IT SYSTEMS SUPPORTING WASTE MANAGEMENT IN MUNICIPALITIES – RESEARCH RESULTS

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Abstract: When a new EU directive on municipal waste management was implemented in Poland over 5 years ago, there were practically no IT systems on the market allowing for comprehensive support of this process. Significant changes revealed a number of problems that the municipalities had to face and are facing today, trying to create an integrated system of waste management. IT systems used by municipal units before the amendment of the act have been proved insufficient to be able to efficiently manage the collection of waste from residents. The new regulations significantly influenced, among others, the process of information flow between entities in the waste management system. New participants in the municipal waste management process have been introduced, which from that moment has had to be dealt with by municipal units – the entire organization of the waste collection process and information activities in this area fell on the municipalities. This article presents the results of research on IT systems used in municipalities and its needs in this area. These surveys were carried out using a questionnaire sent to municipalities in the Silesian Voivodeship. Its aim was to identify the features and functions that should be met by the IT system, allowing for comprehensive management of the new municipal waste management system.

Keywords: waste management system, municipal waste, IT system, municipalities

1. INTRODUCTION

With the entry into force of the provisions amending the law on maintaining cleanliness and order in municipalities, municipal entities were required to manage the waste management system. In the light of the new regulations, the duties of municipal units have been added, among other things, to ensure proper operation of waste treatment installations, selection of entities receiving and managing waste from residents, supervision of the whole process and conducting information and educational campaigns (Pasak and Pikoń, 2018; Act of 13 September 1996 on maintaining cleanliness and order in municipalities). All these activities are characterized primarily by the multiplicity of information sent between the municipality and individual entities, and a large amount of data collected and processed (Stępień and Białecka, 2015).

Efficient and effective management of such a complex process, with many participants, is not possible without the use of appropriate IT systems. When new municipal waste management regulations were introduced, most municipalities were not properly prepared for this. There were practically no IT systems on the market that could support this process in a holistic way (Jąderko et al., 2016). Municipal units, in order to be able to carry out their tasks, had to support actions with many IT systems, but a large number of incompatible systems only hinders entrusted tasks. What, then, new IT systems should be characterized

by and what functions should meet to allow the municipalities fulfill the duties entrusted to them?

2. RESEARCH METHODOLOGY

The research presented in this article were focused on IT systems used by municipal units in the area of waste management. The aim of the research was identification of IT systems supporting the waste management system in municipalities and determining the requirements of municipal units regarding to a comprehensive IT system supporting their work.

The research used the online and postal survey method; the survey questionnaire consisted of 11 questions, including 4 metric questions (type of municipality, number of employees responsible for the waste management system, number of enterprises dealing with waste collection in the municipality and the time for which the contract was signed with the company). The first part of the questionnaire (first 3 questions) concerned IT systems used in municipalities to manage the waste management system, coordinate activities and support decisions in this area. The next three questions, included in the second part of the questionnaire, allowed to identify features and specific functionalities that the comprehensive IT system should have, and which a given municipal unit could use to support the tasks being performed. In the last question of the second part, the municipal units indicated whether they would be interested in such an IT system, and in the selection of the negative answer, they were asked for the short justification.

The questionnaire was sent to all municipal units involved in municipal waste management in Silesian Voivodship. The questionnaire was therefore sent to 167 municipalities (49 urban municipalities, 22 urban-rural municipalities and 96 rural municipalities). The feedback was at the level of 62% – 103 questionnaires were received in response, however, after preliminary analysis, 85 of them were used for further elaboration (18 questionnaires contained formal errors or were incomplete – the authors rejected them to prevent false results).

In the elaboration of the results, survey questionnaires were used from 29 urban municipalities (34%), 11 urban-rural municipalities (13%) and 45 rural municipalities, which gives 53% of all municipalities participating in the survey (Figure 1).
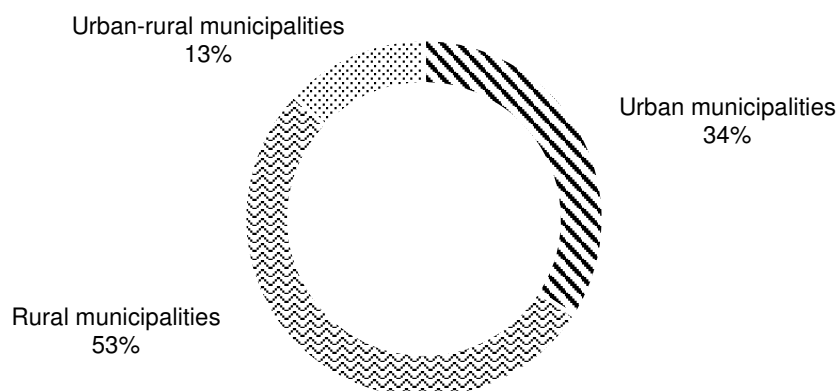

Fig. 1. The structure of the surveyed municipalities

The average number of employees in municipal unit was 5; among urban municipalities, it was average 8 employees, while in the case of urban-rural and rural municipalities, it was successively 3 and 2 employees. The average number of companies receiving waste from residents was 2. The average time for which a contract was signed with the company for

collecting waste from residents was 21 months (on average 22 months for urban municipalities, 20 months for rural municipalities and 26 months for urban-rural municipalities). The longest period for which such a contract was signed was 48 months, the shortest – 6 months.

3. RESULTS

In the first part of the survey, municipal units have been asked about the applied IT systems supporting the waste management system. In 85 municipalities, only 2 units do not use such systems – 83 municipalities use different types of software, often even 4 different IT systems. These are usually accounting and financial and registration systems, however, municipal units also have more complex systems, dedicated to the waste management system (several different modules) or monitoring of the transport fleet responsible for waste collection (often the software provided by the company collecting waste in the municipality). The figure below (Figure 2) presents the functions that IT systems used by municipal units have.
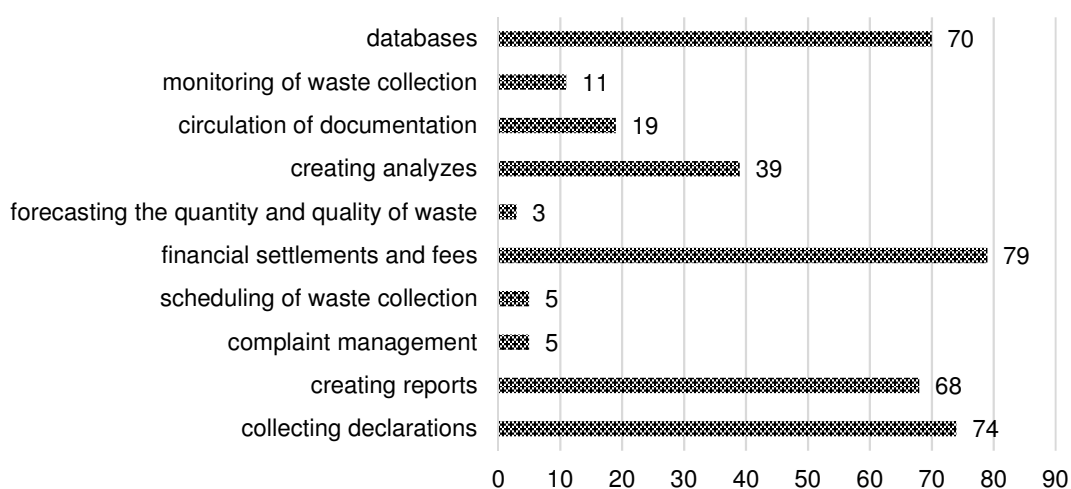

Fig. 2. Functions of IT systems used by municipal units

IT systems used in municipal units are mostly used for financial settlements and fees (79 municipalities use such software), collecting declarations from residents (74 municipalities) and act as databases (70 municipalities). The important function is also the creation of reports that allow municipalities to fulfill their reporting obligations. The least popular functions in used IT systems are: forecasting the quantity and quality of waste (only 3 municipalities have this kind of systems), scheduling of waste collection and complaints management (each of them indicated by 5 municipalities). These functions can be omitted due to the fact that part of the municipality transfers these activities to enterprises that collect waste.

The most frequently mentioned IT systems listed by the municipalities include:
- system Ratusz (producer: REKORD SI Sp. z o.o.),
- system GOMiG – Odpady (producer: ARISCO Sp. z o.o.),
- system ecoSanit (producer: LogicSynergy Sp. z o.o.),
- system EKOKOSZ (producer: GEOBID Sp. z o.o.).

Although these systems are widely used in municipal units, they are not the best in their overall assessment (Figure 3). In the assessment of IT systems, a 5-point Likert scale was used. Among the IT systems mentioned by the municipalities there are also systems used to monitor the transport fleet, such as the SMOK system or XTrack system, as well as other programs that only support the main IT systems (including the KSZOB system for settlements and bookkeeping).
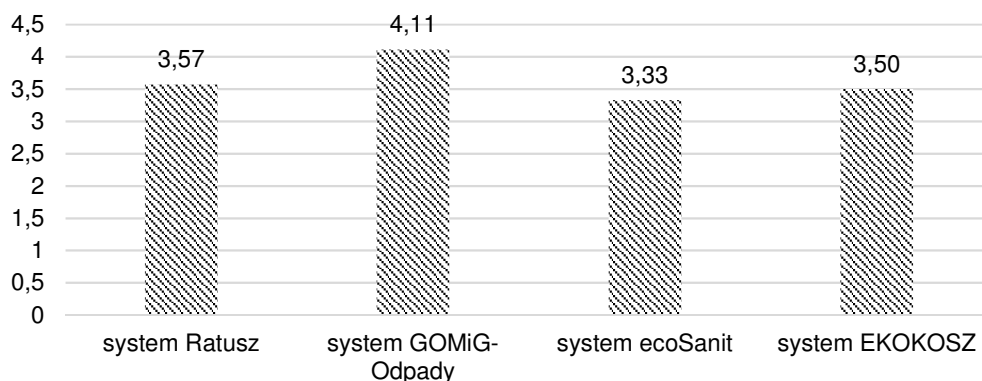
Fig. 3. Average rating of IT systems used in municipalities (selected systems)

The best in this ranking falls GOMiG – Odpady system, which is probably the most comprehensive software dedicated for units dealing with municipal waste management. It has many necessary functions and allows to use of additional software (see more: Stępień et al., 2015).

The first part of the questionnaire made it possible to identify IT systems used in municipal units as well as to indicate their basic functions. The second part of the survey questionnaire allowed to assess the needs of municipalities and specify what should a comprehensive IT system supporting municipal units in their tasks should be characterized by. In the first question of this part of the questionnaire, the municipalities have determined how important for them are the individual features that the IT system should have (here also authors used a 5-point Likert scale). The figure below shows the average weight of this features, calculated on the basis of indications of 85 municipalities (Figure 4).
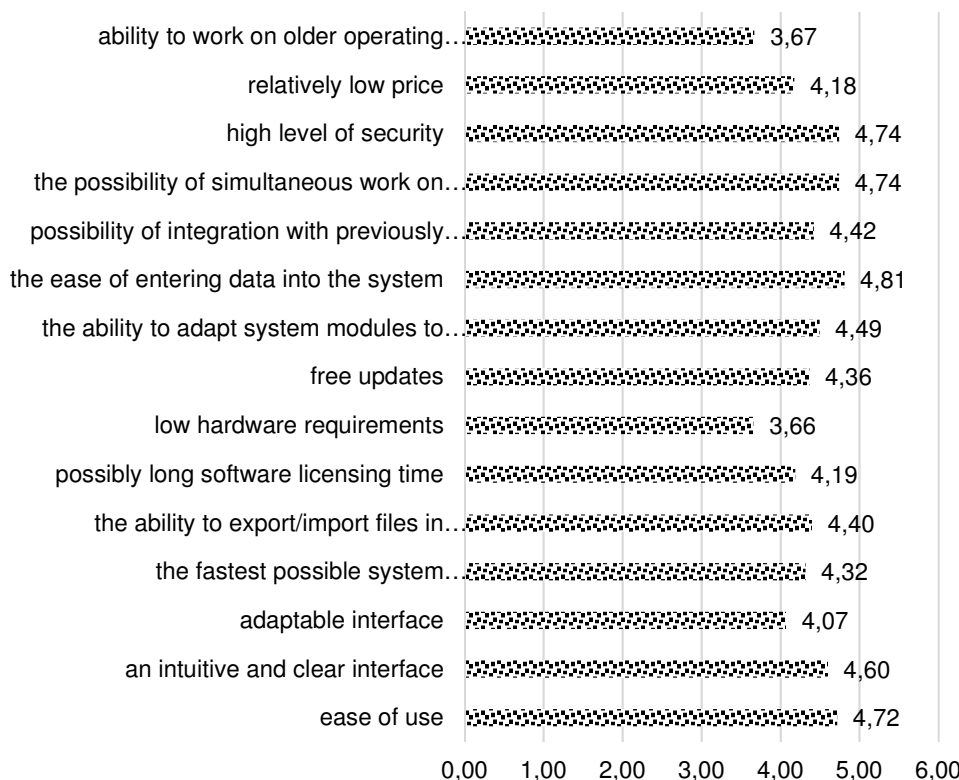
Fig. 4. Average weight of selected features characterizing a comprehensive IT system supporting waste management

Among the most important features that a comprehensive IT system supporting municipal units in managing the waste management system should be characterized by we can indicate: ease of data entry into the system (4.81), high level of security and the possibility of simultaneous work on several positions (both features at 4.74). The least important features are: low hardware requirements (3.66), the ability to work on older operating systems (3.67) and an adaptable interface (4.07).

A comprehensive IT system should be intuitive and quite easy to use, it should also meet all safety standards and be more on-line system than a program available only on one workstation. Municipal units also pay attention to the ability to adapt modules to their own needs and compatibility with other systems, which is extremely important in the case of an IT system that is to carry out many tasks. The survey questionnaire also included a question regarding the functions that should be provided to an IT system supporting waste management dedicated to municipal units (Figure 5).
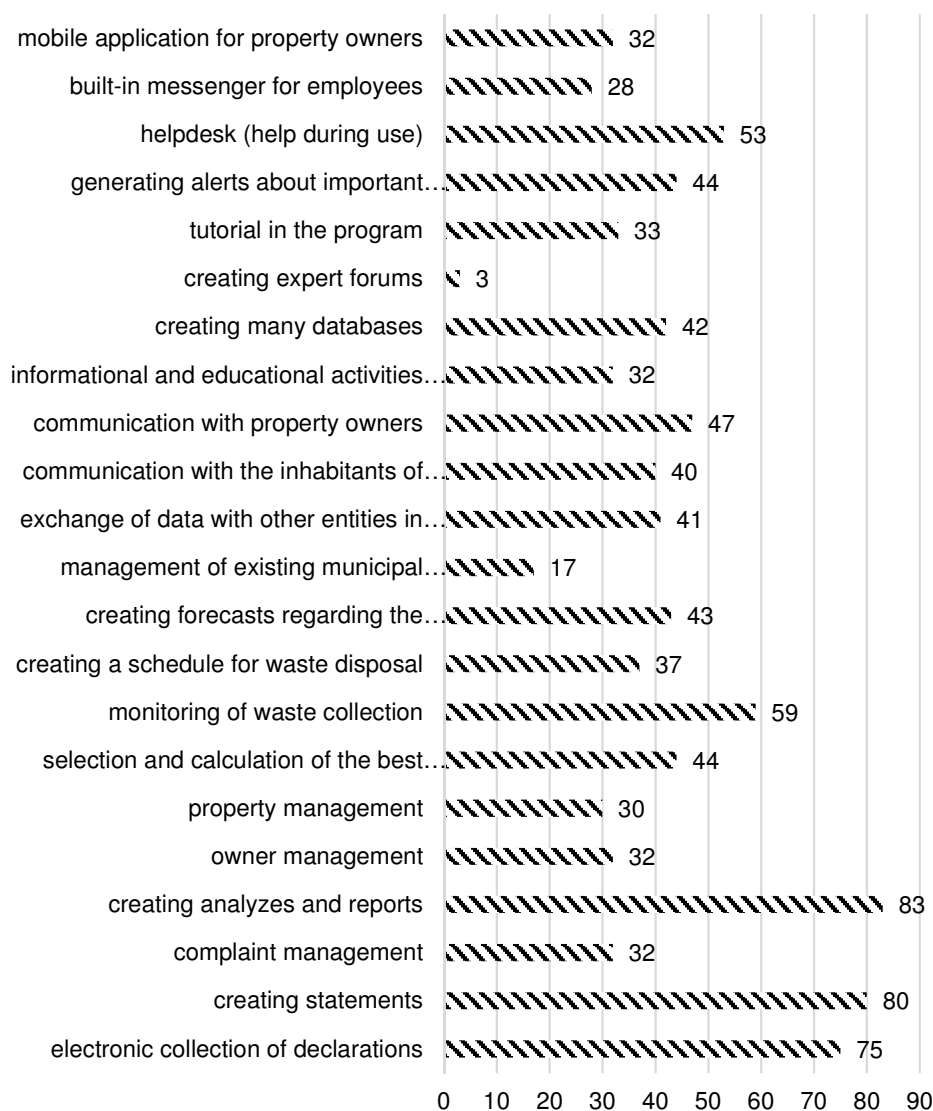
Fig. 5. Functions of a comprehensive IT system supporting waste management

According to the largest number of municipal units, a comprehensive IT system supporting tasks implemented in the field of waste management should allow the creation of analyzes and reports (83 municipalities), as well as statements (80 municipalities) and electronic collection of declarations (75 municipalities). Among other important functions, there were

also: monitoring of waste collection, helpdesk (as an additional function), communication with property owners, creating quantitative and qualitative forecasts of generated waste, data exchange with other entities. Among the least-indicated functions were: creating expert forums (only 3 municipalities), managing existing municipal infrastructure (17 municipalities) and built-in communicator for employees (28 municipalities).

The questionnaire also included a question regarding additional services that should be provided by the software producer. These include: technical/utilitarian training for employees prior to the implementation of the system (average weight 4.81), technical/utilitarian training for employees in the course of using the system (4.68) and technical service (4.78).

The last question addressed to the municipalities was the question of whether they would be interested in such a comprehensive IT system. As many as 51 municipalities expressed interest in such a solution. Among the municipalities most interested in such an IT system were rural municipalities (25 municipal units). On the other hand, the municipalities that chose the negative answer usually gave two reasons: lack of financial resources and possession of sufficient software for their needs. Interestingly, IT systems used by these municipalities in the overall assessment were not at all the best.

4. CONCLUSION

With the amendment to the law on maintaining cleanliness and order in municipalities, the municipal waste management system has completely changed. Municipal units have taken over the entire waste collection system from residents. In cooperation with waste collectors and property owners, municipalities are responsible for the functioning of the waste management system. In order to be able to carry out its tasks efficiently and effectively, municipal units use appropriate IT systems. As research has shown, the IT systems used by the municipalities are not sufficient, they lack a comprehensive approach to managing the waste management system. Most municipalities use several programs that are not compatible with each other – they lack many important functions that would significantly help the actions taken by municipalities.

A comprehensive IT system supporting the waste management system in municipalities should allow collecting declarations from residents, creating a variety of analyzes and reports, and also statements, as well as allowing communication with property owners and data exchange with other participants of the waste management system. According to many municipalities, such an IT system should also enable the monitoring of waste collection (inspection of the transport fleet of the company collecting waste in real time). A comprehensive IT system should be characterized by a high level of security, allow working on many workstations at the same time and be quite easy to use. It is also important to integrate with other systems and adapt its modules (subsystems) to suit your needs.

With the right functions and features, the IT system will actually support the work of municipal units. This will allow for efficient implementation of tasks to which municipalities have been obliged. In the light of the amendment to the law on maintaining cleanliness and order in municipalities, as well as relevant EU directives, efficient waste management process is crucial to ensure adequate levels of waste recovery, and thus closer to the circular economy (Baran et al. , 2016; Szafraniec, 2017, Cobo et al., 2018).

However, it should be remembered that designing such an IT system is not a simple task at all. An IT system that allows the management of the flow of a lot of information between many participants, as well as complicated activities on the collected data, must be designed with all due diligence (Milewska, 2015; Jąderko et al., 2016). The effectiveness of such an IT system will have a significant impact on the quality of services provided by municipal units (Wolniak et al., 2018) – ensuring efficient collection of waste from residents, as well as adequate recycling levels in accordance with EU requirements.

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