

SUPPORTING OF MAIN LOGISTIC PROCESSES BY IT SYSTEMS IN ENTERPRISES OF AGRI-FOOD PROCESSING¹

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Abstract. In this work IT solutions used in logistics systems in agri-food processing companies were compared. Range of supporting logistic processes with IT system in agri-food companies in Poland is still insufficiently recognized. This sphere of activity may not efficiently function without the proper IT tools. This paper examined the scope of logistic processes supporting with using IT solutions. The largest range of IT support in the management of logistics processes was observed for inventory management, warehousing and transportation.

Key words: IT support, logistic processes, agri-food processing

1. INTRODUCTION

Information is usually defined in two ways. The first denotation is notification of something, communicating something, news, instruction, advice. According to the second definition, the information involves any factor that makes people or automated equipment to work more efficiently and intentionally [1]. An information product is then defined as a finite information set modeled in a specific language, on a relatively durable separated and identifiable material medium. The most common information products are books, magazines, compact discs of recorded information, etc. [2].

The information flow involves the movement of information between organizational units of the organization conducting further operations and communication with the environment (customers, authorities, media, contractors, competitors, etc.). The efficiency of information processes depends largely on the infrastructure used in information systems [3]. Logistics processes are often isolated on based on the functional division of the areas of activity of the organization (purchasing, production, distribution). Process approach in logistics

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focuses on coordination, while simultaneously integrating (merging) functions and sections implementing specific actions in the enterprise [4]. The main objective of the logistics process is to ensure proper efficiency of movement and adequate customer service while minimizing the costs incurred [5]. Meeting the objectives set is possible with the IT system, the tool which integrates data from multiple sources into a single stream of information [6]. The ADC (automatic data capture) techniques, with the use of bar codes or RFID facilitating the use of IT systems, are still hardly widespread in Poland. A large part of a recording operation is performed manually. The automation of data reading process allows gathering information in a real time in many areas of logistics [7]. In countries with a higher level of logistics development in companies, mobile technologies based on RFID [8] which should be included in companies that intend to participate in national or international supply chains, are more and more important. Reducing inventory and its costs often involves the cooperation with the use of CPFR (Collaborative Planning and Replenishment) as well, which requires efficient IT and telecommunication systems [9]. For many companies, the cost of their own IT systems may be too high, however, they may take advantage of software-as-a-service, that is information services outsourcing [10], often offered on IT companies servers as cloud computing. This allows lowering the cost barrier of IT solutions implementation [11].

Research companies, which support the measurement of efficiency and effectiveness of the companies, provide their own solutions in the following areas: data integration, expert systems of decision support, data mining and risk management [12]. The results of studies conducted in selected industries of agribusiness sector show that IT support relates to all areas of logistics. For instance, in case of grain companies the sphere relating to packaging management, reverse logistics was supported in a smallest degree [13]. In case of companies producing dairy products basic use of modern product identification methods was recognized as well as shortages in the scope of information integration in one IT system [14].

2. RESEARCH METHODS

The aim of the study was to determine the IT support of logistics processes in agricultural and food processing enterprises. The data were collected on the basis of surveys which were carried out from December 2009 to March 2010. The questionnaires were sent to all small, medium and large companies, operating in the food processing sector, based on REGON number [the National Official Register of the National Economy Units] and 1.5 thousand randomly selected micro-enterprises. There were 10 thousand enterprises in total. 511 responses were obtained (5.11%). The current study focused on the agribusiness sector enterprises,

which employed at least 10 employees. There were 438 companies in total, which included 311 small companies (up to 49 employees), 98 medium-sized companies (50-249 employees) and 29 large companies (more than 249 employees). The structure of companies is presented in Figure 1.

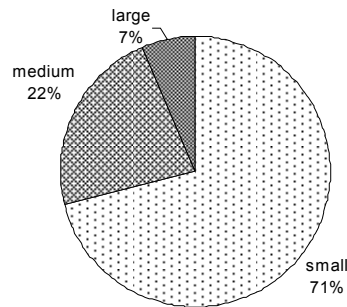


Figure 1. Structure of the enterprises surveyed .

The companies selected for the research of agribusiness sector included the following trades: manufacturing and meat processing, fruit and vegetable processing, production of oils and fats, manufacturing of dairy products, manufacturing of grain mill products and starch, production of bakery and farinaceous products, animal feed production, manufacturing of beverages, tobacco production and production of other food products. Most of the companies were baking and then meat processing companies. The number of companies of the various sectors is shown in Figure 2.

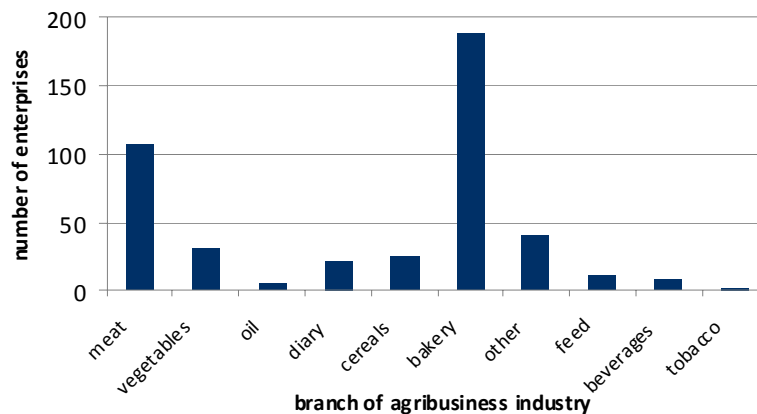


Figure 2. Number of surveyed enterprises in particular branches of agribusiness industry.

The questions asked in the survey related to the use of IT solutions in support of the core areas of logistics such as inventory management, warehouse management, transportation, packaging and information management. The questions related also to the type of IT systems used and their integration. A synthetic index of the level of use of IT in logistics management in enterprise was also prepared. These indicators range from 0 to 5 and the scoring was as follows:

- integrated logistics support through a single system - 1 point,
- supporting logistics actions in one of the five core areas - 0.2 point for each area, maximum 1 point,
- using electronic records of stocks - 1 point,
- electronic automated exchange of data with business partners - 1 point,
- using MRP, ERP, BI systems in any area of logistics - 1 point,

The analyses were carried out in a cross-sectional of the size of enterprises, i.e. for small, medium and large companies.

3. RESULTS

In surveyed companies, the basic area of business activity involves the production of food or feed products. The sectioning of the logistics area responsible for all areas of logistics has not always occurred. Only in 95 of 438 surveyed companies a separate logistics department occurred (22% of companies) dealing with managing of all areas of logistics. Organizational units responsible for individual functional areas of logistics functioned much more often. The units of transportation, storage and inventory management were sectioned most often (Figure 3).

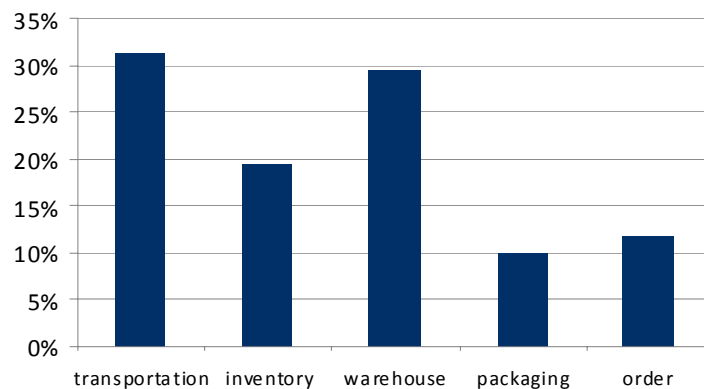


Figure 3. The share of companies with a separate department dealing with one of the areas of logistics.

The presented data show that in the researched companies the logistics activities were not of considerable importance. This is also reflected in the achieved results regarding the level of sophistication of IT solutions supporting logistics activities.

Separate logistics departments functioned more often in large companies. The above included also the frequency of separating small logistics units. This means that the communication level connected with the environment requires distinguishing the department responsible for organizing an efficient products supply and distribution system.

The research, regarding the scope of the use of IT logistics support, analyzed the functioning of information system in companies involving all logistic aspects. Such a system existed in 20% of the surveyed enterprises, including in 17% small businesses and in that 38% of large companies (Figure 4). Chi² test for independence of variables carried out, pointed to a statistically significant relationship between the size of a company and the use of a single IT system supporting logistics ($\chi^2_{emp.} = 9,47$, $\chi^2_{0,05} = 5,99$, p-value = 0,0088, df = 2).

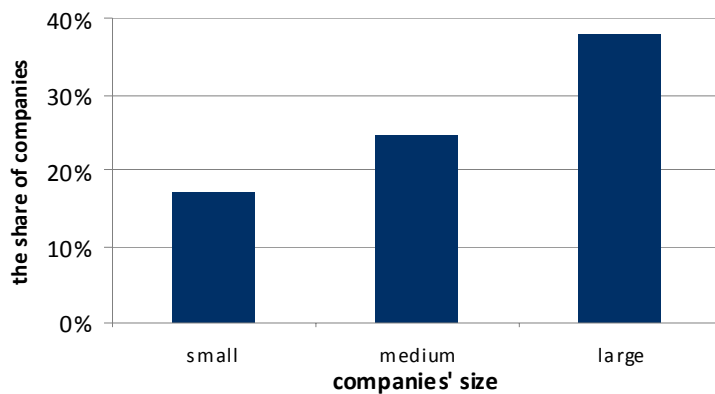


Figure 4. The share of companies with one IT system which supporting all logistics activities.

The study determined also the areas of logistics supported by IT systems which may also be integrated. The following areas were determined: transportation, inventory, packaging, warehousing management and orders management. Mostly, computerized areas included orders management, then warehouse management and inventory controlling (Figure 5).

The frequency of the use of IT systems in particular areas of logistics, increased proportionally to the increase of the company. In each analyzed area the IT support rate was significantly dependent on the size of the company (Table 1). Significant differences occurred between small companies and medium and large

companies. Probably the breadth of assortment, as well as the number of partners in small companies, were not significant enough to enforce the use of IT systems. Lots of small companies were still carrying out written records of inventories.

Table 1. Results of chi-square test for independence for occurrence of IT systems supporting particular logistics area in companies of different size.

Logistics area	Chi ² _{emp.}	Chi ² _{0,05}	P-value	df
Transportation	14,14**	5,99	0,0009	2
Inventory	39,11**	5,99	0,0000	2
Packaging	41,09**	5,99	0,0000	2
Warehouse	29,34**	5,99	0,0000	2
Order mgmt	8,67*	5,99	0,0131	2

Critical value: $\chi^2_{0,05} = 5,99$; $\chi^2_{0,01} = 9,21$

Table 2. The prevalence of IT systems to support particular areas of logistics

Logistics area	Company size			All companies
	small	medium	large	
Transportation	23%	38%	48%	28%
Inventory	26%	57%	59%	35%
Packaging	9%	32%	38%	16%
Warehouse	32%	57%	69%	40%
Order mgmt	37%	50%	59%	42%

The use of IT systems in inventory management was most common in large companies (Figure 5), although it was still over 15% of large companies, which kept written records of inventories. In case of small businesses, written (manual) records were carried out by 61% of companies. A significant increase of companies participation, in which electronic evidence was used, was noticeable together with the increase in their size. In large companies, about 31% used systems for automatic scanning and registering of incoming and issued logistics units from the warehouse. Most of them used a bar code technology regarding this scope.

Also the analysis of independent variables with the use of Chi-square test confirmed these clearly defined dependencies. The hypothesis of no relationship between the size of company and the way of inventory record was rejected ($\chi^2_{emp} = 40,53^{**}$, $\chi^2_{0,05} = 9,49$, p-value = 0,0000, df = 4).

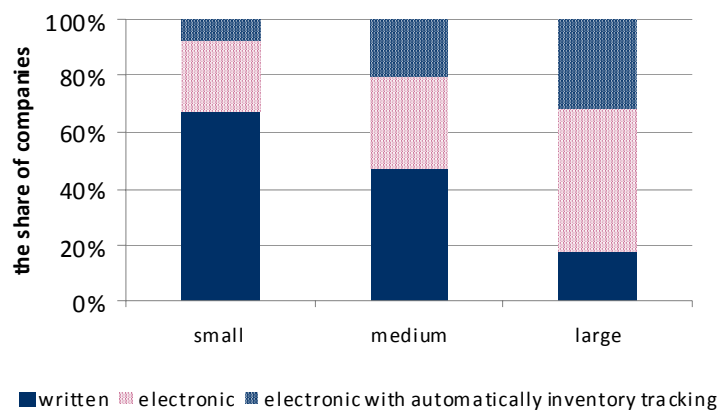


Figure 5. The share of companies with different inventory control system.

Another area of analysis was the communication with business partners, both suppliers and customers. Indicated in most cases the way of communication was communicating directly (in a personal way or by phone) as well as with the use of order sheet transferred directly, by fax or electronic mail. The use of electronic forms available with the record in the database was observed practically only in case of medium and large companies. As much as 69% and 28% of large sized companies used this form of communication with contractors. In large companies it was the most frequently used communication channel, while in small and medium-sized companies direct communication by telephone dominated. Also in this case chi-square test for feature independence was carried out and confirmed the dependence of communication channels on the size of the company ($\chi^2_{emp.} = 83,88$, $\chi^2_{0,05} = 21,03$, $p\text{-value} = 0,0000$, $df = 12$).

IT support in logistics processes may be implemented with the use of various kinds of software. In some cases, it may include simple financial accounting software for performing certain functions of inventory management. The study included the analysis of the use of information systems supporting logistics processes in companies.

The software which was indicated in most cases was FK [financial and accounting] class software and then MRP and ERP. In more than 13% of companies EDI modules were also used allowing for automatic exchange of messages (Figure 6).

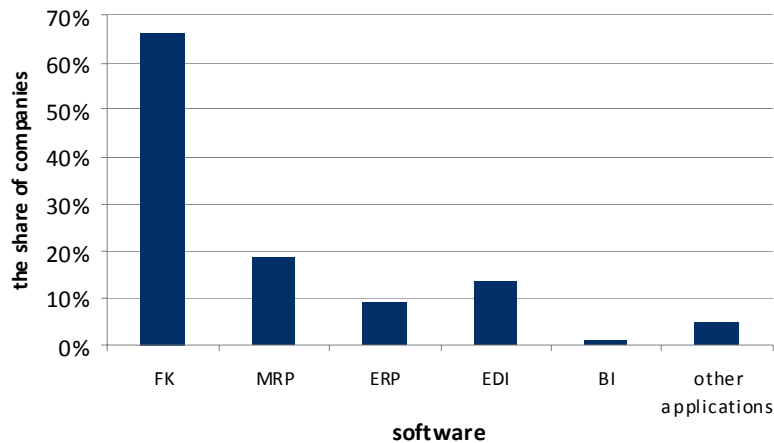


Figure 6. The share of companies with different software used in logistics.

ERP class systems occurred in just 5% of small businesses and in that 45% of large companies. MRP systems were slightly more common, used in 12% of small companies, 35% of medium companies and 41% of large companies. Chi-square independence test confirmed that the types of programs used in businesses to support logistics depend on the size of the company ($\chi^2_{emp} = 65,69^{**}$, $\chi^2_{0,05} = 18,31$, p-value = 0,0000, df = 10).

The surveyed companies indicated that the support of various logistics activities use various kinds of programs, which means that there is no integration of logistics activities, also in the scope of IT support. Dominance of FK programs used for IT support of logistics processes shows that most companies, especially small and medium-sized, do not look for comprehensive solutions which would allow supporting all processes in the enterprise. They are used during the use of already implemented functions in accounting programs. The study should be carried out in this aspect, which would show what the entrepreneurs expectations are regarding the software, especially those operating on a small scale.

The study asked also about investment plans for the future, including investments planned in IT systems. About 24% of all respondents said that they plan to invest in IT infrastructure and software. Such a response was obtained in case of 17% small, 38% medium and 48% of large enterprises (Figure 7). Similarly, only planned investment regarding warehouse and transportation means were indicated.

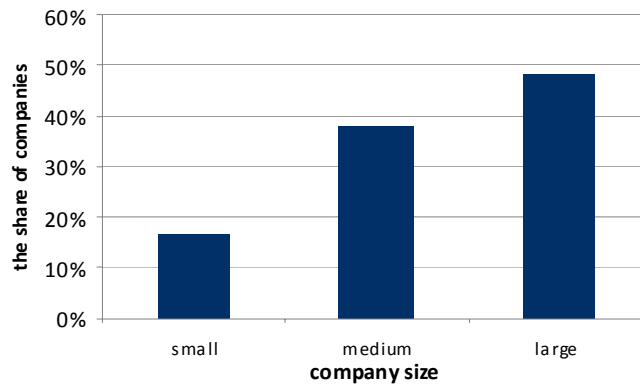


Figure 7. The share of companies planning to invest in IT infrastructure and software.

On the basis of selected characteristics on the use of IT in managing logistics processes, the index of the level of support of logistics processes with appropriate IT solutions was constructed. The index ranges from 1 to 5. Figure 8 presents an average index level resulted in regards to companies of varying sizes. In small companies the average ratio was 1.53, in medium-sized 2.23 and 3.34 in large companies, and the total for the companies surveyed was 1.81. This means that, on average, in case of small business in just one of the areas of logistics, a type of software, not dedicated to handling logistics, was used. Considering different number of the groups of companies, as much as 55% of surveyed companies was characterized by a low or very low level of IT solutions use in logistics, and only in case of 19% of companies an observed level could be considered as high.

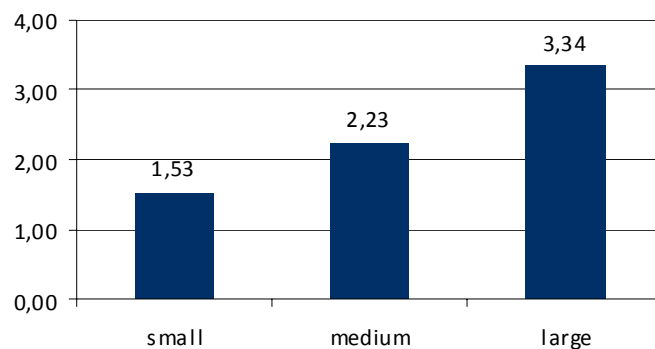


Figure 8. The average level of IT supporting index in logistics.

There were no companies included in a group of low-level IT logistics support among large companies, and in case of 60% of them the level was high (with the average index level of 4.28). In a group of small companies, as much as 65% of companies was observed to have low or very low level of logistics support with the use of IT solutions and the average rate for this subgroup was only 0.75. In a group of medium-sized enterprises, only 12% was reported as having very low level of IT logistics support. The test of feature independence carried out confirmed the diversity of companies based on the scope of IT logistics support. The level of IT support of logistics activity increased significantly, proportionally to the increase of the company size ($\chi^2_{\text{emp}} = 55,96$, $\chi^2_{0,05} = 12,59$, p-value = 0,0000, df = 6).

4. SUMMARY

The studies analyzed the scope and level of IT support of logistics operations in agribusiness enterprises. The analysis was carried out in a cross-section of the size of companies. It was found that the scope and level of the use of IT systems in case of logistics tasks is low. In terms of functionality, most solutions were used in such areas of logistics as transportation and warehouse management. Rarely one integrated IT system covering all aspects of logistics was used. It was present only in case of 20% of surveyed companies, especially large ones.

Strong relationship between the scope of IT support and the size of the enterprise was observed. In medium-sized and large companies, IT systems in logistics were used more often. The level of IT solutions in small enterprises was particularly low. They based mainly on their accountancy software to support logistics processes, such order management.

Among IT systems used for supporting logistics processes, financial and accounting programs were mostly indicated. Only about 20% of companies used MRP or ERP systems. The last ones were present in case of 17% of small, 45% of medium-sized and 86% of large companies. They did not always integrate a whole logistics activity.

There was no strong feeling of need to improve IT supporting of logistics processes in surveyed companies. Investments in the development of IT systems were indicated on fourth position after investing in transportation means, warehouses and warehouse equipment. This means that the enterprises feel mostly the shortages in the scope of physical logistics infrastructure.

The results obtained show that there are significant effectiveness reserves connected with the possibility of facilitating logistics processes (inventory optimization, transportation, reduction of losses) and cost reduction of the company. However, this requires improving the management of information flow within the company, as well as in the supply chain, which is not possible without the intro-

duction of complex IT solutions. According to the results of studies from different countries, the greatest barrier of modern IT solutions implementation are high costs, reluctance of employees and attachment to already existing, often partial, solutions. A possible solution, although still raising fears, is the outsourcing of IT services.

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