The use of Social Platforms as a part of a strategy for improving collection and recycling rates in local communities

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Keywords: social platforms, ICT tools, collection, and recycling.

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ABSTRACT

The technology-enabled ability for anyone, anywhere to be connected to the web, and to capture, create, and share content and information in real time through social media, has permanently transformed the way humans communicate. It has also created ongoing opportunities and challenges for individuals, businesses, governments, and local authorities around the world.

At the same time, innovation has become vital to European competitiveness in the global economy. The EU is intensively implementing policies and programmes that support the development of innovation in order to increase investment in research and development, and to better convert research into improved goods, services, or processes for the market. Applying innovation in waste management procedures is a part of this philosophy, and addresses the modern needs for ICT compatibility and use within the cities.

In this paper, we will answer three questions that connect sustainable waste management, local authorities and Social Platforms – why local authorities should use social platforms for engaging their citizens, improving their collection and recycling rates, how local authorities should use them, and what are the best social platforms practices that exist today and could be used by local authorities to succeed their waste management targets.

For the purposes of this article, the term "local authorities" includes local, municipal, county, regional, and national governments, and their waste management agencies and departments.

Although local authorities are investigating all practical and financial parameters when planning their waste management strategies, they usually do not pay much attention on how to engage successfully the citizens in adopting prevention and recycling behaviours.

The development of social ICT platforms can help significantly waste management practices at a local level. Social platforms can provide to citizens the ability to learn more about the waste management issues, share their opinions with other citizens, and interact actively with their local and waste management authorities, providing valuable feedback.

Specifically, social platforms nudge people to incorporate better recycling habits into their daily routines, discover how to recycle, how to dispose of their waste, new ways of recycling to enhance current recycling habits, can increase citizens' awareness and promote e-democracy and citizens' participation.

The paper presents also the example of a social platform created for the citizens of the municipalities of Chania in Greece, and Seville in Spain, which use ICT tools to optimize waste collection and increase recycling. The conclusions could be useful for other Municipalities which wish to integrate ICT tools for improving their waste management practices, and investigate ways to increase citizens' participation in recycling and prevention.

1. INTRODUCTION

1.1 Background:

After the adaptation of the Waste Framework Directive (2008/98/EC), which clarifies the definition of recycling and reuse, EU members are committed to higher recycling targets and are encouraged to source separation of organic fraction of waste. The achievement of such goals is really difficult to be accomplished in a nationally level, unless there is a systematic and constant effort from all local authorities and stakeholders, giving emphasis to the close interaction with the citizens. Local authorities thus should develop a comprehensive strategy to deliver an efficient and cost effective waste management system that rely less on landfills, or dumping sites, and focus on improved resource recovery processes [8] using tools for raising citizen participation and awareness, achieving in that way faster and more efficiently the national goals and the requirements of the EU legislation.

At the same time, innovation has become vital to European competitiveness in the global economy. The EU is intensively implementing policies and programmes that support the development of innovation in order to increase investment in research and development, and to better convert research into improved goods, services, or processes for the market. Applying innovation in waste management procedures is a part of this philosophy, and addresses the modern needs for ICT compatibility and use within the cities.

Interconnectivity and information flow through various types of modern means create new opportunities for cooperation and ways to work, and waste management could not stay unaffected [2]. ICT technology in the waste management sector can become a powerful tool for the implementation of EU legislation, as it can be the mean for the adaptation in practice of the EU Waste Framework Directive and help achieving the sited goals. Former traditional waste management practices have already started to change, and new opportunities have aroused, by giving local authorities the possibility to increase citizens' awareness in waste management and recycling practices.

Informative and communication technologies and mainly mobile communication technologies are diffusing in a great pace all over the planet, faster than any other communication technology to date [6]. This development is carving a new era that affects human behavior and global governance. National and regional governances can take advantage of this power of influence, which the new informative technologies incorporate, to create successful recycling programs.

More in particularly, the success of a recycling programme depends on the active and sustained participation of citizens in the correct separation and collection of recyclable waste. Such behaviour is not effective, unless there is knowledge and raised awareness from the citizens on recycling issues.

Despite the general perspective that governmental bodies are the only responsible to offer best services and keep areas clean, citizens are a key stakeholder in any waste management plan. Recent developments and analysis do prove that any waste management system that does not consider the social aspect is doomed to fail [4]. In order to have an efficient and well-functioning waste management system it is important that the public understands and supports it, thus citizens should be considered as an integral part of the system.

People are not generally aware of the risks posed by inefficient waste management practices, due to the lack of clear and focused studies which well disseminate and demonstrate the connection between the impact of wastes and waste management to human health and the wider environment [4]. Publishing and making available to citizens the so far hidden, or uncollected data, regarding environmental issues can raise awareness, get them involved, and reveal the severity of environmental problems, which can lead citizens to a more active role. In order to have an effective citizens' participation changes in their

attitudes, daily life etc. should take place [7]. This can be achieved by utilizing persuasive technologies that steer the citizens' attitude towards the desired behaviour [2]. Taking into account the switch of the perspective of well-being from the idea of production accumulation to the ability to access to services, media and information available online [5], and in accordance with the recent development of internet of things, social platforms seem to be the most promising methods/tools for delivering behavioural change interventions among different socio-economic groups.

Social platforms, either web or mobile based, can act as the mean that connect different stakeholders that share the same view regarding waste management, recycling and environmental issues. Through them, a municipal authority can share real time data of the service and disseminate information about its new campaign. Mobile applications can also help workers in the recycling sector acquire significant information and get organized, keep citizens engaged with the waste management system and inform them for local performance.

Social platforms can also provide citizens the ability to learn about waste management issues, share their opinions with other citizens, and interact actively with them as well as with their local waste management authorities, providing to the latter valuable useful feedback. Specifically, social platforms foster people to incorporate better recycling habits into their daily routines, discover how to recycle, how to dispose of their waste, new ways for enhancing their current recycling habits, namely increase citizens' awareness and promote e-democracy and citizens' participation.

For the purposes of this article, the term "local authorities" includes local, municipal, county, regional, and national governments, and their waste management agencies and departments.

1.2 Research objectives

This paper addresses how the local authorities can actively engage citizens in the waste management system in order to achieve the goals set by national and European legislation through the development of ICT tools and namely through the use of social platforms.

More in particular, citizens should be considered as a key stakeholder as their active participation is a cornerstone to the achievement of the set goals such as high performance recycling and collection rate. The best persuasive tool which engage citizens actively in the waste management system is the social platform, either web or mobile. Social platforms can help citizens incorporate better recycling habits into their daily lives, discover how to recycle, how to dispose of their waste as well as help them to enhance current recycling habits. Public awareness, citizen co-operation, education and social consciousness should be the key aspects of a developed social platform.

This paper focuses on the benefits that municipalities gain from the development of a social platform, as well as the main characteristics which the platform should have, in order to aptly engage citizens' participation in the waste management system. Special indicators are presented which can be used for monitoring the social platforms, in order to assess whether its main objectives are served, and be effective bringing tangible results. Finally, in the last section it is also presented four examples of social platforms developed in EU countries, as well as the case study of EWAS platform, a social platform which is designed for the citizens of the municipalities of Chania in Greece, and Seville in Spain, which use ICT tools to optimize waste collection and increase recycling performance, through the LIFE EWAS project.

2. METHODOLOGY

2.1 Social Platforms

In recent years, there is a fast-growing of connectivity, and the use of technology dominates all sectors. At the same time 'big data' is becoming a central element to advance outreach and education strategies for the improvement of the performance of recycling schemes [9]. Recycling has become a main stream in EU and positives results have been in all member states in increasing their recycling efforts. Nevertheless, it has been reported [10],[11] that there is a gap between people's preference and support for recycling activities, as well as a gap in their actual participation during their daily home routine. The reason of this inefficiency is linked with the short- time recycling campaigns and the lack of

understanding of human behaviour [6]. Taking these facts into account a recycling system can be effective only when it can address participant's attitudes, daily habits, life style etc. [7]. In order to achieve this effectiveness it is important to utilize persuasive technologies that steer the user's attitude towards the desired behaviour. With the recent development of internet and 'big data', social platforms seem to be the most promising tools for delivering behavioural change interventions among different socio-economic groups.

The latest years EU invests intensively in the development of innovation in its territories. Within the next 5 years €50bn will be invested in digital innovation across the EU member states [1]. Since the local authorities are forced to develop comprehensive strategies for an efficient and cost effective waste management system serving the national and EU goals, the development of social ICT platforms seems promising, and can help significantly waste management practices at a local level.

A social platform can be a powerful tool for both the citizens, and the municipal authorities, as it can serve as an informative, organizational, and financial tool. More particularly:

- **Informative**: The platform can be used as a public awareness tool for citizens, waste management staff, and local authorities. On the one hand, local authorities can use the platform as an awareness tool, where citizens are informed about the municipal waste management system and the actions implemented, the measures taken from their local authorities for the achievement of set goals, as well as about the campaigns organized and their main purpose. On the other hand, citizens can inform their local authorities regarding the problems they face on their waste management services (e.g rare collection, lack of bins, broken bins, etc.) Moreover, the platform can raise awareness to personnel working on waste services on the hazards they face during their work, and how they can avoid them.
- **Organizational and economical**: By recording citizens' problems and demands on waste management services, the local authorities have the ability to better organize the work program, as well as the budget allocation. They are aware of the needs of the citizens thus; they do not spend time, power and money in services that are useless for the citizens. Moreover, by using ICT tools in its collection system the local authority can collect online real data helping its waste managers. In particular, waste managers who monitor selected on-line data in the platform can allocate work among the staff accordingly to the needs. As a result, frequency of collection is minimized, fitting the real needs, and vehicle routing is optimized. The benefits that citizens enjoy are related to the reduction of collection cost, and the clean environment due to the minimization of fuel consumption, and CO2 emissions respectively.

The main benefits that municipalities and citizens gain for the platform development are both economic and environmental. Through the platform the users are becoming aware of waste reduction and recycling practices, resulted in reduced collection and operation cost (fuel, maintenance, etc.), and GHG emissions due to the reduction of the frequency of waste collection related to the minimization of waste disposed of in bin, and the optimisation of routes. Also, the minimization of the waste that end up in landfill results in reduction of disposal costs and thus in the general municipal waste management costs.

In order to have a well-functioning platform which serves its objectives and provides benefits to the municipality and the citizens, it should have three main characteristics. Namely, it should be:

1. **Educational**: It is of high importance that the platform guides comprehensively, simply and gradually the user towards to the adoption of the sustainable waste management system, by providing general guidelines on recycling and other waste management issues, general information on home-composting, waste prevention practices, regulations, terminology, what citizens should during emergency period (e.g. long term strikes of collection staff, severe weather phenomena, etc.).
2. **Interactive**: It is important that the platform gives to the users the ability to interact either with other citizens, or their municipal authorities participating actively, and affecting positively, in this way their local waste management system. The citizens can interact with the waste management authorities by sending real time quarries, comments, service requests, and reporting problems. The interaction with other citizens can be achieved by making comments and sharing experiences

through posts and social media. The municipal authorities should also interact with the citizens by replying shortly to their requests, so as to persuade citizens that they do actually use the platform as a connection tool. Also they should inform citizens in regular and constant basis on events and campaigns that they organize and on new features in the waste management systems.

3. **Functional**: Finally, the platform should be functional in a way to meet the expectations of the citizens, providing answers to their general questions on waste management issues.

Even when the platform is well designed, and has the above mentioned characteristics, it is of the highest importance that the local authorities, and the administrator of the platform, to: a) keep user's interest undiminished, b) constantly try to increase the users of the platform, c) evaluate the results of the platform. Namely:

a) Keep user's undiminished

After the first awareness of the users on waste management issues, users will seek additional in-depth information. The platform's content should be appropriate to meet their expectations; it should contain benefits, and good reasons for changing their attitudes towards more sustainable waste practices, focused on prevention, waste reduction and increase of their recycling performance. The content of the platform should be specific to serve its objective but should also be dynamic and easily adaptable to the different needs of the users, and frequently updated. The creation of competitions, and gamifications, are highly recommended to keep the user's interest active. In any case, it should be kept in mind that the platform addresses a wide variety of people with different backgrounds, thus the content of the platform should be written in a plain language, without technical terms and abbreviations that confuse those who are not very familiar with waste management issues.

b) Constant try to increase the users of the platform

The platform is used as a public awareness mean on waste management issues; in order the municipalities to develop an efficient and cost effective waste management system to achieve the national and EU goals. The more people engaged to the platform, the easier will be to achieve the goals of the existing local action plans. Thus, it is important that the municipality endorses the platform's existence, and develop supportive dissemination actions such as:

- Creation of Informative documents (Flyers, briefing papers, school resource packs, etc.)
- Mass-education activities (articles in newspapers, news releases, speeches, etc.)
- Lectures for schools, universities, clubs, etc.
- Events (Educational events, local workshops, information evenings, award ceremonies, etc.)
- Audio-visual aids (Information videos, Training videos for work force, etc.)
- Advertisement in other municipal sites
- Employ special information and relations officer [3]

c) Evaluation of platforms' results

The platform serves a particular purpose, so it is important to monitor whether it accomplishes it or not, in order to act accordingly. If the platform does not achieve its purpose, and users do not use it. or they do use it but the results of their actions are far from the targets set on the local action plan, the main raisons should be identified and appropriate movements should be done to improve it. The monitoring of the platform is possible by recording indicators related to the platforms. Such indicators should measure:

- Number of visitors. The number of visitors should increase with time, particularly when dissemination actions are implemented. For each dissemination action, the number of users should berecorded, in order to measure the increase of users and plan future dissemination actions accordingly.
- Number of visitors per platform sector. It is important to know where the users spend more time, and thus be possible to understand which they consider as most valuable information. Thus, in the future, put emphasis in these sectors, and improve the content of other platforms' sectors as well.
- Number of registered users. The registered users are considered as engaged users that fully support the local authority actions. The number of registered users should also be increased with time, especially when dissemination actions are implemented.

- Number of monthly posts. The posts are related to the interaction between the citizens and occur only by register users. The more posts exist, the more engaged the users are with the platform. Therefore, they use it as an important mean for communication with other citizens. The number of posts should increase with time and especially when dissemination actions are implemented.
- Number of requests. The requests are related to the interaction between the citizens and local authorities and occur only by register users. The more requests exist, the more engaged the users are with the platform. Better are the results for the municipality since increased participation means that the requests are answered appropriately.

2.2 Social Platform Research

Social platforms, either web or mobile based, can act as the mean that connect different stakeholders that share the same view regarding waste management, recycling and environmental issues. Social platforms can provide citizens the ability to learn about waste management issues, share their opinions with other citizens, and interact actively with them as well as with their local waste management authorities, providing to the latter valuable useful feedback. Specifically, social platforms foster people to incorporate better recycling habits into their daily routines, discover how to recycle, how to dispose of their waste, new ways for enhancing their current recycling habits, namely increase citizens' awareness and promote e-democracy and citizens' participation.

Based on the above mention idea several social platforms have been developed from municipalities, organizations, EU programs to successfully deliver their objectives and goals. Some of the most well-known and useful platforms based on the authors' experience, are presented in the following section of the paper.

1. Gre-cycle, Hellenic Recycling Agency (EOAN)

Figure 1: Gre-cycle home page preview

Gre-cycle is a web and a mobile platform with an online searchable database of all recycling points within the territory of Greece. It was developed by the Hellenic Recycling Agency (EOAN) and user can enter it through the address http://www.grecycle.gr/index.php/en/. A preview of the home page can be seen in Figure 2.

In this platform, users have the ability to learn where they can recycle different types of waste, the importance and benefits of the recycling, what they can do with other type of waste for which currently there is not a particular recycling system such as Fabrics/Textiles, fried oils, etc and learn news regarding recycling and the agency of recycling. In the mobile platform, users have also the ability to interact with the organization by submitting a picture and a location of a recycling point which is not yet included in the given list of recycling areas. Below are presented in a more detailed way the main sections of the platform.

- Recycle now: In this section users first select one of the given categories of waste (cooked oils, packaging materials, accumulators, vehicles, electrical and electronic equipment, construction and demolition waste) they want to recycle and then they moved in a map where they identify their location and as a results a list of nearby (max 3km for web platform, 10 km for mobile app) recycling banks appears in the map. By clicking on the points appear the name, address and the telephone of the recycling point.
- Importance - benefits of recycling: This part explains to the users how recycling contributes to sustainable development on an economic, environmental and social point of view. It informs that recycling is the most comprehensive approach of waste management since it achieves economic benefits; it contributes to tackling environmental problems and it ensures social equality and employment.
- Recycling of other waste: Users are informed of other type of waste for which currently there is not a particular recycling. These materials are fabric/textiles, fried oil, medicine (medical waste) and Biodegradable materials.
- Report (mobile application): This section exist only in the mobile platform and users have the ability to upload a picture and a location of a recycling point which is not yet included in the given list of recycling areas.

2. Recycling guide, UK

The recycling Guide platform is a web platform developed by the "guides network", a small group of researchers and writers who are aim to help users find exactly what they are looking for quickly and easily [http://www.theguidesnetwork.co.uk/] . Users can enter the web platform through the address http://www.recycling-guide.org.uk/ a preview of the home page it can be seen in Figure 2.

Figure 2: Home page of Recycling guide

In this platform, users have the ability to learn why they should recycle, how they can do so, where to recycle. Moreover users get information regarding the recycling cycle of several materials such as glass, paper, aluminium, how to recycle different materials which are not so usual, how to create useful items from recycled waste. The users have also the ability to interact both with the administrators of the platform and other users through the blog section that exist in the platform or the section of "recycling comments" where users share their recycling tips. Below are presented in a more detailed way the main sections of the platform.

- Why Recycle?: In this section, the user get information on facts about recycling and why recycling is important for the environment and its health, as well as the set recycling target by national authorities and the national environmental agency.

- How to recycle?: In this section user discovers tips about recycling, reduction and reuse, how to recycle different types of waste such as batteries, bulky waste, wood, plastic bottles etc, what is the current waste composition of its country and how to read correctly the recycling etiquettes of the products she/he buys. This section also provides information regarding how schools, industries, house can recycle, while it provides an ability of recognize eco-friendly and recycled products. Finally, it gives a list of activities to encourage recycling through games and constructions from recyclables.
- Where?: This section provide users the information regarding where the local recycling banks are or which materials can be recycled and where.
- Blog: The administrator of the platform posts news regarding recycling and users interact with it or with each other
- Science: In this section the different processing steps required to recycle paper, plastic and aluminium cans are presented.

3. Recycle Now

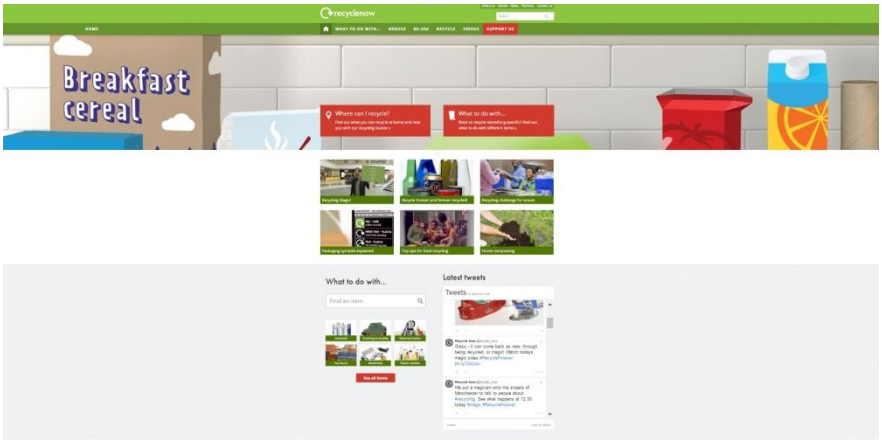

Figure 3: Recycle Now home page preview

Recycle Now is the national recycling campaign for England, supported and funded by Government, managed by WRAP and used locally by over 90% of English authorities. Users can enter this platform through the web address http://www.recyclenow.com/. A preview of the home page can be seen in Figure 3.

In this platform the users can find information regarding reduce, reuse & recycling. People can support the organization by donating money while they can interact with it through the social media that have a dominant role in platform as latest tweets are presented in the home page. Below are presented in a more detailed way the main sections of the platform.

- What to do with…: In this section user can find out what they can do with different type of waste, presented in categories such as aerosols, clothing & textiles, electrical items etc. or in alphabetic order. In formation has to do with recycling and reuse tips.
- Reduce: In this section users discover tips in order to reduce their waste production. Tips in this area have to do with home composting, think before you buy, reduce packaging, unwanted mail and step for waste minimization. The presentation of the solution is given either in bullets or in short description texts and videos.
- Re-use: This part informs visitors about the importance of re-use and what further they can do on this perspective (donation in charities, sell, etc).
- Recycle: This section highlights the importance of recycling and gives information to users regarding how they can recycle in their work, schools , where they can recycle near to their position, explain the recycling symbols. Also in this section users share their tips on food recycling.

- Videos: In this area, facts and figures regarding recycling are presented in short videos, as well as which is the recycling process of paper, plastic, paper and other common waste streams.
- Donate: In this area, the users can help the organization by donating money and support it continue its actions.

2.3 EWAS Platform

Life EWAS, is an EU program that aims to foster innovation in the area of public and private interest of waste management by demonstrating the potential of new information technologies to optimize current EU waste management operational methodologies.

The project is based in the use of sensors in waste bins in order to improve collection in the cities of Chania in Greece, and Seville in Spain, by improving energy efficiency and reduce GHG emissions, noise and traffic congestion during waste collection and transportation. One of its supporting actions is the creation of a platform that links the installation of the sensors with the involved users, like waste managers and the citizens.

Below it is presented the different types of platform users, the different interfaces for each user, as well as the main content, based on the principals presented in the previous chapter.

Type of users

The users of the platform can be separated into three different types, based on the type of the information they are interested in. Namely the categories are presented below:

1. **Administrator**. Into this category falls the administrator, the user who wants to have an overview of how the platform works, and is responsible for its operation. He has access to all information collected by the sensors and generated by the system. Usually the administrator is the technological company who offers the service.
2. **Waste Manager**. Into this category fall the waste managers of the municipality, who want to have access in the real time waste management data given by the ICT tools (sensors). This information is used by managers for planning reasons, but also for real time management. Through the platform they can improve waste collection, and verify if containers are collected when planned, or are damaged.
3. **User/Citizen.** Into this category fall all citizens, independently on whether they live in the municipality that the platform refers, or not. They can benefit from obtaining knowledge on sustainable waste management, communicate with the waste authority, and report an issue. This category has two subcategories which differentiate in the level of access to information:
    a) **Registered users:** users who have engaged with the platform and have created an account by giving their e-mail address; they have full access to the published information and can interact with waste managers.
    b) **Unregistered users:** users who just use the platform without having a registration account: they have limited access to the published information.

Type of interface

The web platform is used as the main entry point for the different users. It has different interfaces, based on the role and requirements of each stakeholder type. Totally, three different interfaces have been developed in the platform, each one corresponding to the different types of user. Thus,

1. **Administrator interface** is accessed by the administrators who can access all the configuration parameters and information of the platform, can manage the rest of the roles, and has access to all the functionalities of the platform.
2. **Waste Manager interface** is accessed by the waste managers of the municipality, or the waste management authority, who have full access to the information (containers, routes, reports, incidences, etc.). This interface gives a) a resume at the home page b) shows a list of existing monitored containers, and enables visualizing and generating historical and statistical reports per container, c) shows a list of existing monitored routes, and enables visualizing and generating historical and statistical reports per route e) shows the alerts and issues reporting, on that list. The technician will be able to monitor the incidents and register the actions and solution proposed for each incident, f) enables real time fulfilment information and forecasting collection date either at container level.
3. **Citizen interface** is accessed by citizens/users and it is modified according to the different type of users. Thus, there are two subcategories of citizen's interface:
    a) **Non registered users** can only access the general information of the system regarding a) the number of sensors installed , b) the routes monitored, c) the population served, d) the starting date of the monitoring, e) the collected amount per hour, f) the fuel burnt per collected ton of waste, g) CO2 emissions per ton of waste, h) why recycling is important, i) where to recycle, j) interesting information about recycling and k) tips to improve the individual recycling performance.
    b) **Registered users** can access in the general information of the system as unregister users but they also access extra services as a) query to locate containers, b) reporting the fulfilling level of a container, c) access to key performance indicators (KPI) of the municipality's waste collection system i) cost of waste per ton, ii) cost of waste per habitant, iii) average filling level, iv) distance travelled per collected ton, v) total distance travelled for the collections vi) total fuel spent, d) posting comments, e) feedback from other users.

Statistics

The area "Statistics" contains information generated by the system, which is showed in the form of key performance indicators.

The indicators translate the data collected by the system into easy and accessible information, which shows in a synthetic way the performance of the methodology in terms of its efficiency and results. Some of the indicators created are:

- Waste collected per hour
- Fuel consumed by the collection trucks per ton of waste
- CO2 emitted by the collection trucks per ton of waste
- Cost of waste collection per ton of waste collected
- Cost of waste collection per inhabitant served
- Average filling level of containers collected
- Distance travelled by the collection trucks per ton of waste collected
- Total distance travelled by collection trucks
- Total fuel spent by collection trucks

The primary data collected by the system is processed through a spreadsheet. The platform extracts the information from this spreadsheet and displays it in a simple way through charts. This information is updated continuously, allowing comparison along the time.

I want to recycle

The area of I want to recycle, is one of the core areas of the platform as the user can find different piece of information regarding recycling, and its' aim is the motivation and engagement of the citizens to the recycling process. The area of "I want to recycle" has four subareas that of "Why recycling is important?", "Where to recycle?", "Did you know?", and "Improve your recycling" which contain

different piece of information regarding recycling. Information ranges from the benefits of the recycling, to tips for individual recycling performance. Analytical presentation of all four subcategories is presented below.

- Area of "Why recycling is important?"
  In this area of the platform the user discovers the main benefits gained from the recycling process. Benefits cover a great range of sectors such as environment, economy, social welfare, etc.
- Area of "Where to recycle?"
  In this area of the platform the user learns which waste goes into which bin, and how this waste is processed. More specifically, the user has the ability to choose from a list of more than 100 different wastes, and learn in which bin she/he should dispose the selected waste, how she/he should dispose it, what happens after its collection, and its treatment (recycled products produced).
- Area of "Did you know?"
  In this area of the platform the user obtains general information about recycling, such as the energy saved from recycling of different types of waste, the time period needed for a waste type to be decomposed in landfills if it is not recycled, etc.
- Area of "Improve your recycling"
  In this area of the platform tips for improving the recycling performance are presented, based on typical mistakes that citizens do. These tips are based in literature research, or have been highlighted by the local waste management authorities. In this area there are included solutions to problems that the local waste management authorities are frequently facing, due to citizens false attitude.

Mobile application

Apart for the web platform, EWAS platform will be developed as a mobile application as well, in order to allow citizens and waste managers' operators to access to the main services and information through mobile phones or tablets.

Apart from the rest uses that will be the same, the main advantage of the mobile application is that users can report incidences easily independently of their location and can even interact by sending pictures from their mobile devices. The operational team from the waste manager entity can have a report of incidences on a real time. The app will be available for the main mobile Operating Systems (iOs and Android), and it will have an easy and straightforward interface with several operational roles.

3. RESULTS

Social platforms can be a very useful informative and communication tool for the development of successful recycling systems. Through raising citizens' awareness in issues related to waste management and recycling practices, they can offer numerous social, economic and environmental benefits, the most important of which are presented below:

- Citizens participate more actively in daily city functions, obtaining a more operating role than before, following their increased responsibility in the waste management cycle.
- Residents can appreciate better the benefits derived from recycling, and participate more willingly.
- Citizens regain trust to local public services. Through providing information and giving emphasis to their contribution and benefits from its proper operation, the social platform can offer to the citizens a sense of reliability and confidence to municipalities and the waste management authorities.
- More transparent services, as data is converted into open and real-time. As a consequence citizens can better realise the results of their actions, as well as the importance of their participation for the successful implementation of the proposed recycling system.

- Increased awareness on waste management issues and mainly on the benefits and process of recycling. The platform gives the opportunity to citizens to learn more about recycling practices and help them resolve queries regarding the process of recycling, on which waste are recycled or not and generally on issues related to waste management. They also have the ability to be informed about special events related to recycling and waste management.
- Expected reduction of GHG emissions, due to citizens' increased participation in the recycling system, which has a result less waste disposed in landfills and less energy consumption for the production of new recyclable waste from new raw materials.
- Citizens communicate directly with local authorities for the reporting of waste management and recycling issues. In this way time is saved and solution can be given in a shorter time eliminating health and environmental hazards that may occur.

CONCLUSIONS

In recent years, interconnectivity and information flow, through various types of modern means has created new opportunities in the waste management sector. ICT technology can become a powerful tool for the implementation of EU legislation and the adaptation of the EU Waste Framework Directive. Nowadays, waste management authorities have the possibility to increase citizens' awareness in waste management and recycling practices by using web and mobile communication technologies. Namely, the development of social platforms can be the tool that makes citizens to participate more actively in the waste management system, and thus help nations and municipalities to achieve easier the national and EU prevention and recycling targets.

The main characteristic and operations of such a platform are summarized below:

- The platform can serve as an **informative tool**, to raise the awareness of citizens on waste management issues (recycling, prevention, collection, etc.).
- The platform can serve as an **organizational tool**, bringing financial benefits, due to the derived better work allocation deriving from the retrieved data of the platform, and the .
- The platform can serve as an **interaction tool** in order the managing and local authorities to act together with the citizens, and get feedback on their waste related activities

In order the platform to serve its objectives, and work successfully, it has to be designed in an appropriate and functional way. In order that is operated successfully, and bring the desired benefits to the municipalities the following conditions should exist:

- Keep user's interest undiminished by interacting with citizens, and updating information frequently.
- Constantly try to increase the number of the users by preparing dissemination actions.
- Evaluate the results of the platform by creating indicators that measure the number of platform users, and their interaction with the platform.
- Give to the platform an educational character, in order to guide comprehensively and gently the citizens towards understanding the waste management system of their city, and personalise the goals for more sustainable waste management depending on the area.
- Maximise interaction, and give the users the ability to network either with other citizens, or the municipal authorities for exchange of experiences, and requests' submissions.
- The platform should be functional, and easy to use in the way that meets the expectations of citizens, and gives answers to their general questions.

Currently numerous existing and developing social platforms exist internationally, and their number and importance is expected to rise, along with the further establishment of the smart cities' concept. These examples can serve as useful lessons for the local authorities that are interested in applying such

technologies. Such example is the EWAS platform, a social platform for the increase of the recycling performance in the areas of Crete and Seville.

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