The analyse of automation level of logistic process in small and medium enterprises

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Abstract: The paper presents the results of survey research of 300 Polish small and medium enterprises. The project "The prototype of e-business service platform" was realized in cooperation with MaxElectronik company as a part of "Initech" Ministry of Science and Higher Education and founded by the National Centre for Research and Development based on the contract ZPB/8/67012/IT2/10. The research was focused on the identification of business process automation level. To analyze the automation level, the following business processes are identified: sales process, logistic process, human resource management process, financial management process. The main goal of the research was analyze of possibilities time reduction of the processes by implementation SAAS system (software as a service) in the enterprise. In the article only a part of the research is presented that is concerned with the automation of logistic process in small and medium enterprises.

Keywords: enterprise resource planning, business process, logistic process, modeling, survey research

1. Introduction

A model is an abstract representation of reality and therefore while developing a model we need to decide what we intend to model and how we are going to do it. Company modelling expresses our knowledge about a company, which is decisive regarding added value and should be shared [8]. Modelling enables describing and analysing organisational structure, processes, resources and corporate behaviour. Company modelling requires coordinating business and decision making processes [1],[6]. Company modelling encompasses the following elements:

- orders,
- products,
- business processes,
- resources:
  - technical,
  - information,
  - organisation and decisions,
  - human;
- time and cost relations.

To understand the way the company (or its part) actually operates, it is necessary to build a model for business processes in that company [4]. There are many definitions of business processes. In 1993, Hamer and Champy defined a business process as a set of activities converting one or several inputs into one output of certain value for the client [3]. A business process has its purpose and remains under the influence of various occurrences and other processes. Davenport defined a business process as a simple structured set of activities, designed to produce a specific result for clients and markets [2]. A business process can also be seen as a set of one or more linked procedures or activities, which together contribute to implementing the policy of a company. It usually happens in the context of the company's organisational structure which determines roles and functional relations. Yet another definition describes the business process as a set of interrelated functions limited by rules and aimed at meeting certain business objectives appropriate for a given company in time [5].

The article includes results of a research project, focused on analysis of business process in logistic area of small and medium enterprises. The project "The prototype of e-business service platform" was realized in cooperation with MaxElectronik company as a part of "Initech" Ministry of Science and Higher Education and founded by the National Centre for Research and Development based on the contract ZPB/8/67012/IT2/10. The main goal of the project was creating a prototype of digital platform (internet application software) that allows support small and medium enterprise management on the base of SaaS (Software as a Service) methodology. One of the most important parts of the project was survey research of 300 small and medium Polish enterprises to evaluate the automation level of business processes in area of sales, logistic, human resources and financial management. The results of the research in area of logistic are presented in this article. In the next chapter the model of business process, research assumptions and the structure of inquiry is presented. The results of the research and discussion are provided in the section 3. Conclusions are presented in the last section.

2. The model of logistic process and the survey research

The main goal of the research was requirement analysis of small and medium enterprises in area of automation (using information technology) of logistic process. To make the research, the set of operations of logistic process that

could be supported by a information technology are specified. The following operations were taken into account:

a. Registration of data of a new deliverer.
b. Preparation of enquiry of a deliverer.
c. Procurement preparation of materials, products and services.
d. Income of materials / products to warehouse.
e. Discount and updating of a stock value.
f. A shipping of goods for a customer.
g. Stocktaking.
h. Preparing of a transportation order.
i. Specification of materials/goods location in warehouse,
j. Specification of an optimal lot of delivery,
k. External spending to sales,
l. Creation of a stock planning,
m. Preparation of purchase projection,
n. Registration of purchasing document.

Figure 1 presents a model of the connections between the operations of logistic process. The structure of connected operations illustrates a model of logistic process realized in the information system of an enterprise.

The presented model of logistic process includes the set of operations that could be supported by a computer application used by enterprises.

Some of the operations could be completely automated (the time of the operations could be reduced to minimum) if an ERP (Enterprise Resource Planning) system will be used. For example if a user prepares a sales offer in the ERP system and a customer accepts the offer, the registration of sales order and later the invoice in the integrated software system is realized automatically because all the data from the sales offer are copied into the new documents (sales order or invoice). It means that the operation of invoice creation can be completed in few seconds. The analysis of the automation level of logistic process was made on the base of survey research. The statistical probe was estimated on the level of 300 enterprises. The number of enterprises (271) was estimated under the conditions that the statistical error will be below 10 % and the estimation error will be 5 times smaller then the standard deviation of defined collectivity [7]. The inquiry is consists with two blocks of questions. The first one includes the general questions and the second encompasses detailed questions about the operations of logistic process. It means that the respondent enterprises in first step fulfilled following general information:

- The name of the company,
- The business area:
  - production,
  - services,
  - trade,
- The company size
  - Micro,
  - Small,
  - Medium,
- Does the company use software to support business management?
- If yes, year of implementation.
- The branch.
- Number of localizations.

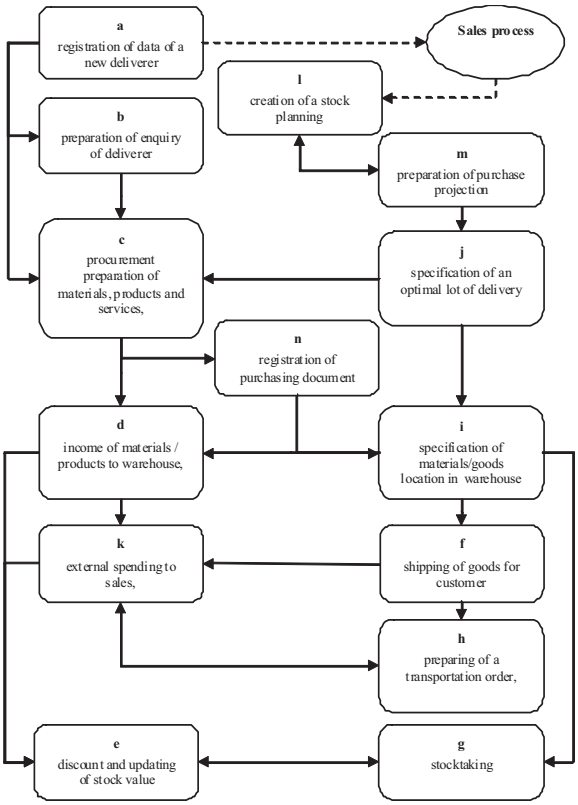

Fig. 1. The structure of logistic process realized in a information system. The source: (own study)

Rys. 1. Struktura procesów logistycznych realizowanych w systemie informacyjnym, (opracowanie własne)

The second part of the inquiry includes the detailed questions about the operations of logistic process that can be supported by the information technology. The inquiry was concerned with the operations listed above and encompasses the following subjects:

- Minimum operation time (in hours),
- Maximum operation time (in hours),
- Minimum number of the operation in a month,
- Maximum number of the operation in a month,
- The method of realisation (manually, in a computer system, outside of the company),
- The heaviness of the operation (1 simple – 5 heavy).

The survey research was made in small and medium polish companies according to directly interview methodology. The number of investigated companies in particular districts presents the fig. 2. The numbers of companies in every district correspond with the size of the district and total number of registered enterprises.

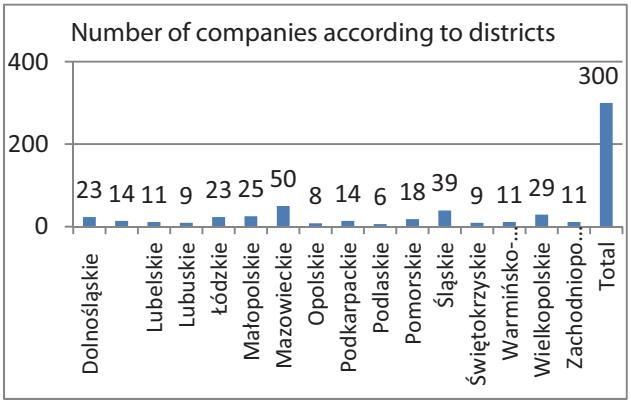

Fig. 2. The number of investigated SME located in particular Voivodships in Poland

Rys. 2. Liczba ankietowanych MSP w podziale na województwa w Polsce

The structure of size of the investigated enterprises is presented in the fig. 3. The most of the companies belong to micro enterprises that employ from 0 to 9 employees (140 companies).

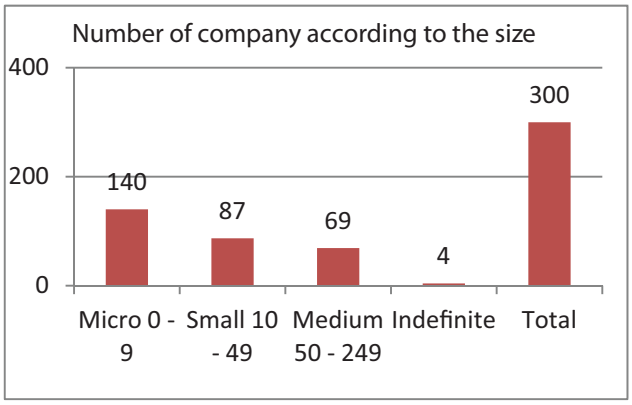

Fig. 3. The number of investigated SME according to the size

Rys. 3. Liczba ankietowanych MSP w podziale na wielkość przedsiębiorstwa

The majority of the investigated companies (227) declare using software that supports business management (see the fig. 4).

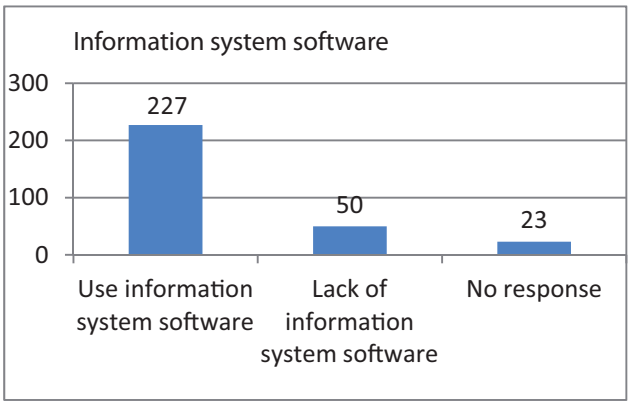

Fig. 4. The employment of information system software in the investigated companies

Rys. 4. Użytkowanie informatycznego systemu w ankietowanych przedsiębiorstwach

From the chapter shown in the fig. 4 results that even small companies use business management software. The further research shows that the great part of the companies use "island solution" (for example small software for material management, invoice preparing or MS Office software). The next figure (see the fig. 5) presents the implementation year of the software.

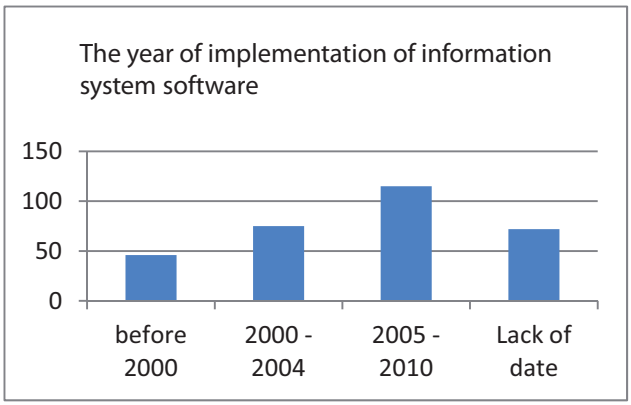

Fig. 5. The year of implementation of information system software

Rys. 5. Rok wdrożenia informatycznego systemu w ankietowanych przedsiębiorstwach

The research was made in 2010. If any company declares the date of the software implementation was 2005 it means that the company has 5 years experiences of using of the information technology in the business area. From the chapter presented on the fig. 4 results that 121 companies implemented the information system software before 2005 and 115 companies between 2005 and 2010 (relatively new implementations it was only 31 companies which implemented the software in years 2009–2010). It means that most of companies use the software long time and the logistic operations are well defined in the software.

The main results of the survey research in area of automation of logistic processes based on information technology are presented in the next chapter.

3. The results of survey research

In the chapter the particular results of the survey research are presented and discussed. The analysis of the survey results was prepared in the same way for every operation of the investigated logistic process.

3.1. Registration of data of a new deliverer

As a first operation of logistic processes investigated on the base of the survey research was – registration of data of a new deliverer. Every company that purchases materials and goods and uses information system software, have to register a new deliverer in the database of the system. The fig. 6 presents the scatter of results of declared minimum and maximum times of a new deliverer registration in the information system. All the time are presented in hours – for example the value 0,0167 hour means 1 minute.

For example the scatter plot presented in fig. 6 shows us that the great number of answers belongs into an interval from five the ten minutes. The time depends from the number of data that should describe of the new deliverer.

The next chart (fig. 7) presents the minimum time of preparing a purchasing inquiry. More than half of investigated companies not answer the question.

Fig. 6. The minimum and maximum time of a new deliverer registration scatter chart

Rys. 6. Minimalny i maksymalny czas rejestracji nowego zamówienia

The 87 enterprises estimate the minimum time between 5 and 30 minutes. It is relatively a lot of time for preparing and sending a purchasing inquiry. Additional 33 enterprises estimated the time as greater as 30 minutes. It means that the operation of logistic process has potential for automation and time reduction.

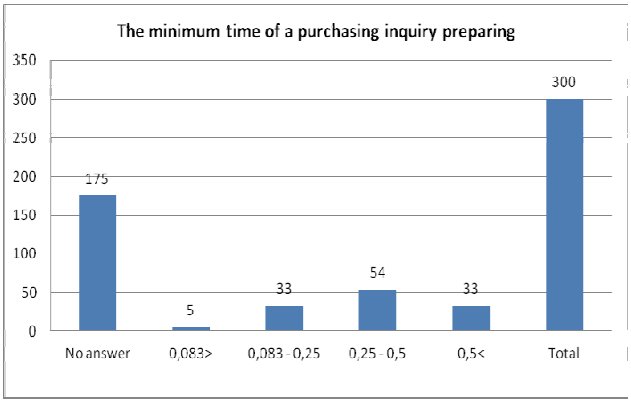

Fig. 7. The minimum time of a purchasing inquiry preparing

Rys. 7. Minimalny czas przygotowania zapytania ofertowego

In the fig. 8 the research of maximum time of procurement preparation of materials, products and services is presented. From the research results that 98 investigated firms (more then 30 %) need more then 0,5 hour maximum time to prepare a material order. To evaluate how strong the operation charges the logistic process it is important to determine what is the average frequency of the order material in the companies. The investigated firms specified minimum and maximum of number of material orders created monthly and the results of the research are presented in the figs. 9 and 10. For more than 30 % investigated enterprises the maximum and minimum number of procurement preparation of materials, products and services created in month is lower than 10. The minimum time of procurement preparation of materials, products and services preparing is for 208 investigated firms lower than 10 minutes and the maximum time is for 107 firms lover then 0,5 hour. If we assume that the average time of procurement preparation of materials, products and services is 15 minutes then the maximum labor intensity in month is 150 minutes (2,5 hour).

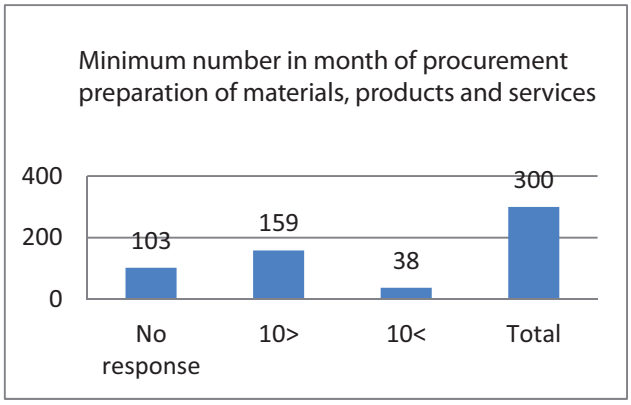

Fig. 8. The minimum number of procurement preparation of materials, products and services created monthly in investigated enterprises

Rys. 8. Minimalna liczba przygotowanych zamówień materiałów, produktów i usług, utworzonych w okresach miesięcznych w badanych przedsiębiorstwach

The maximum time (for 98 enterprises) of procurement preparation of materials, products and services is bigger as 0,5 hour and the maximum number of procurements in month (for 21 enterprises) is bigger as 50. It means that for about 7 % (21 from 300) firms the monthly labor intensity related to procurement preparation of materials, products and services can be greater than 3 full workdays (50 x 0,5 = 25 hours).

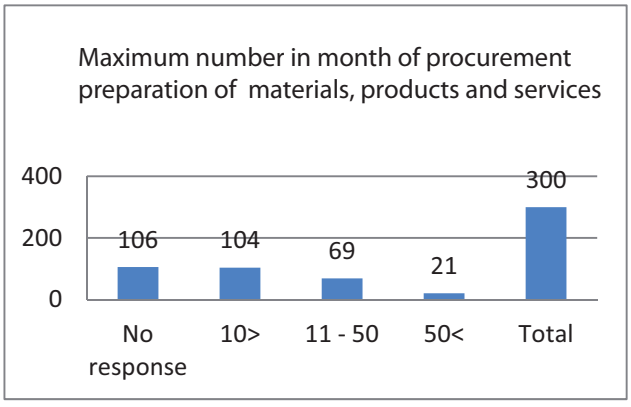

Fig. 9. The maximum number of procurement preparation of materials, products and services created monthly in investigated enterprises

Rys. 9. Maksymalna liczba przygotowanych zamówień materiałów, produktów i usług, utworzonych w okresach miesięcznych w badanych przedsiębiorstwach

The fig. 10 presents the chart of charge of material order preparing (response 1 means operation very simple, 2 simple, 3 normal, 4 difficult and 5 very difficult operation). More than 30 % of the enterprises gave no responses. More than 60 % regard that the operation is inoffensive but about 7 % of firms regard the preparing of material orders as time consuming (difficult or very difficult). The statistic corresponds with the earlier calculation. The inquiry research includes analyze of tools used for the support of the logistic process operations.

The fig. 11 shows the set of logistic process operations and tools to execution of the operations in the investigated enterprises.

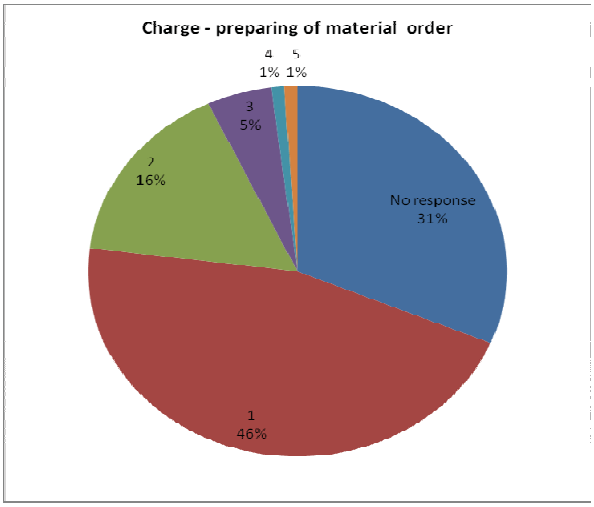

Fig. 10. The minimum number of material orders created monthly in investigated enterprises

Rys. 10. Minimalna liczba zamówień materiałowych utworzonych w okresach miesięcznych w badanych przedsiębiorstwach

For example, the operation: Preparation of enquiry of a deliverer is executed in 51 enterprises in MS Excel, 64 enterprises make it in other software system and 181 enterprises generally not made the operation. 32 enterprises declare that the labor intensity of the operation is greater than 10 hours in a month.

As the results of research hundreds analysis and figures was elaborated. Some of the results are presented in the section. In the fig. 12 the Minimum and maximum labor intensity of logistic process (for example).

From the graph displayed in the fig. 12 results for 44 investigated enterprises, the operations of logistic processes take less than 5 hours time and for 32 enterprise the maximum time of the operations of logistic process take 32 hours time. By maximum monthly labor intensity, 10 % investigated small and medium enterprises, service of logistic process need one employee in a month. 18 enterprises declare that the maximum monthly labor intensity of logistic process is greater than 100 hours in a month. Because the data of the enterprises are available, it is possible to identify in which enterprises the labor intensity of the business process is the greatest. Hence the relation between business branch and the labor intensity of the business processes could be found.

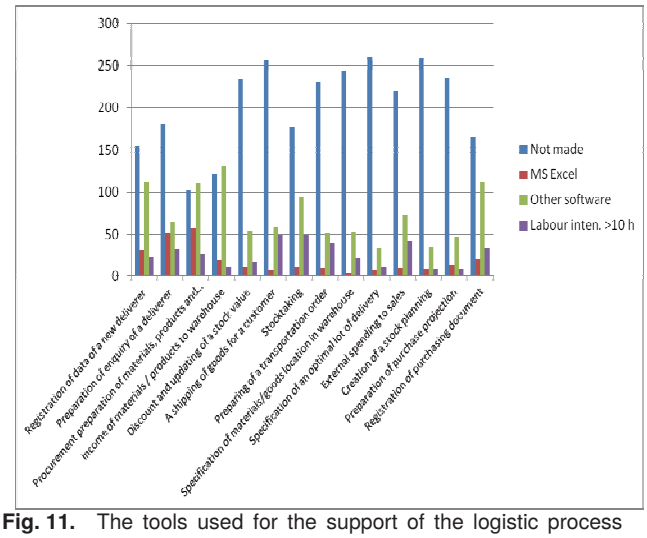

Fig. 11. The tools used for the support of the logistic process operations in the investigated SME

Rys. 11. Narzędzia używane do wsparcia operacji w procesach logistycznych w badanych MSP

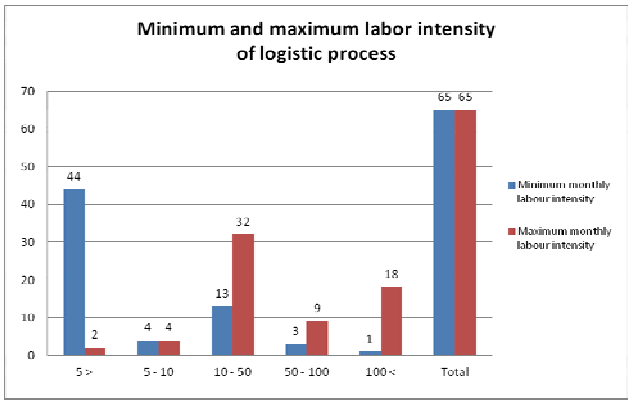

Fig. 12. Minimum and maximum labor intensity of logistic process in hours

Rys. 12. Minimalna i maksymalna intensywność pracy procesu logistycznego w godzinach

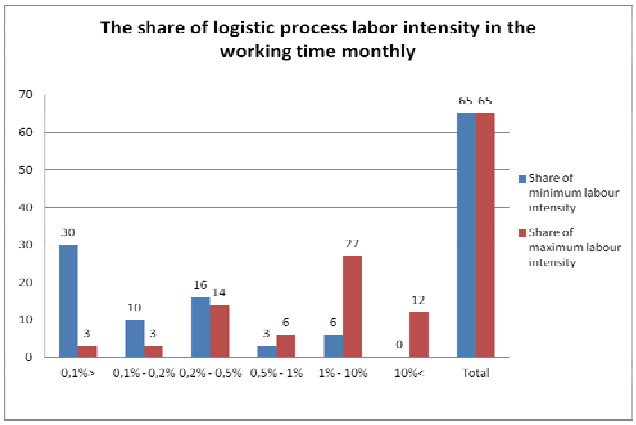

Fig. 13. The share of logistic process labor intensity in the working time monthly

Rys. 13. Udział intensywności pracy procesu logistycznego w czasie pracy miesięcznie

From the graph displayed in the fig. 12 results for 44 investigated enterprises, the operations of logistic processes take less than 5 hours time and for 32 enterprise the maximum time of the operations of logistic process take

32 hours time. By maximum monthly labor intensity, 10 % investigated small and medium enterprises, service of logistic process need one employee in a month. 18 enterprises declare that the maximum monthly labor intensity of logistic process is greater than 100 hours in a month. Because the data of the enterprises are available, it is possible to identify in which enterprises the labor intensity of the business process is the greatest. Hence the relation between business branch and the labor intensity of the business processes could be found.

On the base of the same data, a share of logistic process labor intensity in the working time monthly is presented in fig. 13. The chart displays how many percent of the working time (number of employees x 40 hour in month) is dedicated for the logistic process in investigated enterprises. For example, 12 firms need more than 10 % working time to service the operations of logistic process.

4. Conclusions

In the paper the research the results of analysis of logistic process in small and medium enterprises are presented. The main goal of the research was identification of possibilities of business process automation using SaaS software. The survey research of 300 enterprises results with enormous number of data which are analyzed to find relations between labor intensity of business processes and other rations which describe investigated small and medium enterprises.

From the research results that the majority of investigated small and medium enterprises don't use any software tools to improve operations of logistic processes.

The analysis of particular operations shows that there is a great potential of reduction of the operations time of the logistic process. However, the majority of the operations are regarded by the investigated enterprises as simple and the question should be given if the enterprises are interested in the time reduction. The labor intensity of the operations is not very great for the enterprises and the profits (costs reduction) that results from the automation of the process can be very poor.

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Analiza poziomu automatyzacji procesów logistycznych w MSP

Streszczenie: Artykuł przedstawia wyniki badań ankietowych 300 małych i średnich polskich przedsiębiorstw. Badania były realizowane w ramach projektu „Prototyp Platformy Usług e-Biznesowych" realizowanym w ramach Przedsięwzięcia Ministra Nauki i Szkolnictwa Wyższego „InniTech", finansowanym przez Narodowe Centrum Badań i Rozwoju w ramach umowy ZPB/8/67012/IT2/10 we współpracy z firmą Max Elektronik SA. Badania obejmowały między innymi analizę procesów w obszarze finansów, sprzedaży, logistyki, zarządzania personelem, opracowanie modeli procesów biznesowych dedykowanych sektorowi MŚP, analizy ilościowe stopnia automatyzacji oraz zapotrzebowania na automatyzację procesów biznesowych. W artykule przedstawiono część wyników badań dotyczących możliwości automatyzacji operacji procesu logistycznego realizowanego w przedsiębiorstwach sektora MSP.

Słowa kluczowe: systemy informatyczne zarządzania, proces biznesowy, proces logistyczny, modelowanie, badania ankietowe

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