The Impact of New Information and Communication Technologies on the Development of Constantine City for a Smart City: The Case of Household and Similar Waste Management

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Abstract

Throughout human history, cities have sought to offer their inhabitants a better quality of life, and being a smart city has become a label that all city managers seek to have. Constantine is a thousand-year-old city that suffers from several urban problems where the use of ICTs can be a sustainable and effective solution

In this article, we try to find the impact of this use on the waste management sector and the transformation strategy to be a smart city.

Key words: Constantine, ICT, smart city , Sustainable development, waste management, household and similar wate.

INTRODUCTION

In recent years, there has been a new wave in digital innovation strategies and initiatives in governance around the world (Daniel and Pettit 2021). It is currently improving because it is supported by the concept of Smart City and its implementation in the different sectors (Rachmawati 2019). The use of new information and communication technology makes it possible to skip certain stages of development and/or to free itself from tools experienced by older industrialized countries, (Kenyon and Lyons 2007), the local authorities have a high responsibility to guide the digital transition of their territory, to regulate the generation of data and their operation and synergize the stakeholders. They must appropriate this new skill and promote good management of the approaches, uses and digital tools. (Criqui, Barthel, and Jaunet 2018).

The phenomenon of rapid urbanization, whether in developed or developing countries, raises significant challenges at the economic, social, urban level and triggers complicated problems mainly related to the pollution of the urban environment (Sergeyeva et al. 2021) .

In fact, The social and environmental sustainability must be taken into consideration as a major and strategic component of cities (Crutzen and Cours 2015) we find the three pillars of sustainable development which are the human, the economy and the environment (Beghin and Desmet 2015) since 2010 the majority of smart cities are oriented towards ecological sustainability.

Today the urban population is close to 55% of the world population, which will be increased to 68% in 2050 (World Urbanization Prospect 2018), as well as its waste generation which reaches 3.40 billion tons (Kaza et al. 2018).

The waste management has become a major environmental challenge in Algeria. Since it consumes about 80% of the municipal budget in some cities due to the high rate of waste production, the lack of recycling and disposal sites, and the absence of a sustainable management strategy. The waste management sector has made constant progress by integrating NICTs into the various processes to correct failures and increase the quality of services and the living environment. This strategy falls within the framework of sustainable development and the transition to smart cities.

In the field of science, this article is part of a doctoral research, which aims to examine the evolution and impact of the use of NICTs in the waste management sector in Algeria by giving the example of the national waste agency and focus the research on the current situation of Constantine city, with the aim of better optimizing resources

This article seeks answers to the following questions:

1- Is there a national and/or local will to integrate NICTs into the environmental protection sector, specifically the management of waste ?

2- How do they currently use data and digital technologies in their daily work ?

3- What obstacles do they identify to these changes?

4- To what extent (materials and human resources) do they feel prepared for any anticipated change?

MATERIALS AND METHODS

This analysis is based on documentary research and surveys of institutions and actors responsible for environmental protection and household and similar wastes management in Algeria, and then on a survey of a representative sample (the waste management companies in Constantine EPIC). The survey techniques such as the interview plan and the questionnaire were used with the concerned officials. The conceptual aspect has been briefly treated. Thus New ICT's, household waste and strategies have been developed.

Interviewee	Role	Location	Sector	Duration
National Waste Agency	External Relations Manager	ALGIERS	Public	47 minutes
EPIC PROP.CO	manager	Constantine	Public	36 minutes
EPIC PROPEC	External Relations Manager	Constantine	Public	41 minutes
SOPTE	External Relations Manager	Constantine	Public	30 minutes

RESULTS AND DISCUSSION

A- At national level : The National Waste Agency "AND"

It was created in accordance with the provisions of Executive Decree No. 02-175 of May 20th, 2002, under the supervision of the Ministry of the Environment and Renewable Energies. The National Waste Agency "AND" is an assistance towards the digital transition of the waste sector in Algeria. since its appearance it has been working on the creation and updating of a database on waste as well as the implementation of "Smart" software to help the various actors.
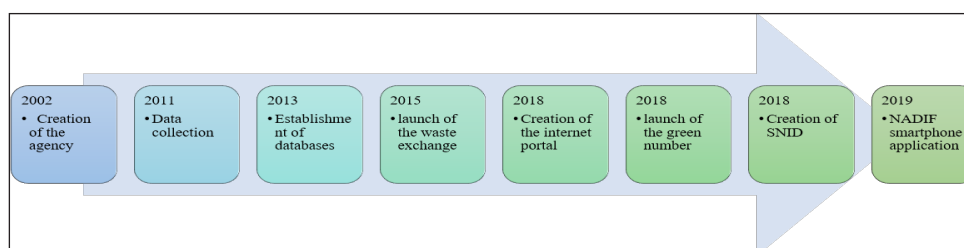

Figure 1. Evolution of AND digital tools. Source: Drawing by the Authors according to the data provided by the AND

In accordance with the work of (Wharton 2016)"The use of new ICT is able to improve the rate of livability, workability, and sustainability in a city by connecting and integrating various components from one government to another (G2G), from one government to its citizens (G2C), and from one government to businesses (G2B)". We assimilate the digital solutions of the AND with this theory to see if it has the necessary technological tools to measure its impact on the ground.

From One Government to Another (G2G)

The National Information System on Waste "SNID" is a digital platform whose objective is to popularize the exchange of data between the various actors involved in the field of waste management and to establish indicators, which constitutes a dashboard for the local, and the national decision makers.

From a Government to a Business (G2B)

The "waste exchange" digital platform facilitates the linking of supply and demand for waste that is likely to be recovered (HDPE, PET, iron, glass, battery, etc.) as well as the market price of each type, and this all in the aim of the emergence of a circular industry. It is open to manufacturers, traders, local authorities, administrations, approved recovery companies, installed collectors and brokers.

In 2021, the waste exchange allowed more than 690 generators and collectors registered on the platform among the 2,531 companies approved on the recycling market. This platform allows
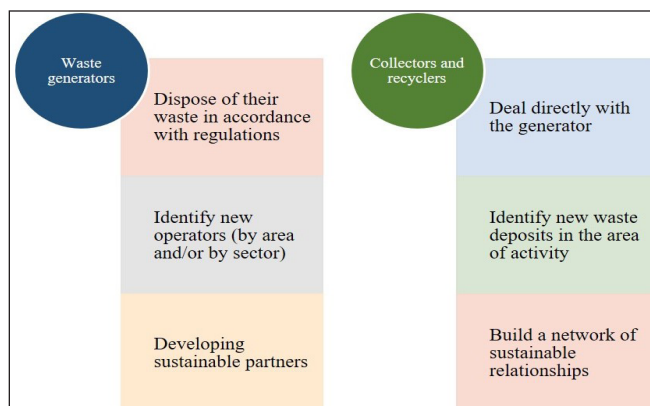

Figure 2. Desired goals of the platform`s users. Source: Authors and the AND survey

From a Government to the Citizens (G2C)

The monitoring system: Green number "3007" & the "N'Dif" application

The monitoring system is a digital platform hosted on the AND site where citizens can send their writtem complaints (electronically) or by the toll-free number "3007" for any complaint or request concerning waste management in their respective communities.

Figure (3,4). Intervention before/after 48 hours of declaration. Source. National Waste Agency

Since 2019, with the appearance of the 4G and the development of smartphones, the system has been reinforced by "N'DIF" application, which is a mobile application that facilitates obtaining instant services without having to resort to phone calls, or other traditional ways. All the users have to do is to take a photo and choose their declaration between a need of waste skips or a request for waste pick up, so that the AND services detect the location of the complaint through the GPS before transmitting the message to the various services concerned. (Epic, local authorities, etc.) in order they can intervene and solve the problem.

The AND thus plays the role of intermediary between the latter and the waste collection services.

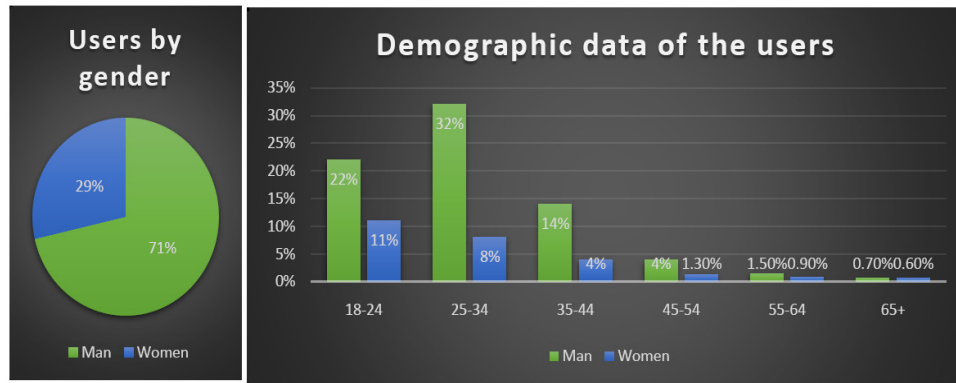Above some statistics of the use of the application:

Figure (5, 6). Users statistic. Source: Authors according to the data provided by the AND

B- At the local level

The Case Study: Constantine City

Constantine is one of the oldest cities of the world (more than 2500 years old). It is located 430 km to the east of the capital Algiers at an altitude of 650 m above the sea level, The city is based on a triangular mass of limestone whose base rises to the north while the summit descends to the south.
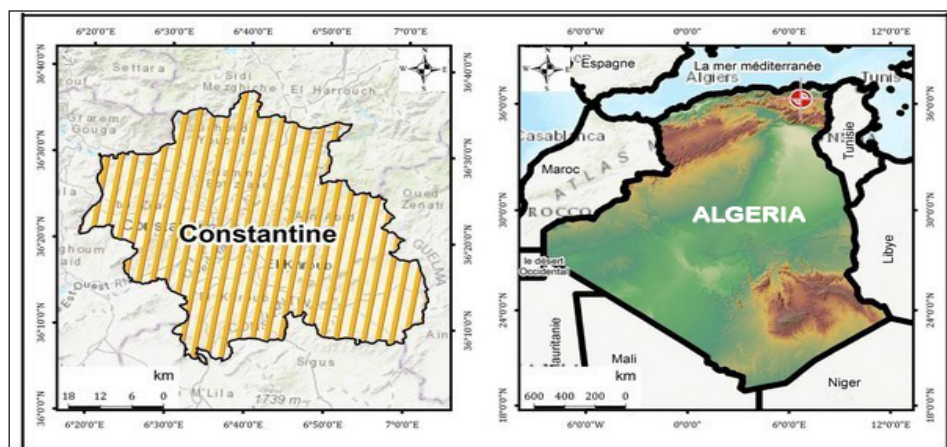

Figure 7. Desired goals of the platform`s users Source: Authors

During the year 2021, the various actors responsible for cleaning, collecting and transporting household waste were able to collect more than 1,250 tonnes/day of household waste in Constantine, 73% the equivalent of 900 T/ day of waste is disposed at the level of CETBOUGHRAB. But since December 2022, the waste of the city of Constantine and Ain Smara passes through the sorting center at the 13th KM before disposing them at the CET.

Above some statistics of waste management production in Constantine :

Figure 8. Waste management production in Constantine. Source: Authors according to the data provided by SOPTE & ONS

In Constantine, the collection and transport of household waste (HSW) is mainly provided by two entities:

➢ Public actors: the APC (communal popular assembly) of Constantine is the first responsible at the local level on the financial and operational plan (collection and transport). But its tasks have been delegated to Public Establishments of an Industrial and Commercial nature (EPIC propec, EPIC propco and EPIC SOPTE) or to private companies

➢ Private actors: are small businesses, their interventions are essentially linked to the collection and transport of HSW in small areas according to the specifications issued by the APC of Constantine, they cover 10% of the local market.

In order to know the use and the problems related to NTIC we have chosen the three public actors (EPIC prop.co, Propec and Sopte) which together cover 90% of the market for the collection and transport of HSW

Our questionnaire which aims to provide information on two aspects of the Smart City:
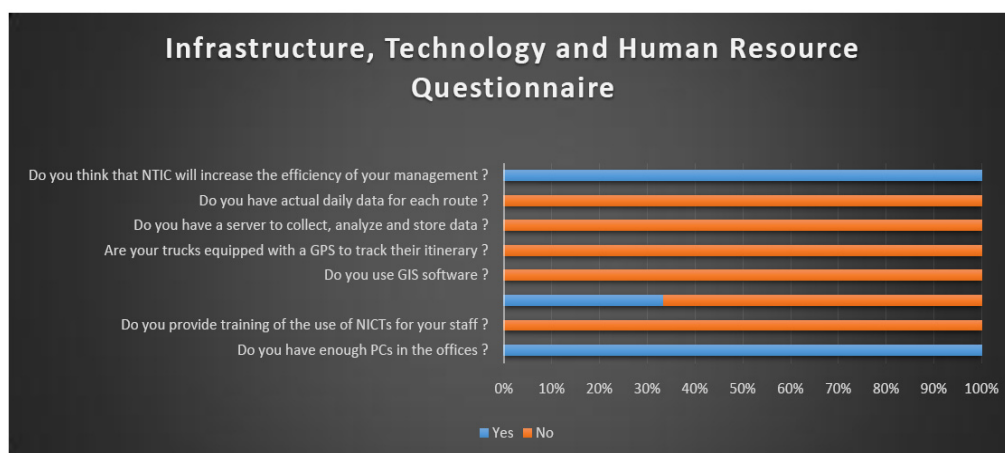
1- Infrastructure, technoogies and humanresources

Figure 9. Infrastructure, technoogies and human resources Questionnaire Source: Authors

2- Institutionalorganization

Figure 10. Institutional organization Questionaire. Source: Authors

According to (CARAGLIU, DEL, and C–NIJKAMP 2011)"A city to be smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance"

The purpose of these key questions is to know the different problems faced by managers at the level of Constantine to digitize waste management at the level of their companies as well as to know the impact and the way this use if it exists, the results were almost the same in all companies where we can summarize the problems most mentioned in this diagram
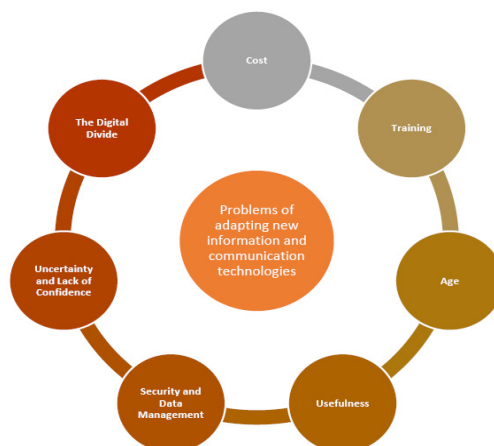
Figure 11. Problems of adapting new information and communication technologies. Source: Authors

The interview showed that employers who were recruited after 2010 tend to accept and adapt ICT in their work unlike those over 45 years old who need training.

These results aligned with the literature, which found that older employees struggle to adopt smarter technologies due to their limited technology knowledge. (Friel, Potts, and Shahab, n.d.; Law and Lynch 2019; Kleinhans, Van Ham, and Evans-Cowley 2015). The other key factor is the cost of investments where each transformation is necessarily linked to additional budgets and a short and medium term vision to make it profitable. The thing that cannot be achieved with business leaders who are afraid to make this digitalization decision

CONCLUSION

In this study, we looked for the different initiations of ICT use in the waste management sector at the national level as well as at the level of Constantine, the results showed that digital waste management is a double-edged sword. Indeed, by the operationalization of the action, it makes it possible to show a clean territory well organized, due in particular to the political requirements in environmental matters and the improvement of the living environment of the citizen

ICTs propose technical, economic, and environmental strategies for intelligent waste management. It would also be necessary to empower not only the inhabitant but also the various actors in a compartmentalized approach highlighting a multitude of informal strategies. In Algeria, strategies integrating ICTs have emerged at the central level thanks to the efforts of the national waste agency, but they remain dependent on managers at the local level.

We have seen that the managers of the many companies and administrations concerned in Constantine have difficulty adopting technology and accepting the transformation of management given the problems of human and material resources as well as the lack of a vision in the short and medium term.

Abbreviations

4G : 4 generation of telecommunication

AND : National Waste Agency

APC : Communal People's Assembly

CET : Technical landfill

EPIC : Public industrial and commercial establishments

G2G : government to government

G2C : government to citizens

G2B : government to businesses

HSW : household and similar wastes

NICT : New information and communication technologies

ONS : National Statistical Office

PEHD : high-density polyethylene

PET : polyethylene thermoplastique

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