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RifiuTIAMOci: ECO-EFFICIENT MANAGEMENT OF URBAN WASTE*

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Abstract

In the concept of circular economy there is more and more talk of intervening upstream of the production of waste, intervening on the differentiated system downstream of use, but there is no fundamental step inside the homes. The step consists in reflecting on what happens inside the houses introducing a score alarm in the house.
The design idea is to intervene with the census inside the houses on the potential waste present. In every house there are various objects that are potentially waste but which remain silent until they become waste. The house, however, becomes a flow of objects that is always unbalanced towards accumulation to the detriment of its disposal. The idea was born precisely from these concepts, in which to have an application that reminds at the user if and how many objects are owned in the house with a potential value of waste present in the house, also compared with estimated production waste for inhabitant. This census is a real window into the situation of each home that can lead to careful reflection and a general and personal improvement of one's habits.

Keywords: environmental impact, LCA, recovery, special waste

1. Introduction

The growth of waste generation rates is an important issue in the whole world. For us is now important to reduce the waste. The concept of a circular economy has gained significant attention in recent years, with increasing emphasis on addressing waste generation at various stages of the product lifecycle (Ellen MacArthur Foundation, 2019). While efforts have been focused on intervening upstream of waste production and implementing effective waste management systems downstream, one crucial step has often been overlooked - the need for

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fundamental interventions within our own homes. Within the context of a circular economy, it is essential to recognize the significant role that households play in the generation and management of waste (European Commission, 2020). Despite advancements in waste management infrastructure and recycling programs, the success of these initiatives ultimately depends on individual behaviors and choices made within households. Intervening at the source, inside our homes, becomes a fundamental step toward achieving a more sustainable and circular approach to waste management (Kaza et al., 2018).

By targeting interventions within households, we have the opportunity to address the root causes of waste generation. This includes raising awareness about consumption patterns, promoting responsible purchasing decisions, and encouraging waste reduction and recycling practices at the household level. Implementing effective waste segregation systems within homes and providing access to appropriate recycling facilities can significantly contribute to reducing waste sent to landfills and maximizing resource recovery (Feitosa et al., 2016). Furthermore, education and awareness campaigns aimed at households can foster a culture of sustainability and empower individuals to take proactive steps in waste reduction. By promoting behavioral changes and providing practical guidance on waste management practices, we can create a collective impact that extends beyond individual households and contributes to a more circular economy.

We always work with refusal from the conferred, leaving out the potential refusal we have inside the house. To play a great importance beyond the communication on how to differentiate also the awareness on the reduction of the production of decline. This must be done by giving the population technological tools with the possibility of self-regulating. The data of waste produced are in various studies, but these are non-personal and aseptic data and do not arouse the right reflection that each of us should do (Gorbenko et al., 2021; Hoornweg et al., 2013).

Since the growth of waste generation rates is a pressing global concern that requires immediate attention, it is crucial for us to focus on waste reduction strategies. While we often prioritize the waste we dispose of externally, it is necessary to address the potential waste generated within households. Achieving significant progress in waste reduction entails effective communication, emphasizing the importance of waste differentiation, and raising awareness about declining waste production (Dzawanda and Moyo, 2022; Gopal Sahoo, 2021).

To effectively tackle this issue, it is imperative to equip the population with technological tools that enable self-regulation. By providing individuals with the means to monitor and manage their waste output, it is possible to empower them to actively contribute to waste reduction efforts. This approach emphasizes personal responsibility and encourages individuals to make conscious decisions regarding their consumption and disposal habits (Phuong et al., 2021; Torio et al., 2020).

While various studies provide data on waste generation, it is important to note that these figures often lack a personal connection and fail to inspire the necessary introspection within each individual. It is crucial for each of us to reflect upon our personal waste production and its implications for the environment and society. By fostering a sense of responsibility and encouraging self-reflection, we can foster a more sustainable and waste-conscious society (Stöckert and Bogner, 2021)

The objectives of this application is to make everyone aware of the impact that their behavior has on the environment and on the circular economy in general. Giving full awareness to every citizen of how he acts with good actions to safeguard the environment is an element that stimulates the reflection and my improvement in general of those who want to participate in personal improvement.

The development of this application was divided into the following phases:

- identify the bibliographic data made available;
- develop an app that contains such data;
- analyze the necessary needs of users to make this application bearer of benefits;
- analyze the results and formulate the relative conclusions.

2. Materials and methods

The application was created using the Microsoft Visual Studio Community 2019 development environment. The starting data of the single Municipalities have been uploaded from the official ISPRA data which it publishes annually (https://www.catasto-rifiuti.isprambiente.it/index.php?pg=comune&aa=2020&regid=12058&nomereg=Lazio&p=1). Once registered (Fig. 1), users are prompted daily to input their activities, such as purchases or disposals. By tracking these actions, the application calculates the volume of waste generated at home each day, providing users with valuable insights and assessments (Fig. 2). From these, the user registry was populated. This application, after registration (Fig. 1) ask every day the operations that people use made like if he buys something or if trash something. With this it can be counted how many liters of waste you have at home every day and this returns a good user assessment (Fig. 2). This feedback allows users to evaluate their waste production and make informed decisions to reduce it.

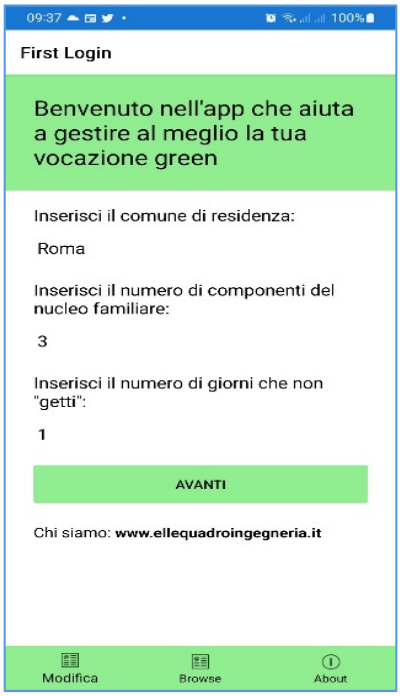

Fig. 1. Registration

Fig. 2. Score

The application was created using the Microsoft Visual Studio Community 2019 development environment. The programming language is C # and for the development of a multi-platform IOS and Android mobile app it was decided to use the popular toolkit "Xamarin.Forms ". Xamarin Forms provides the most common components of a Model-View-

ViewModel (MVVM) framework, making the link between data and user interface simple and intuitive, separating them from the rest of the application. The key elements of the MVVM pattern are:

• Models: represent the data, the business entities of an application.

• Views: represent the pages (or screens) of an application, together with all the elements that make up the appearance of what the user sees on the screen. Ideally, the View is defined exclusively with XAML, which does not contain the business logic

• Models of the View: they act as an intermediary between the View and the Model, and are responsible for managing the logic of the View. Typically, it interacts with the model by invoking methods in the classes of the Model. The View Model then provides the data from the model in a form that the View can use easily.

• Binder: The fundamental mechanism for this pattern by which the View Models and the view are constantly kept synchronized, typically through a declarative syntax within the view itself. This implies that data changes made by the user through the View will automatically be reflected in the View Templates, without this burden on the developer.

The application opens on a first login page, where the user enters residence data, number of family members and number of days of non "revenue" to initialize the app counters. Subsequently, the user indicates daily the amount of material that is introduced and what is unloaded from their home. Finally, there is a results page, where the user can view the periodic trend of waste management, and compare it with the city average.

5. Results and discussion

The extrapolation of the data clearly shows how much the percentage of waste to be differentiated can still be reduced but above all how much it can affect the initial production value. In the municipalities where the differentiated waste collection is started, the value of waste reduced by many percentage points, even reaching half of the annual waste produced. The data analyzed were those of the province of Rome. As can be seen from Fig. 3, cost ranges from 129 to 324 € / inhabitant / year as well as the estimated annual production ranging from 242 to values greater than 500 kg / inhabitant * year (Fig. 4).

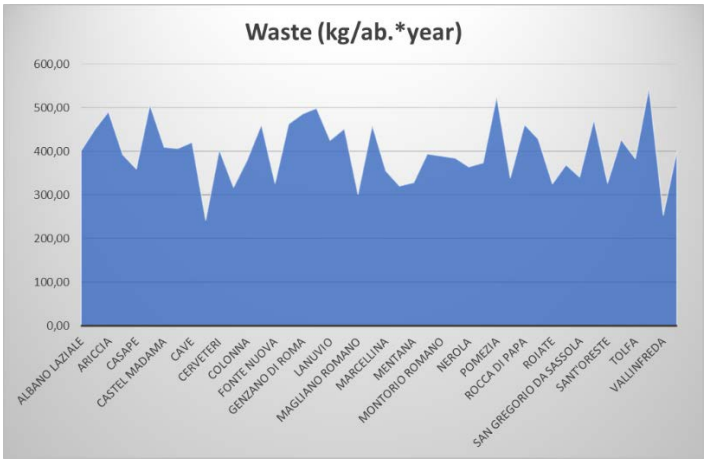

Fig. 3. Production of waste

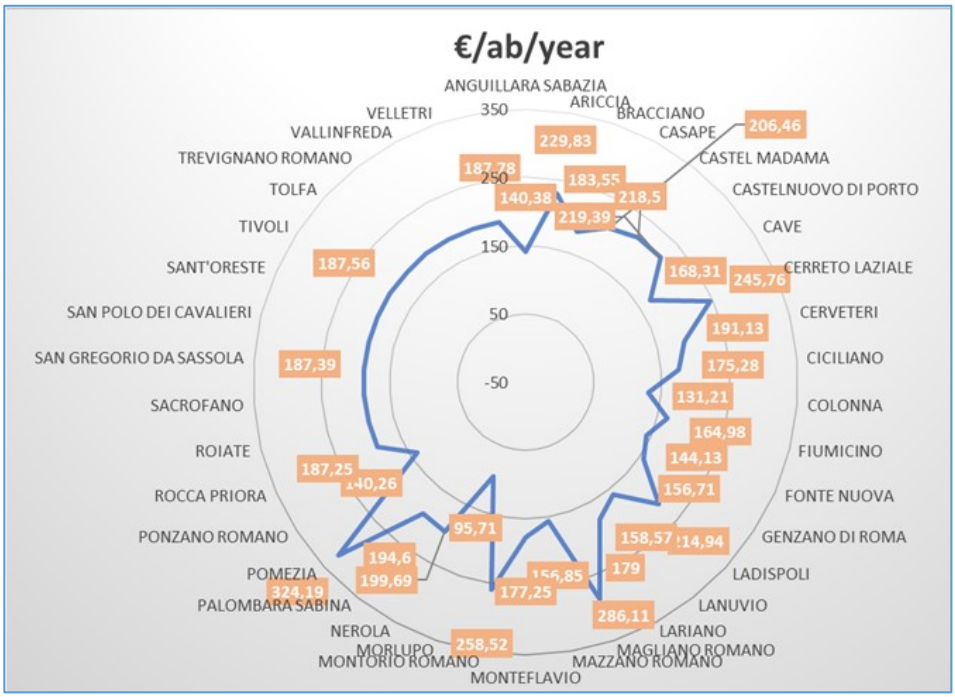

Fig. 4. Cost €/ab/year

From the production data it is clear that the quantity of annual waste produced in the Municipalities are the same annually but what varies is the different type of waste produced. Instead, what must be reversed is what is generally produced as waste by eliminating what increases its quantity.

By imposing a maximum annual production value for each citizen and inserting this parameter also on production, it would generally allow environmental savings of the order of several percentage points while generating fewer resources to be used on collection services.

6. Concluding remarks

The first data collection highlighted how there is still little awareness of what our waste generation behaviors are and what we actually introduce at home while the awareness of how to properly separate waste is higher. If combined, these data could be used by municipal administrations in terms of organizing services and avoiding collection crises in the face of enormous accumulations of waste. Generally, these are associated with festivities in a bibliographic manner while in this case an excess of production could be expected in some areas in the face of the reporting of the conferring users. We saw that only 1% for every people (about 5 kg a year) is possible to reduce more than 100.000.000 € the cost of the waste.

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