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Acta Logistica Moravica is a periodical Internet magazine of the College of Logistics in Přerov. The magazine is platform for publishing original scientific and professional papers in the field of logistics and supply systems with a focus on applications in the areas of logistics in transport, logistics in service, logistics in tourism, logistics in air transport and informatics for logistics. Acta Logistica Moravica also monitors important events in the world of logistics. It brings information and news from logistics institutions and businesses, reports on the results of tasks, book reviews, reports on conferences, anniversaries, etc. In the magazine, it is possible to publish advertisements concerning the content of VŠLG activities. ALM closely cooperates with Logistics Monitor.

The ALM magazine is published twice a year. The deadlines for numbers are on 15. 2. and 15. 9. Contributions are accepted in Czech, Slovak and English. All submissions are subject to peer review.

This scientific issue is dedicated to International Students Scientific Conference mSVOK. Its 3rd year was held at College of Logistics. All scientific papers were peer reviewed (by local and abroad reviewers). Our industry and other partners who supported mSVOK 2019 are mentioned too.

Supervisor for Acta Logistica Moravica

assoc. prof. Oldřich Kodym
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The mSVOK conference was established in 2017. The first year was organized on May 2nd and 3rd, 2017 by the Department of Logistics and Transport of the Faculty of Mining, Ecology, Management, and Geotechnology at the Technical University of Košice in Slovakia; The second year was held on May 9th and 10th, 2018 at Faculty of Economics and Management at the University of Zielona Gora in Poland and the third year was held on April 16th and 17th, 2019 by the College of Logistics in Přerov, Czech Republic as a joint international professional conference for students of logistics fields.

**PROGRAM OF CONFERENCES**

This year, the 3rd International Student Scientific Conference (mSVOK) for Master and Bachelor students and the 4th annual Conference on Advanced Methods in Logistics (PMvL) for doctoral students and the professional public were held jointly.

The competition was held in the congress lounge of the FIT hotel. Emphasis was put on the international conference mSVOK, selected PMvL paper of

- **Kubáč**: Logistics 4.0 - Opportunities vs. Implementation

was presented as introductory, opening, non-competitive contribution. A total of 14 contributions by Bc. and Mgr. students were presented. Total of 5 universities took place in conference:

- College of Logistics, Přerov
- Poznan University of Technology, Faculty of Engineering Management
- Slovak University of Technology in Bratislava, Faculty of Materials Science and Technology in Trnava
- Technical University of Košice, Faculty of Mining, Ecology, Process Control and Geotechnologies
- University of Zielona Gora, Faculty of Economics and Management

(Listings in this report are in alphabetical order.)

The papers were divided into 2 sections focused on logistic processes and managerial issues:

- **Vogelova**: Data Acquisition in Logistic Chains
- **Siget**: Designing an Autonomous System for the Purpose of Receipt and Dispatch of Materials Based on Mobile Application
- **Vietoris**: Improve of the production line by using logistics methods and computer simulation
- **Chudobova**: Monitoring of Transport Means Activities
- **Pavlik**: Proposal of measures for implementing the 7S method in chemical storage cabinets in IKEA Industry

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1 Head of conference, Vice-rector for strategy and development
- Vasil: Use of additional programming method in computer simulation to support logistic processes
- Podracka: Using computer simulation for production planning

- Kubisova & Sabolova: Analysis of Factors Influencing the Perceived Organizational Performance with Regard to Various Generations of Employees
- Gon: Analysis of Effectiveness of Storage Process on the Example of Production Enterprise
- Syczupakowski: M-commerce as a Response to Consumer Needs
- Reif: Perspective of Shared Individual Passenger Transport
- Burdejova: Proposal to Improve the Process of Quality Measuring and the Productivity of Employees Through the CIM System in Industrial Enterprise
- Cizkowsky: The Toll System Project of the Czech Republic
- Pekalska: Transport management in the transport company X

The language of the conference is English with the possibility of presenting the contributions in mother tongue of presenting student. All speakers received a certificate of participation in the conference. The conference was presented at the Přerov Television. The presentation is available at YouTube: https://www.youtube.com/watch?time_continue=466&v=3wW_Zp85pX4.

CONFERENCE COMMITTEE MEETING
The competition part of mSVOK conference was followed by a joint informal social meeting of both participants and their supervisors. One of the topics was the organization of the next, 4th year of the mSVOK competition conference. According to information from colleagues from TUKE, the organizer will be the University of Belgrade, Faculty of Transport and Transport Engineering. More information will be available in the coming weeks. The Slovak University of Technology in Bratislava, Faculty of Materials Science and Technology in Tmava, has been offered as the "alternative organizer". Another topic was the possibility of cooperation in other areas (projects etc.). It was agreed that the presented papers will be processed in the form of a scientific articles, which will be published in the Acta Logistica Moravica magazine after a standard review procedure. Two numbers are expected (2/2019 and 1/2020). For this purpose, the instructions for the ALM authors were translated into English. As an alternative to the full English text, the English annotation and the article in the author's language are widespread. Colleagues offered their participation as reviewers. If necessary, the above-mentioned 2 issues will be physically published as a Proceedings of the Conference with ISBN in the circulation of several printed pieces (according to feasibility).

SPONSORS
The evaluation of the conference and awarding ceremony was preceded by introduction, respectively presentation of conference sponsors who supported its organization and negotiations:
- Karat Software, Přerov
- Meopta – optika, Přerov
- Oltis Group, Olomouc
- Toyota Material Handling, Rudná
- TQM, Opava
- Statutar city of Přerov
- Olomouc Region

Each sponsor received a certificate of support for the student conference.

EVALUATION AND AWARDS
The results of the competition were evaluated by representatives of the participating universities: Vaclav Cempirek, Zdenek Cujan, Helena Fidlerova, Katarzyna Huk, Oldrich Kodym, Mateusz Kurowski, Martin Straka, Jaromira Vanova. A total of 5 awards were awarded: the 1st, 2nd and 3rd place, the Rector's
Award and the Sponsors' Award. Each evaluator identified the first 5 places, the other works were evaluated on a common 6th place. The final ranking was determined as the average of the ratings:

- **1st place**: Michal Siget, TUKE
- **2nd place**: Bibiana Burdejová, STU
- **3rd place**: Miroslav Vietoris, TUKE
- **Rector's Award**: Anna Goń, UZG
- **Sponsors' Award**: Jaroslav Reif, VŠLG

The student conference mSVOK was evaluated and awards were presented at the College of Logistics. The prizes (a certificate for the university of the awarded author and the cup for the 1st - 3rd place) were also material prizes for the authors of the awarded papers.

After evaluating mSVOK, the participants took guided tour at the teaching facilities of the College of Logistics and were presented and commented on the professional classrooms of Automatic Identification, Transport Systems, Modeling and Simulation and Packaging Techniques.

College of Logistics is proud to be organizer of the 3rd mSVOK conference. We thank all participants, paper authors, their supervisors, participating universities and last but not least all sponsors to participate at this scientific event. We’re looking to the next year of mSVOK.

**PHOTOGALLERY**

![Rector of College of Logistics opens students’ conference](image)
Opening lecture

Authors of competition papers
Participants got certificate

Awards waiting for authors of best presentations
Student of Information management Jaroslav Reif from College of Logistics got Sponsors' award

Authors of awarded papers
Conference was supported by partners of College of Logistics
Abstract

The paper deals with the quality and productivity of employees' work, the measurement of these processes through the CIM system in a selected company, whose business is the production of a wide portfolio of power systems, solar and renewable energy systems, industrial automation systems, electronic components for the IT sector, telecommunications, automotive and medicine. The aim of the CIM analysis was to determine the current state of measurement of the quality and productivity processes of the company's employees and the usability of the CIM system. Based on the findings, the company has been designed with improvements that can effectively measure the quality and productivity of its manufacturing staff through CIM, strengthen its reputation in the market, and optimize production goals.

Abstrakt

Príspevok sa zaoberá kvalitou a produktivitou práce zamestnancov, meraním týchto procesov prostredníctvom systému CIM vo vybranej spoločnosti s ručeným obmedzeným, ktoréj predmetom podnikateľskej činnosti je výroba širokého portfólia napájacích systémov, systémov solárnej a obnoviteľnej energie, systémov priemyselnej automatizácie, elektronických komponentov pre sektory informatiky, telekomunikácie, automobilovej dopravy i medicíny. Cieľom analýzy systému CIM bolo zistiť súčasný stav merania procesov kvality a produktivity práce zamestnancov skúmanej spoločnosti a využiteľnosť systému CIM. Na základe zistených skutočností bola spoločnosť navrhnuté zdokonalenia, vďaka ktorým dokáže efektívne merat kvalitu a produktivitu práce svojich výrobných zamestnancov
prostrednictvom systému CIM, posilní svoje dobré meno na trhu a optimálne dosahovanie výrobných cieľov.

Key words

Computer Integrated Manufacturing (CIM), quality measurement process, labor productivity, industrial enterprise, black box

Klíčová slova

Computer Integrated Manufacturing (CIM), proces merania kvality, produktivita práce, priemyselný podnik, čierna skrinka

INTRODUCTION

"Quality means doing it well when no one looks." Quote of Henry Ford. This "Ford" statement resonates in societies to this day. Each of the companies in the market wants to have reliable employees who do their job responsibly, are productive and achieve quality standards. In this way, companies are able to maintain market leadership, attract potential employees and customers. [1], [2]

The issue of employee productivity and the quality of their work concerns all companies active in the market, offering their products and having human capital. It is essential that the company is able to measure, evaluate quality and productivity of work, and to reach relevant conclusions on the basis of evaluations. [3]

The main goals of each manufacturing company include employees who do a quality job, are productive enough to meet the company's goals and help to transform vision into reality. Human capital is an integral part of society, participates in its running and prosperity. [4]

For manufacturing companies, setting productivity and quality of work is an important indicator. It is therefore essential that we can measure these two basic indicators. Thus, we could provide relevant values, measurement results not only to superiors, but also to employees. Correctly set parameters of measurement and data collection would allow us to objectify the view of the quality and productivity of individuals in the production process. [5], [6]

1 CURRENT STATE OF PROCESSES FOR MEASURING THE QUALITY AND PRODUCTIVITY OF WORKERS WORKING WITH THE CIM SYSTEM

The selected company is engaged in the production of a wide portfolio of power systems, solar and renewable energy systems, industrial automation systems, electronic components for the IT, telecommunications, automotive and medical sectors. The company's production concept is based on the implementation of innovative and modern customer-specific solutions. The company ranks among the thriving companies on the market and currently employs a total of 579 employees. All 579 employees are tribal, with a total of 331 male employees, and 248 female employees. We used a qualitative method, an interview, to determine the actual state of affairs in society. We asked six equal questions to Directors I and II. divisions (focus on manufacturing processes and production processes).
The aim of the interview was to find out how supervisors are currently measuring and evaluating the quality and productivity of their employees' work, whether measuring, evaluating quality and productivity of work is subjective or objective. We were also interested in whether the superiors use the currently collected data on the quality and productivity of employees from the CIM system and whether they have some subjective, objective measure of employee quality and productivity.

1. The interview was made up of six questions:
2. How many employees are in production in your division?
3. Please describe, specify your division (what is produced in the division, how it works).
4. How are you currently measuring and evaluating the quality and productivity of employee work at Telecom Power Systems (TPS)?
5. Do you use up-to-date data on employee quality and productivity from Computer Integrated Manufacturing (CIM), if so, to what extent do you process and evaluate them?
6. How do you get the CIM data you need (what are the search parameters)?
7. Do you have some subjective/objective measure of quality and productivity of employees?

Based on the interview and responses from the Director of Division I, TPS, we can say that the system for measuring the quality and productivity of TPS employees is currently not relevant. The evaluation of two of our indicators, the quality and productivity of employees is subjective. Rather, the CIM system is generally used, although it could be a full help in collecting important data for us. Measuring the quality and productivity of employees' work is perceived across the board, per line or production, and is not directed at individuals, which means that it can measure indicators in the current state of the company, but not enough to specify the results for individuals.

Thanks to Director II's replies. Division, Custom Design Business Unit (CD BU), we conclude that processes aimed at measuring the quality and productivity of employees working in the production of BU BUs are not currently set objectively and correctly. The data collection system, CIM, is generally used, although it has the potential and the assumptions. With the current setup, they can measure how much they produce for a given change, but not in what quality. The process of measuring labor productivity of employees is also not effectively set because they cannot specify when a given employee is productive and when not. Although the company collects the data, it is not complex and also not sufficiently evaluated.

The company currently employs 320 people in production. Based on interviews with both Division Directors, we conclude that the CIM system has the necessary potential. It can collect, store, and then work with data.

2 THE CIM SYSTEM USED BY THE COMPANY

The CIM system has been used by the company since 2008. The initial and basic system platform was designed as a shop floor system, a system designed to check whether a product passes through a given production process correctly, based on barcodes. For example, the modification has programmed the auto-stop function for products where a recurring error has occurred. As a result, the line will automatically stop, a notification will be sent to the responsible employee who can more effectively identify the fault and diagnose its cause. The company thus upgraded the CIM system to a precise, SMART system that meets the requirements necessary for the smooth and efficient operation of the company.
CIM has made significant progress, simplification of work, more effective control and communication for the company. Thanks to the CIM system, there has been a significant increase in the efficiency of human resources management, as data has been able to collect one complete system. It was no longer necessary for several production departments to be assigned to each production line and each activity carried out by operators was directly controlled. The system allows the company to effectively control the process flow of individual products.

All employees working in production and administration have access to the system. The CIM system is easily accessible to employees on the company's main intranet site. After logging into the CIM system, the initialization of the subscriber is loaded, and what is their company's position in the company. The CIM system includes (see Fig. 1):

- under the reports report (e-Reports) and utilities, you can find various reports from production outputs and configuration tools that work primarily with the engineering department
- documents (eDoc) are mainly operated by company operators, this tab contains documentation for performed testing tests, manuals and operating instructions,
- warehouse tab serves as a tool for preparing, picking up the necessary components for production,
- planning is a new feature in CIM to replace scheduling in Excel tables and to simplify and streamline planning work
- MIR transport - serves as a control and communication platform for MIR robots used by the company.

![Fig. 1 CIM system in the company](Source: Burdejová, 2019)

One of the CIM control platforms is the control of mobile industrial robots, shown in Fig. 2. The MIR robot serves as a helper in transport operations.
The company's production employees use the CIM system on a daily basis, while still doing their job. Employees consider this system to be clear, able to find everything they need for their work, make it easier for them to work, and easily navigate it while using it.

In Fig. 3, a worker's production site can be seen, subject to strict company criteria. All employees have a touch-screen monitor available in the workplace to communicate with the CIM and everything they need to do their job. They also have a barcode scanner without which they could not work in the CIM system.

Upon arrival, a workplace employee logs into the CIM system by scanning his access chip card. The supervisor then assigns him the work to be done. Every single product has its unique number, which makes it able to communicate with the CIM. This unique barcode employee
scans the barcode scanner. In the CIM system, it displays a technological drawing of the assembly, a rough work schedule for some products, a manufacturing process, which parts it needs, and if there is any error in the past, it also includes photo documentation to help employees avoid what. The employee is constantly communicating with the CIM system. Fig. 4 illustrates how an employee scans a unique barcode into a CIM system.

![Scan barcode into CIM](source: Burdejová, 2019)

At present, the system is more product-oriented than operator, so it collects data that the company cannot fully evaluate or contains incomplete, uncomplicated data collection. An employee working in production is evaluated indirectly for a line or for a change because they cannot specify the individual's quality and productivity. Also, monthly bonuses cannot be concretized by a company to a particular employee, operator. Assessing people from the point of view of quality and productivity measurement processes is very subjective. As clearly pointed out by both division directors, they use the system more generally and do not use CIM sufficiently in processes to measure the quality and productivity of their employees and do not have an objective benchmark to clearly specify, measure and evaluate these processes.

3 PROPOSAL FOR IMPROVING PROCESSES FOR MEASURING THE QUALITY AND PRODUCTIVITY OF WORKERS WORKING WITH THE CIM SYSTEM

The in-depth analysis of the CIM system, the company's manufacturing industry and the need for the company to move forward in terms of quality and productivity of its employees, clearly indicates the shortcomings in the current process of measuring these processes. Therefore, the company has been proposed to implement clear logic for data collection and evaluation via BLACK BOX.

BLACK BOX is considered a material system, a process with a clear internal organization, a structure that, however, has no visible information to the observer, but has the ability to influence that system. Influence occurs through inputs and outputs, because only those who know us and its inner logic do not see the structure. If well-defined inputs, clear logic and algorithm of this black box are defined, we will get the desired and necessary outputs.
In order to clearly identify the logic of our BLACK BOX we needed:

1. Find out what and to what depth we want to measure. Two processes, the quality and productivity of employees' work, were clearly set out, especially in terms of outputs.
2. Diagnose and simulate what the BLACK BOX output should consist of.
3. Determine the basic variables, inputs on the basis of which the internal logic of the proposed BLACK BOX can act as a real part of a functioning CIM system that collects data in real time.
4. Maintain the principle of well-thought-out and especially real functioning internal logic of the whole BLACK BOX.

Fig. 5 shows BLACK BOX, with internal structure and defined inputs and outputs, designed as part of the CIM system, a system that is actually used in society. The scheme of this BLACK BOX consisted of the above four steps. Also, as with the general schematic representation, the BLACK BOX proposed by us also includes inputs, outputs and a core, that is, logic.

As a first step, we have identified processes for measuring the quality and productivity of company employees. The BLACK BOX output has been defined so that we can make the processes of measuring the quality and productivity of employee work objectively, specifying the work done, quality and productivity per individual and thus overall evaluating the employee. The output simulation and diagnostics is primarily subject to inputs, factors that affect and detect the entire BLACK BOX logic.

![Diagram of BLACK BOX](image)

**Fig. 5** BLACK BOX

Source: Burdejová, 2019.
The next step was to determine the input variables. We divided the entering parameters according to our processes into two categories:

1. Productivity parameters - here we have taken into account all that the labor productivity of employees must include in terms of DELTA production. Productivity parameters are:
   - the number of products produced - that is, all products produced by an employee from specific product types, the products contain their unique codes, which makes it possible for the CIM to recognize the product at any time
   - average time per piece - average time value of manufactured products of a given type,
   - the number of OK products - that is, products that have been manufactured correctly, flawlessly, without the need for further repairs.
2. Qualitative parameters - all those quality parameters that are unconditionally related to the work done by the employee are:
   - the number of products produced - again, as with productivity parameters, we need to know the total number of products manufactured of that type,
   - the number of repair products - products that have to be tested for repair, due to an error in the manufacturing process,
   - OK repair products - all those products that have undergone repair and are able to reconnect, meet maximum functionality and can be fully packaged and shipped to the customer,
   - products from NOK repair - products that cannot be serviced, repaired and returned to the process as repair, are considered waste.

As can be seen in Fig. 5, the BLACK BOX core consists of multiple components. Each of these parts will contain its unique, real-time, CIM-gathering data when scanning the unique code of each product type. The BLACK BOX internal logic consists of:

- Productivity parameters - a summary of all input information that we defined as necessary for data collection and storage for employee productivity, three information inputs to the BLACK BOX kernel for productivity data
- Qualitative parameters - consisting of four input data needed for effective evaluation of employees' quality
- Individual evaluation - draws information from productivity and quality parameters, its logic consists of pulling already collected data on employee quality and productivity and serving as one of the factors of overall employee evaluation
- Calculation of statistical dependence - draws on data again, data collected through inputs moving into parameters of productivity and qualitative parameters, is the evaluation of statistical dependence in determining the relevance of the information obtained, serves as a complement to the assessment of the individual into the summation member, the ring that connects data to relevant and necessary outputs.

The entire internal logic of BLACK BOX consists of clearly defined partial parts that form an output in the summation member. The output creates the desired objective evaluation of the necessary processes on behalf an individual. We used this BLACK BOX made by ourselves to create and design BLACK BOX logic into the CIM system.
We have applied the BLACK BOX principle into Tab. 1 when using a portion of the data that are already being collected by the CIM system, and the part is designed to reach relevant and usable data in daily life of business, output.

Data collected by CIM system:

- **Employee ID** - identification of individuals working in the production at company, we use the label only in general as ZAM1, ZAM2,
- **Product ID** - product identification is based on a unique code that holds information and is associated with specific product groups,
- **TOTAL** - represents the value of the sum of all manufactured products of a given type by particular employee,
- **SEL. TOTAL** - the value of all selected products of a given type produced by particular employee,
- **PEAR_IN** - products that are faulty and need to be sent for repair,
- **PEAR_OUT** - products that return to the process after repair, meet the criteria and can be sent to the customer.

Based on the data that the CIM system is currently able to collect, it was necessary to design other areas of data acquisition needed to achieve BLACK BOX output. They are:

- **NOK** - products that cannot be repaired are faulty and cannot be reconnected, we consider them a scrap, calculation → difference between pear_in and pear_out,
- **ASSY** - assembly, represents the difference between all manufactured pieces of a given product type produced by particular employee (TOTAL) and NOK products, ie defective pieces, scrap, the value of this column is considered to be real made pieces that are fine and can move to the next Palletization Operation (PLT)
- **TACT (s)** - the tact is given in seconds and represents the timing of production per one piece of product of given type, i.e. time that given operation/manufacture should take,
- **average time per piece** - average time calculated as the sum of all times in proportion to all pieces of a product of given type by particular employee,
- **qualitative parameter** - takes into account all inputs presented in the BLACK BOX scheme, the calculation takes into account the ASSY value, which is in proportion to the TOTAL value, i.e. correctly made products in proportion to all products of given type produced by particular employee,
- **Productivity parameter** - parameter taking into account the inputs implemented into BLACK BOX, the result of this parameter is achieved as the difference of average time per one piece of product and TAKT, in proportion to the value of TAKT, i.e. the difference of average time the employee performs his work and what is the tact for the production of a given type of product and consequently we put this value in ratio with the tact in seconds, when we subtract the result from the value 1 and the formula is calculated in absolute value, example → 1 - | (89 - 65) / 65 |,
- **Overall evaluation of the ZAM** - the last step in achieving the relevant output, the overall assessment of the employee is to take into account their quality of work and productivity of the given product type, the resulting value is based on the sum of these two parameters and the subsequent ratio to two. We will achieve the resulting value of employee quality and productivity on a particular product type, where 1 is 100 percent.
### Tab. 1 Calculation of productivity and quality for first product type

<table>
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<tr>
<th>Employee ID</th>
<th>Product ID</th>
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<th>TOTAL</th>
<th>PEAR IN</th>
<th>PEAR OUT</th>
<th>NOK ASSY</th>
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</tbody>
</table>

Source: own processing.

In the following Fig. 6 there is clearly shown how individual employees were doing their job well and being productive in the process of producing a given type of product. The graph takes into account not only the qualitative parameter and the productivity parameter, but also the overall assessment of the employee.

![Fig. 6 Graphical evaluation of employee quality and productivity for the first product type](image)

Source: own processing.
We repeated the same procedure for another type of product. Analysis of the second type of product was necessary to evaluate the resulting comparison of measured quality and productivity processes of employees.

In the following Tab. 2 we show the calculation of the quality and productivity of employees for the second type of product using the same BLACK BOX logic.

<table>
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<tr>
<th>Employee ID</th>
<th>Product ID</th>
<th>TOTAL</th>
<th>Sel. TOTAL</th>
<th>PEAR_IN</th>
<th>PEAR_OUT</th>
<th>NOK</th>
<th>ASSY</th>
<th>PLT</th>
<th>TAC</th>
<th>T (s)</th>
<th>Average Time per Piece</th>
<th>Qualitative Parameter</th>
<th>Productivity Parameter</th>
<th>Overall Evaluation of the Employee (ZAM)</th>
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</thead>
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</table>

Source: own processing.

There is shown a clear representation of quality and productivity of employees in production of the second type of product in Fig. 7.
Fig. 7 Graphical evaluation of employee quality and productivity for the second type of product

Source: own processing.

The overall assessment of the measurement of processes of quality and productivity at work represents simulation of production of two types of products produced by a specific number of employees during a calendar month. Tab. 3 shows the resulting values for specific employees working on the first and second type of product. As can be seen in the table, we take into account final values, i.e. the overall assessment of employee, for the first and for the second type of manufactured products, when these values are added together. We observe two processes, quality and productivity, so we put the resulting sum of the first and second type of product into two. We will thus achieve the total value of measured processes of quality and productivity of employee's work for his monthly work. The resulting value for the first employee is 0.82, i.e. 82 percent of the quality and productivity of his work during the calendar month. On the basis of this value, they can clearly identify how a particular individual is doing in the processes being measured during the reporting period and on the types of products involved.
### Tab. 3 Calculation of quality and productivity for first and second product type, result value

<table>
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<th>Second Product Type</th>
<th>Result Value</th>
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</table>

Source: own processing.

Fig. 8 shows the graph of overall employee quality and productivity evaluation of both product types. In this chart, it can be clearly seen how respective employees performed, production of which product are they respectively better performing: better and more productive, or where they have reserves. The chart allows you to accurately identify the potential and reserves of employees.

![Overall graphic evaluation](image)

**Fig. 8** Overall graphic evaluation of the quality and productivity of employees for both product types

Source: own processing.
4 CALCULATION OF STATISTICAL DEPENDENCE

Another part of the BLACK BOX internal logic is the calculation of statistical dependence. The aim of implementing this component into BLACK BOX was to point out the interdependence between individual processes we investigate.

We used Correlation Analysis because it is a method of calculating statistical dependence for our processes. It examines the tightness of statistical dependence between individual quantitative variables. Given that we have included the calculation of statistical dependence in the BLACK BOX internal logic, the values of the overall employee evaluation as well as the resulting value of the measured and monitored processes were given in decimal numbers and not in percentages.

Tab. 4 shows employees producing second type of product which produced NOK products, that is, products that can no longer be repaired and recycled. The input parameters used were NOK product values and the average time to produce one piece of product to a particular employee. After applying the correlation analysis calculation, we reached the resulting value of the dependence of these two variables.

<table>
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<th>x*y</th>
<th>x^2</th>
<th>y^2</th>
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</table>

Source: own processing.

Result of Correlation Analysis $\rightarrow |r| = 0.527355$

The result showed a correlation of 0.527, which is a great dependence, tightness. Based on the result of the Correlation Analysis, we conclude that there is a high statistical dependency amongst the employees who produce NOK products and their average time per piece of product. Thus, we can say that there is a clear correlation between the processes of quality and productivity of employees and between the parameters of NOK products and the average time per piece of product.

CONCLUSION

The present time offers us a wide range of products, products, or services, so quality is often the decisive criterion for us. Companies want to be successful, thriving in the market. Processes of quality and productivity of their employees are a necessary factor of success. They are fully aware that they can stand up to competition with hard work, enthusiasm and proper process setting.
Processes for measuring of employees’ quality and productivity have an important value not only for society but also for their human capital. It is therefore necessary to be able to measure these processes, to correctly analyze the collected data and then to evaluate and implement them in common practice.

BLACK BOX takes into account all company needs. It allows to deliver relevant outputs that will be available to both employees and management. The priority for society is to make the most of modern technology and integrate it into the CIM environment so that:

- reserves in terms of quality and labor productivity could be clearly identified, these reserves would be opportunities for improvement and refinement,
- creating a training program where, after clearly identifying process deficiencies, employees are included in a particular area of the training program and trained in what is unclear, or where qualitative and productive deficits have been identified,
- clear assessment of the employee's ability to do the production processes, objectification of employee measurement and evaluation,
- encouraging motivation and desire to achieve goals,
- clear output model shown in the table, a chart that would be clearly legible for stakeholders, supervisor, employee,
- output would serve as an effective basis for personnel and financial department,
- more efficient redistribution and assessment of the quality and productivity of the work done specifically for individuals,
- collecting data in real time and in the real production process.

For the company, the BLACK BOX design represents optimum solution for measuring of processes observed by us. The proposal is not a financial burden for the company DELTA, and its profitability is a future opportunity to move its employees' quality and productivity to a competitive place.

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REFERENCES


SELECTED ASPECTS OF STORAGE IN A PRODUCTION ENTERPRISES ON THE EXAMPLE OF COMPANY X

VYBRANNÉ ASPEKTY SKLADOVÁNÍ VE VÝROBNÍCH PODNIČICH NA PŘÍKLADU SPOLEČNOSTI X

Eng. Anna Goń
University of Zielona Góra
e-mail: aniagon130696@gmail.com

Mgr. Katarzyna Huk, PhD.
University of Zielona Góra
e-mail: k.huk@wez.uz.zgora.pl

Mgr. Mateusz Kurowski
University of Zielona Góra
e-mail: m.kurowski@wez.uz.zgora.pl

Abstract
The development of enterprises is associated with changes that should be introduced in management. It will apply to all functional areas of a given unit. These changes will result in the necessity to implement new solutions. One of the most frequently changing areas in the company is logistics and with it all logistics processes that take place within it. The article presents selected aspects of storage in a production enterprise. Its purpose is to present the specifics and index analysis of storage processes in the context of logistics management.

Key words
logistics, storage, analysis of indicator

Klíčová slova
logistika, skladování, analýza indikátorů

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6 Student, member of the Scientific Society of Logistics LogUZ, University of Zielona Góra, Faculty of Economics and Management.
7 Adiunkt, University of Zielona Góra, Faculty of Economics and Management, Department of Logistics.
8 Assistant, University of Zielona Góra, Faculty of Economics and Management, Department of Logistics.
INTRODUCTION

Along with the development of technology and the increase in the earnings of the society, and thus the improvement of the quality of human life and the development of globalization, the requirements and needs of consumers have become more and more important day by day. Demand for products continued to grow, which was connected with the need to store even more products. At the same time, warehouses began to be an important element of the functioning of every enterprise, as well as private individuals, and began to be an important link in the development of the global economy. The changes that have taken place in the economy in recent years have caused that logistics is developing very quickly. It is not only the development of transport, distribution centers, but also the development of manufacturing enterprises that requires changes in the field of logistics management. In a narrower sense, these changes will affect all functional areas in the organization. They will also affect individual logistic processes taking place in a given unit. The article presents a case study of the storage process in a selected production company. In addition to characterizing the storage process, the article presents changes that should be implemented as a result of increased production. The aim of the study is to present the specifics and index analysis of storage processes in the context of logistics management.

1 THE ESSENCE OF STORAGE PROCESSES IN THE LOGISTIC MANAGEMENT

Nowadays, logistics is a very important element of the functioning of every enterprise. In the literature on the subject one can meet many definitions of this concept. J. Coyle, E.J. Bardi and J.C. Langley. They think that „logistics is the process of planning, implementing and controlling the efficient and economically efficient flow of raw materials, production materials, finished products and relevant information from the point of origin to the point of consumption in order to meet customer requirements” [1]. Many activities carried out in organizations are based to a large extent on logistic management, which according to S. Krawczyk is „activities creating a comprehensive concept of logistics undertakings, taking into account their course both in the enterprise and in the partners, and coordination of implementation (in a broad sense) of this concept by relevant organizational units using appropriate instruments of management and control” [7]. Logistic management allows efficient control of logistic processes at a high quality level. One of the mentioned processes is storage which is one of the basic activities that is carried out in production, commercial and service enterprises [5].

P. Murphy i D. Wood they think that storage is "an element (function) of the company's logistics system, which is responsible for storing products from the moment of their manufacture or purchase until consumption.” [9]. In the vocabulary dictionary, storage is defined as "a set of activities related to time receiving, storage, storage, completing, moving, maintaining, recording of, controlling and issuing material goods (stocks)” [2]. Storage therefore occurs everywhere where the flow of materials is stopped and where there is waiting for the next transport and production process [6]. It is a process whose primary task is to store and protect products from the moment they are made until their final use. Storage concerns both the flow of goods and related information.

According M. Gubalý i J. Popielasa the storage process consists of four basic phases: receipt, storage, picking and release. These phases are the stages of the flow of loads in the warehouse from their delivery to their send. Phase 1 - adoption - involves the collection of
ordered goods, products, etc. using the available storage infrastructure. Phase 2 - storage - consists of all activities related to storage of goods in the warehouse. Phase 3 - picking - consists in proper preparation of goods and their completion according to the customer's order. The last one is phase 4 - release - which is made up of activities aiming at transferring prepared and completed goods to recipients in order to deliver them to the final customer [3]. The above-mentioned phases usually coincide with zones located in the warehouse. As in the case of phases, four zones are usually distinguished in the warehouse: the reception area, the storage zone, the picking zone and the release zone [4,8]. The location of the zones in the warehouse allows you to specify how technological system it occurs. There are three basic systems, which include a through system, an angle system and a bag system. The first one is characterized by the fact that the admission zone and the release zone are located on opposite sides of the storage zone. In the angular arrangement of the admission and release zone, adjacent storage walls are adjacent to each other. The last layout - the sack system - is characterized by the fact that the admission zone and the release zone are located at the same wall of the storage zone [10]. Therefore, it is important to properly arrange the zones so that their position facilitates each other, and thus accelerates work performed in the warehouse.

Savills research suggests that the demand for warehouse space is constantly increasing. It can therefore be concluded that warehouses are a very important element of the functioning of any enterprise. According to the report from February 2018, total resources of industrial and warehouse space in Poland at the end of 2017 amounted to around 13.5 million m2 and are still growing. Over the last 10 years, gross demand for warehouse space has increased from 1.2 million m2 in 2007 to 4.3 million m2 in 2017. It is also worth noting the level of the vacancy rate. The year 2017 is only 5.4% and it is one of the lowest results of recent years. In 2009, the vacancy rate was around 17%. The largest demand for warehouse space was generated by the logistics sector and traditional and internet trade. Their demand oscillated around 60% of the entire demand [11]. The increase in the number of warehouse space forces flexible management and creating new solutions that will increase warehouse space.

2 THE CHARACTERISTICS AND FUNCTIONALITY OF THE WAREHOUSE IN THE ENTERPRISE X

Development of a warehouse in the company X

The company X is a production company that is part of a group founded in 1882. The warehouse, on the basis of which the efficiency of the storage process was carried out, is a fairly new facility built in 2016 and covering an area of approximately 10,000 m2. The warehouse has a height of 4.7 m. It consists of 4 zones, such as (see Figure 1):

- semi-finished zone,
- storage zone for finished products,
- production zone.

The zone of semi-finished products occupying the area of 2,136 m2 is intended for receiving and storing blanks needed in order to produce the final product. It consists of a loading ramp and a storage area, which in Fig. 1 are marked with numbers 1 and 2, respectively. The production area (3) includes processing machines used for the production of packaging and a palletiser. The finished product storage area with an area of 2,593 m2 includes a storage area
(4), a pallet magazine (6) and a loading platform (5). This arrangement of the warehouse is determined by a through system. This means that the reception zone and the release zone are located on opposite sides of the warehouse.

![Fig. 1 An overview of the warehouse layout](image)

Source: own processing.

The storage zones listed and described above also consist of sectors. The table below (Table 1) contains information on the number of storage places in terms of two options: one level and two levels of storage.

<table>
<thead>
<tr>
<th></th>
<th>Semi-finished products</th>
<th>Finished product</th>
</tr>
</thead>
<tbody>
<tr>
<td>The number of sectors</td>
<td>45</td>
<td>189</td>
</tr>
<tr>
<td>Pallet size [m]</td>
<td>1,2 x 1,5</td>
<td>1,2 x 0,8</td>
</tr>
<tr>
<td>Number of pallets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One level</td>
<td>1 180</td>
<td>2 570</td>
</tr>
<tr>
<td>Two levels</td>
<td>1 534</td>
<td>3 855</td>
</tr>
</tbody>
</table>

Source: own processing.

The total number of sectors in the semi-finished zone is 45. It stores pallets with dimensions of 1.2 m × 1.5 m. When pallets are stored on one level, the number of pallets is about 1 180.
pieces, while by storing them in two levels their number increases to 1 534 pallets. In the case of the finished product storage area, the total number of sectors is 189. In this zone, the finished products are stored on pallets with standard dimensions 1.2 m x 1.8 m. When storing the products at one level, then the number of pallet is 2 570 pieces. In the case of storage on two levels, this number increases to 3 855.

**Warehousing process in the enterprise X**

![Diagram of the implementation of the finished product storage process](image)

*Fig. 2 Diagram of the implementation of the finished product storage process

Source: own processing based on internal company data.*
As it was mentioned in the previous section, the X company warehouse consists of two sectors: the semi-finished sector and the finished product storage sector. In this article, only the sector of storing finished products has been analyzed. This is the storage of products manufactured before the company. The diagram of the storage process is shown in Figure 2.

The process of storage of finished products begins with the controls placed on the finished product palette. This control is carried out by a dedicated operator for this process. In the event of failure to meet any criteria, the pallets with packaging are withdrawn for re-palletizing. However, if the decision is positive, the operator uses a forklift to deliver the pallet to an automated machine that is used to pack the pallets together with the goods. At this stage, control is also carried out. The positive course of control allows the adoption of pallets to the warehouse storage. The forklift operator scans the bar codes of each pallet to the IT system supporting processes in the warehouse, which goes to the designated storage place. The next step is to determine the destination warehouse by the forwarder.

At the moment when the pallets with the goods are to be delivered to the external warehouse, the forwarder orders a means of transport. Then, the forklift operator prepares the shipping lot for shipment. The loading is carried out on the loading ramps located in the upper right corner of the warehouse (Figure 1). Before loading, the forklift operator and the forwarder are obliged to check the technical and hygienic condition of the loading semi-trailer. In the event that the opinion is negative, the loading is refused. A positive result allows loading based on the order in the system. Next, the forwarder transfers the inter-warehouse of a given batch of packages and generates a MM document - Internal Delivery Document.

If the palette with the goods are to remain in the company's warehouse by the decision of the Internal Sales Department, the forklift operator uses the barcode reader to read the finished products for the electronic storage system - Main Warehouse section of Finished Products section. The produced packaging is stored on a maximum of two levels. However, it depends on the customers' requirements. In addition, at least once a year, inspection of warehouses and inventory is carried out. This control is carried out by approved committees.

The last stage of the storage process is the release of the finished product from the warehouse. The Sales Department orders delivery and provides necessary information to the forwarding department by means of annotations on production plans, electronic mail, telephone or orally. The forwarder, after receiving the relevant decision, plans shipment. After determining the route and selecting the means of transport, he instructs the forklift truck operators to prepare the goods through an electronic order in the system. Prepared delivery batch is subject to packaging control by the trolley operator based on specific criteria. A positive result allows you to forward pallets to the next stage. A negative opinion is forwarded to the forwarder who makes the final decision on further proceedings.

As with the transfer of goods to another warehouse, it is important to check the means of transport. In the case of a positive opinion, the truck operator loads the pallets onto the trailer and assembles the so-called "Forwarding sections" of loaded pallets, on the basis of which a delivery document is issued, which is generated in the IT system storage module. The document is issued in three copies: one for forwarding and two for the driver. After delivering the goods to the customer, one of the copies of the driver is signed by him and goes back to the company's forwarding. This document is the basis for the settlement of the cost of the transport service and the issuance of a sales invoice. The invoice is issued using an IT system for accounting and material management.
3 STORAGE RATIO ANALYSIS AND PROPOSALS OF IMPROVEMENTS

The ratio analysis of the storage process in company X was carried out with consideration of three months - September, October and November 2018. Table 2 presents the results of this analysis, taking into account individual time periods.

Tab. 2 Selected Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>September</th>
<th>October</th>
<th>November</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  The utilization rate of storage locations</td>
<td>39,30%</td>
<td>44,12%</td>
<td>51,44%</td>
</tr>
<tr>
<td>2  The utilization rate of forklifts on shift</td>
<td>I shift - 100% II shift - 33,33% III shift - 16,67%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3  The utilization rate of storage space</td>
<td>0,61 pallets/m²</td>
<td>0,69 pallets/m²</td>
<td>0,80 pallets/m²</td>
</tr>
<tr>
<td>4  Percentage availability of the warehouse</td>
<td>71,43%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5  Percentage of orders carried out in relation to all orders</td>
<td>108,12%</td>
<td>116,22%</td>
<td>116,89%</td>
</tr>
<tr>
<td>6  Percentage rate of advertised orders</td>
<td>2,06%</td>
<td>2,03%</td>
<td>1,42%</td>
</tr>
<tr>
<td>7  Average number of goods issued in the order</td>
<td>13 516</td>
<td>15 163</td>
<td>14 524</td>
</tr>
<tr>
<td>8  The average daily number of accepted orders</td>
<td>13,55</td>
<td>12,87</td>
<td>15,10</td>
</tr>
<tr>
<td>9  The average daily number of orders issued</td>
<td>14,65</td>
<td>14,96</td>
<td>17,65</td>
</tr>
<tr>
<td>10 The average number of pallet units for delivery in a month</td>
<td>27 p.u.</td>
<td>32 p.u.</td>
<td>25 p.u.</td>
</tr>
<tr>
<td>11 The average number of pallet units on the load per month</td>
<td>24 p.u.</td>
<td>21 p.u.</td>
<td>22 p.u.</td>
</tr>
</tbody>
</table>

Source: own processing.
The conducted ratio analysis indicates the continuous development of the company. This is indicated, inter alia, by the utilization rate of storage spaces, which is growing. However, it should be noted that this is still a rather low result. It may be related to the fact that the plant is a relatively new enterprise and only enters the market, and a larger number of vacancies is a security for further years.

It is worth noting that the warehouse managers appropriately use the potential of both the warehouse and its employees and machines. Percentage availability of the warehouse is over 71%. This means that the plant operates from Monday to Friday in a three-shift system. At the moment, this period of activity is sufficient for the enterprise. The same applies to warehouse workers as well as forklifts. With the decreasing amount of work in the warehouse related to movement of goods, the number of workers and forklift trucks is also reduced. Other employees are delegated to perform other warehouse works. Such a turn of events leads to the fact that employees engage in their work to the maximum extent so that the activities ordered are carried out as planned, and the trucks are not operated more than required.

When analyzing the designated indicators, one should pay attention to the very good level of the rate of the advertised orders. In September and October, this indicator fluctuated around 2%, while in November it amounted to less than 1.5%. This means that 48 orders have been correctly processed in the first two months for one poorly executed order, and in November this number has increased to 70. This is a very optimistic result for the company.

A surprising result was obtained in the case of the percentage of orders placed in relation to the total orders. For the three months analyzed, this indicator was over 100%. This is due to the fact that orders are processed in the company in whole and in part. This means that orders can be duplicated, which is why the number of completed orders is greater than those accepted.

Analyzing the data from table 2, it can be seen that the organization receives more and more orders from month to month. The same applies to their releases. Such a turn of events may result from the fact that the company is constantly developing and there is a greater demand for its products on the market. Therefore, it is worth considering how to increase the efficiency of the company's product storage, assuming that its production will double.

In the current situation, the warehouse is not equipped with shelves. Finished products are stored on pallets in two levels, as long as the customer agrees. In the case of storage on one level, as already mentioned earlier, the number of pallet places is 2570, while on two - 3855 pallet places.

<table>
<thead>
<tr>
<th>Tab. 3 The number of stored pallets after placing shelves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pallet size [m]</td>
</tr>
<tr>
<td>1,2 x 0,8</td>
</tr>
<tr>
<td><strong>Number of pallets</strong></td>
</tr>
<tr>
<td>shelves (70% of the area)</td>
</tr>
<tr>
<td>One level</td>
</tr>
<tr>
<td>Two levels</td>
</tr>
<tr>
<td>Three levels</td>
</tr>
</tbody>
</table>

Source: own processing.
The proposal for improvement is therefore the introduction of shelves. Thanks to such a solution, the company would gain an additional third level of storage of products. The shelves would occupy about 70% of the space intended for storage of products, which would give 4668 pallet places at three storage levels. The remaining 30% would be managed according to the previous arrangement, because some orders require special storage conditions, which can not be achieved with shelves. In the case of single-level storage on the floor, the number of pallet spaces would be 772 places, while two levels would give 1,158 seats. The table above on (Table 3) presents the number of pallets before changes, in the case of storage on the floor and after the shelving.

With this solution the maximum number of components in the warehouse would be 5826 pallet places, it is about more than 1971 sites in the absence of shelves.

The implemented changes would allow to provide the company with the need to increase production and store finished products. They would also affect specific aspects of storage and its effectiveness. The table below (Table 4) presents selected indicators concerning storage processes using shelves in the analyzed company.

**Tab. 4** List of selected indicators before and after introduced changes (shelves)

<table>
<thead>
<tr>
<th>Lp.</th>
<th>Indicators</th>
<th>Before changes (data from November 2018)</th>
<th>After changes (increased production)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The utilization rate of storage locations</td>
<td>51.44%</td>
<td>67.80%</td>
</tr>
<tr>
<td>2</td>
<td>The utilization rate of forklifts on shift</td>
<td>I shift - 100%</td>
<td>II shift - 33.33%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>III shift - 16.67%</td>
</tr>
<tr>
<td>3</td>
<td>The utilization rate of storage space</td>
<td>0.80 pallets/m²</td>
<td>1.60 pallets/m²</td>
</tr>
<tr>
<td>4</td>
<td>Percentage availability of the warehouse</td>
<td></td>
<td>71.43%</td>
</tr>
</tbody>
</table>

Source: own processing.

With the increase in production, the storage space utilization ratio doubled to 67.80%. Per one square meter of the warehouse there would be 1.6 pallets, two times more than in November. The utilization ratio of forklifts and the percentage of warehouse availability would not change, as there would be no need for this. Due to the lack of access to financial data, the study does not include investment outlays that must be incurred in the case of a new investment. Additional investment expenditures should be included as well as the company's revenues should be compared in the case of increased production.
CONCLUSION

When managing an enterprise, one should remember first and foremost to make the most of its business opportunities. An important aspect informing about the level of organization's functioning is monitoring its effectiveness. Nowadays, many enterprises are highly developed, have access to many tools supporting their activities and it happens that the only element that can strengthen their competitive advantage on the market is just the right use of the company's potential. Organizations must therefore pay particular attention to whether the level of effectiveness of their functioning is adequately high and systematically control it. Properly used efficiency can increase the company's profits by reducing costs. The unused potential of the company makes it lose the opportunity to enrich itself. This study presents selected aspects related to the storage process in business management. The essence and role of the warehouse in the economy of the enterprise and as a supporting function in production were pointed out. A case study of a manufacturing enterprise is presented. The study uses index analysis of the storage process, which presented the condition of the organization. In addition, changes have been proposed to improve the storage process if production is increased. This analysis should be extended to include the indication of investment outlays and financial analysis. Due to the lack of data and their confidentiality, they have not been presented in this study.

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PROPOSAL OF MEASURES FOR IMPLEMENTING
THE 7S METHOD IN CHEMICAL STORAGE CABINETS IN IKEA INDUSTRY SLOVAKIA S.R.O., TRNAVA BRANCH ESTABLISHMENT

NÁVRH OPATRENÍ NA ZAVEDENIE METÓDY 7S V CHEMICKÝCH SKRINKÁCH V PODNIKU IKEA INDUSTRY SLOVAKIA S.R.O., ODŠTEPNÝ ZÁVOD TRNAVA

Marián Pavlík
Slovak University of Technology in Bratislava
e-mail: marian.pavlik1@gmail.com

doc. Ing. Miroslava Mílka, PhD.
Slovak University of Technology in Bratislava
e-mail: miroslava.mlkva@stuba.sk

Abstract

The aim of the present article is to propose measures of applying the 7S method to chemical storage cabinets. To fulfil the aim it, was necessary to collect basic theoretical information in the field of lean manufacturing while focusing on the 7S method, and then to analyse the current state of storing chemicals in chemical storage cabinets and handling hazardous substances directly in the production process with regard to health, labour safety and environment. We designed a method of applying the 7S method to chemical storage cabinets, trying to provide a new option of using chemicals outside the chemical storage cabinets in the IKEA Industry Slovakia s.r.o., Trnava branch establishment.

Key words
chemical storage cabinets, safety, environment, lean manufacturing, 7S method

INTRODUCTION

In the present time, we must heed for more effective manufacturing processes, by application of a new lean methods. We can produce more components in less time with higher quality and for less money, in industrial organizations. It is also important to produce our products with high safety and environment level, too. Therefore, modern industrial organizations have decided to apply systems of quality management in their processes.
7S method is the most up-to-date method in this time, which can be applied in industrial processes. It consists of 5S method with added two modern steps – safety and environment. Safety and environment are considered as a pillars of success of the production strategy. This new method of production organization will make it possible to classify and to identify each one procedure used to make outputs.

1 SPECIFICATION OF LEAN MANUFACTURING AND PRINCIPLES OF 7S METHOD

Every organization tries to produce products in the highest quality, for the best price and in the shortest time, as much as possible. If we want to organize work of our employees in practise the most effectively, we must make unproductive process flexible and productive, with implementation of various improvement tools. One of them is lean manufacturing, which have regards to material basis and higher requirements. [1] [2]

Basis of the lean manufacturing is a systematic approach for identification and elimination the waste of time. Japanese use, for introduction of the waste of time, term Muda. [3] [4]

Lean manufacturing contains elements as 7S method, Jidoka, Poka Yoke, ergonomical principles and various of visualizations at workplaces. These sets of various methods are especially focused on employees in production and administration. Further on production lines, production workplaces and production facilities. [5]

The main principles of 7S method is quality establishing of worplaces and employees satisfaction in their workplaces. It is making process with seven pillars, which will lead industrial to all-round excellence and flexibility of organizations. 7S method is more safety and environmental with compared to the 5S method. [6]

![Figure 1 All pillars of the 7S method](source: own processing based on [7].)

New steps of the 7S method in japanese are defined Seiiki and Shizen. It means more safety and environmental in industrial processes comparing to the 5S method. In this time it is the best procedure for implementation of modern manuals in dynamically developing organizations. Safety and environmental questions are the most famous topics, in this time, for top managers and leaders of industrial corporations. Peoples and their health should be a priority number one for all employers. [8] [9]
2 ANALYSIS OF THE CURRENT STATE OF APPLICATION OF THE 5S METHOD IN IKEA INDUSTRY SLOVAKIA S.R.O., TRNAVA BRANCH ESTABLISHMENT

IKEA Industry is the largest producer of wooden furniture in the world and manufactures wood-based furniture for IKEA customers. Together with IKEA suppliers, we represent the IKEA production capacity. IKEA Industry is the core of the Inter IKEA Group. Growth capacities for growth. The aim is to create products that have great customer value, in terms of quality and price.

IKEA Industry consists of 38 production units in 9 countries: China, Hungary, Lithuania, Poland, Russia, Slovakia, Sweden, and the USA. It has around 20,000 co-workers. The top five production countries are Poland, Russia, Slovakia, Portugal and Sweden.

IKEA Industry is a one of four members of Inter IKEA Group. Each member must follow strict rules of IWAY standards. It’s a basic rule for better workplaces and relations between employees. [10].

Analysis of the current state of the chemical storage cabinets with using the 7S method in IKEA Industry Slovakia s.r.o., Trnava branch establishment

Analysis of the current state of the chemical storage cabinets in the IKEA Industry Slovakia s.r.o., Trnava branch establishment was realised with theoretical basis and information from lean, environment and safety departments.

In the IKEA Industry Slovakia s.r.o., Trnava branch establishment employees often use different types of chemicals in their workplaces. If employees use the chemicals incorrectly, it can be very dangerous for them, their co-workers and environment, of course.

For environmental, lean and more safety workplaces chemical storage cabinets should be used. It’s special type of storing for a various types of chemicals used in an industrial organization. Chemical storage cabinets are suitable for storing hazardous chemicals, toxic chemicals, chemicals which are dangerous for water, combustibles and detergents. They have been introduced in the IKEA Industry Slovakia s.r.o., Trnava branch establishment in 2015.

In present time there is a lot of problems with chemical storage cabinets, specifically with a few numbers of them. On a figure number 2 we can see the old layout of IKEA Industry Slovakia s.r.o., Trnava branch establishment. On the layout we can see eleven yellow and one bordeaux squares. The yellow squares show typically chemical storage cabinets used in production and bordeaux square represents the main chemical storage cabinet.
Currently there is a lot of unresolved safety and environmental issues, which have a correlation with chemical storage cabinets. After analysis we found a lot of lacks. On a figure number 3 we can see a one type of chemicals in a plastic bottle from a non-alcoholic drink. Firts problem is that the chemical hasn’t a certificate label. The employees don’t know any chemical information. They don’t know how it can be used and which working tools they need. The chemical can erode the bottle, too.

On a figure number 4 we can see the current situation in the chemical storage cabinets in the IKEA Industry Slovakia s.r.o., Trnava branch establishment. There are a 7 lacks, which are defined by numbers from 1 to 7:
• 1 – chemical without lid, which is situated on the top of the chemical storage cabinet,
• 2 – hazardous substances without certificate label,
• 3 – unlabeled bottle with chemicals,
• 4 – empty bottles,
• 5 – missing labels with name of chemicals,
• 6 – one type of chemicals is laid on a second type of chemicals,
• 7 – gloves or fabrics textile can’t be freely laid in a chemical storage cabinets.

![Image](image1.png)

**Figure 4** Current situation in chemical storage cabinets  
Source: own processing.

On a figure number 5 we can see the chemical, which is put on the electrical switchboard. There are a 3 lacks:

• 1 – the container is put on a electrical switchboard,
• 2 – the container is without certificate label,
• 3 – the container is without lid.

![Image](image2.png)

**Figure 5** The chemical, which is put on the electrical switchboard  
Source: own processing.
In this situation there is a risk of a fire. Because is too much concentration VOC in the air. The chemical can pour out on the electrical switchboard and destroy all production process.

3 PROPOSAL OF MEASURES FOR IMPLEMENTING THE 7S METHOD IN CHEMICAL STORAGE CABINETS IN IKEA INDUSTRY SLOVAKIA S.R.O., TRNAVA BRANCH ESTABLISHMENT

Our proposal of measures for improvement the storage system are focusing on use and manipulation with hazardous substances. We want to focus on our several-months analysis from the current situation.

- At first we want to establish external miniature chemical storage cabinets, trays and scrubbing towers system, which are showed on a figure number 6.

![Figure 6 External miniature storage cabinets, trays and scrubbing towers system](source: own processing)

The proposal should help: to eliminate „dead spots“, with space definition for chemicals and to correct usage of hazardous substances. Each external miniature chemical storage should contain a label with description „chemicals“ and flammability pictogram. Each external miniature chemical storage cabinet should be used only by a one employee during a one working shift.

Trays will be used only on workplaces with a one type of chemical. On the front side of the trays there will be certificate labels from safety data sheets and their activities. On the workplaces with a higher frequency we propose to introduce the scrubbing towers. One scrubbing tower can be use at one department. The is a lot of advantages of the scrubbing tower. For example body of our scrubbing tower is very ergonomic friendly and static. It is easy to lift it from the static place to temporarily place, too.

- At the second point we want to describe comprehensive implementing the 7S method to the chemical storage cabinets.

In the first step we suggest to use special containers with red labels for separating necessary and unnecessary chemicals. In the second step we make special labels for chemicals. In the third step to do a special yellow informational card with the name, e-mail and phone contact
of responsible persons for individual chemical storage cabinets. In the fourth step to create a standard for chemical storage cabinets. In the fifth step we propose to do trips, with increasing tendency, around the halls.

For comprehensive implementing most up-to-date the 7S method we propose establish special Environmental, Health and Safety training. In this EHS training will employees of environment, lean and safety department use a special cartoon movie. There is Napo, like the main character. He says universal language, language without words. Employee Napo shows very dangerous situations from real workplaces. It’s very educational movie with great visualization.

On a figure number 7 we can see Napo employee, which have a problem with unlabeled chemicals. Industry Slovakia s.r.o., Trnava branch establishment has a special iChemistry program available for relevant all departments. In this program can be found all chemicals which are in production halls or warehouses. Employees of the environment, lean and safety departments will be showing there the real illustrations from IKEA Industry Slovakia s.r.o., Trnava branch establishment with their expert comments.

**CONCLUSION**

A prerequisite for success of each process is improvement of the all elements of lean manufacturing, as the main factor for smooth production and long-time sustainability in the market. 7S method, as a part of lean manufacturing, will be helping for comprehensive implementing safety and environmental module to 5S method. The big advantages are the more safety and eco-friendly workplaces with lean elements.

However, the integration of the 7S method to the chemical storage cabinets is very complicated and long-time process. For successful implementing the 7S method we need to perform a special several-months analysis with photos, expert comments and complete list with chemicals in individual departments. And we have to do constant controlling in the production halls. The main part for implementing the 7S method is the part with EHS training. This training we proposed is very practical including employees experience.
REFERENCES


Abstract
The main purpose of this article is to present and analyse the transport management process in the enterprise X. It was prepared mainly on the basis of questionnaire surveys carried out with people employed as professional drivers in the transport company X. They were conducted in December 2018 in a group of 45 drivers. The article presents an analysis including studying the scope of the company’s operation and an analysis of the effectiveness of transport processes as well as an assessment of the course of implementation of activities in the sphere of transport.

INTRODUCTION
Nowadays transport is an inseparable part of everyone's life. It is used to move people, animals as well as goods and loads on a huge scale. Continuous development and the demand for large quantities of materials, finished products or food lead to a dynamic expansion of truck transport. Therefore, the organization and implementation of the transport process has become an enormous challenge facing many shipping companies around the world. Nowadays it is possible to notice the multitude of systems and various types of devices that are necessary for these operations, thanks to which transport management in the enterprise can be much more efficient.
The article presents an analysis including studying the scope of the company's operation and an analysis of the effectiveness of transport processes as well as an assessment of the course of implementation of activities in the sphere of transport.

1 THE ESSENCE AND TRANSPORT CLASSIFICATION

The essence of transport

Nowadays transport is the basis of every company's operation in various sectors of the global economy. It is worth noting that it concerns both manufacturing and service enterprises as well as people. All products available, among others, in shops, restaurants, petrol stations, and ultimately in our homes have gone through the delivery process, which is carried out with the help of transport. It can be said that transport accompanies us in every aspect of our lives.

The word transport derives from Latin - transportare [1], which means to carry, to move.

One of the most extensive definitions of transport is J. Żak's interpretation, referring to the position edited by W. Rydzikowska and K. Wojewódzka - Król, the author states that: “The concept of transport is ambiguous and can mean:

- a set of activities related to the displacement of persons and material goods by means of appropriate measures (process approach),
- an economy department including all measures and related activities with displacement of persons and loads (industry approach),
- field of knowledge dealing with various related phenomena with the displacement of persons and material goods “. [2]

It is one of the most extensive definitions of transport, including both process and industry approaches.

The main purpose of the transport activity is to ensure an adequate flow of goods and services as well as to improve the quality of life of the society and to support competitiveness in the economy on a national and global scale. [3]

Transport classification

In the literature on the subject, it is possible to encounter many transport divisions. When classifying transport, the vertical and horizontal division of transport is worth mentioning. It is best known and distinguished by most authors publishing works on transport. The vertical division of transport consists in presenting the space in which transport takes place and its type, including car, rail, pipeline, sea, inland waterway, air and space transport. The criteria for horizontal classification are slightly more extensive and cover five main requirements, such as [4]:

- object of carriage,
- organizational and functional reasons,
- continuity of the transport process,
- geographical coverage,
- accessibility for the user.
Figure 1 shows the systematics of distant transport and its distribution due to the type of transported goods.

![Transport System Diagram]

**Fig. 3 Classification of transport**

Source: [5].

An important aspect is also the type, amount of cargo, volume, weight and method of completing the pallet load unit. The physical state of the transported goods also affects the choice of means of transport. It should be determined whether the product is in a solid, liquid or gas state, because in this case it requires adapting the appropriate method of transport or shipment.

2 TRANSPORT MANAGEMENT IN THE ENTERPRISE

Transport process

When defining transport issues, it is worth considering the differences that exist between transport and the transport process. Referring to the approach by S. Kwaśniowski [6], transport process can be defined as “(...) a specific sequence of activities, as a result of which the goods
move from the sender to the recipient”. According to J. Kubicki [7]: “The transport process can be understood as a set of internally coordinated activities related to the movement of goods, people, services and information or their temporal and spatial transformation”.

By analysing the definitions presented above, it can be seen that the difference between transport and the transport process is significant. The transport process includes only organizational, executive and commercial activities related to the transfer of material goods, products, services and information from the place of shipment to the place of destination or in the case of people from point A to point B. Transport, however, in addition to carrying out the above activities, also includes means of transport; is the field of science and even the branch of the economy. In conclusion, it can be stated that transport is a much broader concept than the transport process.

Activities carried out as part of the transport process include activities in the organizational, executive and commercial spheres, these are so-called activities preceding the transport process. They are presented in Figure 2.

![Division of transport process](image)

**Fig. 4** Division of transport process

Source: [8].

Moreover, the transport process consists of such items as: the object of carriage, contract terms and obligations of the buyer and recipient as well as the sender's requirements. When managing transport in the supply chain, it is necessary to have a fleet in order to meet transport needs as well as possible and at the same time as cheaply as possible. It is important to optimally use the working time of vehicles, their mileage and payload.
Effectiveness of road transport

For many enterprises operating in this area of business, the analysis of road transport efficiency plays an important role. There are many different indicators that allow making such an analysis. One of the selected indicators was the index of transport efficiency in the use of rolling stock. Thanks to it, it is possible to present the degree of using the course of a vehicle with a load in relation to the total mileage. The recommended value of the indicator should be from 0.5 to 0.7. It is calculated using the following formula:

\[ B = \frac{kL}{K} \]  

where:
\( kL \) – the course of rolling stock with cargo,
\( K \) – the entire course of the rolling stock. [9]

3 METHODOLOGY OF RESEARCH AND CHARACTERISTICS OF THE ENTERPRISE

Research methodology

The purpose of this analysis was to assess the efficiency of transport management in the transport company X. An important aspect of the conducted research was to get familiarized with each stage of the transport process. The effectiveness of transports is also significant. In order to obtain detailed information on the real course of the transport process, a survey was conducted with people working as professional drivers in the enterprise X. Using the questionnaire, 45 drivers working in the abovementioned company were studied.

There are many different research methods in the literature on the subject. Thanks to them, planning, implementation and description of the research process or their results becomes extremely simple. This paper uses research methods such as:

- analysis of available literature on the subject,
- participant observation, based on intended, planned and systematic gathering of information as well as analysis of facts,
- informal interview, which consisted of a free conversation with employees of the company,
- an individual questionnaire, consisting of 36 thematic questions allowing authors to obtain detailed information,
- calculation methods.

Selected research methods allowed authors to obtain the information necessary to perform the analysis.

Characteristics of the enterprise

The registered office of the X company is located in the Lubuskie voivodship. It specializes in the transport of furniture, space and general cargo as well as various refrigerated goods, such as food and
medicine. In order to carry out the transport of such diversified goods, the company has many suitably prepared transport sets. Currently, the company’s fleet consists of 45 tractor units with various semi-trailers. The company employs 65 employees, of which 45 are professional drivers. The transport company X mainly carries out international transport. The greater part of them takes place in the countries of Western Europe. The company declares the possibility of carrying goods up to 14 countries such as: Austria, Belgium, the Czech Republic, Denmark, France, Spain, the Netherlands, Lithuania, Latvia, Germany, Slovakia, Switzerland, the United Kingdom. Currently, the company bases its activity exclusively on searching transport orders on the online trans.eu transport exchange.

4 ANALYSIS OF TRANSPORT MANAGEMENT IN THE ENTERPRISE X

Analysis of the effectiveness of the company's operation

Selected indicators regarding the assessment of the effectiveness of the transport process were calculated on the basis of data obtained from the enterprise X. The values of indicators were obtained using the data presented in Tables 1 and 2. It is worth noting that the values in them refer to 14 out of 45 truck fleet of the company X. This situation results from the occurrence of random events (accidents, replacement of cars with new ones), which make it impossible to maintain the continuity of recording car mileage.

<table>
<thead>
<tr>
<th>Vehicle number</th>
<th>Total course of the rolling stock in individual years (km)</th>
<th>Dynamics index in 2017 in relation to the base year 2014 (w %) - (2014=100)</th>
<th>Rate of change index (in %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>414 100 534 100 654 100 774 100</td>
<td>186,94</td>
<td>86,94</td>
</tr>
<tr>
<td>2</td>
<td>840 000 960 000 1 080 000 1 200 000</td>
<td>142,86</td>
<td>42,86</td>
</tr>
<tr>
<td>3</td>
<td>536 400 656 400 775 400 893 400</td>
<td>166,55</td>
<td>66,55</td>
</tr>
<tr>
<td>4</td>
<td>300 230 420 230 545 230 665 230</td>
<td>221,57</td>
<td>121,57</td>
</tr>
<tr>
<td>5</td>
<td>390 100 505 100 623 100 743 100</td>
<td>190,50</td>
<td>90,50</td>
</tr>
<tr>
<td>6</td>
<td>634 200 749 200 867 200 987 200</td>
<td>155,66</td>
<td>55,66</td>
</tr>
<tr>
<td>7</td>
<td>419 100 534 100 652 100 772 100</td>
<td>184,23</td>
<td>84,23</td>
</tr>
<tr>
<td>8</td>
<td>286 000 407 000 528 000 648 000</td>
<td>226,57</td>
<td>126,57</td>
</tr>
<tr>
<td>9</td>
<td>758 000 879 000 1 000 000 1 120 000</td>
<td>147,76</td>
<td>47,76</td>
</tr>
<tr>
<td>10</td>
<td>649 000 770 000 890 000 1 010 000</td>
<td>155,62</td>
<td>55,62</td>
</tr>
<tr>
<td>11</td>
<td>1 073 000 1 194 000 1 206 000 1 324 000</td>
<td>123,39</td>
<td>23,39</td>
</tr>
<tr>
<td>12</td>
<td>621 200 742 200 863 200 984 200</td>
<td>158,44</td>
<td>58,44</td>
</tr>
<tr>
<td>13</td>
<td>542 500 657 500 775 500 893 500</td>
<td>164,70</td>
<td>64,70</td>
</tr>
<tr>
<td>14</td>
<td>960 000 1 080 000 1 200 000 1 320 000</td>
<td>137,50</td>
<td>37,50</td>
</tr>
</tbody>
</table>

Source: own processes based on information obtained in the enterprise X.
Based on the analysis of the data in Table 1, it should be noted that the total dynamics index of rolling stock in relation to all vehicles in 2017 compared to 2014 is greater than 100%, and in the case of two vehicles is greater than 200%. In this connection, the rate of change index takes positive values. This indicates positive changes in the implementation of orders by the company during the period considered.

Table 2 shows the average mileage of trucks with the load and the load capacity of the vehicle.

**Tab. 4** The average course of the rolling stock with the load in kilometres and the load capacity of vehicles

<table>
<thead>
<tr>
<th>Item</th>
<th>Average course of the rolling stock with the load in kilometres</th>
<th>Vehicle capacity in tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2014</td>
<td>2015</td>
</tr>
<tr>
<td>1.</td>
<td>104 500</td>
<td>224 500</td>
</tr>
<tr>
<td>2.</td>
<td>360 000</td>
<td>480 000</td>
</tr>
<tr>
<td>3.</td>
<td>388 000</td>
<td>423 800</td>
</tr>
<tr>
<td>4.</td>
<td>970 000</td>
<td>120 900</td>
</tr>
<tr>
<td>5.</td>
<td>55 700</td>
<td>170 700</td>
</tr>
<tr>
<td>6.</td>
<td>189 900</td>
<td>305 000</td>
</tr>
<tr>
<td>7.</td>
<td>71 600</td>
<td>187 000</td>
</tr>
<tr>
<td>8.</td>
<td>26 800</td>
<td>147 700</td>
</tr>
<tr>
<td>9.</td>
<td>310 000</td>
<td>431 000</td>
</tr>
<tr>
<td>10.</td>
<td>245 000</td>
<td>336 000</td>
</tr>
<tr>
<td>11.</td>
<td>435 400</td>
<td>556 500</td>
</tr>
<tr>
<td>12.</td>
<td>227 500</td>
<td>348 600</td>
</tr>
<tr>
<td>13.</td>
<td>185 100</td>
<td>300 200</td>
</tr>
<tr>
<td>14.</td>
<td>432 000</td>
<td>552 000</td>
</tr>
</tbody>
</table>

Source: Data from the enterprise X.

**Transport efficiency indicator for the use of rolling stock**

This index was determined for 14 car sets in 2014 – 2017. The transport efficiency of the use of rolling stock should be from 0,5 to 0,7. Table 3 presents the obtained values of the transport efficiency indicator for the use of rolling stock for the above-mentioned values.
Tab. 5 The values of the transport efficiency indicator for the use of the rolling stock

<table>
<thead>
<tr>
<th>Vehicle number</th>
<th>Transport efficiency indicator for the use of rolling stock</th>
<th>YEARS</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2014</td>
<td>2015</td>
<td>2016</td>
<td>2017</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>0,25</td>
<td>0,42</td>
<td>0,53</td>
<td>0,60</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>0,43</td>
<td>0,50</td>
<td>0,56</td>
<td>0,60</td>
</tr>
</tbody>
</table>

Source: Data from the enterprise X.

Tab. 3 The values continued

<table>
<thead>
<tr>
<th>Vehicle number</th>
<th>Transport efficiency indicator for the use of rolling stock</th>
<th>YEARS</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2014</td>
<td>2015</td>
<td>2016</td>
<td>2017</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>0,72</td>
<td>0,65</td>
<td>0,59</td>
<td>0,55</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>0,37</td>
<td>0,55</td>
<td>0,65</td>
<td>0,55</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>0,14</td>
<td>0,34</td>
<td>0,46</td>
<td>0,55</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>0,3</td>
<td>0,41</td>
<td>0,49</td>
<td>0,55</td>
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<tr>
<td>7</td>
<td></td>
<td>0,17</td>
<td>0,35</td>
<td>0,47</td>
<td>0,55</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>0,09</td>
<td>0,36</td>
<td>0,51</td>
<td>0,60</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>0,41</td>
<td>0,49</td>
<td>0,55</td>
<td>0,60</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>0,38</td>
<td>0,48</td>
<td>0,55</td>
<td>0,60</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>0,41</td>
<td>0,47</td>
<td>0,56</td>
<td>0,60</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>0,37</td>
<td>0,47</td>
<td>0,54</td>
<td>0,60</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>0,34</td>
<td>0,46</td>
<td>0,54</td>
<td>0,60</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>0,45</td>
<td>0,51</td>
<td>0,56</td>
<td>0,60</td>
</tr>
</tbody>
</table>

Average annual value | 0,35 | 0,46 | 0,54 | 0,58 |

Source: own processes based on information obtained in the enterprise.

Analysing the results presented in Table 3, it is worth noting that each subsequent year brought better results. In 2014, the average value of the transport efficiency indicator for the use of rolling stock for 14 cars was 0,35. The year 2015 brought much better results. The
average value of this indicator was 0.46 that year. In 2016, the average value of the transport efficiency indicator for the use of rolling stock for 14 cars was 0.54, which means that the company undertook actions aimed at reducing the so-called “empty runs of cars”. The average value of the indicator in 2017 was towards 0.6. There was a slight change compared to the previous year, but it does not change the fact that this value has increased.

**Results of the conducted surveys**

The purpose of the survey was to learn how to manage transport in the company X. The questionnaire consists of 33 thematic questions and respondent’s particulars with 3 questions. The survey was conducted in a group of 45 professional drivers working in the company X.

Figure 3 presents the stages of the transport process, which according to the respondents should be improved.

![Fig. 3 Stages of the transport process requiring improvements](source)

According to professional drivers working in the enterprise, timely delivery of loads is a process that requires the greatest concentration of office workers. The next step requiring improvement is searching for new goods. Planning employee travel times should be improved by more than 23% of the respondents' votes. The last process requiring improvement is the transport of goods.

Figure 4 presents the stages of transport implementation, which generate the most problems.
Fig. 4 Stages of transport implementation that generate the most problems
Source: Own processes based on the conducted questionnaire surveys.

According to the drivers, the most problems arise from the passing of the goods at the destination. The notification of the goods is also a problematic part of transport operations. The least problems with the implementation are generated by taking the goods. Figure 5 shows the most common reasons for delays in order fulfilment.

Fig. 5 The most common reasons for delays in order fulfilment
Source: Own processes based on the conducted questionnaire surveys.
According to respondents, the most common reasons for delays in order fulfilment are:

- traffic jams on the road – 40,78%, which is 42 responses,
- poor organization of loading and unloading at the destination – 33,83%, as indicated by 40 respondents,
- car breakdowns, road accidents or language differences, this answer was chosen by around 20% of the respondents.

During the research, the self-assessment of the tasks entrusted to employees as a professional driver was checked. The majority of employees (23 respondents) believe that the duties entrusted to them perform well enough, while the remaining drivers assess their work as good. Another question was related to the method of obtaining orders by the company X. It turns out that a significant proportion of drivers – 82,22%, that is 37 people know the system of obtaining orders in the company. Over 11% (5 respondents) of employees declare ignorance of the method of obtaining orders by the company, while 6,67% of respondents are not interested in this issue.

In the company X, communication between drivers and office workers is assessed as follows:

- 33 (73,33%) drivers assess the level of communication as very good,
- 8 (17,78%) drivers say that the level of telecommunications with the office is good,
- 4 (8,89%) believe that communication with office employees during the execution of the order is bad.

As it results from the conducted research, as many as 42 drivers declare the obligation to wait for a new transport order after completing the previous order. Such a state of affairs may be caused by poor organization of work of persons responsible for organizing transport activities in the enterprise. Only 3 (6,67%) drivers declare to receive a new transport order immediately after finishing the previous one.

Most respondents (over 77%) execute orders outside the country several times a week, while the remaining 22,22% execute international orders once in the week. The countries where the most frequent transports are made in the company are: Austria, which accounts for just over 42% of all transports and Germany also around 42% of all orders.

CONCLUSION

Summing up, the results of the conducted surveys should indicate the possibility of improving selected aspects of management and transport implementation in the enterprise X. Table 4 presents recommendations for improvements in this enterprise.
After analysing the effectiveness of the company X, it should be noted that the efficiency of its operation is medium. The obtained result of the transport efficiency index of using the course of rolling stock from year to year is reaching an ever higher level. This means that the company eliminates the so-called “empty passes” for the transport of goods, which is the main goal of the company's operation.

An important aspect in the company's operation is to acquire regular customers, in this respect, a CRM system can be introduced to support this process. In the case of enterprise X, it is worth considering the implementation of the telematics system, which will allow better communication between office workers and drivers by displaying messages from dispatchers on the GPS screen. Thanks to this, the driver can easily get acquainted with the provided information. The process of planning subsequent transport should take place at the moment of commencement of the current order. This problem is directly related to the limited tools and methods of searching for loads. When the company's employees benefit from a larger number of online transport exchanges or establish permanent cooperation with contractors, this problem can be completely eliminated. Another aspect is the introduction of contractual penalties for the extension or improper conduct of organizational activities at the place of loading or unloading.
Such a solution would allow proper servicing of drivers at the destination, which would result in the reduction or complete elimination of delays related to the extended notification.

REFERENCES


DESIGNING AN AUTONOMOUS SYSTEM FOR THE PURPOSE OF RECEIPT AND DISPATCH OF MATERIALS BASED ON MOBILE APPLICATION

PROJEKTOVANIE AUTONÓMNEHO SYSTÉMU PRE POTREBY PRÍJMU A VÝDAJA MATERIÁLU NA BÁZE MOBILNEJ APLIKÁCIE

Ing. Michal Siget
Technical university of Košice
e-mail: michal.siget@gmail.com

Abstract
Purpose of this paper is to design autonomous system for the needs of receipt and dispatch of materials based on mobile application. Thesis contains analysis of technologies used in automatic identification, types of electronic data interchange, description of the system and evaluation of the system.

INTRODUCTION
The importance in managing all flows in the business is growing. Development of new technologies such as smart homes and industrial facilities, using drones for various activities, or Internet of Things (collectively named Industry 4.0) bring new methods of their management. With an expanding amount of goods, the data processing needs to be quicker and more effective. The use of technologies mentioned above is an excellent way of doing so.

1 TECHNOLOGIE VYUŽÍVANÉ SYSTÉMAMI AUTOMATICKEJ IDENTIFIKÁCIE

The automatic identification systems (SAI) have great importance in increasing company’s responsiveness, quality increase and cost reduction. These systems could be used within various areas of human activities from food processing industry through heavy industry to wholesale… Using them is required because of needs of improvement of logistics information systems.

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10 Faculty of Mining, Ecology, Process Control and Geotechnologies, Institute of Logistics and Transport
Automatic identification systems are systems meant to create, collect, and accelerate information processing and improve accuracy. These systems are being developed along with information technologies. Using SAI allows to process more information, it saves time by eliminating manual data processing and it minimizes impact of human factor as well. [1]

Basic concept of these systems is creation and collecting information to ensure accurate data and automate related activities. Accordingly it is possible to determine their key advantages: Increasing efficiency i.e. workers are able to do more work in the same time. Due to the automation of identification, the amount of administrative activity is considerably smaller, as the systems performs it. Since it is automatic system, it performs all task according to exact, predetermined procedures defined by developer without significant user intervention. Therefore, proportion of errors caused by human faults is minimal, as is the cost of sorting information manually. Another significant advantage is the improvement of customer services in the form of providing required information without delays.

There are various technologies to process data. The most common technology are barcodes however, RFID technology is getting in the lead eliminating barcode imperfections and flaws such as sensitivity to printing quality, weather conditions, handling. Unlike barcodes, RFID chips do not require immediate proximity of chip and reader, and the data are read even if the reader is several meters away, and these two objects don’t see each other [2].

![RFID schema](source)

**Fig. 1** RFID schema
Source: [3].

### 2 ELECTRONIC DATA INTERCHANGE

The use of electronic communication minimizes the need for manual information processing, and allows the sending of structured messages from the sender's computer to the recipient's computer. In order to use this method of communication, it is necessary to provide hardware equipment (computer connected to the network), software, and operator communication services. [1]

- EDI-based data exchange uses structured files. These files have different formats and not every format is suitable for use in any conditions. The most common formats are:
- XML - The structure of such files is readable for both computers and humans. it is very similar to HTML, but HTML is used to display data (used when writing web pages). The
advantage of XML is its ability to simplify sharing, transfer availability and compatibility between different platforms because it stores data as text without formatting. [3]

- JSON - a language for storing and transferring data in a structured form based on JavaScript programming language. It can be used in various other programming languages.

- CSV - data are separated by comma, or a predefined character. Similar to previous types, .CSV stores data as plain text without formatting, but compared to .XML or .JSON, .CSV files have a much simpler structure. [4]

Electronic data exchange brings a number of advantages over the classical form. First and foremost, when you exchange data electronically, time and work are saved because specific information is not needed to be entered multiple times. Data exchange takes place almost immediately after it is sent, so the time it takes to physically move documents can be used in a different way. The fact that there is no need to rewrite the data several times reduces the possibility of a false entry. In addition, the possibility of an error caused by a carrier in the form of loss or destruction of a document is also minimized. Electronic data exchange also increases flexibility in responding to customer requests.

3 PROJECT OF SYSTEM FOR RECEIVING AND DISPATCHING MATERIALS

The system is designed in MS Excel 2013. While the system works in newer versions of Excel, backward compatibility is not guaranteed as older versions may not support the features that were used to create this system.
The system works with external data that can be stored on the local hard drive of a computer, server organization, or cloud server. In practice, the most used method of storing on a particular organization's server, because storing on the hard drive of the user's computer is impractical and the use of cloud services is costly and reliability and security is not guaranteed. The proposed system works with data stored on the computer’s hard drive. These data are automatically loaded into the appropriate databases when opened. In addition, the data can be updated as needed. When work with the system is completed, the external data is updated depending on the changes. The cloud is used only as the data carrier from the NFC card simulating a particular material palette to the computer when it is received or dispatched.
Figure 5 shows the operation of the system. The first step is to pair the order with the delivery note. Subsequently, supplier data is added and the system starts loading NFC tag information and records it in the appropriate databases and updates the inventory status. In addition, it also archives all transactions and can generate the necessary documents.
CONCLUSION

The aim of the work was to design an autonomous information system in MS Excel environment using RFID technology, evaluate the efficiency and economic benefits of the proposed system.

The work includes a description of the system and its functioning to maintain its functionality. It uses NFC technology, which is significantly cheaper than RFID technology. However, it has some limitations that can be eliminated by further research.

Complete automation was not possible due to the limited tools available, but it is possible to automate the individual processes to a great extent and, compared to the system proposed in my bachelor thesis, the benefits of time saving, error minimization and barcode quality dependency are significant.

REFERENCES


Abstract

Shared passenger transport is becoming an important player in the field of passenger transport and a competitor of transport services in the future. This service has found its clients among people who do not want to own a car for some reason. This trend is most prevalent in densely populated metropolises, where traffic conditions are often poor.

Key words

shared transport, passenger transport, car, CO$_2$, Uber

INTRODUCTION

Shared passenger transport becomes a major player in the field of passenger transport and in the future also a competitor of transport services. This service has found its clients among people who for certain reasons do not want to own a passenger car. This trend is most advocated in densely populated metropolises, where the traffic situation is often poor. Cars are one of the most widely used types of mobility in today’s society. They provide a comfortable, flexible, and even private way to travel. Although private means of transport have many advantages, there are shortcomings. Most cars are stationary for a considerable part of the day and car ownership is expensive and many times even very inefficient. As the number of cars on the road grows, parking issues and CO2 and other emissions are also increasing.

The method of solving these issues could be in the sharing of cars, a kind of car rental for people who want to rent a vehicle for a short time or a small distance. Car sharing provides its users with the benefits of a private vehicle, eliminates fixed and unexpected costs and delegates responsibility for maintenance and repair to the service provider. Benefits are not limited to individual users by sharing vehicles. By sharing the car, the average daily active time of the vehicle is increased, and the time spent in the stationary state is reduced, resulting in the use of smaller number of passenger cars to meet all travel needs. Car sharing organizations use fuel-
efficient vehicles or even electric cars, which is also beneficial for the environment.

For individual and collective passenger transport, the means of transport and distance exceeded are decisive factors. In the context of transport, it is important to use practicality and minimize time losses. In the assessment, we must take the risks of the traffic situation and prevent them by selecting an adequate type of transport.

**KINDS OF TRANSPORT**

Individual passenger transport involves the transport of individuals, mostly by means of transport, which are in their personal possession or use of foreign or public transport means for a fee. The historically first automobile was patented by German engineer Karl Benz in the year 1886. It was a tricycle driven by an internal combustion engine. However, the development of electric cars began even earlier. Although the first electrically driven engine saw the light of the world already in 1835, the first electric vehicle was created only in 1898. It was created by Ferdinand Porsche (born in Vratislavice nad Nisou) and resembled a chariot that was placed in motion by an electric motor instead of horses. In 1899, the Belgian Camille Jenatzy, with the electric vehicle La Jamais Contente, surpassed the speed of 100 km∙h⁻¹ for the first time. From the beginning of the twentieth century in the US, electric cars dominated the vehicles with internal combustion engines [1].

**Non-motorized transport**: non-motorized transport is characterized by the non-use of fuel and motorized equipment. In the last decade it is very popular and supported by the cities and EU-funded projects. Its main positives are a healthy lifestyle, environmental investigation and the fight against civilization diseases.

- **Pedestrian**: Pedestrian transport is becoming increasingly popular especially at the beginning of the 21st century. With the building of pedestrian and recreational zones, cities are building with subsidies, they positively contribute to the healthy evolution of the population. Extensive locations such as city parks, walking and nature trails precede civilisation diseases.
- **Cycling**: The main advantages of cycling are the speed of short-haul transport, the main advantage is its independence from the current traffic situation. Another important point is the financial modeness and long-term sustainability of this mode of transport.

**Road**: Car transport is in the last decade on imaginary peak popularity and in the following period will be more likely to be in recession, due to its dependence on traffic situation and the number of cars that are now circulating. Shared passenger transport is unlikely to be affected by this recession, as the rate of return on shared means of transport is higher than in personal ownership and the market is a micro share.

- **Bus transport**: The characteristics of the bus service are basically clear, but there are also articulated buses, all two-part axles and also two-storey buses.
- **Catenary Passenger Transport**: in the trolleybus passenger transport is included mainly trams, trolleybuses and all means of transport using electric current on the contact routes.
- **Taxis**: Taxis, as everyone knows, transport services for one-time payment are mostly short distances and for individuals or small groups of people.
- **Non-Dispatch transport services**: One of the most popular non-dispatch taxis is Uber or Taxify. Uber is a service designed for transportation around the city and in a small
percentage of cases and beyond. The organization uses communication through an application dependent on the Internet connection in smartphones. The service is ordered and paid via the mobile application; the approximate price is known to the customer before the ride. Now Uber is the most widespread in the US and has occupied almost a hundred cities in Europe. You can't tell Uber's cars in the streets, these are unlabeled cars, they can only be found via the mobile app.

**Rail transport**: Rail transport is a rail service operated on a railway line. It is usually performed by a railway company. Against road transport, the rail transport is characterized by relatively low energy consumption, it is due to the low rolling resistance of the wheel and rail system. The difference between road and rail transport is also that the railway movement is fundamentally forbidden and allowed, conversely, in road transport, movement is always permitted and only, where necessary, limited or prohibited.

We divide rail transport into freight and personal. Although the development of road and air transport in the second half of the twentieth century has declined, the railway is still an important and virtually irreplaceable carrier of large volumes of materials (e.g. coal). Together with the construction of high-speed lines, the railway transport of people again becomes a competition for road and air transport between city centers at medium distances.

**Water transport**: Water transport is a mode of transport, which is ensured by boating in water streams (especially rivers), artificial and natural lakes, seas, oceans and artificial canals and canals, on the surface of water or underwater. We also include vessels on the air cushion, i.e. hovercraft moving above the water surface.

**Air Transport**: Air transport is one of the youngest types of passenger transport and demoles. In the course of its development, it has seen a dramatic boom that today, without it, international cooperation, tourism and trade can’t be imagined. Air transport is today the safest, most convenient and fastest way to transport people and has become indispensable for transporting many types of goods.

**Space transport**: space transport has a military, research and commercial segment. It includes launching of satellites for commercial and business purposes, such as telecommunications undertakings, others for military and research purposes. Also operations carried out by operators of space equipment, such as transport of goods and persons for the purposes of scientific experimentation and research. Kinds of cosmic means: unmanned spacecraft, space vehicles, piloted spacecraft, carrier missiles.

**Unmanned means of transport**: Nowadays, unmanned, non-pilot propeller planes of small size are becoming increasingly popular. Quadcopters or drones: Their greatest use is in the field of digital, graphic, geoinformatics and, more recently, logistical segment.

**Army unmanned Vehicles**: These are also kind of drones, but not propelling, but rather resembling fighter planes of smaller proportions, mostly equipped with weapons of mass destruction. These drones are widely used in foreign military missions, both for exploration and intervention.

**CURRENT SITUATION IN SHARED PASSENGER TRANSPORT**

**Definition**: Vehicle sharing allows people to rent a vehicle for a short period of time, while the cost of using them is based on kilometers or the time we use the service.
The first car-sharing service in Europe was the Witkar project in the Netherlands. The service had a total of 4,000 registered users. The lack of government support meant that Witkar could not continue after the experimental phase. Studies done at the end of the 20th century suggest enormous growth potential for vehicle sharing services. This potential has not been transformed into success. In 2015, the Dutch government first concluded partnerships with private companies such as Capgemini, Greenwheels and SnappCarto create a Greendeal 2018, initiative to create awareness, build and share knowledge, and launch pilot projects for car sharing. These types of cooperation are important for the growth of car sharing. Cooperation between the public and private resort is essential to create a successful vehicle-sharing service.

Modern studies recommend special organizational structures, adequate distribution and risk-sharing, and tools for building profitability assessments. Car sharing is growing across Europe. In addition to the Netherlands, other countries such as Switzerland show an increase in these services, with an above-average growth rate. Both countries supported vehicle sharing experiments. Germany is now also undergoing an increased rate of growth in shared passenger transport.

Although the concept of car sharing shows great potential, car sharing has not been as widely accepted as expected. It is not a lack of effort, as well as in Germany itself there are more than 100 companies that share cars. Companies try different approaches to customers. It is possible to distinguish more opportunities to improve the car sharing service and to gain a greater market share. For distance passengers travelling by private cars, car sharing is not interesting because of the cost and limitations of certain services.

A bike is another solution for short-distance shared passenger transport. Cycling bikes can usually be found at train stations where people can rent them for a certain amount of time. In the Netherlands, for example, bike sharing is the most popular. The initiative is owned by Dutch Railways. Their portfolio consists of simple bikes in recognizable colors strategically located near the train stations. This project had even such a success that the offer could not keep pace with demand. The only drawback is that you must always return the bike back to the station. Bicycle sharing is a major competitor to car transport, as it provides people with means of transport, from door to door.

Passenger transport can be divided into two main types on individual and shared. Shared transport is located in densely populated areas with proper or limited parking options. This is also the result of research carried out by specific companies doing business in shared passenger transport. These companies have established their activities primarily in major economically advanced western cities such as Toronto, Amsterdam, San Francisco, Bremen etc. The employees of the magazine Glotz-Richter found that in Bremen every fifteenth passenger car on the road is rental one. The government is actively trying to help and promote car sharing by reserves car-sharing parking spaces that increase every year. Newly integrated areas must comply with home regulations and are encouraged to integrate car-sharing into infrastructure. [2] This cooperation between the different parties has helped car sharing grow in more cities and is necessary. The demographics of users sharing cars currently exhibit many similarities in the behavior of partnerships between private and public entities.

More local governments are increasingly interested in integrating car sharing into their current transport infrastructure. For example, the municipality of Enschede in Germany wants to create a service that will allow employees to travel with shared cars, which will be used by other people during office hours. For companies sharing cars, these initiatives are a great way to increase the customer base.
The evolution of peer-to-peer carsharing in the Czech Republic (SmileCar, HoppyGO): The company SmileCar comes up with the so-called peer-to-peer P2P acronym, a carsharing platform that connects two groups of people – those who would like to earn to rent their cars, which are freely available, and on the other hand those who would like to borrow a car only when they use it, do not need to own a car, do not mind to rent it, because they know that it is for them more economically efficient. SmileCar creates a new community of like-minded people and a system of evaluation that helps to build mutual trust in this community. An essential element of the entire concept, which eliminates the risks of vehicle owners (damage, theft and other similar cases) is a unique system of vehicle insurance and liability, which has SmileCar enclosed with insurance company ČSOB Pojišťovna. At a later stage, SmileCar will also offer short-term rental without having to physically pass the keys. The whole system is built as much as possible in order to borrow not only cars, but also other kind of property, eg. Motorbikes or yachts.

TYPIC BEHAVIOUR OF PASSENGERS

Many people travel daily by public transport. For some it is a daily commuting, others use it to travel for personal purposes. People use public transport for a variety of reasons. A passenger travelling to work might want a quiet and undisturbed journey, while tourists might want to be able to land with their fellow passengers. Commuter does not need much information, because it remembers the trip, but the tourist needs more information, or an information map, to advise the station on which he wants to get off, not missed or not lost. This big difference in motivation, frequency and knowledge of passengers makes it impossible to create a system in public transport that suits all needs.

- **The behavior of passengers outside the densely populated areas:** passenger behavior in these areas is quite different, people here make much more use of motorized means of transport, even almost every one of them owns. The sharing of means of transport only works between Acquaintances and almost at all on a commercial basis. People in these areas have a greater need to possess a means of transport and are more slowly accustomed to changes and modernization in transport.

- **The behavior of passengers in densely populated areas:** due to the energy and spatial demands of transport in densely populated areas and its impact on the environment, this transport is heavily taxed and also charged. Passengers in densely populated areas are mainly used by public Transport, or by trolleybuses and buses. In large metropolises, people have even used bicycles to increase the intensity of emissions and restrictions on car movements in historic centers and expanding pedestrian zones.

- **The influence of high buildings on traffic situation in practice:** from acquired data we can create the following model situation. Consider as an example a house that has five above ground floors, on average here can live twenty people, the area around the house in the urban building creates parking spaces for eight cars. The owner decided to renovate the attic in the house, thus creating space for five more people. Let us be aware that these people will not have a place to park if every urban building is dealt with in this way. This example only describes the impact that only one floor difference is. The consequences of creating a fifty-meter tall building on the same surface of the structure are striking and will significantly affect the amount of use of cars in personal possession.
DEVELOPMENT PERSPECTIVES

So, let's go from the following table, where we have the development of the number of shared cars:

Tab: Development of the number of cars from year 2012 to 2018

<table>
<thead>
<tr>
<th>Year</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicles</td>
<td>9</td>
<td>16</td>
<td>32</td>
<td>90</td>
<td>213</td>
<td>344</td>
<td>1500</td>
</tr>
</tbody>
</table>

We can use different methods to extrapolate the development of the number of shared cars. The simpler (realized algebraic equations of low orders) do not give acceptable results. It is necessary to use polynomical functions of higher orders.

From linear regression you may notice that deviations from the real values are very noticeable. The coefficient of determination in the forecast for the next two years is very low. Based on the values obtained, it can be determined that a linear regression is inappropriate for this type of hypothesis. As already mentioned in the previous point, the linear dependence creates such a big mistake that it will be necessary to use a method of display using a quadratic function or a function of higher orders.

For the optimum line or curve, we boil the space that minimizes the sum of the squares' faces. Create squares with a vertex in the middle of a point and from a straight, opposite vertex, lying on a line. However, as we can see, the deviation is too large on average.

Polynomials of at least 4 are considered to be among the most complex polynomials used or higher. For our purpose we used polynomial 6. Order. There is a somewhat growing complexity here.

Exponential regression is a method to deal with the cases of additive functions that are often converted in a multiplicative function, such as Power or exponential function. However,
linearization of the logarithm of the functional regulation generally gives only a sub-optimal solution. [3]

CONCLUSION

Using statistical methods of regression analysis and the TREND function in Excel, I have created several hypotheses that could theoretically replicate the trend of the number of cars in the shared passenger transport in 2018 and subsequent years. This is, of course, an approximation that may be different as a result, as we do not have enough information to implement the analytical solution. This solution does not take into account legal regulations and legislation that could affect the trend and have the opposite tendency to projected growth. We also need to take into account the saturation of the market, which will significantly affect the annual increase in the number of cars in shared passenger transport at some point. In the finals, the curve should therefore begin to stabilize in a horizontal form when it reaches its maximum.

In order to assess the prospects of shared passenger transport, it is very likely to be argued that we are currently experiencing the so-called Boom and in the next few years there will be a saturation of the market at least in the territory of the Czech Republic.

If there was a positive externality on the part of the city, such as in the Netherlands-by creating parking spaces for shared passenger services, there could be a significant increase again.

The main enemy of the perspectives in the shared passenger transport is the property – "forced car ownership", affecting populations living in central and Eastern Europe, which are faced with the need to possess a means of transport. This phenomenon considerably limits the prospects for shared passenger transport.
All charts have a certain real basis, some more, some less likely. From my point of view, the most suitable quadratic function is to predict the number of cars in the shared passenger transport.

REFERENCES
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prof. Ing. Jozef Gnap, PhD., Žilinská univerzita, F-PEDaS, ved. Katedry silniční a městské dopravy, SK
prof. Ing. Jozef Majerčák, PhD., Žilinská univerzita, F-PEDaS, ved. Katedry železniční dopravy, SK
doc. Ing. Ivan Hlavoň, CSc., Vysoká škola logistiky, o.p.s., rektor Vysoké školy logistiky o.p.s., CZ
doc. Dr. Ing. Oldřich Kodym, Vysoká škola logistiky, o.p.s., prorektor pro strategii a rozvoj VŠLG, CZ

NÁZEV PŘÍSPĚVKU PROSÍME ZASLAT DO 18. 10. 2019, z důvodu sestavení programu.
PLNÉ TEXTY příspěvků zasílejte do uzavírky dne 19. 11. 2019.

Jaroslav Horečný, koordinátor projektu www.logistickymonitor.sk, tel.: +421 41 562 00 88