné systémy*. Bratislava: EPOS, 2005, p. 208. (Original in Slovak)
[6] IZOLOVÁ, J., CHABADOVÁ, L., JAMNICKÝ, D.: *The use of RFID technology with a focus on ZSR*, Proceedings of the 2nd PhD. research work - Kosice: TU, F BERG, 2011 p. 31-35.
[7] KERN, CH.: *Radio-frequency-identification for security and media circulation in libraries*. Zug, Switzerland; 2004.

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