REGIONAL ASSOCIATION OF SOLID WASTE MANAGEMENT AGENCIES OF CENTRAL MACEDONIA

Title: e-Governance in Solid Waste Management of Central Macedonia

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Abstract

Solid Waste Management (SWM) represents one of the greatest challenges faced lately due to wastes' severe environmental externalities.

E-Governance in Public Administration is a way to provide faster, cheaper and better services. Implementing digital governance systems is putting in place a new contemporary management framework. Based on these, one of the digital transformation targets is the cloud computing services. At National level, one of the main goals of the Digital Transformation Bible 2020-2025 is the productive utilization of public data. Under this scope, the digitalization of SWM services will provide a real-time monitoring of their performance and efficiency, allowing improved and on-time decision making and preventive measures.

FoDSA CM in order to achieve an integrated monitoring and supervision of existing and new infrastructure based on the National and Regional Waste Manager Plan and because of the necessity to comply with more strict regulations and to provide valid, accurate and real-time waste management data, proceeded to the design and operation of an Integrated Monitoring Information System in SWM (IMIS-SWM).

The IMIS-SWM system operates online through a digital platform and is hosted in a cloud service. It is an online platform where waste management data from all facilities, services and activities of FoDSA CM are being collected and analysed. It enables the export and transfer of data in various ways (Excel, CSV, API etc).

Two systems, (the Basic System already applied and the new IMIS-SWM System), have been evaluated and criticized according to five variables, focusing on the benefits that every system provided. The outcomes have been analyzed and interpreted. As a result, the new IMIS-SWM system has proven to be more advantageous from all aspects.

Keywords: solid waste, cloud, data, monitoring, e-Governance

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1. Purpose

On 9 March 2021, the Commission adopted the Communication *"The 2030 Digital Compass: the European way for the Digital Decade"*. The Communication presented a vision, targets and avenues for a successful digital transformation of the European Union by 2030, *which is critical to achieve the transition towards a climate neutral, circular and resilient economy* [1]. The Digital Compass (the Compass) is part of the EU's 2030 Policy Programme "Path to the Digital Decade" and sets out a 10-years-long roadmap for Europe's digital transition. Generally, digital transformation is directly related with the transition to a sustainable economy, as the latter requires *smarter management of data*. In most cases the information exists, but is not available or easily accessed to those that could use it best. Digital technologies provide the possibility to tag, trace, localize and share data. The goals for the Digital Decade include among others:

- By 2030, 75% of European enterprises should use *cloud computing services*, big data and Artificial Intelligence (AI).
- By 2030, 100% of key *public services will be available online for citizens and businesses* [2].

The main idea is that online *government services* go beyond simple online forms, and technology enables advanced solutions for citizens. For example, interoperability across government levels could *increase efficiency in the public sector*; exchanging online information among different governments would facilitate mobility and help solve common issues, use of big data could improve life quality [3].

Additionally, one of the several policy actions underway within the Digital Single Market Strategy include the *Digital innovation for modernizing public services,* which allows public authorities to deliver services more quickly, more precisely, and more efficiently [4].

At National level, the Greek Ministry of Digital Governance recently presented a Digital Transformation "bible" for the years 2020-2025 [5] outlining a holistic digital strategy that was initially designed before the pandemic outbreak, it had though to move faster due to the urgent situation. The "bible" outlines the guiding principles, the strategic axes and the horizontal and vertical interventions that will lead to the digital transformation of the Greek society and economy. Through collaborations with stakeholders from the public and private sector as well as with the research & academic community and the civil society, the "bible" describes the objectives but also the implementation measures of the digital transformation strategy. *Integrated waste management and circular economy* are included in the strategic directions and objectives of the Digital Transformation Sectors. One of the tools included in the digital transformation is the Digital Waste Registry, which aims at the valid tracking and monitoring of waste management. The Digital Waste Registry (DWR) enables online procedures for registration and authentication in a database for companies (waste producers, transporters and waste recipients). DWR facilitates the users to fulfill their obligation of submitting annual waste report about waste generation, management and disposal, so as to both hamper the uncontrolled waste distribution and help the Ministry of Environment & Energy to apply the waste management policy according to the Law's 4042/2012 requirements.

The former president of ISWA, Mr Mavropoulos, stated in an ISWA Report that *governance is the key to unlock the benefits and restrict the problems of IND 4.0*. IND 4.0 makes necessary a revolution in governance in all the levels involved: international cooperation, national, regional, municipal and corporate and together with Global Warming and Circular Economy it is extremely necessary to put in place innovative policies, *technological disruption*, new business models and financial schemes [7].

Greece is characterized by a medium level of Penetration and a low level of Digitalization that is 19 percentage points below the European average, based on the e-Government Benchmark 2021. Therefore, Greece is part of the unexploited eGov scenario, a scenario that includes countries that might still be in an ongoing digitalization process [6].

Regional Association of Solid Waste Management Agencies of Central Macedonia (FoDSA CM) is responsible for the reduction, the treatment, the recovery and the final disposal of municipal waste, through contemporary environmental projects in line with the waste hierarchy. The Joint Ministerial Decision 2527/2009 [8], concerns the integrated solid waste management, according to the Regional Waste Management Plan, and in particular the specialization and implementation of objectives and actions for the preliminary storage, treatment, recovery and disposal of solid waste of his territorial jurisdiction. Members of the Board of Directors are representatives of 38 Municipalities of Central Macedonia, the second largest populated region of Greece, with a population of around 2.000.000 citizens.

Within this framework FoDSA CM is the competent authority for the operation of 15 waste management facilities in Central Macedonia Region and particularly:

1. Mavrorachis Sanitary landfill, Thessaloniki
2. Kilkis Sanitary landfill, Kilkis
3. Giannitsa Sanitary landfill, Pella
4. Edessa Sanitary landfill, Pella
5. Almopia Sanitary landfill, Pella
6. Litochoro Sanitary landfill, Pieria
7. Anthemounta Sanitary Landfill, Chalkidiki
8. Polygyros Sanitary landfill, Chalkidiki
9. Serres Sanitary landfill, Serres
10. Waste Transfer Station (WTS) of Western Thessaloniki (Efkarpia), Thessaloniki
11. Waste Transfer Station (WTS) of Sithonia, Chalkidiki
12. Waste Transfer Station (WTS) of Ierissos, Chalkidiki
13. Waste Transfer Station (WTS) Kiklis, Kilkis
14. Recovery Recycling Facility of Serres, Serres
15. Recycling facility of Tagarades, Thessaloniki

In line with the principles of Circular Economy, FoDSA CM is planning in the following years to include in the Regional Waste Management Plan two Recycling and Recovery Facilities (RRF) that will receive separately collected waste streams and also Biowaste Management Facilities to receive separately collected biowaste.

In order to monitor all these waste management facilities and fulfill the reporting obligations of waste legislation to national Authorities and to submit a yearly waste report to the Digital Waste Registry held by the Ministry of Environment and Energy, FoDSA CM had to develop extended datasets of waste details per facility.

Additionally, FoDSA CM estimates annually the pricing policy according to the new regulation (FEK 1277/B/15.04.2019). According to the regulation the annual levies are determined for the full recovery of the annual management cost. Therefore FoDSA is obliged to keep analytical records for all the waste treatment services provided, per Municipality based on the most recent annual data available [9].

These institutional obligations make the development of waste databases and the monitoring of waste data mandatory for FoDSA CM. The practice applied so far for the monitoring of waste data included time-consuming procedures, fragmented information, creation of multiple databases, difficulty in interconnecting datasets, and over-employment of staff to collect the data, to detect and correct errors and to ensure comparability and reliability of real time data (Basic System).

Therefore, FoDSA CM in order to achieve an integrated monitoring and supervision of existing and new infrastructure based on the National and Regional Waste Manager Plan and because of the necessity to comply with more strict regulations and to provide valid, accurate and real-time waste management data, proceeded to the design and operation of an Integrated Monitoring Information System in Solid Waste Management (IMIS in SWM). The digitalization of SWM services are actually online government services that go beyond simple online forms. Therefore, technology enables advanced solutions that will provide a real-time monitoring of performance and efficiency, allowing improved and on-time decision making and preventive measures. Eventually, the future of waste management will be reformed. E-Governance in SWM will consist a core component for all policies that are heading towards a more sustainable planet.

2. Methodology

Waste management seems to be moving towards a more integrated orbit in Central Macedonia. This is presumed as the following facilities are in Progress:

- Two Recovery Recycling Facilities in the Regional Unit of Thessaloniki.
- One Sanitary Landfill in the Regional Unit of Chalkidiki.
- Eight Biowaste Management Facilities in the Region of Central Macedonia, of which:
  - Two in Thessaloniki,
  - Two in Chalkidiki,
  - One in Pieria,
  - One in Imathia,
  - One in Kilkis and
  - One in Pella.
- Four Waste Transfer Stations in the Region of Central Macedonia, of which:
  - One in Thessaloniki,
  - One in Chalkidiki,
  - One in Kilkis and
  - One in Imathia

This progress will change both the quality and the quantity of waste related details that have to be properly processed by FoDSA CM. While the tonnage of waste generated remains almost unchanged, the tonnage of waste treatment increases remarkably as well as the relevant costs. The need for prompt collection, processing and storage of the relevant data is apparent. The necessity to improve the comparability, the transparency and the reliability of the data is imminent.

In order to criticize the IMIS-SWM System, we will compare it to the previous Basic System. Then we will examine the benefits and the results.

Till 2016 FoDSA CM offered only disposal services. Thus, the Basic System could satisfy the need for monitoring waste data. Since 2017 waste transfer and recovery services are also provided. Furthermore, in 2017 a new requirement has been introduced, set by the Central Government, concerning the exchange of data through the Digital Waste Registry. FoDSA CM had to optimize and automate the business process in order to improve the management, to cover administrative issues involving personnel from the highest to the lowest level, planning and implementation stages and all the waste treatment services provided at present and in the future. By 2019 it had been documented that the Basic System needed improvement and the following year FoDSA CM decided to integrate technological innovations in the operational process. The new system had to cover specific minimum requirements, include built-in functions and controls intended:

- To meet the requirements of management of each level (Monitoring Departments, Financial Directorates, Audit Authorities, Ministries and Municipalities, other Companies and of course the General Assembly)
- To ensure the appropriate correlations between the levels in question (to exchange data with the Digital Waste Registry, to estimate the Annual Waste Management Cost, to provide discounts according to the recycling performance of the producers and to determine the Pricing Policy of FoDSA CM)
- To allow the competent officials at each management level to check that commitments are being fulfilled effectively, to introduce modifications where necessary, to monitor the rates of implementation and to effectively assess the results.

At first, a wide range of on-site visits was needed with computer experts and analysts, in order to collect and interpret information. Then they had to develop a computer system, configure hardware and software, train end-users and ensure that FoDSA CM uses computer technology efficiently. Where the existing equipment was obsolete it had to be upgraded or replaced. In some cases internet connections had to be improved to speed-up the network. After the system implementation, software specialists collected and transferred large datasets from the Basic System to the New System and a trial period began which lasted 6 months. During the trial operation the system was tested, the properties and the functionality of the performance, as well as the technical conditions have been evaluated with real data. Security requirements have been verified. FoDSA's project manager was present during the trial operation to ensure the successful completion of this stage. The facilities adopted the system gradually one by one, putting an end to the diverging conditions of the Basic System. After the 6 month period, the normal operation of the IMIS-SWM began.

Hence, since 2021 the IMIS-SWM operates online through a digital platform and is hosted in a cloud service. It is actually an online platform where waste management data from all facilities, services and activities of FoDSA CM are being collected and analyzed. The technical characteristics of the system include and allow:

- Two factor authentication
- Backups
- Business Intelligence System
- REST API
- RFID System
- Export and transfer of data in various ways (Excel, CSV, PDF etc)
- Custom email server
- Electronic submission of details via the internet for interesting parities
- Retrieval of data with multiple search criteria
- A variety of options for data analysis and presentation, with tables, graphs and statistical tools, meeting requirements for updating, management and publicity
- Security logs and an audit trial which enables documentary evidence of the activities that could affect a specific operation, or device

The IMIS-SWM is scheduled to link and use the (open) datasets of the Digital Waste Registry to address the challenge of providing accurate information, which has been properly cross checked and therefore provides a high level of credibility, transparency in waste management and waste generation and fits for the digital age.

3. Results

The monitoring procedure is non - stop and particularly important for all the waste management facilities and the administration authorities. In Central Macedonia, FoDSA is responsible for the operation of 15 waste management facilities in the seven Regional Units.

To export results the two monitoring systems were compared *(Basic system and IMIS - SWM system).* The main criteria checked concern the following variables:

1. The number of employees
2. The calculation of person-hours
3. The personnel cost calculation
4. The number of datasets (worksheets)
5. The qualitative composition of the errors- Risk

3.1. Criterion 1: Number of employees

The number of personnel that FoDSA CM employs for collecting and processing weighing data in Central Macedonia is *forty seven (47)* (Table 1). The staff involved are:

1. weighers
2. supervisors of weighers
3. supervisor of business operation
4. supervisor of administrative operation
5. supervisor of financial operation

Table 1 lists all personnel involved in the two monitoring systems in all waste management facilities in Central Macedonia and for all the organizational operations. It should be noted that only FoDSA's regular personnel has been taken into consideration. No other third parties involved are included as they don't affect the study.

The *staff/facility* ratio for both the monitoring systems is the same *47/15= 3.1* with approximately three employees per facility working for the monitoring systems. The number of employees does not differ between the two systems.

Table 1. Number of personnel and facilities of FoDSA CM

<table>
<tr><th>Facilities</th><th>Weighers</th><th>Supervisor of weighers</th><th>Supervisor of business operation</th><th>Supervisor of administrative operation</th><th>Supervisor of financial operation</th></tr>
<tr><td></td><td colspan="5">Basic system and IMIS-SWM system</td></tr>
<tr><td>Mavrorachis Sanitary landfill</td><td>5</td><td>2</td><td rowspan="15">30</td><td rowspan="15">1</td><td rowspan="15">1</td></tr>
<tr><td>Kilkis Sanitary landfill</td><td colspan="2" rowspan="8">Third parties</td></tr>
<tr><td>Giannitsa Sanitary landfill</td></tr>
<tr><td>Edessa Sanitary landfill</td></tr>
<tr><td>Almopia Sanitary landfill</td></tr>
<tr><td>Litochoro Sanitary landfill</td></tr>
<tr><td>Anthemounta Sanitary Landfill</td></tr>
<tr><td>Polygyros Sanitary landfill</td></tr>
<tr><td>Serres Sanitary landfill</td></tr>
<tr><td>Waste Transfer Station (WTS) of Western Thessaloniki (Efkarpia)</td><td>4</td><td>2</td></tr>
<tr><td>Waste Transfer Station (WTS) of Sithonia</td><td colspan="2" rowspan="4">Third parties</td></tr>
<tr><td>Waste Transfer Station (WTS) of Ierissos</td></tr>
<tr><td>Waste Transfer Station (WTS) Kiklis</td></tr>
<tr><td>Recovery Recycling Facilities of Serres</td></tr>
<tr><td>Recycling facilities of Tagarades</td><td>1</td><td>1</td></tr>
<tr><td>Sum</td><td>10</td><td>5</td><td>30</td><td>1</td><td>1</td></tr>
<tr><td>Total sum</td><td colspan="5">47</td></tr>
</table>

3.2. Criterion 2: Calculation of person-hours

The above mentioned information indicates that there are no differences between the two systems. Nevertheless, if we take into consideration the person-hours spent by this personnel for each system we observe considerable differences.

In Table 2 we compare month-hours per staff involved in the two systems. The month-hours for the weighers remain unchanged, as this is an ongoing operation common for the two systems. On the other hand, month-hours for all the rest of the staff involved are reduced. Total month-hours for all the staff decreases by *23.6%* or by *1,034* hours in the IMIS-SWM system compared to the Basic system. If we exclude from our calculations the weighers, total month-hours decrease by *83.0%.* The business operation personnel appears to be benefited the most with a total gain of *87.5%,* followed by the supervisor of weighers with *84.6%* and administrative and financial operation personnel with *80.0%.*

Table 2. Comparison of person-hours (Basic system – IMIS SWM System)

Person Hours (h)	**Weighers**	**Supervisor of weighers**	**Supervisor of business operation**	**Supervisor of administrative operation**	**Supervisor of financial operation**	**Sum**
Basic System SWM (month-hours/person)	3.172	650	480	40	40	4.382
IMS-SWM (month-hours/person)	3.172	100	60	8	8	3.348
Difference of month-hours	**0**	**550**	**420**	**32**	**32**	**1,034**
Difference percent (%)	**0.0**	**84.6%**	**87.5%**	**80.0%**	**80.0%**	**23.6%**
Average month-hours - without weighers (%)		**83.0%**				

Figure 1, indicates total month-hours per employee. Excluding the weighers, all staff categories show a decrease in month-hours after applying the IMIS –SWM System.

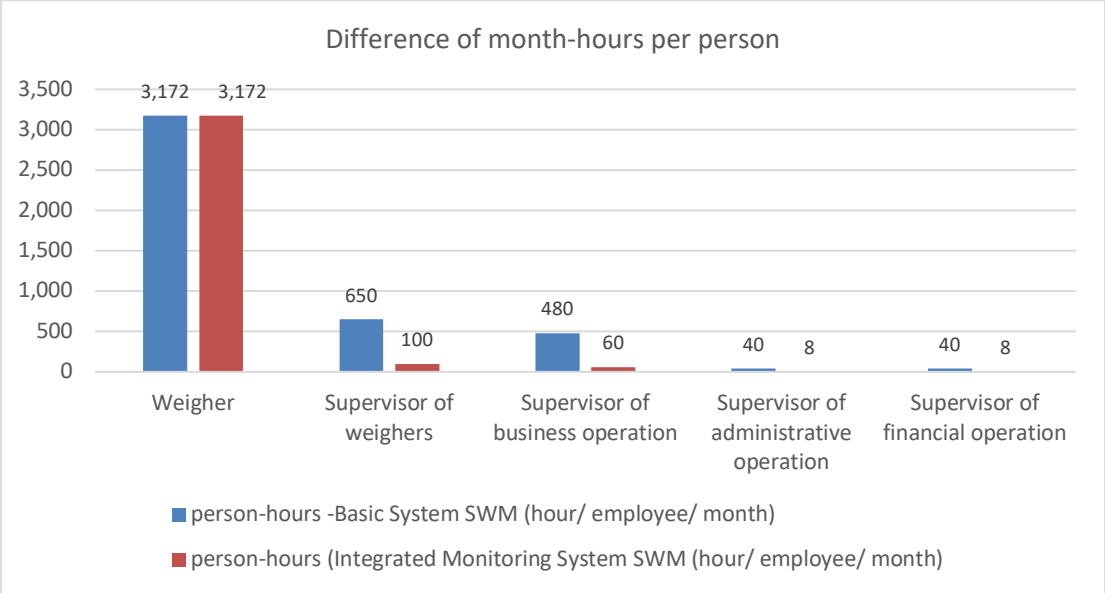

Fig. 1. Difference of month-hours/ person using two systems

3.3. Criterion 3: Personnel cost calculation

FoDSA CM benefits from using the IMIS -SWM system by 1,034 month-hours per person. Nevertheless, the 3rd criterion is of greater interest. For FoDSA CM the average personnel cost per hour for the year 2021 was *10.1€*. In Table 3, we compare personnel cost in the two systems. The economic benefit after using the new monitoring system is remarkable. The personnel cost decreases by *10,443.4€/month* or by *125,320.8€/year*.

Table 3. Personnel cost calculation in the two systems

System	Person-hours (h)	€/person-hours	Personnel Cost €/ month	Personnel Cost €/year
Basic System	4.382	10,1	44.258,2	531.098,4
IMIS-SWM	3.348		33.814,8	405.777,6
Difference	**1,034**	**10.1**	**10,443.4**	**125,320.8**

3.4. Criterion 4: Number of datasets

An important criterion to evaluate, is the number of datasets needed for each monitoring system. With the Basic System, for each waste management facility numerous primary datasets had to be prepared every month. These datasets were prepared by different staff categories and there wasn't any common template of uniform application for all these files. Each staff member used to prepare datasets according to his/her own convenience. The only common stage was that all datasets were computer generated files that contained information about waste management. The format varied.

The IMIS-SWM system requires a centralized database that is located, stored, and maintained in a cloud location, easy to be accessed by every interested party. Furthermore, this database can be accessed through various devices (computers, tablets, and smartphones), 24 hours a day, 7 days a week. In Table 4 we compare the number of datasets in the two systems. In the calculations we have taken into consideration datasets prepared by Municipalities, as they are highly involved in the procedure. The result indicates a total benefit of *705 datasets less per month* or *98% decrease* (Figure 2).

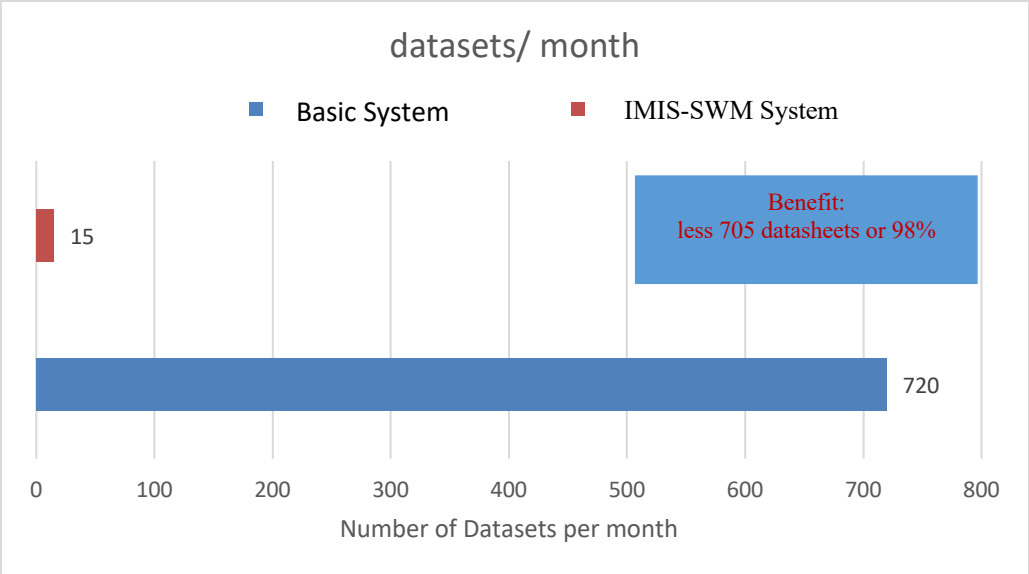

Fig. 2. Number of datasets using the two systems

Table 4. Number of datasets per month in the two systems

Facilities	Weigher		Supervisor of weighers		Supervisor of business operation		Supervisor of administrative operation		Supervisor of financial operation		Municipal personnel	
	Datasets/ month											
	Basic system	IMIS-SWM	Basic system	IMIS-SWM	Basic system	IMIS-SWM	Basic system	IMIS-SWM	Basic system	IMIS-SWM	Basic system	IMIS-SWM
Mavrorachis Sanitary landfill	**51**	1	**0**	0	**1**	0	**1**	0	**3**	0	**18**	0
Kilkis Sanitary landfill	**35**	1	**1**	0	**1**	0	**1**	0	**3**	0	**2**	0
Giannitsa Sanitary landfill	**38**	1	**1**	0	**1**	0	**1**	0	**3**	0	**4**	0
Edessa Sanitary landfill	**39**	1	**1**	0	**1**	0	**1**	0	**3**	0	**4**	0
Almopia Sanitary landfill	**36**	1	**1**	0	**1**	0	**1**	0	**3**	0	**2**	0
Litochoro Sanitary landfill	**35**	1	**1**	0	**1**	0	**1**	0	**3**	0	**2**	0
Anthemounta Sanitary Landfill	**36**	1	**1**	0	**1**	0	**1**	0	**3**	0	**2**	0
Polygyros Sanitary landfill	**36**	1	**1**	0	**1**	0	**1**	0	**3**	0	**2**	0
Serres Sanitary landfill	**42**	1	**1**	0	**1**	0	**1**	0	**3**	0	**9**	0
Waste Transfer Station (WTS) of Western Thessaloniki (Efkarpia)	**45**	1	**0**	0	**1**	0	**1**	0	**3**	0	**14**	0
Waste Transfer Station (WTS) of Sithonia	**33**	1	**1**	0	**1**	0	**1**	0	**2**	0	**2**	0
Waste Transfer Station (WTS) of Ierissos	**33**	1	**1**	0	**1**	0	**1**	0	**2**	0	**2**	0
Waste Transfer Station (WTS) Kiklis	**33**	1	**1**	0	**1**	0	**1**	0	**2**	0	**2**	0
Recovery Recycling Facilities of Serres, Serres	**42**	1	**1**	0	**1**	0	**1**	0	**3**	0	**9**	0
Recycling facilities of Tagarades	**31**	1	**0**	0	**1**	0	**1**	0	**0**	0	**0**	0
Sum datasets/ month	**565**	15	**12**	0	**15**	0	**15**	0	**39**	0	**74**	0
Total sum of datasets/ month with the Basic system	**720**											
Total sum of datasets/month with the IMIS SWM system	**15**											

3.5. Criterion 5: Qualitative composition of errors- Risk

The evaluation of the two systems included the risk variable. A qualitative analysis of the errors in the two systems. The errors that might occur when using the two monitoring systems concern the following factors:

1. Data entry of waste tonnage
2. Data entry of waste producer
3. Data entry of waste truck
4. Data entry of the debtor
5. Data entry of European Waste Code (EWC)
6. Data entry of waste transporter
7. Duplicate data entries

In order to criticize the risk variable we took into consideration two dimensions: the probability and the impact. The probability addresses how likely the error is to occur (the uncertainty). The impact details the extent of what would happen if the error materialized (the effect). Total risk is calculated as probability times impact. For both these two dimensions we took into consideration a 1 to 5 scale grading system as shown in the following tables:

Table 5. Probability Dimension

5	Almost certain	Greater than 90% probability that the error will occur
4	Probable	Probability between 75% -90% for the error to occur
3	Possible	Probability between 50% -75% for the error to occur
2	Unlikely	Probability between 10% -50% for the error to occur
1	Rare	Less than a 10% probability that the error will occur

For the impact dimension, the values from 1 to 5 correspond to the economic effect of the error.

Table 6. Impact Dimension

5	Maximum	Greater than 90% economic impact
4	Major	Between 75% -90% economic impact
3	Moderate	Between 50% -75% economic impact
2	Minor	Between 10% -50% economic impact
1	Insignificant	Less than a 10% economic impact

The probability and the impact dimensions for each error has been evaluated for both monitoring systems. Risk score equation is Probability x Impact. The risk score is being interpreted as follows and is shown in figure 3:

- Red flag *13-25 Unacceptable:* Immediate action required to control the risk
- Amber flag *9-12 Issue:* Action required to control the risk
- Yellow flag *5-8 Supplementary Issue:* Action is advisable if it is cost-effective
- Green flag *1-4 Acceptable:* No action required

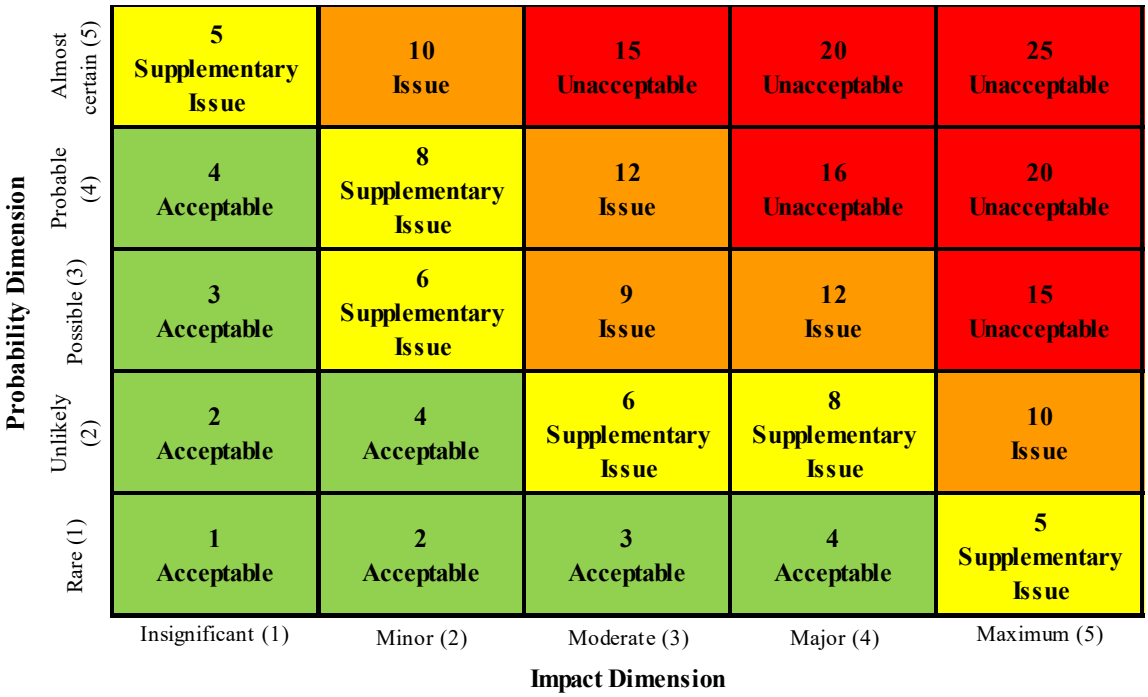

Fig. 3. Scoreboard

The risk assessment of the two systems has been calculated and is shown in Table 7. It is more than apparent that the risk variable in the Basic system ranges between amber and red area, indicating high risk, while the risk variable in the IMIS-SWM system ranges between yellow and green area, indicating low risk.

Table 7. Risk assessment of the two systems

Error factors	Basic system			IMIS- SWM system		
	Probability	Impact	Risk	Probability	Impact	Risk
Data entry of waste tonnage	3	5	**15**	1	5	**5**
Data entry of waste producer	5	5	**25**	1	5	**5**
Data entry of waste truck	5	3	**15**	1	3	**3**
Data entry of the debtor	3	5	**15**	1	5	**5**
Data entry of European Waste Code (EWC)	3	3	**9**	2	3	**6**
Data entry of waste transporter	2	5	**10**	1	5	**5**
Duplicate data entries	2	5	**10**	1	5	**5**

4. Conclusions and Recommendations

In Greece there isn't any common way for collecting, processing, monitoring and storage of data, nor a mandatory legislation, as waste management is locally organized by Waste Management Organizations. The most significant difficulty faced during the implementation period, was the fact that the IMIS-SWM system was the first cloud integrated database applied in FoDSA CM, so no prior experience existed. Furthermore, e-Governance in waste management in Greece is very recent, so we couldn't learn from others' experience.

4.1. Conclusions

FoDSA CM decided to optimize its business process by integrating technological innovations, as waste management represents a significant cost for Municipalities and citizens and is a key concern in National and European environmental policies. Furthermore, waste management is a significant component in delivering National environmental objectives.

During the implementation period we managed to avoid the pitfalls of digital transformation. Every person involved knew that technology causes only technological changes. The responsibility for successful transformation lies among the working team. We had well understood that new technological tools don't serve procedures the old way. We never underestimated the important role of administrative and executive personnel. We were focused on the final outcome not, on the software application.

The new IMIS-SWM system reflects FoDSA's digital policy and requires that every business, administrative and financial operation should comply with its properties, as all the information can be accessed at the same time from the same location and updates at any given set of data are simultaneously available to every end-use.

We evaluated the two monitoring systems and we criticized them according to five specific variables, focusing on the benefits that every system provided. The results have been analyzed and interpreted. As a result, the new IMIS-SWM system is more advantageous from all aspects. The outcome from all these results are gathered in the table 8:

Table 8. Disclosure of results per criterion between the two systems

Criteria	Basic system	IMIS-SWM system
The number of employees	47	47
The calculation of person-hours	4.382	3.348
The personnel cost calculation	44.258,2	33.814,8
The number of datasets (worksheets)	720	15
The qualitative composition of the errors- Risk	Red and Amber area	Yellow and Green

Overall, we found that e-Governance in Solid Waste Management through the IMIS-SWM system, is reflected to varying degrees of waste management procedures and its coverage and application in every organizational operation is intense.

4.2. Recommendations

FoDSA CM should assess the scope for strengthening the integration of the IMIS-SWM system into other areas of organizational operation like the Business Plan and the Regional Waste Management Plan.

FoDSA CM established the IMIS-SWM system based on the European 2030 Digital Compass and the National Digital Transformation "bible". We found that with respect to the personnel involved, the month-hours for the weighers remain unchanged, as this is an ongoing operation common for the two systems. Nevertheless, the experience gained so far on the IMIS-SWM system, although very short, indicate gaps in the computer literacy across weighers. With the use of the new system, their work routine has become more demanding. Therefore, their

job description has to be rescheduled and actions regarding the up-skilling of the present weighers should be taken. FoDSA CM has not been able to address this shortcoming.

After one year of full operation of the IMIS-SWM, FoDSA CM should start considering the connection and the interoperability of the system with other National databases like the Digital Waste Registry and the Digital Environmental Registry (the Digital Waste Registry is already interconnected with Taxisnet).

E-Governance is highly dependent on network connectivity. The slower the internet connection is, the longer the database access time needed will be. FoDSA CM should ensure that internet connection will operate non-stop and with high speed. Otherwise bottlenecks might occur leading to high traffic.

Another important step that FoDSA CM should take into consideration is to gradually transfer historical data of the previous years from the Basic System to the new IMIS-SWM system, in order to have integrated information under one single database.

The quality of a country's governance and public administration is a key factor in its economic performance and the wellbeing of its citizens. Efficient public administrations serve the needs of citizens and businesses. It is essential that public authorities are able to adjust to changing circumstances. The digital transformation of public administrations is a way to provide faster, cheaper and better services. E-government improves efficiency and increases user-friendliness and accessibility [10].

With respect to the digital transformation, although many steps are yet to be addressed, e-Governance in Solid Waste Management of Central Macedonia is already in progress as shown in Figure 4.

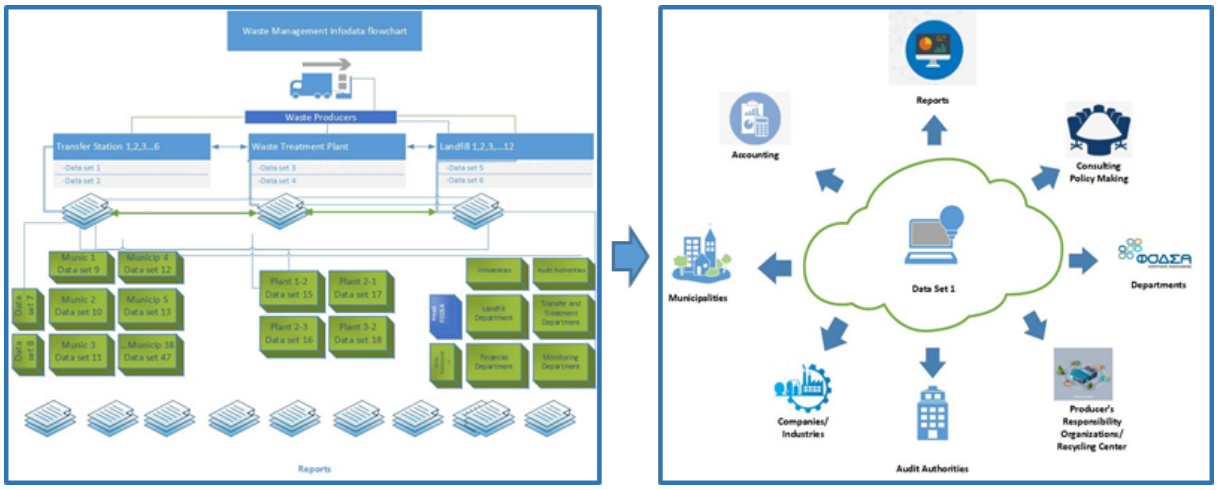

Fig. 4. Waste monitoring before and after the IMIS-SWM system

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