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Propelling Plastic into the Circular Economy

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KEYWORDS: circular economy, re-cycling, landfill reduction, resource efficiency, low carbon, packaging, value, plastic, mixed plastic waste, end of life plastic.

ABSTRACT:

Plastic is a tremendous material with a significant role to play in the quest for efficient transportation, reduced food waste, affordable housing and quality of life. With demographics shifting to urban locations, we are also growing ever more reliant on plastic as a packaging material to transport and protect goods. Materials that cannot be sourced in cities (food, electrical goods, primary materials, etc.) must find their way in, and at the end of their lifespan, make their way out again as waste. Currently, strategies for coping with plastic waste lag behind the development of cities and the recyclability of other common materials such as paper, glass and steel. Today, most plastic ends up in landfills, is sent to Energy from Waste plants, or leaks into the environment, with dire consequences to ecosystems. Only 2% of all plastics undergo closed-loop recycling due to technical limitations caused by current practise of single-stream mechanical recycling. Recycling Technologies Ltd. have developed a technically and financially attractive solution to process end of life, mixed plastic waste, into Plaxx™. This clean hydrocarbon material is a feedstock to make more polymers. This technology can, in an affordable way, dramatically boost the quantity of plastic that is recycled. It offers a way for cities to eliminate plastic going to landfill and to reduce the leakage into the world's fragile eco systems.

1. PLASTIC: THE MIRACLE MATERIAL

Plastic has become ubiquitous in most aspects of modern life, for some very good reasons. Its flexibility and low cost make it the material of choice for many applications, many of which are environmentally beneficial. It has facilitated reducing the weight of planes and cars, boosting energy efficiency. Carbon intensive food is preserved from the field to the plate. The quantities of higher carbon materials traditionally used in construction have been replaced with lower carbon footprint plastic alternatives. Consequently, it is unsurprising that the quantities of plastic used in 2014 were 311Mt, 20 times greater than 50 years ago and set to double again in the next 20 years. [The New Plastics Economy, Project Mainstream, 2016]

2. PLASTIC: THE PROBLEM WASTE

The aim of the Circular Economy is to maintain the value in resources at their highest level for as long as possible. Against the backdrop of this objective it is shocking that only 14% of

plastic packaging is collected for recycling globally and of this just 10% is actually recycled. This means that plastic packaging with an economic value of €70-110 billion is lost annually to the economy after just one short use. [The New Plastics Economy, Project Mainstream, 2016]. The same report also indicates that the vast majority of plastic is still disposed of by incineration or landfill. Worryingly, in excess of 8Mt of plastic is identified as entering the oceans each year. In a business-as-usual scenario, it estimates that by 2025 there will be 1t of plastic for every 3t of fish and by 2050 more plastic than fish! The EU commission believes that plastic waste washed away from landfills accounts for around 80% of the plastic in the marine environment [UNEP, 2005].

Though many plastics can be economically recycled into new products using a mechanical process, the Achilles' heel of plastic recycling is that it is usually only possible for single streams of polymer type. Polymers such as PET, HDPE, PS and PP are mechanically recycled, if they can be recovered in large enough quantities from waste sorting facilities. However, many plastic items are made from blends of plastics. Containers such as toothpaste tubes, crisp packets, drinks cartons etc. use laminates of differing polymers, frequently including an aluminium layer. Whilst clever packaging keeping their contents in good condition, such constructions make mechanical recycling extremely difficult or impossible.

The widespread use of dyes, fillers and other additives present further challenges to mechanical recycling as does the high level of contamination from the contents of the original packaging. These contamination issues are particularly troublesome when the aim is to produce recycled polymers for food packaging.

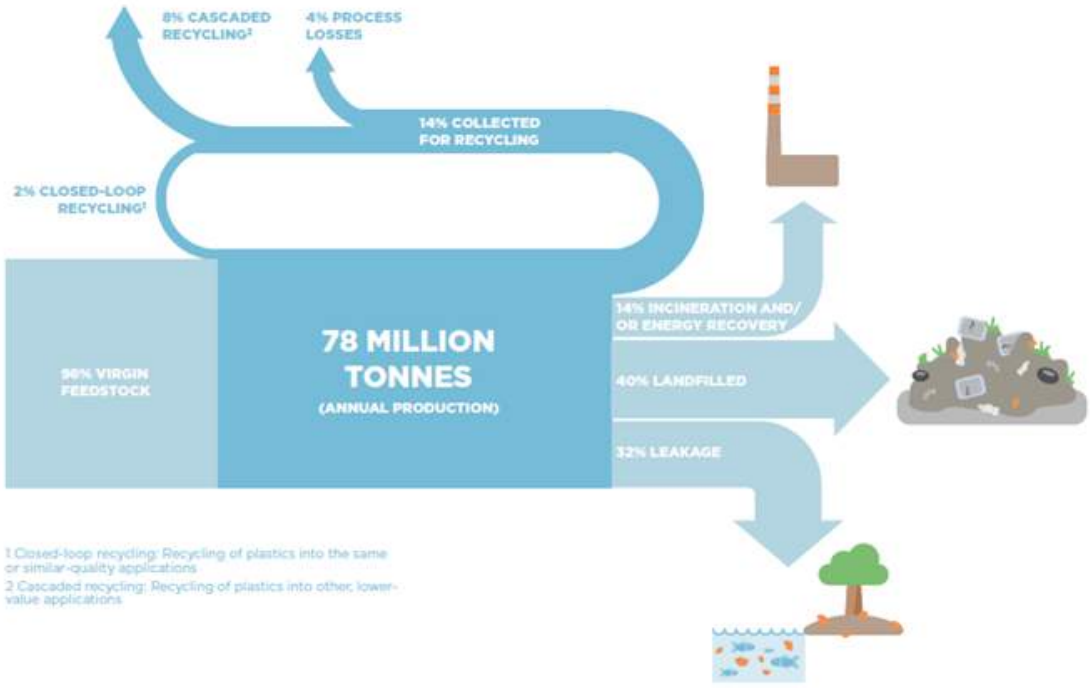

Figure 1- Global Flows of Plastic Packaging Materials in 2013
Source: The New Plastics Economy, Project Mainstream (2016)

Consequently, whilst some plastic bottles are recycled into more bottles, so called 'closeed-loop' recycling, as shown in Figure 1 the quantities of this are very small. More typically the value of plastic is downgraded, so called 'cascade' recycling. Bottles made of PET frequently end up as polyester fabrics and HDPE items become lumber replacement items; railway sleepers, fence panels and posts etc. that at the end of their life are not recycled.

To propel plastic into the circular economy, innovative and cost effective techniques are essential to capture and reuse these polymers at higher value levels. The feedstock recycling technology developed by Recycling Technologies provides one such solution for a Smart City.

3. A SOLUTION: FEEDSTOCK RECYCLING AND THE RT7000

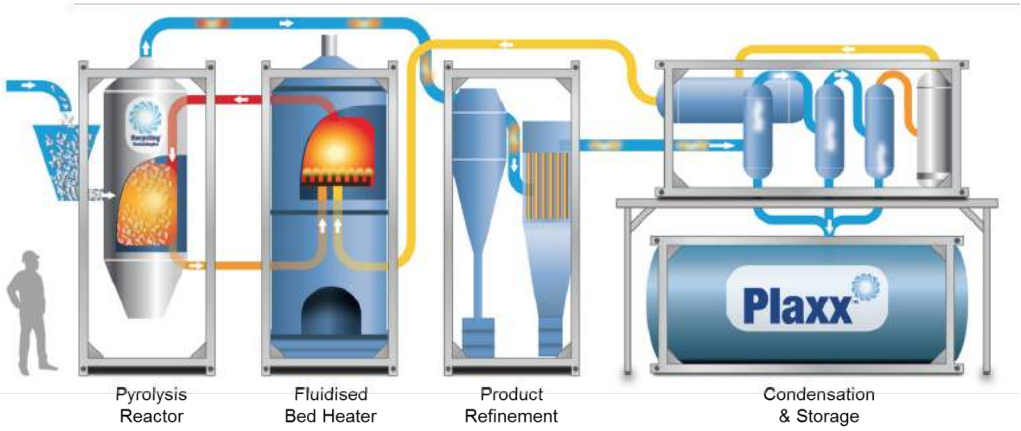

Figure 2 - RT7000 Schematic
Source: Recycling Technologies

Recycling Technologies Ltd. [RT] has developed an innovative process that recycles end-of-life plastic waste into a commercially valuable hydrocarbon called Plaxx™ (Figure 2). The technology has been incorporated into a modular machine, the RT7000, designed to be situated at Material Recovery Facilities [MRFs] and process 7000t [dry weight] of unsorted end of life plastic per year. The machine is constructed as a series of 6m intermodal shipping frames as shown, providing a small footprint, transportability and the ability to be mass produced. This latter feature enables low capital cost and ease of capacity scale up.

The technology uses pyrolysis to crack the long hydrocarbon chains found in plastic, into shorter molecules. This process is not sensitive to varying types of polymer, so there is no need to pre-sort the plastic waste into individual grades. While the pyrolysis gas is hot and hence in the gas phase, fillers, pigments, fire retardant and other contamination associated with plastic are removed using reactants, catalysts and a hot gas filter. The clean hot gas is then condensed to form a product called Plaxx™. At room temperature, Plaxx™ is a soft waxy material similar to a soft candle in texture.

Figure 3 – Recycling Technologies processes end of life plastic often destined to landfill or EfW plants
Source: Recycling Technologies

Within the waste system, whether at the kerbside or at a MRF, material with sufficient value is separated by the waste operator and sold for recycling as depicted in Figure 3. This leaves a residual stream that is currently either landfilled or sent to an EfW facility so that a proportion of its energy can be recovered. This residual material is a liability to the waste operator as currently they have to pay gate fees to have the material incinerated or landfilled. RT's aim is to provide an alternative that reduces the cost for waste operator and preserves more of the polymers value. It is proposed that the end of life plastic is removed and converted by the RT7000 into Plaxx™, a clean and versatile hydrocarbon.

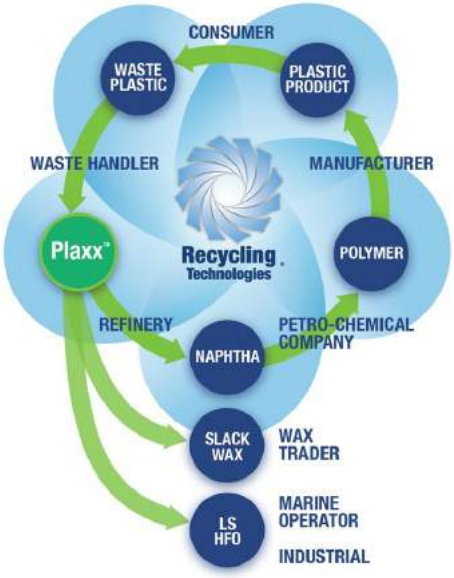

Figure 4 – Diagram depicting evolution of Plaxx™ end use.
Source: Recycling Technologies

As shown in Figure 4, Plaxx™ is a substitute for crude oil derived Heavy Fuel Oil [HFO] but with two main advantages. Firstly, it has a low carbon footprint since each tonne of plastic waste that is diverted from EfW and processed through this technology saves 1544 kg of CO_2 emissions [Source: Recycling Technologies internal assessment]. Secondly, it has a very low sulphur content, typically less than 0.01%. The former, combined with its low cost, makes it attractive for use in industrial applications where gas in unavailable. The latter makes it attractive to the marine sector, where the MARPOL Annex VI regulations now demand the use of fuels with less than 0.1% sulphur content. Being a slack wax, its use as a bitumen modifier or similar is recognised, however, it use as a feedstock for producing more polymers is the subject of this paper.

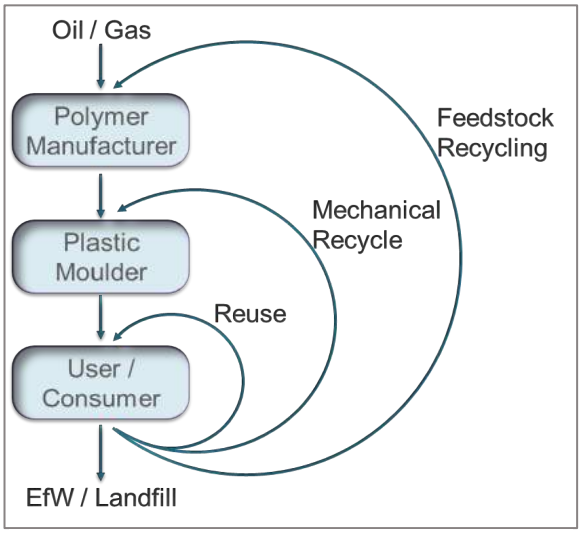

Figure 5 – Plastic in the Circular

Figure 5 shows the role that Feedstock Recycling can play to keep the value of the plastic at higher levels than Energy from Waste or landfill.

4. FEEDSTOCK RECYCLING IN A SMART CITY

Each person in Western Europe uses 136kg of plastic each year [Statista, 2016]. With reference back to Figure 1, the likely destination of this plastic per person can be considered and an estimate made as to the value of this plastic that is currently recovered.

Destination		kg/ person	€ / person	Recovered Value	
				%	€
Closed loop Recycling	2%	2.7	3.84	75.0%	2.88
Cascade Recycling	8%	10.9	15.34	50.0%	7.67
Lost from recycling process	0%	0.0	-	0.0%	-
Feedstock Recycling	0%	0.0	-	0.0%	-
Energy from Waste	18%	24.5	34.52	11.8%	4.06
Landfill	40%	54.4	76.72	0.0%	-
"Leakage"	32%	43.5	61.37	0.0%	-
	100%	**136.0**	**191.79**		**14.61**
Overall value recovery					7.6%

Table 1 – Destination of plastic per person and recovered value.

Note: In Figure 1, reference is made to 4% of plastic that is collected for recycling but then ejected as "Process Losses". We believe that the majority of such losses are subsequently sent to EfW facilities and therefore in our analysis we have added this into the waste steam destined for EfW.

The "as is" scenario in Table 1 shows that just 7.6% of the initial value in the plastic consumed by one person is recovered. This compares well to the 5% reported by the Project Mainstream report already cited. [The New Plastics Economy, Project Mainstream, 2016].

The opportunity for a Smart City is to create a low cost option for all the residual plastics that are not currently recycled. The Circular Economy package has established the objective of

eliminating landfill where possible and recycling much higher proportions of packaging and all other materials. The challenge is of course where all that material should be recycled in the future? EfW could consume the material but it does not achieve the recycling aims. Our proposal is that this material should be recycled as a feedstock.

Destination		kg/person	€/ person	Recovered Value	
				%	€
Closed loop Recycling	2%	2.7	3.84	75.0%	2.88
Cascade Recycling	8%	10.9	15.34	50.0%	7.67
Lost from recycling process	0%	0.0	-	0.0%	-
Feedstock Recycling	75%	102.0	143.85	20.5%	39.23
Energy from Waste	5%	6.8	9.59	11.8%	1.13
Landfill	0%	0.0	-	0.0%	-
"Leakage"	10%	13.6	19.18	0.0%	-
	100%	**136**	**191.79**		**50.91**
Overall value recovery					26.5%

Table 2 – The potential of Feedstock Recycling to boost recovered value.

Our analysis indicates that implementing Feedstock Recycling within a city would boost recycling rates potentially up to 85% and lift the value retained in the plastic from 5 – 8% to over 26%.

There is no reason to feel that Feedstock Recycling, i.e. "end of life" plastic into Plaxx™ would displace either closed-loop or cascade recycling which play a vital role in maintaining the value of plastic in the circular economy. However, it will have a significant impact on EfW, Landfill and Leakage. Each is considered in turn in contemplating the extent to which Feedstock Recycling could enhance a city's sustainability.

4.1 Feedstock Recycling v's EfW

To achieve the 2030 landfill reduction targets a large ramp up of EfW facilities across the EU is sometimes tabled, though this would do little to achieve the recycling targets also defined in the Circular Economy Package. Such an approach would also depress the value of plastic when compared to that achievable via Feedstock Recycling. It is fully recognised that EfW may well be the best solution for the short carbon cycle biogenic fraction, however, for the long cycle carbon associated with plastic EfW is not as beneficial as feedstock recycling.

Furthermore, removing the highly calorific plastic from the material destined for EfW would in general serve to increase the tonnage of material that an EfW facility can process reducing the capacity to demand gap. By removing plastic from the residual waste stream such facilities can be largely dedicated to biogenic material, normally regarded as renewable, which will enhance their sustainability contribution.

Not all existing EfW plants could operate on 100% biogenic content, neither could all plastic be separated from a MRF's residual waste stream. Consequently, in Table 2, the use of EfW for plastic is not eliminated, but reduced from 18% to 5% of plastic.

4.2 Feedstock Recycling v's Landfill

Landfill offers no economic value, rather their maintenance represents a liability to a cities populous. Therefore, all the plastic currently going to landfill should be redirected to Feedstock Recycling.

Such a move would also have an effect on road transportation. The RT7000s small size and low cost allows easy installation within a city boundary, bringing the solution to the source of the plastic avoiding the need to transport waste plastic to out of city facilities like landfills. This approach avoids both the cost, congestion and carbon impact of such transportation. Once plastic waste is recycled into Plaxx™, the transportation requirement is approximately one fifth of that needed to move unbaled plastic waste.

4.3 Feedstock Recycling: impact on "Leakage"

The modular nature of the RT7000 allows the system to be mass produced providing a cost effective route to Feedstock Recycling. This will allow gate fees to be significantly lower than that for EfW facilities, alleviating the cost driver for the current "leakage" from the waste collection system.

It is widely believed that collection of plastic is negatively impacted by the lack of clarity that exists regarding which polymers can or cannot be recycled. Faced with uncertainty people will deposit plastic into general waste, exacerbating the work that the MRF has to do to recover this material. Since the RT7000 is able to process unsorted, mixed and contaminated plastic, the message to the population of cities can be simplified to "all plastics". Consequently, we believe that the RT7000 system would play a significant role in reducing the proportion of plastic that currently "leaks" from the waste system.

5. FEASIBILITY OF FEEDSTOCK RECYCLING

To become a realistic option in the Circular Economy's objective of reducing landfilling to 10% of current levels by 2030, significant feedstock recycling capacity would be required around the EU within this time frame. Referring to Table 2, 102kg of plastic per person could be processed this way. Each RT7000 can process 7000t pa which means installing one machine for every 70,000 – 100,000 people. By way of example, a city the size of Barcelona with 1.6M people would need 16 - 23 RT7000 machines.

Since the machine is modular and designed for mass production this could be achieved within two to three years. However, the payback period of each machine is around 3 years, so rather than financing the whole fleet at one time the modular approach provides the opportunity to install some initial machines and then grow the capacity from now to 2030 using the income from the sale of Plaxx™.

To further enhance the benefits of this Feedstock Recycling approach, the RT7000 is to be assembled by RT within the EU. RT will Build, Own and Operate the machines and manage the sale of Plaxx™ to achieve the highest value for residents of a city. By operating and maintaining our own machines, we are confident that the life of the machines will be well in excess of 20 years. At the end of their life, the intention would be to return them to the factory for refurbishment, preserving the value of the machine at its highest level. This ability to return individual modules from the system to the factory also creates an upgrade route. Future refinements in the process and or machine can be migrated across a city's fleet of RT7000s by simply removing modules and replacing them with upgraded versions.

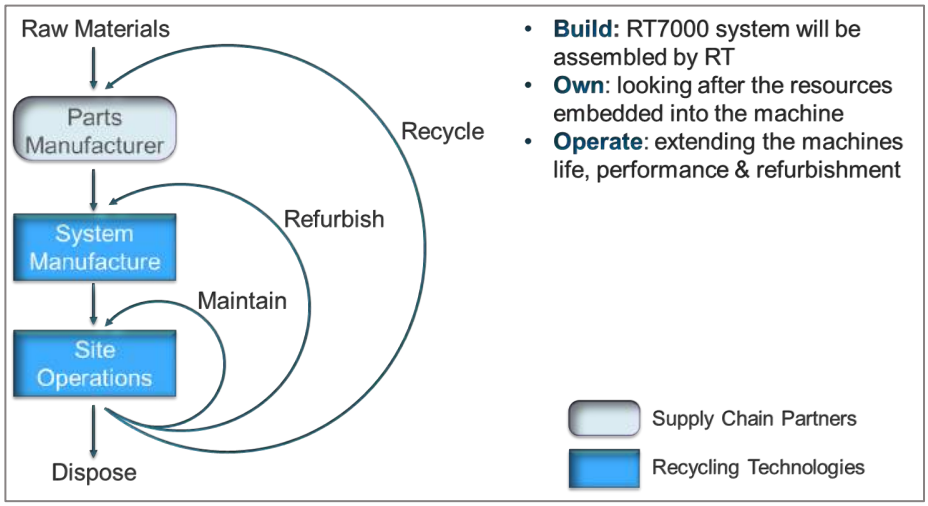

Figure 6 – The RT7000 in the Circular Economy

6. SUMMARY AND CONCLUSIONS

Due to its tremendous flexibility and potential for environmental good the use of plastic is growing rapidly. In 2014, around 311 million tonnes of plastics was produced around the world and in the next 20 years this is set to double. However, most is discarded after their first use. In spite of efforts to recycle plastic waste, the majority ends up either in landfills, leaking into the environment or sent to Energy from Waste plants where it is incinerated to recover electricity and in some cases heat. Only 2% of the plastic waste that is collected for recycling is truly recycled and only 5 – 8% of the value of all plastic is retained after its first, usually short, use.

The challenge for cities of the future is to make a step change in the quantity of such material that is recycled and to retain much higher value levels in the recycling approach.

Recycling Technologies proposes to achieve this by introducing a mass produced machine, the RT7000 which facilitates Feedstock Recycling. This relatively low cost approach processes mixed and contaminated plastic waste, removing the need to separate the plastics into polymer type-streams beforehand. Each machine recycles 7000t of plastic per year into Plaxx™, a clean and versatile hydrocarbon product. This approach is suitable for all plastics currently going to landfill, leaking from the system and going to EfW facilities. Engaging with the population of a city and removing the confusion about which plastics can or cannot be recycled could boost recycling of plastics from the current 10% average to 85%, split across closed loop, cascade and feedstock recycling. This will bring plastics more in line with the recycling performance of steel.

The value of the plastic processed through these routes is likely to be increased from 5 – 8% now to 26% by these means. Per person using an average of 136 kg of plastic per year, equivalent to €192, this is €36 improvement. For a city such as Barcelona this amounts to in excess of €58M pa increase in retained polymer value.

Since the system is modular, it is easy to trial. One machine can be established and its potential assessed. If this demonstrates the impact that RT believes that it can and will, scaling up to a city wide scheme can be done in a step wise fashion, largely paid for by the value produced by the initial machines.

GLOSSARY

EfW	Energy from Waste facilities
HDPE	A polymer type, high density polyethylene.
HFO	Heavy Fuel Oil
MRF	Material Recovery Facility
MARPOL	Marine Pollution organisation
PET	Polyethylene terephthalate, a type of polymer.
RT	Recycling Technologies Ltd.
Slackwax	A hydrocarbon commodity produced by Class 1 refining.

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An IoT platform for decentralized end-to-end security and privacy for smart cities: SMARTIE

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KEYWORDS: smart city, security, privacy, reference architecture, IoT

ABSTRACT:
The vision of the European Union (EU)-funded project SMARTIE (Secure and sMArter ciTIEs data management) is to create a distributed framework for storing, sharing and processing large volumes of information under requirements of security, privacy and trust. This project has taken other EU-funded projects' experience (condensed in the EU IoT reference architecture, that is, the IoT-Architecture Reference Model) to design and develop its IoT platform for smart cities. Interoperability and security are pivotal in the SMARTIE platform, which has been tested in three different cities in Germany, Spain, and Serbia.

1 INTRODUCTION

Smart Cities are envisioned to strongly benefit citizens' life by improving and adapting the city services such as water supply, transportation, healthcare, education, safety and energy usage to their needs. Smart cities rely on a wide range of technologies comprising advances in hardware, radio communications, network protocols, software frameworks among others. In particular, the Internet of Things (IoT) paradigm encompasses many of the technologies that are crucial for connecting objects to smart Cities. These technologies are expected to enable collecting fine-grained data of the city and its residents, and remotely controlling the city's infrastructures in order to intelligently manage the city's traffic, buildings, parkings, and so on.

Whereas the big scale of cities and the increasing population in urban areas, there is a global need for energy savings and cost effectiveness in city management. As Chirstianna Figueres, executive secretary of the United Nations Framework Convention on Climate Change (UNFCCC), is quoted by the Guesi SMARTer2020 report (SMARTER2020 2015), Information and Communications Technology (ICT) can play an essential role in saving energy to stem climate change. According to this report, the energy consumed by data centers will increase by 81% by 2020. Being the biggest collective source of IoT information, smart cities will have a big impact on the ICT's energy footprint.

Besides energy consumption, there are other big concerns for the IoT that stem from the big scale of smart cities: security, scalability and interoperability. With smart cities putting more information on telecommunication networks and allowing remote control of public

infrastructure and even citizens' personal devices, the risk and impact of security threats can have profound and serious consequences to the community. Thus, security and trust are essential for the success of smart city solutions and for their acceptance by citizens. Moreover, the tremendous heterogeneity of smart cities will inevitably demand for interoperation between IoT and cloud platforms from different providers. Interoperable and scalable solutions are therefore paramount for the success and promotion of smart cities.

The European Union (EU)-funded project SMARTIE (SMArter ciTIEs data management) started in 2013 with the aim of making progress towards the security, privacy, trust, and interoperability of IoT platforms for smart cities. The project is now entering the final stretch and will be actually completed by the end of 2016. Two important industrial partners, two Small and Medium-sized Enterprises (SMEs), one research institution, one public university and one governmental agency have collaborated to develop the SMARTIE platform during three years. Figure 1 shows a smart city infrastructure as it is envisioned by SMARTIE. Various sensors provide data into a data platform and actuators in the city receive actuation commands from the platform. The platform offers interfaces for various kinds of services, such as energy metering and control, transportation and traffic management.

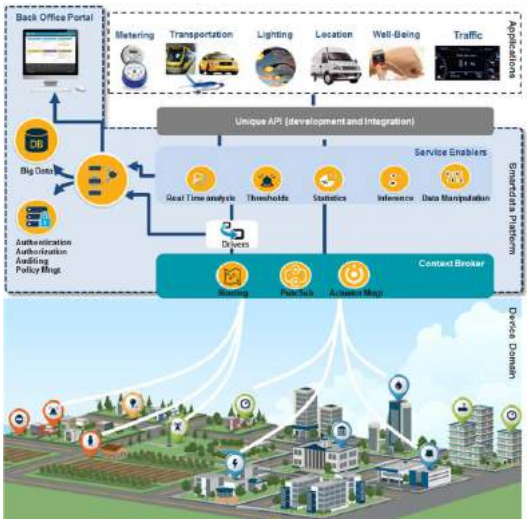

Figure 1. Visualization of a Smart City Infrastructure with Sensors, Smart Data Platform and Applications

This article describes the main challenges for smart cities that have been faced by the SMARTIE project in Section 2. Section 3 briefly outlines the contributions of this project to address the challenges introduced by Section 2. Section 4 describes the use cases that are being tested in real scenarios. Finally, Section 5 gives some conclusions.

2 CHALLENGES IN SMART CITIES

Smart cities are an extremely complex technological ecosystem that faces many challenges. Specially, interoperability, security and privacy (Al-Fuqaha et al. 2015) will be crucial for the promotion of new federated IoT platforms for smart cities that will result in valued-added, services for citizens (Gubbi et al. 2013).

2.1 Security

Critical city infrastructure must be protected from malicious attacks by security mechanisms of IoT platforms. Furthermore, access to private information of users and the city itself in smart cities' platforms must be strongly controlled. The integration of heterogeneous subsystems in smart cities' platforms can make it difficult to guarantee the integrity and security of all the platform's components. Many kinds of threats are possible in IoT platforms for smart cities. An attack might try to sabotage or compromise subsystems to take over control of certain aspects of the city. Hacking and Sabotage can be dangerous since once a part of the system is compromised, this attacker can use the compromised subsystem to attack the full smart city infrastructure. External attackers may try to access private data from users, components or subsystems of the IoT environment (e.g., the energy consumption of city areas or even single houses is potentially interesting for unwanted commercial purposes). Furthermore, an external attacker can try to remotely control the city's smart infrastructure such as display units, traffic lights, heating systems, fire doors, etc. Besides external attacks, the IoT platform should be protected against internal adversaries that have bypassed protection mechanisms (e.g., the IoT platform's raw data should be encrypted in the platform's storage system).

A smart city's platform must ensure fundamental principles of information security such as confidentiality, integrity, access control and availability for the different aspects of a smart city. These principles must be applied to all the aspects of the platform's architecture and any kind of communication in order to guarantee the overall system security and user privacy. Ensuring security properties in smart cities is tricky because of scalability issues and the constrained computation power of "things", that is, sensors and actuators. Traditional approaches that are widespread in Internet such as centralized access control servers, asymmetric cryptography and TLS among others do not work well in the IoT. Lightweight and decentralized security mechanism are paramount to ensure overall security in smart cities.

2.2 Interoperability

IoT is intrinsically adhered to heterogeneity. There is a plethora of IoT application domains and for any of them, each specific application needs to handle with its own diversity in device characteristics, communication technologies, required functionalities, and so on. This high degree of heterogeneity has resulted in numerous "IoT islands" that are designed to accomplish some application-specific goals.

For the sake of interoperability in IoT, the European Union (EU) has invested efforts on several FP7-programme-funded projects in the last few years (Krco, Pokric & Carrez 2014). Notably, the IoT-Architecture (IoT-A) project started in 2010 in order to develop a reference architecture and finally released the IoT Architectural Reference Model (IoT-ARM) (Bassi et al. 2014) in 2012. Despite the European efforts for standardizing an IoT reference architecture, works that show the application of the IoT-ARM are almost non-existent. To the best of our knowledge, only the architecture presented in (Fernandes et al. 2015) is based on the IoT-ARM.

3 SMARTIE CONTRIBUTIONS

Below, we outline the main contributions of the SMARTIE's project towards the security and interoperability of IoT platforms for smart cities.

3.1 Interoperability-driven design

Reference architectures will be key for the interoperation of future IoT platforms by providing a reference framework that permits to guarantee the quality of IoT platforms, compare platforms, measure their level of interoperability, and so on. Nevertheless, reference IoT architectures is a recent research topic. Very limited experience and feedback has been reported about the application of these architectures in real scenarios. To promote quality aspects of IoT in smart cities, the architecture of the SMARTIE platform has been designed from the IoT-ARM. This reference architecture addresses the different phases of the architecting process by providing inputs (e.g., guidance, examples, common semantics, etc.) that can greatly help architects to design their IoT systems. The IoT-ARM was conceived as an abstract and application-independent reference framework in order to support the generation process of IoT architectures in any IoT domain. Thus, the IoT-ARM defines high-level concepts, semantics, and functions that are common to any IoT platform.

The SMARTIE project look at smart cities from a security point of view in order to enable the exchange of heterogeneous information while guaranteeing privacy and trust. SMARTIE requirements on security, privacy and trust as well as their associated architectural design choices were deduced from a deep analysis on the IoT-ARM's threat analysis, unified requirements, and the "Trust, Security and Privacy" perspective (Bassi et al. 2014). We refer the reader to (SMARTIE requirements 2015) and (SMARTIE Architecture 2015) for information on the SMARTIE requirements and design choices, respectively.

The ARM-compliant SMARTIE architecture is shown in Figure 2. This architecture is composed by a set Functional Groups (FGs). Each FG is composed by different Functional Components (FC) that encompasses common functionality. By having the SMARTIE's architecture built up from the basic principles and components defined by the IoT-ARM, the SMARTIE's platform increases the interoperability with other platforms compliant with the IoT-ARM. Indeed, it allows easily comparing between different architecture so as to define a level of interoperability and other quality aspects such as security between them (Bassi et al. 2013).

The Device and Application FGs contain the physical devices of interest and the applications that will access to our platform, respectively. The IoT Process Management FG provides an environment for the modelling of IoT-aware business processes (i.e. Process Modelling FC) and their execution (i.e. Process Execution FC). Our architecture does not contemplate yet these activities, since business processes are as of now pre-configured in the platform. The Service Organization FG is used for composing and orchestrating services of different levels of abstraction. Applications can interact with the IoT system at the VE level that models high-level concepts of the physical world (e.g., "give me the status of windows in the room 102") by the FCs provided by the Virtual Entity FG. Besides the VE level, applications can interact with the IoT system at the IoT Service level by directly communicating with services hosted by devices (e.g., "give me your status" on a temperature sensor) by the FCs given by the IoT Service FG. The Communication FG represents the variety of communication technologies that can be

used by devices in IoT systems and provides a common interface for the IoT Service FG. The Management and Security FG are transversal FGs with FCs that are common to the rest of FGs. The former provides all the functionalities that are necessary to govern an IoT system and the latter those related to security, privacy and trust. For more information on the SMARTIE architecture we refer the reader to (SMARTIE Architecture 2015).

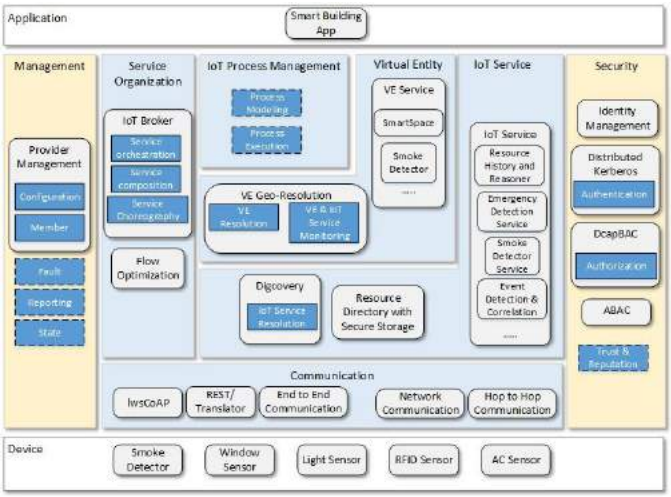

Figure 2 - Simplified version of the IoT-ARM-Compliant SMARTIE architecture. White rectangles represent Functional Groups (FGs) that are out of the scope of the ARM, and yellow rectangles are FGs with common functionality to the other FGs. Grey rounded rectangles represent SMARTIE FCs. Within them, blue rectangles represent implemented ARM FCs. Dashed-line rectangles represent ARM FCs that have not yet been considered.

3.2 Lightweight and decentralized security solutions

SMARTIE platform implement scalable and distributed security and privacy mechanisms that provide a better scalability and optimize energy consumption at constrained devices, as described in the following subsections.

3.2.1 Decentralized access control

The SMARTIE platform implements capability-based access control (DCapBAC) (Hernandez-Ramos et al. 2014) that is a decentralized Attribute-Based Access Control (ABAC) mechanism. To access a resource, the requester needs to hold a signed JSON token that contains the authorization to which the requester is granted. Thus, the resource server verifies the token's signature and, if this verification is correct, grant access to the requester based on the rule contained in the token. As depicted by Figure 3, the requester (subject) requests first a token from the issuer, afterwards he attaches the token to the request and the resource server (device) verifies the token to decide whether or not to grant access to the requester.

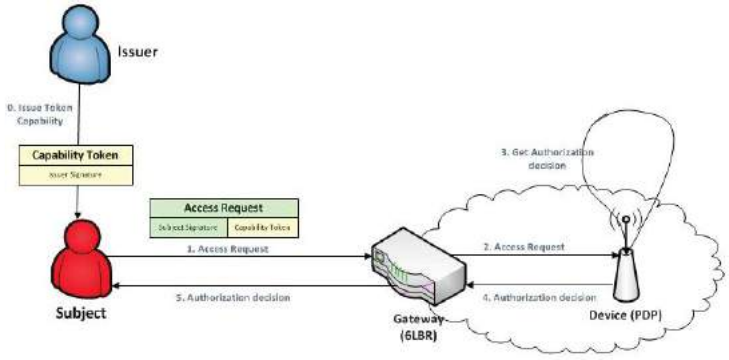

Figure 3 – Outline of DCapBAC operation

Moreover, the SMARTIE platform relies on Ciphertext-Policy Attribute-Based Encryption (CP-ABE) in order to efficiently implement group-based authorization in one-to-many communications. In short, CP-ABE (Bethencourt, Sahai & Waters 2007) allows encrypting and decrypting information based on certain identity attributes of the information receivers. Thus, implicit authorization is given to all the information receives that possess the encryption key, without the need of any centralized access control server.

3.2.2 Efficient event-based dissemination of private information

The SMARTIE platform implements a context broker that provides applications with one single access point for subscribing to any event in the smart city and receive timely notifications of interest. At subscription time, the subscriber application is given a set of attributes that implicitly represents the authorization for future notifications. Afterwards, CP-ABE is used to encrypt notifications to the subscriber without any further authorization checking. Indeed, the encryption represents the access control policy since only the consumers holding the proper attributes will be able to decrypt the message. This mechanism is very efficient when multiple receivers are involved, since the information does not need to be encrypted individually for each receiver.

3.2.3 Other security services

First, Lightweight Secure Constrained Application Protocol (lwsCoAP) provides a secure data channel between the IoT devices and the backend cloud platform employing light-weight encryption schemes. It applies cryptographic primitive based on elliptic curve cryptography (ECC) to CoAP (Shelby, Hartke and Bormann 2014) that is the de-facto application layer protocol for the IoT. This solution is based on ISO/IEC 29192 standards that aim to provide lightweight cryptography for constrained devices, including, block and stream ciphers and asymmetric mechanisms. This method is further optimized in order to reduce the key size and make the algorithm more efficient in terms of computational requirements and still provide the satisfactory level of the security.

Second, PrivLoc (Bohli et al. 2014) offers a secure geo-fencing service that alerts users if objects enter or leave a defined area. Location information is disseminated in different modes (e.g., one-to-one and one-to-many) in a secure way. And last, an intrusion detection system (IDS) for IoT (Krimmling and Steffen 2014) has been integrated into SMARTIE to scan the network traffic for intrusions and report unknown or unwanted traffic to the network operator. This component gathers and stores data to build a knowledge base for detection.

4 SMARTIE PLATFORM: USE CASES

The rationale behind the SMARTIE project is the security and interoperability challenges introduced by Section 2. Different real scenarios has served as the perfect environment to test these challenges under real circumstances (SMARTIE Use Cases 2015). The following subsections outlines these use cases, the facilities and environments in which they have actually being tested, and the security challenges faced by them.

4.1 Smart Energy Management

The goal of this use case is to provide a reference system able to manage intelligently the energy consumption of buildings. To this end, the SMARTIE platform interacts with a number of actors and entities that provide energy monitoring and consumption feedback, relies on automation systems, sensors and actuators, and applies economic strategies to save energy. Users are informed about energy use aspects and can interact with the platform to define specific strategies for saving energy or to control their own devices integrated in the platform. In order to protect buildings' facilities and data owners, the SMARTIE platform provides end-to-end security and trust in information delivery that guarantees the proper decision-making for energy management, building automation and even indoor emergency handling.

The pilot test is set in the Region of Murcia, where different city facilities are monitored and managed by the SMARTIE platform to deal with energy efficiency. In particular, Figure 4 outlines the SMARTIE deployment in a smart building located in University of Murcia (UMU), Spain. This building has a total of 8 floors with a total area of 6.500 m2 and is fully monitored and automated by the SMARTIE platform through a wide variety of sensors and actuators. A Building Management System (BMS) has been developed and installed in the building for information gathering from sensors and control on actuators among other advanced functionalities. Figure 4 shows some FCs that are implemented by the BMS and the platform (see Figure 2). The BMS interacts with the platform server through RESTful communication (i.e., HTTP or CoAP) and connects to Home Automation Modules (HAMs) that serve as GWs to sensors and actuators. HAMs are intelligent modules that are distributed throughout the building and provide a uniform interface (i.e., CoAP and MQTT) to the BMS. Each HAM monitors and controls a smart space in the building (i.e., monitored by sensors and controlled by actuators).

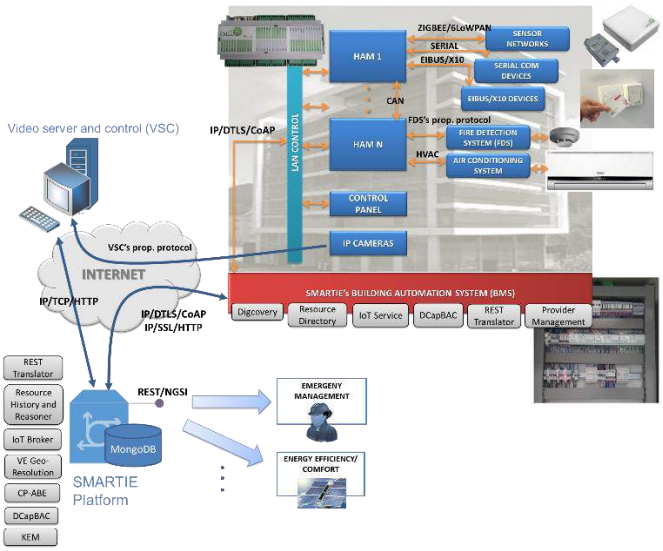

Figure 4 – Big picture of the scenario for energy management for the SMARTIE platform. Grey boxes indicate the architectural FCs that are exclusively implemented by the BMS or the platform server. The rest of FCs are distributed between the BMS and the platform. The BMS communicates with HAMs (IoT gateways e.g. picture at the top- left corner)

4.2 Traffic Management

One of the main future challenges for urban administration will be the management of the constantly increasing amount of urban traffic, especially in the metropolitan areas. In nearly every city in the world, traffic jump situations affecting large areas of the city are a daily occurrence. This is not only problematic because of the higher amount of noise and pollution caused by the traffic, but also causes higher transport costs to the communities and decreases traffic safety considerably. The aim of this use case is to use the SMARTIE platform to improve traffic situations, traffic safety and the quality of information to road users.

This use case is being tested as part of a pilot system in the city of Frankfurt (Oder), Germany. This pilot demonstrates the possibilities of the SMARTIE platform that is integrated with the city's existing traffic infrastructure. The platform enables the traffic management authorities to join different traffic data sources and actuators to improve traffic flow and traffic safety in relevant areas. The SMARTIE platform is being used by the Traffic Green system[1] that allows to switch traffic lights whenever an emergency car approaches and has been in operation in Frankfurt (Oder) for over 10 years now. Today about 20 emergency vehicles (mostly fire trucks and ambulances) and over 30 traffic lights in the city are equipped with the system. This system relies on the SMARTIE platform to collect information from floating car (i.e., GPS coordinates) in a secure way, detect and process real-time traffic events, notify the emergency crew of emergency situations, and so on.

[1] Traffic Green, http://www.greenwaysystems.de/web/engl/?content=produkte&site=green

4.3 Public Transport Management

This use case aims to improve the management of the public transportation network in order to thus promote and encourage the greater use of sustainable transport modes and to provide time and cost benefits to travellers. The use case is already being tested in Novi Sad (Serbia) by enabling smart transport options for users of the city's public bus transport network operated by a local company, JGSP[2]. As of now, the pilot only includes 2 routes within the bus transport network but it will be extended to other routes and other transport means in the future. Bus stops are equipped with Augmented Reality (AR) markers in the form of an image (e.g., logo or QR code). Furthermore, fleet management devices are attached to busses in order to track their location in real-time. Users are able to find out the bus arrival time and also request information on the best route for a given destination by using their smart phones, dedicated applications and the AR markers at bus stops (see Figure 5). Data generated by the fleet management devices is owned by the public transportation company and the access to this data is highly restricted to authorized users. Furthermore, citizens generate private data such as their location and travel plans. This data is securely stored within the SMARTIE platform. The platform also ensures access control policies for both end users (or citizens) and IoT devices (i.e. fleet management devices).

Figure 5 – Illustration of a possible response to traveller request: a) bus stop has an AR marker, b) and c) the marker is used by the traveller to see details about next bus arrivals

5 CONCLUSIONS

Security and interoperability are two important quality aspects that can empower IoT platforms for smart cities. The SMARTIE project was granted by the EU in order to research on these aspects and come up with a tangible IoT solution for smart cities. After three years, the SMARTIE platform represents the project's goals that have been successfully achieved: a) we have learnt lessons about other EU projects related to smart cities and consequently we have developed an architecture as much interoperable as possible, b) we have developed new technologies for scalable information retrieval, processing and sharing, c) we have developed methods for trusted information creation and storage, and d) least but most importantly we

[2] Public City Transportation Enterprise of Novi Sad, http://www.gspns.co.rs/?selected_lang=eng

have ensured the security and privacy of all the aspects of the platform in a scalable way. The SMARTIE platform has been tested in real smart cities in Serbia, Spain and Germany for several crucial aspects of urban areas such as energy, traffic and public transportation management.

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REVOLUTIONISING STREET LIGHT CONTROL

Replacing remote control with truly intelligent autonomous system

Alar Võrk
Cityntel

Street lighting control solutions have become more advance over the preceding decades and the functionality offered by modern street lighting control systems is impressive.

However, most smart street lighting control systems use technology, which concepts stem from the nineteen seventies, when centralized control and fixed architectures was the norm. While offering the functionality and level of control expected from street light control solutions, these systems are complex and costly to deploy, a challenge to maintain and do not feature a high level of robustness.

Using centralized control approach will not enable to deploy large networks of “Smart Devices” due to a complex, time consuming and expensive deployment process. Moreover, even if some of such systems are deployed their reliability is extremely weak due to a centralized control where computing and decision making is made by the central server from where commands are sent to the end devices. Due to long communication line and data packet loss, which is natural in distributed network architecture, there is built-in unreliability of such systems and delay in receiving commands.

Therefore it is difficult to take the next step and build more advanced systems which can include sensor information from the street to make street lights truly context aware rather than following time based dimming schedule.

Alternatively modern control and Internet of Things technologies are moving towards local, single device based, autonomous control and distributed computation.

So, in order to make Internet of Things work in large scale urban environment we need to have a paradigm shift in what is real IoT.

In reality it can’t be just connecting “things” to the internet and having computing in a centralized server as described above. To make a real revolution in IoT we have to look beyond the horizon and acknowledge that IoT is also Intelligence of Things.

It means that we go to have to bring computing to the distributed form and enable devices to gather information locally, process it locally and make decisions and actions as a result. All this without involving central computing.

It does not mean that will dismiss central computing completely but it just takes another role.

Central computing will process collected data to provide analysis to us but it will also help to improve computing in low level devices teaching them based on statistical analysis.

In Cityntel we have taken such an approach and we have developed Smart Street Light control which is based on flat wireless mesh network which allows direct communication between devices, also on application level.

We have also embedded intelligence and data processing capabilities at the edge of network eg luminaire controller.

At first each luminaire knows its location, current date and time and based on that also sunset and sunrise time every day. Moreover, it can also process data from external sources like sensors.

So, at first each luminaire can switch itself on and off at the right time every day without the need to receive a command from a higher level. Secondly, each luminaire is able to receive sensor information from independent sensors in the area of human density, traffic intensity and weather conditions. This information is then processed in each luminaire and brightness is adjusted based on the situation and requirements for any given moment

By using such a local communication and distributed computing approach we can ensure high reliability of the system and also a very precise operation taking into account actual need at a given area.

Moreover, due to a nature of flat wireless mesh network there is no need for network configuration as devices start to network operation automatically.

It means that networks of such devices can be deployed fast and cost efficiently and new devices like additional luminaires or new types of sensors can be added at any time without the need for highly skilled engineering personnel for deployment.

Combining ease of deployment with low cost hardware which can use just 8-bit processors will bring the next generation Internet of Things solutions to the masses.

Cityntel already has deployments of its Smart Street Light Contorl in 8 countries and the number is growing.

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FOSTERING SMART CITIES THROUGH SHARING ECOSYSTEMS – THE MILAN EXPERIENCE IN H2020 "SHARING CITIES"

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KEYWORDS: Smart City, Digital Ecosystem, Sharing Economy, API Economy, Coopetition, Data,

ABSTRACT: (max 2500 chars)
Milan is the "smartest city" in Italy, and is in the top 50 most innovative cities in the world. These prestigious achievements are the outcome of an ambitious process started in 2012 with the "Milano Smart City" strategic initiative. Milan is strongly engaged in renovation investments, and constantly develops and participates in projects aiming to experiment new and innovative smart technologies. One of the most remarkable opportunities in this direction is the H2020 Smart Cities and Communities project "Sharing Cities", started in 2016, in which Milan is involved as one of the three lighthouse core cities together with London and Lisbon. "Sharing Cities" aims to take a digital-first and data-driven approach to overcome some of the key environmental challenges facing cities: carbon emissions from buildings and transport, and air quality. This project aims to enable and support a more agile and more collaborative smart cities market that dramatically increases the speed and scale at which smart solutions across European cities can be implemented, engaging society in new ways to cause them to play an active role in the transformation of their communities – delivering more vibrant, liveable, economically active and resource efficient cities. Milan's smart interventions in "Sharing Cities" focus on domains such as building retrofitting, energy management, mobility, lighting. A key element supporting these interventions is the Urban Sharing Platform, the IT overarching solution encompassing an ecosystem of technical components, capabilities and processes which provide functions and services for fully enabling and sustaining the enactment of a smart city. The purpose of this platform is to aggregate data and control from a wide variety of devices and sensors, store and process the data, enable cross-city federation between different platform instances, and present information to the cities and to the citizens, which enables

better use and control of the available resources. This paper summarizes Milan's main achievements along the path to becoming a lighthouse smart city over the last few years, introduces the objectives of the "Sharing Cities" project, and in this context illustrates the smart interventions planned in Milan's demonstrator area and how the Urban Sharing Platform is supporting them.

1 THE MANY FACETS OF THE SMART CITY CHALLENGE

Making a **smart city** out of a city is a complex process requiring a deep-rooted innovation strategy. Innovation relates to various aspects: tangible and intangible infrastructures, citizens' lifestyles, regeneration and design of public spaces, approaches and tools to develop the economy and the handling of complexities etc. Building a smart city requires rethinking policies and actions to create a community able to live and compete in a globalized world, also in terms of the changing rhythms of life and work in a "glocal" context. Many different players can play a part in this process, from large multinationals to social enterprises, from small and medium businesses to universities, from research centres to the world of associations. Public institutions can play a key role in facilitating, connecting and coordinating. Public authorities on their own cannot transform a city into a smart city, but they should be in charge of creating a favourable environment where the best players operating within their area can work successfully towards common and shared goals. A smart city not only cultivates its technological components, but it also has to combine factors like economic development and social inclusion, innovation and training, research and participation. At the same time, a smart city has to acquire all of the tools necessary to provide and sustain the strategic framework, the internal coordination and the synergies, bringing together the different key players.
In order to address these many challenges, in 2012 Milan started an ambitious process – "Milano Smart City" – targeted at triggering a virtuous circle towards fully turning Milan and its metropolitan area into a next-generation smart city. This process includes enhancing existing synergies between city stakeholders, meeting the city's many needs, effectively listening to and allowing for active citizenship and other fundamental initiatives that a real smart city must put into action.

2 MILAN, ITALY'S SMARTEST CITY

Milan is the second most populous city in Italy and the capital of Lombardy, with a population of 3 million residents plus 1.9 million tourists annually. Producing 10% of national GDP, the mega city is home to 11 universities and academies, media companies and key players in the field of creative economy (fashion and design) and it outstandingly embodies the peculiar feature of the "Made in Italy" and of the "Italian Way of Life". Milan hosts about 180,000 students and 285,000 companies, including a relevant number of start-ups.
Milan is also a European and international city, a hub of economic, social and cultural networks. In 2015, the city hosted the Universal Exhibition "Expo Milano 2015", the six-month international event that attracted more than 21 million visitors, and left a remarkable legacy in terms of business growth, innovation and international relationships.
Since 2012 Milan has been developing and adopting a range of plans across different policy areas such as urban development, sustainable mobility and logistics, energy efficiency and sharing economy. Milan is constantly strongly engaged in renovation investments, developing projects to experiment new and innovative energy

technologies, as well as in awareness raising for energy efficiency, improving zero-emission and energy efficiency standards in urban planning and mobility. Milan is one of the first cities worldwide for recycling bio-waste, a leader in bike and car sharing, and has recently received the Transport Achievement Award by the Organisation for Economic Co-operation and Development (OECD) as one of the most car-independent cities in Europe for having introduced measures such as a restricted traffic zone ("Area C").

According to the ICity Rate Report 2015, Milan keeps the top among the Italian "smartest cities", reinforcing its smart characteristics of economy, liveability, human capital and still keeping a very good rank on mobility, governance and environment. Milan is in the top 50 most innovative cities in the world according to the Innovation Cities Index 2015. The city is experimenting new forms of public-private partnerships and several sharing economy initiatives, with the goal of becoming one of the first European Sharable Cities.

The Municipality of Milan believes in the institutional cooperation with the main international urban systems to confront and overcome together the main key territorial challenges. The city is member of C40 Cities Climate Leadership Group, having recently been recognized as a mega city. It participates in the Open and Agile Smart Cities (OASC) initiative. Milan is a founding member of Eurocities, recently elected in its Executive Committee, and an active participant of the Knowledge Society Forum and Smart Cities Working Group. It is member of the City Protocol Society and the National Observatory on Smart Cities (led by the National Association of Local Authorities). Milan has recently entered the network of the 100 Resilient Cities movement.

In this context of urban, economical and identity transformation, the main strategic challenges for Milan as a smart city are: inclusion and cohesion, sustainability, innovation, cultural economic development and internationalization. To be able to innovate in a sustainable way means to constantly engage in radical changes regarding the ways in which people live, move and work, as well as regarding the way in which the Municipality engages with its citizens. Since 2012 the Municipality has adopted specific plans and strategic policy frameworks regarding urban development, sustainable mobility, energy efficiency and sharing economy. By 2020, the city of Milan aims to drastically improve smart services offered to citizens, in particular:

- Ensure better accessibility and inclusion for everyone.
- Become a more sustainable, green and efficient city.
- Support a public-private system capable of fostering long-term investments in business, research and innovation.

Milan's idea of smart city is not only as technology-driven, but also centred on its citizens. Milan is one of the first European cities adopting a sharing policy framework, aiming to activate new forms of collaboration between public authorities, private companies, civil society organizations, citizens etc., where different actors are not only simple stakeholders, but also solution holders capable of co-producing, co-developing and co-designing services, goods, practices, and policies. A smart city, in fact, is a city where each citizen is unique and where all kinds of "intelligences" and all diversities create value. An inclusive and smart city can be achieved through the use of new technologies able to foster the social realignment between public and private resources; to enhance existing informal networks and cooperation between the different stakeholders; to devise new ways of supporting and promoting multiculturalism; to give a voice to citizens otherwise considered "weak".

One of the most remarkable opportunities oriented at turning Milan into a next-generation smart city is the H2020 Smart Cities and Communities project "**Sharing Cities**", in which Milan is involved as one of the three lighthouse core cities together with London and Lisbon.

3 THE 'SHARING CITIES' PROJECT

"Sharing Cities" is a 5 year project funded by the European Union's Horizon 2020 research and innovation programme under Grant Agreement N° 691895. It aims to take a digital-first and data-driven approach to overcome some of the key environmental challenges facing cities, namely: carbon emissions from buildings and transport, and air quality. The overall goal is to integrate these issues and interventions, using data from a wide range of sensors and sources, across an IT platform to better enable their management. In doing so, the project will deliver cost savings in terms of energy bills and by tackling and optimising demand will reduce the need to invest in electricity infrastructure. Citizen engagement is at the heart of the project, involving the co-design of services by residents and a digital bond scheme to ensure their take-up. Through the integration of different measures and thanks to the IT ecosystem, new smart services will be available and it will be possible for citizens to access information to change their behaviour virtuously in order to produce environmental impact.
By taking a collaborative approach across the three lighthouse core cities (London, Lisbon and Milan) to the development of products and services, and rolling these out across the three follower cities (Bordeaux, Burgas and Warsaw), the "Sharing Cities" project aims to create the level of certainty and demand that will drive the market, turning an initial European Union investment of 25 million Euros to draw in 500 million Euros of external investments.
The "Sharing Cities" project has four key objectives.

1. To achieve **scale** in the European smart cities market by proving that properly designed smart city solutions, based around common needs, can be integrated in complex urban environments. This will be done in a way that exhibits their true potential and allows for the significant scale-up and consequent increase in social, economic and environmental value.
2. Adopt a **digital first approach** which proves the extent to which ICT integration can improve and connect up existing infrastructure, as well as the design and running of new city infrastructure. This will also allow for the creation of a new set of next stage digital services which will help citizens make better and beneficial choices around energy efficiency and mobility, which when scaled up will enhance the city's ability to hit key targets for mobility, housing, energy efficiency and resilience, and economic development.
3. **Accelerate** the market to understand, develop and trial business, investment and governance models, essential for the true aggregation and replication (through collaboration) of smart city solutions in cities of different sizes and maturities. In doing this, the projects intends to accelerate the pace by which transformative improvements are made, and enhance sustainability in communities.
4. **Share and collaborate** for society: to respond to increasing demand for participation; to enhance mechanisms for citizens' engagement; to improve local governments capacity for policy making and service delivery through

collaboration and co-design; resulting in outcomes that are better for citizens, businesses and visitors.

These objectives are in line not only with the H2020 Call requirements but also with other European initiatives such as the EIP Action Clusters. Project goals will be addressed by implementing a portfolio of digital-first and interconnected measures in specific smart districts of each of the three core cities, all of which have clear and ambitious implementation strategies and leadership commitment.

4 MILAN AS A LIGHTHOUSE SHARING CITY

Each of the three core cities selected a demonstration area of strategic importance. Milan's demonstration area, "Porta Romana/Vettabbia" (see Figure 1), is undergoing complete redevelopment and its renewal will connect the historical centre of the city to its agricultural belt by "stitching together" two areas which are now geographically, economically and socially separated.

Porta Romana is a brownfield and former railway yard of 216,000 square meters. The opportunity for this area is to host a functional mix of private and social housing, multi-modal integration around a new station and a large park of at least 74,000 square meters. The main road axis (via Ripamonti) will be redesigned as an "urban quality road", exploiting the tram line number 24 to sustain public transport linkage to other areas of the city. Crossed by the Vettabbia canal, the southern part of this area is characterized by the connection between urban and rural, e.g., the 12th-century complex of the Chiaravalle Abbey. This area also hosts remarkable integrated infrastructures, e.g., a heat recovery system for exhausted purified waste at the Nosedo Wastewater treatment plant: among the first in Europe, it is highly replicable and scalable, and in 2014 was awarded as the best eco-friendly innovation by Legambiente national organisation.

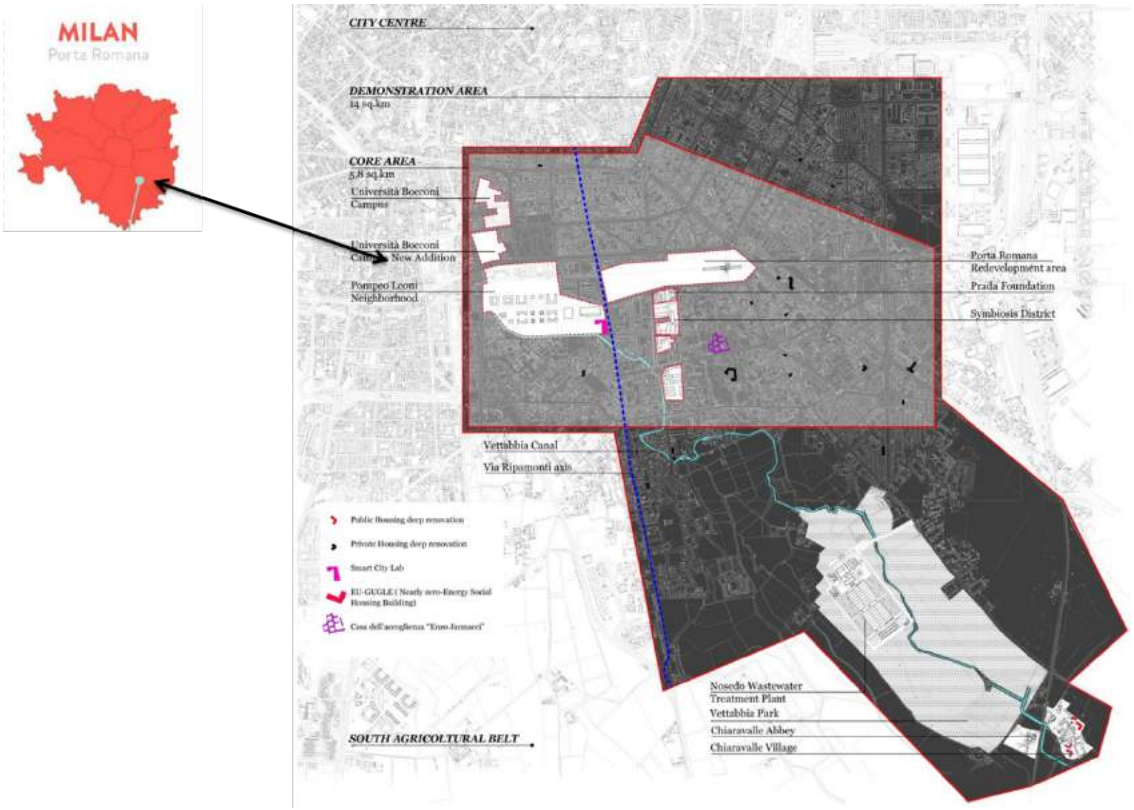

Figure 1. Porta Romana/Vettabbia, Milan's Demonstrator Area in "Sharing Cities" Project

The following Italian partners are directly involved in Milan's pilots: Comune di Milano, CEFRIEL, Politecnico di Milano, Fondazione Politecnico di Milano, Poliedra, Teicos, Siemens, Future Energy, A2A, Kiunsys, NHP, Legambiente, RSE, AMAT, ATM, Selene, ARL.

The planned impact of the "Sharing Cities" smart interventions in this district can be summarized as follows.

- Retrofit of 7 mixed-owner buildings (300 private housing homes, 25,000 square meters).
- 150 electric bikes for bike sharing (14 stations).
- 62 electric cars for car sharing.
- 60 charging points for electric vehicles (20 of which provide rapid charge).
- 125 smart parking bays.
- 300 smart lampposts.
- 11 vehicles for e-logistics.
- Sustainable Energy Management: real-time demand response, energy optimisation and micro-geographical information and visualisation.
- Citizen Engagement: collaborative activities to catalogue current practices across cities; co-creation of sharing services for relevant measures with active citizen participation; development of a district bond scheme to incentivise behaviour change.

- Development of a common open standard reference IT architecture for federated information sharing and exploitation between and beyond the lighthouse cities, i.e., the Milan instance of the Urban Sharing Platform.

5 URBAN SHARING ECOSYSTEM: THE CORNERSTONE OF A SMART CITY

One of the core Work Packages of the "Sharing Cities" project is dedicated to architecting and building an open Urban Sharing Platform (USP) that enables both the technical and functional aspects of the project interventions. An Urban Sharing Platform is a logical collection of technical components, capabilities and processes which provides functions and services enabling a smart city. Its purpose is to aggregate information and control from a wide variety of devices and sensors, store and process the data, enable cross-city federation between different platform instances, and finally present information to information consumers, e.g., the city and the citizens, which enables better use of city resources. The USP is being co-developed within the "Sharing Cities" project to:

- Provide a shared reference architecture at European level that extends the strengths and capabilities of each of the cities both "vertically" increasing each cities capability and "horizontally" shared between the core, followers and scale up cities.
- Enable information and functional sharing by providing an interoperable federated platform based on open and reliable standards, technologies and reference models (e.g., FIWARE, EIP Action Clusters).
- Utilise Micro Services Architecture and API Economy best practices to align city needs with services and technology.
- Provide a federated governance structure to ensure alignment between the cities and ensure that the USP is linked to evolving city management goals ,which are in turn mainly linked to citizen engagement.

Each core city shares significant existing capability which informs the design of the USP and provides valuable skills, experience, blueprints and resources. In particular, Milan has invested in an internal Interoperability Platform and in the E015 digital ecosystem, that constitute the foundation of the IT platform supporting urban smart digital interventions: an ecosystem of open, multi-stakeholder service environments enabling digital interoperability between different players to effectively support the smart city. In particular, smart interventions in mobility and logistics, building retrofitting, lighting, energy management etc. will take advantage of current expertise and solutions of Milan project partners, in particular to: support real-time data collection from field sensors and devices; provide components for data storage and business intelligence; provide API-based access to all data and functionalities managed by the USP, in line with the API Economy and Micro Services Architecture trends; support seamless integration of third-party open data and APIs; support people engagement enabling the development of dashboards and applications for the end-users (e.g., citizens, city managers) to exploit data collected and elaborated through the USP.

5.1 Urban Sharing Platform Reference Model

The reference model of the USP supporting the key project interventions in Milan encompasses different **logical layers** across three **tiers** (see Figure 2) at which the Platform can operate and scale.

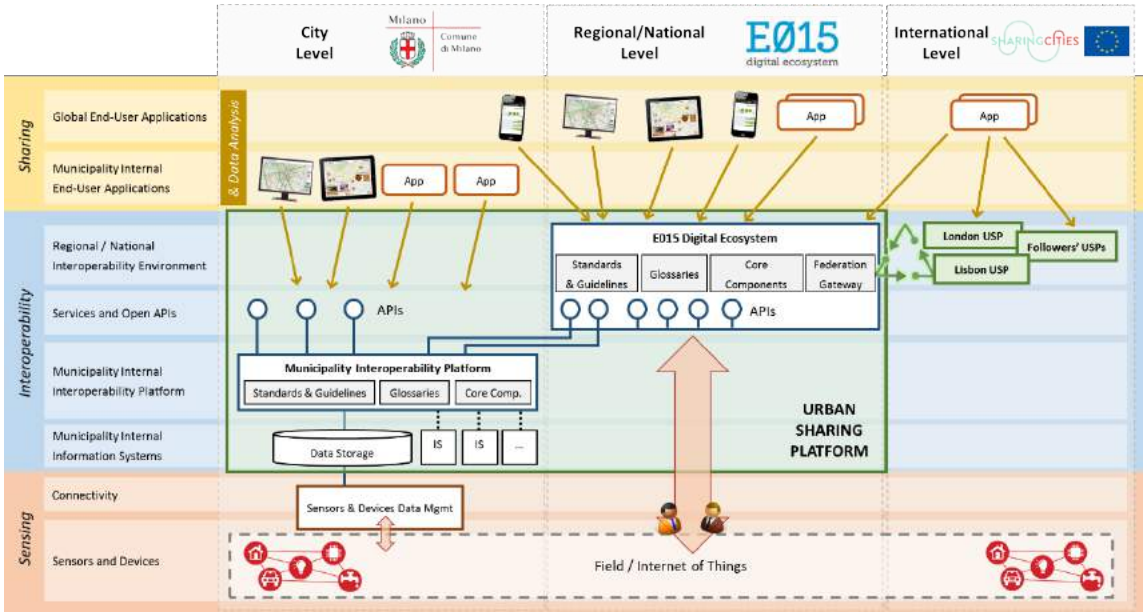

Figure 2. High-level logical view of the Urban Sharing Platform in Milan

The layers considered in the model are:

- **Sharing**, encompassing city sensors and devices (i.e., IoT management and data collection) and related connectivity features (i.e., communication networks and protocols for adapting and conveying data coming from the field).
- **Interoperability**, including the internal information systems and interoperability platform of the Municipality of Milan, as well as regional/national interoperability environment (i.e., the E015 digital ecosystem) enacting an API-based federated interoperability framework.
- **Sharing**, comprising end-user applications that leverage data and features provided by the USP.

The tiers (i.e., operational levels) in which the reference model is articulated are:

- **City level**, to respond to the needs of the Municipality and of its users, and to address specific requirements of the local project partners.
- **Regional/national level**, to enable cooperation and interoperability between the project partners at a wider level, as well as engaging a larger set of business players in Lombardy and in Italy (adopters of project solutions, content providers etc.).
- **International level**, to enable cross-city interoperability at European scale and beyond through federation of different USP instances.

Each layer of the reference model is described in further detail in the remainder of this section.

5.1.1 Sensing Layer

This part of the reference architecture deals with information that can be directly collected from the urban “Internet of Things”, i.e., sensors, devices and other

information sources that the project will operate or already existing in the city of Milan, e.g.,

- Sensors installed in smart buildings.
- On-board units installed on electric vehicles such as e-cars and e-bikes.
- Sensors installed on smart lampposts.
- Third-party services and open data.

In some cases it will be possible to convey such data directly to the upper layers of the reference model (e.g., when a smart sensor or smart device can directly expose its data and functionalities through standard APIs accessible via the Internet). In most cases, it will be necessary to collect and process such data through mediators able to properly address integration, control and monitoring of different kinds of sensors and devices (lampposts, lamps, bulbs, displays, speakers, i-beacons etc.), including legacy ones, as well as to provide communication protocol adaptation when necessary.

5.1.2 Interoperability Layer

Information gathered from the field is collected and stored through approaches enabling real-time processing of big data. Moreover, such data can be enriched thanks to the several datasets existing in the IT infrastructure of the Municipality of Milan. A selection of such information sources, which are relevant to the smart city and community domain, are conveyed towards the **Interoperability Platform of the Municipality of Milan**.

This IT platform enables, fosters and governs interoperability at city level. The platform is able to collect and process different kinds of information from different sources, internal or external. Moreover, the platform provides features such as: big data warehousing, business intelligence, data analytics, complex event processing monitoring, dashboards etc. The platform enables the realization and management of different kinds of APIs providing authenticated access to data and features.

Features and APIs exposed by the Interoperability Platform of the Municipality of Milan are federated with the **E015 digital ecosystem** to achieve service interoperability at regional/national level. E015 is an open API ecosystem operating in Italy since 2013. It was initially developed in order to exploit the Expo Milano 2015 as a major opportunity to introduce disruptive innovation in providing visitors and citizens with a novel and immersive experience, as well as in all aspects of urban daily life: infrastructures, transportation, cultural and social life, accommodation, services and facilities etc.

E015 enables a new, “coopetitive” approach to the design and implementation of advanced digital services. It provides members (e.g., companies, public authorities) with participation guidelines and a set of shared and consolidated standards, processes, policies and technologies to develop their digital products (i.e., APIs, end-user applications) and enable information systems interoperability. E015 fully exploits the notion of API Economy and Micro Services Architecture. Its interoperability model is based on open consolidated standards. E015, with its constantly growing number of participants, is one of the legacies that Expo Milano 2015 left to the city and, more generally, to the Italian and European public and private economic system after the closure of the event.

In the context of “Sharing Cities”, E015 implements a specific **federation** component that enables digital interoperability at international level between different instances of the USP, e.g., between the three core cities, as well as the follower cities or other adopters.

Thanks to their seamless integration, E015 and the Interoperability Platform of the Municipality of Milan together form a federated **urban sharing ecosystem** capable of enacting the "Sharing Cities" USP reference model to support interventions in Milan and at project level. Both systems adopt the same open standards and technologies, as well as common data models (i.e., formats, glossaries, taxonomies, ontologies, metadata) and governance processes, so to promote and guarantee internal and external interoperability. Such an overarching IT infrastructure represents a modular, open, scalable, replicable backbone sustaining Milan's (and Italy's) evolution process towards building a network of federated smart cities.

5.1.3 Sharing Layer

The ultimate goal of the USP is to provide citizens with applications (mobile apps, Web sites, information kiosks etc.) for promoting awareness and exploiting the smart city. Such applications provide end-users with value-added contents and functionalities built by integrating the data and functionalities provided in real-time by the E015 services or directly by the Interoperability Platform of the Municipality of Milan.

5.2 Evolution and Governance

Each key aspect of the USP reference model is meant to evolve during the "Sharing Cities" project on a continuous basis throughout the project. In particular:

- Technical standards, guidelines and best practices will be kept up-to-date with respect to the state-of-the-art, including European initiatives.
- Shared components will be updated in order to comply to the technical guidelines as well as to the needs and requirements of the different stakeholders.
- Governance models and processes will be updated according to the needs and requirements of internal and external stakeholders.

In particular, the governance model in Milan operates at different levels. Two Technical Management Boards (TMBs) are active both at the Municipality and E015 level. These TMBs have specific responsibilities and cooperate in a coordinated way through well-defined processes. Moreover, they interact also with the corresponding teams operating in London, Lisbon and in general at international level, thus creating a cross-city TMB encompassing core cities and follower cities.

6 FUTURE WORK AND CONCLUSIONS

Milan is the "smartest city" in Italy, and is becoming even "smarter" also thanks to know-how and best practice exchanges and international cooperation with other cities. Milan is currently involved in "Sharing Cities", a project funded by the European Union's Horizon 2020 research and innovation programme. In this context, several smart interventions in a specific urban area are being carried out, targeting housing, energy efficiency, mobility, lighting and eventually promoting environmental sustainability and economic development. Such interventions are supported by the Urban Sharing Platform, an open ecosystem of technical components, capabilities, technologies and processes which provides functions and services fully enabling a meaningful, next-generation smart city. Thanks to this approach, Milan can take advantage of a framework connecting citizens' needs with the vision and challenges of city leaders. Moreover, the federation mechanisms provided by the Urban Sharing Platform allows

for both governance and technical alignment between different smart cities, thus fostering digital interoperability and cooperation at European and international scale.

7 ACKNOWLEDGEMENTS

The authors would like to thank all the partners of the "Sharing Cities" project and all the people who helped make such an ambitious vision a reality.

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FORM DA COMPILARE PER LA SUBMISSION

Short speaker's bio * (max 300 chars)

Piero has 8 years of experience in climate change policies and adaptation planning and is Co-Founder of Climalia, start-up providing climate services, where he operates as Resilient Specialist. He is the project assistant manager for the EU H2020 Sharing Cities within the Milan Municipality Staff.

He is also member of the Local Authorities for Kyoto Working Group at Kyoto Club No Profit. Currently he is an external consultant for the Italian Ministry of Environment Land and Sea for training activities on Urban Adaptation Policy to Climate Change. He was a member of the Milan Municipality Working Group that is in charge to develop the Urban Resilience Strategy. He has extensive expertise in projects financed by the

European Commission, including the LIFE+ project BlueAP Bologna Local Urban Environment Adaptation Plan for a Resilient City (Senior Expert), LIFE+ RECOIL Recovered waste cooking oil for combined heat and power production (Technical Director), MED ZeroCO2 Small communities for big changing. He is member of the Advisory Board of the EU FP7 Ramses Project that aims to structure a cost\benefit analysis methodology for Urban Adaptation Plans.
He further specialised in Energy Scenario and Climate Change Impact Models through his working experience at the Stockholm Environment Institute – Tallinn Office. In past years he collaborated with EU MP, Umberto Guidoni. He writes for different specialised magazines and web-portals on climate change issues.

Track (choice)

Data & Technology

Linked keywords for Data & Technology (choice)

apps, city platform, distributed architectures, integration, internet of things, interoperability, open data, sensors, service integration, standardization

Brief description of the proposal * (max 300 chars)

We are on the edge of a significant moment, a point in time at which a market breaks from its usual means of functioning to cross into new territory. This is the territory of digital- and data-driven transformation. The potential to marry these with new technologies to transform the model of government - encompassing all of day-to-day efficiency of city operations; strategic city-level decision making.

Additional Keywords (max 200 chars)

Decision-making, co-design, resilience, data-design

Abstract – Short summary of the proposal * (max 2500 chars)

"*You may include the strategic objectives, context of implementation, added value of the proposal, methodology of resolution, the current state of implementation, solutions/conclusions, and any other information helpful to understanding the main ideas of your proposal.*"

Milan is the "smartest city" in Italy, and is in the top 50 most innovative cities in the world. These prestigious achievements are the outcome of an ambitious process started in 2012 with the "Milano Smart City" strategic initiative. Milan is strongly engaged in renovation investments, and constantly develops and participates in projects aiming to experiment new and innovative smart technologies. One of the most remarkable opportunities in this direction is the H2020 Smart Cities and Communities project "Sharing Cities", started in 2016, in which Milan is involved as one of the three lighthouse core cities together with London and Lisbon. "Sharing Cities" aims to take a digital-first and data-driven approach to overcome some of the key environmental challenges facing cities: carbon emissions from buildings and transport, and air quality. This project aims to enable and support a more agile and more collaborative smart cities market that dramatically increases the speed and scale at which smart solutions across European cities can be implemented, engaging society in new ways to cause them to play an active role in the transformation of their communities – delivering more vibrant, liveable, economically active and resource efficient cities. Milan's smart interventions in "Sharing Cities" focus on domains such as building retrofitting, energy

management, mobility, lighting. A key element supporting these interventions is the Urban Sharing Platform, the IT overarching solution encompassing an ecosystem of technical components, capabilities and processes which provide functions and services for fully enabling and sustaining the enactment of a smart city. The purpose of this platform is to aggregate data and control from a wide variety of devices and sensors, store and process the data, enable cross-city federation between different platform instances, and present information to the cities and to the citizens, which enables better use and control of the available resources. This paper summarizes Milan's main achievements along the path to becoming a lighthouse smart city over the last few years, introduces the objectives of the "Sharing Cities" project, and in this context illustrates the smart interventions planned in Milan's demonstrator area and how the Urban Sharing Platform is supporting them.

Innovative characteristics of the proposal * (max 300 chars)

"*You are encouraged to refer to the evaluation criteria when filling out the following section*"

The reference model of the Urban Support Platform supporting the key project interventions in Milan encompasses different logical layers across three tiers at which the Platform can operate and scale. *Sharing*, encompassing city sensors and devices and related connectivity features comprising end-user applications that leverage data and features provided by the USP. *Interoperability*, including the internal/regional/national information systems enacting an API-based federated interoperability framework.

Feasibility of the proposal * (max 300 chars)

Milan is the "smartest city" in Italy, and is becoming even "smarter" also thanks to know-how exchanges. Several smart interventions in a specific urban area are being carried out, targeting housing, energy efficiency, mobility, lighting and promoting environmental sustainability and economic development.

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Km4City: an ecosystem from city resilience to city users assistant

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KEYWORDS: smart city, smart city ontology, smart city API, smart mobility, multidomain smart city, smart services.

ABSTRACT: In Km4City Ecosystem a unified model and services based on aggregated data and services, data hub, is the first instrument to control city evolution, provide services to city stakeholders, accelerate commercial activities, create a common environment on which new data and services can be easily added to the ecosystem for all. For a city, to cover the role of data aggregator is strategic decision that put the control back in the hands of the city and not in those of the multinational commercial operators. Km4City models and simplify the production of semantically integrated data from different domains, takes advantage of inferential deductions, enables a set of solutions for setting up Control Rooms, perform data business intelligence, data analytics, decision support, risk analysis, user behaviour analysis, suggestion and stimulus towards city users, etc. Examples of services guided by the city strategy may be: personal assistants for city users and operators, connected drive, decision support systems for risk prevention and resilience analysis, personalized suggestions to stimulate city users to move towards virtuous behaviours (more sustainable, less consumptions, conservative parking, inter-modality, etc.), bonus system for pushing city user to use public transport, shared logistic delivering, personal car sharing, promotion of commercial activities and districts, etc. All of them are strategic models to understand the population and for communicating with them via specific thematic areas. The efficient delivering of these solutions strongly depends on computing of user behaviour, and can enable the acceleration of commercials and art-craft activities. The application of smart decision support systems and the assessment of city resilience against natural and non-natural disasters, taking into account of resilience of critical infrastructures in the city. This paper presents Km4City solution, major tools and innovation, impact and feasibility providing the evidence that the solution is viable as adopted in Sii-Mobility SCN, RESOLUTE H2020 and REPLICATE H2020.

1 - Introduction

Different kinds of Smart City solutions can be set up with the aim of enabling Smart City Services and Applications, and their corresponding architectural solutions. They mainly differ each other from the strategy to transform data to services for the city (from data to business).
Case (a): the Info Integrators collects information about several APIs provided by different data and/or service providers in the city (including their authentication and licensing), and provides a common place for developers and other city operators to browse and learn how to access at the exposed API services and data. Data/service providers can be city operators such as: mobility operators, energy operators, waste and water operators. They may provide some open and/or private data, static and/or real time data. In Case (a), the data/services are not integrated each other, each API set allows to access the specific data/service of a single operator. Thus, the API and the data are not semantically interoperable, and the problems in

managing the semantic integration of data and services are left in the hands of the developers, that have to cope with different, not harmonized APIs and providers, different authentications, and so on. The developers have to select the data, get them and integrate them every time they change. An example of this Case (a) is the E015 solution for Milan [EO15], where structured information is requested to the API providers via Excel files, and published in their original formats on the E015 Web portal. The approach enabling the passage from "data to services" is not well activated, since the data is not interoperable, and the licensing agreement is in multiple relationships arranged between each developer and several data providers. The solutions belonging to this category does not satisfy most of the sub-goals of the EIP document about the Urban Platforms [EIP_SCC].

Case (b): the Data and Metadata Aggregator collect data and metadata information (mainly open data) to index and aggregate them in a common model according to the structure of the open data files and tables in input. The resulting aggregated data are made accessible to web and mobile App via some automatically generated APIs disregarding their semantics and thus the match among entities collected from different data sets and representing the same elements. In some cases, graphic rendering is provided via some data visualization tool, presenting the similar problems of semantic. The automatically produced model does not lead to a satisfactory semantic interoperable data service [Bellini et al., 2014]. The data are not re-conciliated each other, and maintain the same quality of the original, missing data are still missing. The data integration is mainly performed on the basis of syntactic and lexical forms of data names and content values. In some cases, a semantic model for data access is provided as marketing strategy for the 5 stars; and thus they provide SPARQL based API and service. The generated ontological model is a mere representation of tables and does not provide significant inferential support. This also means to have limited reasoning on time and space. Belong to this category of solutions CKAN [CKAN], ArcGIS OpenData [ArcGIS], OpenDataSoft [OpenDataSoft] based on ArcGIS, SOCRATA [SOCRATA] also based on ArcGIS. The solutions based on ArcGIS provide more capabilities on geospatial queries. Case (b) approaches can be regarded as first level solutions for data interoperability, and can be viable when mainly open data are integrated, without real-time and/or private data. The solutions compliant to Case (b) do not cover all sub-goals of the Urban Platforms [EIP_SCC] since data are not harmonized.

Case (c): the Semantic Aggregators and Reasoners collect data and services from the City Operators, to aggregate and integrate them in a unified and semantically interoperable model based on a multi-domain ontology. This approach allows re-conciliating data and exploiting a coherent model to reduce the errors, integrating data representing the same concept and coming from different structures, operators, and sources. The usage of a multi-domain ontology allows the adoption of a model representing relationships of specialization among classes and relationships, aggregation, association, and similarity, that enable the inferential processes in the RDF Graph Database [Bellini et al., 2015], [Bellini et al., 2014], [RDF]. Thus, the obtained knowledge base can be used for creating strategies for data quality improvement and for setting up algorithms and reasoning about the several aspects and services belonging to multiple domains. This advantage is also evident on the provided API and tools for Decision Makers. For the same reason, the obtained Knowledge Base, by populating the ontology with data and inference, can be profitably and easily used for producing smart services such as routing, multimodal routing, suggestions on demand, personal assistants, connected drive, etc. With respect to a perfect Case c solution, CitySDK [CitySDK] provides some limitations involving major cities and providing specific REST API; and OASC (Open & Agile Smart Cities) adopted the FIWARE NGSI API agnostic model [OASC] for producing smart city API based on CitySDK with the corresponding limitations; Transport.API [Transport.API] is a service for providing

aggregated open data in the UK. This startup makes available, via a Rest API system a relevant number of datasets integrating both static and real-time data, mainly regarding mobility aspects. It can only be partially classified as a Case (c) solution for the lack of an effective semantic engine. The proposed Km4City (Knowledge Model for the City) [Bellini et al., 2014] more widely covers features of Case c. Km4City is exploited by Sii-Mobility Smart City project (http://www.sii-mobility.org), RESOLUTE H2020 Project (http://www.resolute-eu.org) and REPLICATE H2020 Project of the European Commission (http://www.zabala.co.uk/en/projects/replicate), providing Smarty City API of Km4City [ServiceMap], [Bellini et al., 2014].

Solutions of Case (c) mainly differ from those of (b) for the presence of a real ontological model among city entity and not on data structure of the tables. The solutions of Case (c) are better ranked with respect to the sub-goals of the Urban Platforms [EIP_SCC] covering aspects connected to the harmonization of data, and production of intelligent services. Moreover, the implementation of user experience for value added services (subgoal 5) is only accessible in a few of them as analyzed in the following. The ontology can model city domains entities and their relationships and not only metadata of data sets and tables as in Case (b). An effective integration at semantic level of the data domain enables the creation of Smart Decision Support Systems that exploit the possibility of making semantic queries on multiple domains, to make probabilistic reasoning on Bayesian decision support [Bartolozzi et al., 2015], and to enable the production of algorithms for implementing personalized routing and Personal Assistants in the city. Case (c) solutions have to cope with Graph Database collecting huge amount of data, thus resulting in Big Data cases and scenarios presenting relevant data such as variety, velocity, veracity, volume, etc. [Bellini et al., 2013].

In this paper, Km4City open source smart city ecosystem is presented. Km4City is grounded on an ontology driven smart city Case (c) aggregation solution, and provide a set of integrated tools that allow collecting data and exploiting them for smart city decision support, resilience analysis and for providing to the city users general and specialized personal assistants. In Section 2, the high level tools of Km4City are presented as: dashboard solution, city resilience modeling tool, and smart decision support. Section 3 presents the tool for social media monitoring and analysis called Twitter Vigilance. In Section 4, the main features that the Km4City ecosystem provides regarding the smart city personal assistant via smart city API are presented. The solution allows providing services on demand to commercial and city operators, and at the same time monitor and analysing the city communities. Section 5 provides some notes about the adoption of the Km4City solution and actual cases, and thus the present Km4City roadmap for development. Conclusions are drawn in section 6.

2 - Smart City Control and Resilience Assessment

Smart Cities need to computer in real time high level city indicators to keep under control on some cockpit/dashboard, Control Room for city monitoring and decision support. The whole set of city operators and their infrastructures have to be kept under control with specific service level agreements they have with the city: public transport, traffic, energy on public services, welfare, parking, cultural services, governmental services, people flows, Wi-Fi, water services, traffic flows, environment, air pollution, water supply, weather, waste, economic indicators, social media, taxi, car sharing, etc. The classical dashboard tools for data rendering are unsuitable since are only focused on presenting graphs according to some database, disregarding the complexity of multiservices, service level agreement, historical collection of data, and by the fact that data may be obtained by using pull and push.

The Dashboard tool in the Km4City environment [Bellini et al., 2014] allows multiple users to build multiple dashboards by means of a visual composition tool allowing the production of the dashboard as a set of graphics widget representing data, tickets, critical conditions, smart decision support, etc. The example on a Florence dashboard is accessible on http://dashboard.km4city.org (see Figure 1). It has been developed for REPLICATE H2020 EC project.

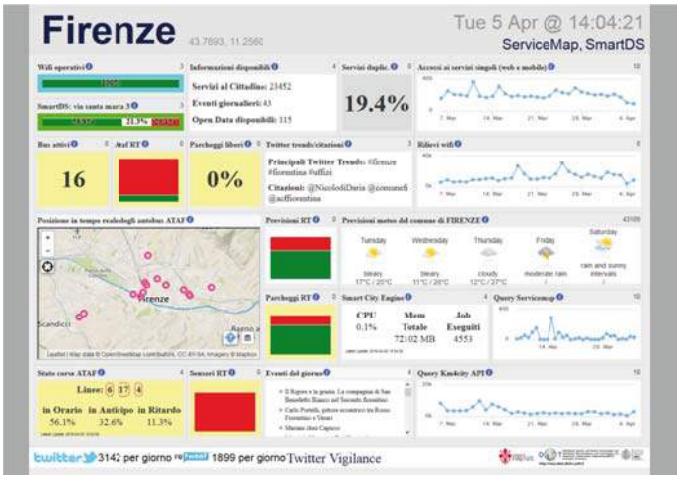

Figure 1. Example of dashboard, http://dashboard.km4city.org

A city and its infrastructures are resilient if they provide the ability to sustain required services and operations in both expected and unexpected conditions. This means that some capability of continuously adapting its operational environment to persecute system intention/ purpose, the quality of life for its city users. Understanding resilience for city and its critical infrastructure is becoming more and more important: transport, water, communication, hospital, energy, etc., are even more connected and depending each other. A failure in one of those subsystems may affect the system as whole. Resilience analysis and assessment aims to tackle the challenges of the uncertainty and interdependency expanding and integrating the current Risk Management approach, usually based on known threats.

The aim of a Resilience Decision Support, **ResilienceDS** (http://www.disit.org/fram), is to support decisions at strategic, tactic and operational levels to develop sustained adaptability capacity as well as to be effective during the preparation, plan, absorption, recovering and adapting phases (see Figure 2).

The ResilienceDS tool extends the Functional Resonance Analysis Method (FRAM) for several aspects. It is a visual tool for system resilience modelling and risk focuses on system interdependencies, their dynamics and complexity, exploiting different decision support systems, including the identification of conditions on Km4City data. Within this context, a system functionality/process can transform its state on the basis of actions performed by human, technological devices or natural. Thus the model of the city with respect to all causes and affects is modelled and studied. ResilienceDS is operatively modeling the European Resilience Guidelines developed in RESOLUTE H2020 project (http://www.replicate-eu.org).

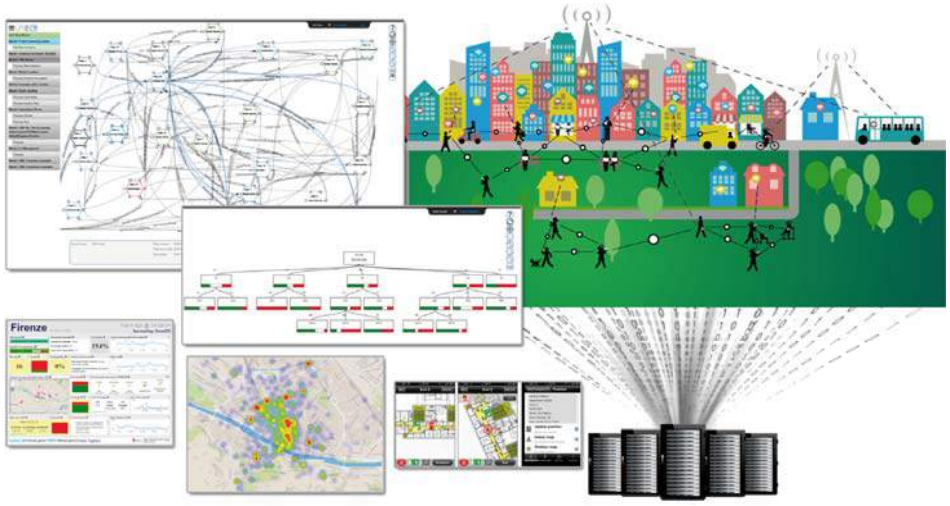

Figure 2. Resilience Smart Decision solution based on Km4City data collection and dashboard

The ResilienceDS is capable to take into account the non-linear nature of city performance, as opposed to building cause-effect sequences of events over time. It is based on the principle that accidents in complex sociotechnical systems are produced by unexpected combinations (resonance) of "normal performance" variability. Hence the visual tool supports resilience assessment by providing an understanding and steering option towards controlling (damping) sources of variability. Functions, selection, coupling and the identification of their potential sources of variability can be investigated through Smart City Big Data Analytics on Km4City or other data assets as well as through the classical stakeholders workshops and focus groups with Decision Makers, Critical Infrastructure managers, First Responders, Civil Protection, Citizen association, etc. The making decision processes can be modelled by using **SmartDS** (Smart Decision Support System) of Km4City which in turn compose uncertainties combining data and stakeholders experiences (http://smartds.disit.org). SmartDS is based on the evolution of the Analytical Hierarchical Process model (which support System Thinking model), which has been integrated with the Italian Flag 3-values logic representation. SmartDS integrates social and data processes by accessing and querying external repositories, to gather Smart City related data assisting decision makers, through the use of properly defined functions and thresholds; directly update the assessment of the decision model according to the updated data and to communicate them to decision makers and making visible on a widget of the Km4City Dashboard.
In Km4City, the integrated resilience analysis tools allow to produce and validate models for resilience and decision making in case of emergency and hazardous cases of critical infrastructures by composing different data: open data, real time data, and other data coming from surveys, stakeholders opinion assessments, collaborative platforms, services reports, city operators, user behaviours, city users apps, social media, etc. it allows city managers to tackling classical decisions under critical conditions, to be prepared and to absorb and react to them at the best.

3 - Twitter Vigilance on Smart City

Social Media channels are: (i) sources of information for assessing the moods of the city users, for assessing services, for predicting audience at large events, predicting flue, (ii) channels for communicating with the city users, etc. Among the several social media platforms Twitter is probably one of the most reactive in terms of velocity by which the information is flooding in

it. Twitter has been successfully used for prediction and measuring events in the cities. Together with the measures performed by the mobiles it completes the view about the occurrences and city users in the territory. Twitter Vigilance (http://www.disit.org/tv) is a multi-user tool for Twitter analysis capable to monitor and analyse slow and explosive events on Twitter with same efficiency and precision, acquiring all tweets and retweets, performing statistical computation, natural language processing and sentiment analysis (see **Figure 3).** A fast or explosive event occurs with several hundred thousands of tweets per day/per hour. Slow events can occur with very few tweets per day or week or their absence. Twitter Vigilance provides adaptive algorithms to allow effectively cope with slow events that become explosive without losses

Figure 3. Twitter Vigilance: monitoring city moods via social media, http://www.disit.org/tv .

4 - Smart City Personal Assistants via Smart City API

The duty of a city is to provide access to data, aggregated data and services, so that a set of mobile and web Apps can be produced by city operators and firms. Business of Apps are hardly sustainable since the offer is high, most of the Apps are vertically focused on specific services and offered for free, multi-service Apps are very expensive to be created and maintained if the data have to be singularly accessed and personally aggregated. Aggregated data and Apps are becoming commodities and city users expect to have them free of charge. Thu a wide range of Apps are produced and promoted by public, operators, supporting private transport, tickets services, parking, commercial mall, etc. Specific Apps can only give a partial view of the city service. Therefore, the Open Km4City App allows to freely putting in the hands of the city users and city operators a range of strong and valuable multipurpose Apps in short time and at low costs by exploiting the Km4City development tools, Smart City API and model (supporting REST Call, SPARQL Calls [SPARQL] and query ID calls), which can:

- provide access to multi-domain integrated data, searching them by text, GPS, region, by navigation;
- provide suggestions for instilling virtuous behaviour for the city according to their profile and city purpose;
- inform population about city hot issues and alarms from: civil protection, environmental aspects, weather forecasts, hot events, major communications, cycle paths, changes in the viability;

- collect comments and feedbacks about services to enrich their information and improve them;
- measure service efficiency in the city, measuring Wi-Fi and Bluetooth iBeacon fields.

Each Personal Assistant derived from Km4City Mobile App exploit the Smart City API and services on demand (see **Figure 4** and Km4City App on all stores). The resulting App can be regarded as a sensor and front end desk for the city in the hands of the city users. All data are collected in a completely anonymous manner, while they inform and maps collective behaviour of city users. The Open Km4City Mobile App exploits the Km4City Smart City API. Km4City Mobile App provides suggestions based on the user profile selected (citizen, commuter, tourist, student, and all) and on past anonymous action; measures the power of Wi-Fi and iBeacon. The user can deactivate suggestions totally or selecting categories. These are classified as suggestions of: events, weather forecast, mobility and transportation, interesting issue to be done, utilities, accommodations, restaurants, twitter informative channels, etc. The Km4City suggestion engine is at the disposal of the city and of city operators, learns from the city users, is an intelligent assistant for the city users, detecting problems in advance, suggesting best places to park, etc. The collective profiles can be exploited by the city for tuning services, extract what, when, which, where, and how they use the city services; and thus for producing Origin Destination matrices, also suitable for city operators. Exploiting Smart City API, other Mobile App can be realized by City Operators, and commercial operators; Thus enabling a wide range of commercial and business applications.

Figure 4. Personal Assistant on demand from Km4City ecosystem, city user analyser (only a small part of data are shown)

The derived Apps can be used to distribute information to the city users in the case of critical conditions and events, as well as it is used to understand the people flows and typical paths in the city for tuning public services, improving access to attractions and as a support for commercial applications.

5 - Km4City Roadmap and adopting projects

Km4City is a knowledge model for Smart City solutions and services. It allows semantically integrate data coming from different operators. Data which can be static and realtime, open and private. In the process of data aggregation it allows to establish all needed relationships among elements, thus making a general data set semantically interoperable at model level

(e.g., associating the street names with toponimous coding, resolving ambiguities in names, removing errors in data, completing missing data, etc.).
Km4City multi-domain ontological model is

- open, well documented and accessible free of charge, aggregating open and private data, static and real time data;
- modeling services and relationships in the city as: accommodation, advertising, agriculture, engineering, cultural, education, research, emergency, entertainment, environment, financial, governmental, health, industry, manufacturing, mining, shopping, tourist, transfer and mobility, utility, wine and food, etc. for over than 500 different specific categories;
- representing localized and relationships among: services, areas (e.g., districts, LTZ, parking, green area), paths (e.g., cycle, tramline, busses), weather forecasts, events, Wi-Fi access points, iBeacon, sensors (e.g., traffic, environment),..;
- covering: street and geographical aspects, point of interests and services, public local transport, environmental and traffic sensors, temporal aspects of data, data licensing, real time events, etc.

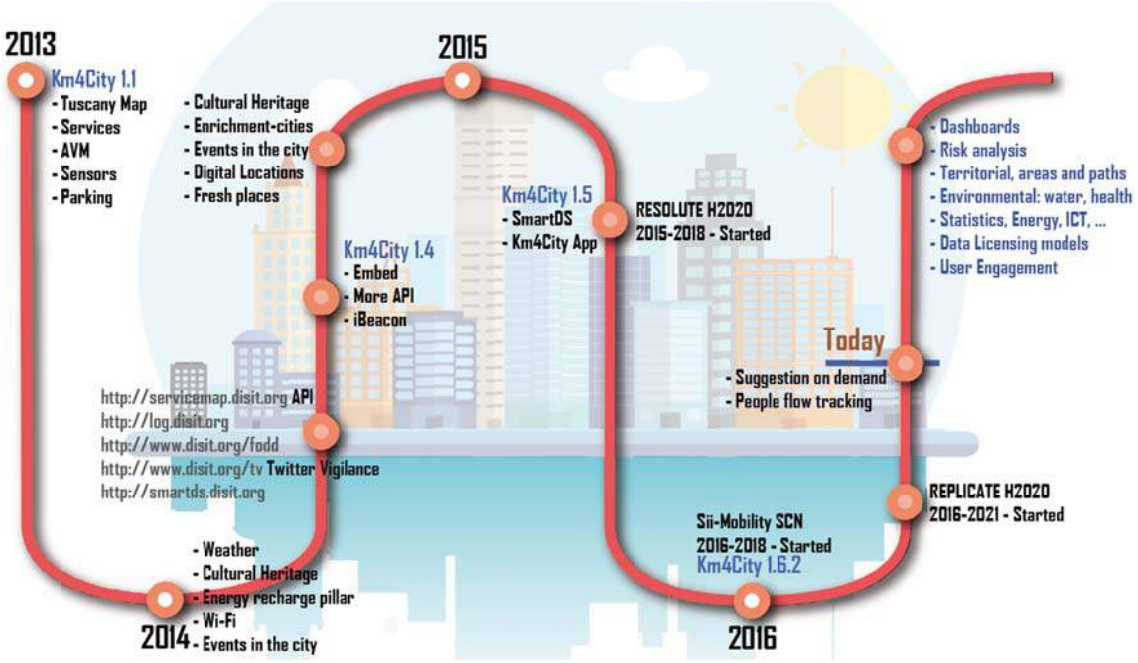

Figure 5. Km4City roadmap with respect to projects adopting it: Sii-Mobility SCN, RESOLUTE H2020, REPLICATE H2020, …

The Km4City model and ontology has a certain and founded roadmap to evolve with the support of a number of projects (see Figure 5) investing on its technology and solutions, such as:

- Sii-Mobility is providing a regional level environment for inter-modality and advanced services on mobility and transport, licensing;
- RESOLUTE DRS14 H2020: on risk and resilience analysis and tools, people and traffic flows, etc.;
- REPLICATE SCC1 H2020: on integrating sensors, IOT, energy aspects, lighting, smart benches, etc.

For example, the Florence and Tuscany case, accessible from http://servicemap.disit.org and "Firenze what where, …" mobile App on all platforms. The identification of the most relevant data sets was performed to activate the data aggregation process by integrating information for the city users about services and mobility/transport. Geographic data have been integrated from MIIC (Mobility Integration Information Center of the Tuscany Region), many open data from Florence Municipality, sensors, weather forecast from LAMMA agency, several information about commercial activities from the web, and social media. The data which are present on Km4City for Florence and Tuscany are presently covering the whole Tuscany region with all districts and more dense data on Florence Metropolitan Area for a total of more than 120 million of elements including among them

- Elements: Road Graph (Tuscany region) as 132,923 Roads, 389,711 Road Elements, 318,160 Road Nodes, 1,508,207 Street Civic Numbers; 110,374 Services (20 main categories, 512 subcategories); 2,326 Bus stops & 86 bus lines (up to now only in Florence); 210 Parking areas in Tuscany; 424 Traffic Sensors in many cities; information on elements that are located on GPS points, paths, areas, etc.;
- hundred thousands of measures per day about: position of busses, parking status, traffic sensors, weather forecast, new events, power measures about Wi-Fi and iBeacon, restricted traffic zones, etc.

6 - Conclusions

Most of the smart cities projects are based on sectorial targets related to specific vertical applications, with closed technologies and high costs. This makes impossible any replication unless substantial funding for adaptation and replication. This approach is no longer viable and neither sustainable. Public administrations need to manage complexity in the smart city services and corresponding sustainability issues. This is highlighted by the fact that proposed services are scalable and moving to city level become inadequate. They need sustainable solutions based on open standard, open source, interoperability, scalability and flexibility.

A Km4City based smart city project can be easily started exploiting the experience of the Km4City team, which can easily pass from your objective to a plan realized in months and not years. The plan includes: identification of possible scenarios; training activity to coach in the public administration; analysis of the available data; identification of the information to activate any use case and scenario. From these activities, a report is defined with the details of possible scenarios and use cases, a detailed roadmap of activities and time schedule, the definition of the architecture and a detailed costs planning for the solution. Then, the infrastructure configuration and the start of the phase of customization of the Km4City tools and solutions is activated, and progressively other feature added.

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MAYOR OF LONDON

Office of Data Analytics (ODA) Pilots

@EddieACopeland, Director of Government Innovation @nesta_uk

IN A NUTSHELL

Nesta plans to run a series of pilots in London (with the GLA) and the North East of England (with local universities) to demonstrate that performing data analytics on data sourced from multiple local authorities and public sector bodies can help reform public services, boost local business growth and significantly improve the quality of open data. If successful, the pilots will pave the way for Nesta to run a two-year programme to create permanent Offices of Data Analytics (ODAs) in several UK cities.

WHAT'S AN ODA?

In its mature form, an ODA would be a team with the resources, technology and expertise to bring together, translate, analyse and provide actionable insights from data sourced from all local authority and public sector organisations across a city or city region (and later from businesses, charities and citizens as well). In addition to an analytics team, each ODA would feature a technical team (to manage the technology platform to pull data from multiple bodies) and a legal team (to provide hands-on assistance in making data sharing arrangements possible). A subset of each ODA's data would be made available to the general public as open data on a city data marketplace that connected organisations and individuals that have useful data with those that want it. The model is inspired by the Mayor's Office of Data Analytics (MODA) in New York City, but adapted for a UK context. See details of the New York model.

WHY WOULD A CITY / CITY REGION NEED AN ODA?

The primary need for ODAs is based on three premises:

1) There is an urgent need to find more cost effective ways of delivering local public services. Local authorities in England alone face a £12.4bn funding shortfall by 2020.
2) Many of the known ways of being more efficient – shared services, targeted action, intelligent coordination of different teams, prediction and prevention – require making smarter use of data.
3) It is not sufficient for each local authority / public sector body to master the use of its own data. Real reform requires joining up datasets across organisational / geographic boundaries.

Currently, most UK cities lack even the most basic mechanisms to use data at a city scale. Experience from the USA suggests that ODAs are a major solution to this problem.

WHAT'S NESTA'S ROLE?

Versions of ODAs have been successful in eastern US cities such as New York, but have not yet been proven in a UK context. To move beyond ODAs being merely good ***intheory*** ,there is a need to:

- Prove that data-driven interventions can actually save real money in UK local public services. (Current case studies are limited because they involve data interventions within a single local authority, are written by corporates with products to sell, or come from different countries.)

- Determine if ODAs can work in a UK city / city region political and administrative context, and if so under what conditions and with what organisational set up.
- Help refine the ODA methodology for the UK so that external funding can be sought to scale and institutionalise the model.

Nesta can address these points and act as a catalyst for the creation of ODAs with:

1. Expertise on how the model works, both in-house (Eddie Copeland has written three reports on the ODA model) and from outside (e.g. Mike Flowers, Founder of New York's Mayor's Office of Data Analytics).
2. Convening power to bring together local authorities, public sector bodies, city leaders, central government and subject matter experts (without any partisan agenda);
3. Resources to support the design of ODAs and their project management;
4. Experience of running pilots and documenting and scaling best practice;
5. Knowledge of how to bid for external funding.

In addition to providing individual support to each city, Nesta plans regularly to convene the pilot cities (and any other areas working on their own city data initiatives) to share ideas, assess what works / doesn't work, and scale best practice. The entire process will be documented on a dedicated website to create an off-the-shelf framework that other cities can adapt to establish their own ODAs.

PROGRAMME PHASES

In each city, the process will be to broken down into 4 key phases:

Phase 1 – Pre-Pilot

1. **Secure support from key local stakeholders** (e.g. city leaders, local authorities, local universities) and identify a coalition of the willing (i.e. subset of local authorities and public sector bodies) to take part in a pilot.
2. **Assess the city's current data, technology and personnel resources and capabilities** compared with requirements for an ODA.
3. **Identify where an ODA will best be situated**,e.g. in City Hall, a local university, etc.

Phase 2 - Pilot

The main part of each pilot will be a 100 day sprint – enough time to deliver concrete results, but short enough to generate a sense of urgency and make the commitment of external parties manageable. Nesta will engage a small team of data science specialists to explore available data from the pilot cities, understand those cities' needs, and prototype predictive or analytical models using that data. The topic area for these models may include areas as diverse as Troubled Families' risk factors, coordinated procurement, or social housing predictive maintenance.

Having identified a coalition of the willing and the relevant team of data scientists, key steps will be:

1. **Identify challenge areas and data availability.** Through a workshop with representatives of each organisation taking part in the pilot (followed by individual calls and visits), Nesta and the data science team will engage with a range of expert stakeholders who can describe their needs and wishes, establish success criteria (for example, required accuracy thresholds for predictions), collaborate with them to explore what data might be available as raw material, and understand ethical, legal, and practical issues (for example, personal data may often only be used in specified ways;critical data may be held on proprietary systems).

Broadly speaking, successful data science projects meet the following three criteria: a) Good data available; b) Big problem to solve; and c) Actionable insights likely (in this case, the insight needs to be something that pilot organisations will be willing to test in the real world).

For these specific pilots, additional criteria may include: d) If possible, uses non-personal datasets (to avoid protracted legal wrangling); e) Joins up data across multiple geographic boundaries (to prove that there is value in seeing how issues transcend borders); and f) Saves money (this is the primary criterion that will interest public sector leaders and central government.)

2. **Collect and explore data.** Based on the challenge areas identified in Step 1, Nesta and the data science team will work with data owners within each organisation, acquire as much relevant raw data as possible, augment where relevant with open data, and establish how to join disparately structured and formatted datasets across common identifiers such as place, person, or business.

3. **Build data models.** The data science team will build the data into initial versions of predictive models or systems which tackle the questions identified.

4. **Review initial results with city stakeholders.** Nesta and the data science team will present the findings back to the pilot organisations for review.

5. **Refine and deploy model.** Based on feedback from Step 4, refine, test, and secure models and data, and deploy into production systems for more extensive use.

Phase 3 - Implementation

1. **Implement Change.** Avital step at the end of the 100 day pilot will be to act upon the data insights to prove that the data intervention can save money. (Six weeks has been allocated for this phase in the project plan.)

2. **Dissemination.** The results of the pilots should be widely communicated via blogs, events and meetings to city leaders, policymakers and central government.

Phase 4 - Embed and Scale ODA

1. **Secure funding to scale the model.** With the evidence from the pilots, funding will be sought to put in place mechanisms, staff and resources to embed an Office of Data Analytics in each city.

NEXT STEPS

- Nesta is working directly with the GLA (Andrew Collinge and Paul Hodgson) to identify boroughs willing to take part in a pilot for a London Office of Data Analytics. In the North East, Nesta is working with local universities to determine which local authorities and public sector organisations wish to take part in this programme.
- Nesta is seeking partner organisations who can support this programme of work with expertise, resources and/or funding.

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PALMA DE MALLORCA DESTINO INTELIGENTE FREE WIFI 365 DIAS. SMART WIFI PALMA

Tomeu Crespí Seguí: Responsable innovación y NNTT Consorcio urbanístico de la Playa de Palma y Smart Office Palma

Resumen: El proyecto que se presenta es la implantación de una infraestructura para dotar de red Wifi gratuita de alta calidad en las zonas de gran afluencia turística de la ciudad de Palma. Este proyecto constituye los ladrillos digitales de un futuro destino turístico digital. Una plataforma tecnológica que permita tanto a la administración pública, como a la empresa privada, establecer nuevos modelos de servicios y negocio en el destino turístico, que aseguren un nuevo ciclo de competitividad y crecimiento económico en toda la zona turística de Palma y sus playas, además que sirva de proyecto piloto para el resto de destinos turísticos inteligentes.
Palabras clave: SmartWifi, Destino turístico inteligente, Open data, Smart city, isla inteligente, ciudad inteligente, administración electrónica, bigdata, smartmetering, geoposicionamiento; experiencia turística digital, turismo digital.

INTRODUCCIÓN

Tras el éxito del proyecto de la Playa de Palma "Smart Wifi Playa de Palma" adjudicado por el Consorcio de la Playa de Palma en 2014 a la empresa mallorquina MallorcaWifi (A pesar de la carencia absoluta de presupuesto para poder materializar el proyecto), se ha exportado el modelo técnico-administrativo a todas las zonas de gran afluencia turística de la ciudad de Palma. Es importante remarcar que el proyecto de la Playa de Palma nace de la iniciativa de la Policía Local de Palma y de la UIB que se remonta a Octubre de 2012.

Esta red fue diseñada por la Policía Local de Palma para apoyar las comunicaciones de la Policía Local y de todos los servicios públicos Municipales. Uno de los requisitos de esta red es que el 50% de las capacidades de la red están reservadas a estos fines: seguridad y servicios públicos, ofreciendo un modelo de colaboración público-privada único en España y siendo un modelo de red sostenible en el tiempo, auto financiado y con un nivel de calidad muy superior en capacidades al de otras redes similares existentes en el mundo.

Obviamente la iniciativa privada es aquí fundamental para dicha red, donde el otro 50% de las capacidades de red, son usados en un modelo de negocio único que asegura su funcionamiento y sostenibilidad, sin que las arcas municipales se vean afectadas por inversiones imposibles.

Los destinos turísticos afrontan un **reto de cambio.** Debemos alinearnos hacia los destinos turísticos inteligentes o Smart Destination, que promuevan la economía basada en la creatividad, respeto por el medioambiente, la innovación y el turismo.

Tanto la administración pública como la empresa privada deben aunar esfuerzos para conseguir elementos diferenciadores del resto de los destinos turísticos competidores, ya sea a través de la legislación, a través del urbanismo o como en este caso, a través de una infraestructura de telecomunicación y las TIC's.

La actual crisis económica, combinada con las crecientes expectativas de los ciudadanos, está aumentando la presión sobre las ciudades para proporcionar mejores infraestructuras y más eficientes servicios, a menudo por menos costo.

El Ayuntamiento de Palma de Mallorca a través de la **Smart Office Palma** y del **Consorcio Playa de Palma** está participando activamente en los últimos años en los foros nacionales e internacionales que estudian la evolución de las Ciudades

Inteligentes como la Red Española de Ciudades Inteligentes y foros sectoriales. En el ámbito interno, está desarrollando una estrategia de **Ciudad y Destino Inteligente** que le ha permitido evaluar su situación actual en cuanto ciudad inteligente de los servicios urbanos, así como definir indicadores de ciudad, que le permitirán en un futuro compararse de forma objetiva con otras ciudades del mundo en cuanto a nivel de calidad de vida e inteligencia en la gestión de sus servicios urbanos.
La ciudad de Palma de Mallorca se distingue por ser una destinación turística madura que precisa con urgencia un proceso de diferenciación o generación de valor añadido. A día de hoy es una necesidad real poder **facilitar todas las herramientas tecnológicas disponibles** y en proceso de estandarización, para la futura toma de decisiones y que supongan implantar el nuevo concepto de ciudad y destino inteligente.
El Plan Director Palma Smart City / Smart Destination plantea objetivos ambiciosos y reales para la realización de actuaciones en materia de innovación, I+D+i y la sociedad de la información, encaminados a potenciar la excelencia de servicios públicos y privados, incrementando las capacidades productivas y competitivas. Palma de Mallorca avanza decididamente hacia una ciudad y un destino inteligente.

Imagen 1: Principales Pasos para la transformación de la ciudad de Palma en una ciudad y destino inteligente

EL PROYECTO

Siguiendo con los objetivos estratégicos de convertir la ciudad de Palma en un referente de destino inteligente, el ayuntamiento de Palma a través de la Smart Office y la Fundación 365 adjudica el concurso Smart Wifi Palma.
El proyecto *"Palma de Mallorca destino turístico inteligente Free Wifi 365 días. Smart Wifi Palma", (*en adelante Smart Wifi Palma) adjudicado en Noviembre de 2015, se despliega en todas las zonas de gran afluencia turística de la ciudad de Palma y se centra en dar una alta calidad de servicio, disposición de una red Wifi rápida y ágil y sobretodo una excelente experiencia y satisfacción de uso, en los nuevos servicios digitales públicos y privados y en el potencial de las redes sociales como elemento de promoción de destino
Este proyecto tiene importancia para la industria turística nacional en su conjunto, pudiendo ser un referente en la manera de llevar a cabo la modernización y mejora del

posicionamiento de destinos turísticos maduros que suponen un valor fundamental para la oferta turística española.
Gracias al éxito de la experiencia piloto red Smart Wifi en la Playa de Palma, se licitó en Mayo del 2015 una red Wifi de gran calidad para su implantación en el resto del litoral del municipio y en el casco antiguo de Palma (zonas esencialmente turísticas) dotando a la ciudad de una progresiva implantación de red Wifi.0
La implantación del servicio Wifi en las zonas urbanas descritas puede aportar beneficios tanto para el visitante como para la ciudad de Palma.
Por un lado, el visitante podrá tener acceso a datos y seguir conectado con su entorno y redes sociales como una sóla Wifi. Su estancia en la ciudad será más grata, además podrá acceder a tiempo real a Internet y buscar la información que necesite para sacar el máximo provecho a su visita, todo al mismo momento, sin tener que ir a buscar un local con Wifi gratuito.
Por otro lado, la ciudad de Palma ofrecerá una imagen de ciudad moderna, se verá beneficiada de la difusión de los usuarios mediante el uso de redes sociales a tiempo real de la visita, y se podrá conocer cuáles son los flujos y tendencias de los visitantes, así como poder crear una base de datos y estadísticas que permitan conocer mejor los mercados y por lo tanto, la ciudad y la iniciativa privada podrán encaminar los recursos y las acciones hacia las estrategias más certeras.

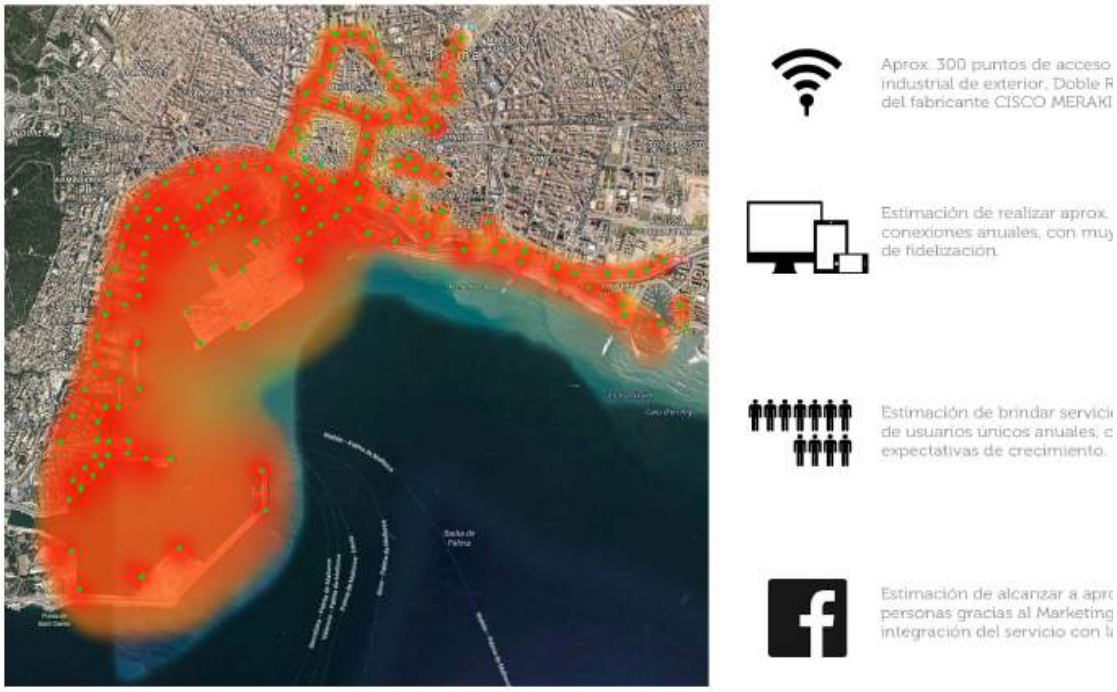

Imagen 2: Futura cobertura Smart Wifi Palma

Básicamente la estrategia de despliegue seguirá estas 4 premisas:
1) Desarrollar un nuevo modelo de concesión de la gestión de una Zona ifi pública gratuita de grandes dimensiones.
2) Consolidar un nuevo modelo de explotación basado en el patrocinio publicitario que permita garantizar la sostenibilidad del proyecto.
3) Desarrollar un nuevo modelo de gestión del BigData y del IoT que permita entre otros eficiencia y ahorro en la toma de decisiones por parte del DMO (Destination Management Organization)

4) Transferir el conocimiento a otras ciudades y destinos en colaboración de la Smart office del Ayuntamiento de Palma, el Consorcio Playa de Palma y la Red Española de Ciudades Inteligentes (RECI).

El servicio es pionero a nivel europeo, no ha tenido ningún coste para el Ayuntamiento y supone un incremento exponencial de la viralidad del destino turístico

El desarrollo y expansión de la que será la red Wifi pública más extensa de Europa contendrá 3 etapas bien diferenciadas que se prolongará a lo largo de los próximos años. Sólo en playa de Palma y en lo que va de año se ha superado con creces la previsión de 10 millones de usuarios y batiendo estadísticas en un día consiguiendo un record de 23.697 usuarios conectados.

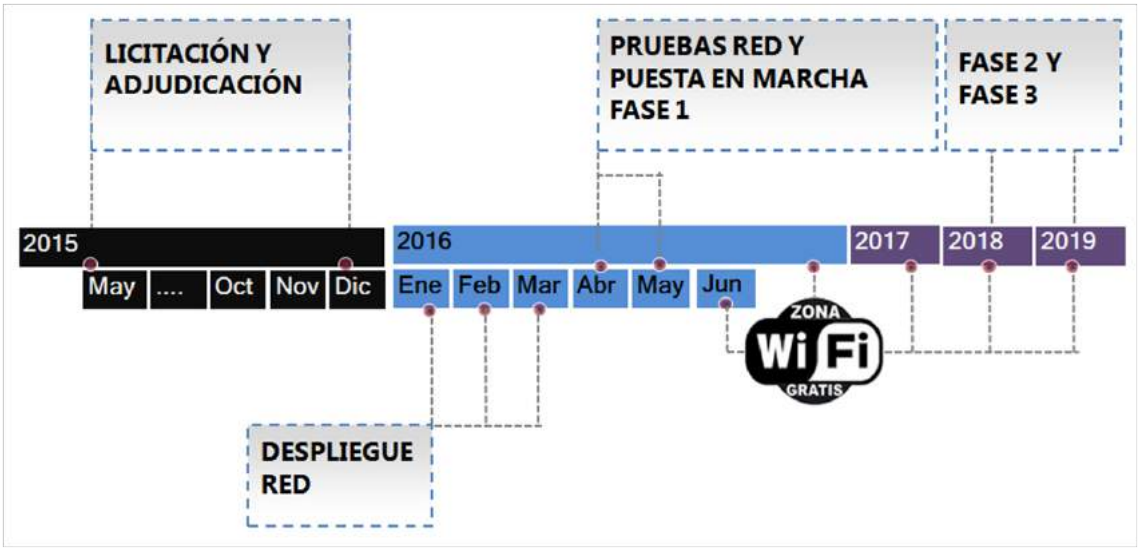

Imagen 3: Cronograma de proyecto SmartWifi Palma

VENTAJAS DEL PROYECTO

- Unificación Wifi desde el puerto hasta las zonas de gran afluencia turística.
- Coste “0 “ de una infraestructura tecnológica innovadora para la administración
- Inversión de 1M€ en 4 años en las zonas de gran afluencia turística de Palma
- 50% de capacidad de la red destinada a la creación y mejora de servicios públicos
- Mejora continua de la red por parte de la empresa privada. A mejor funcionamiento de la red, mejor retorno de la inversión y mayor rentabilidad
- Interoperabilidad con otras redes existentes y optimización de recursos. Mantenimiento de la red y la conectividad gratis para la administración.
- La red instalada, una vez implantada, pasará a ser de titularidad pública.
- Con este proyecto se consiguen herramientas digitales innovadoras de promoción tanto para el gestor del destino como para las empresas turísticas.

- Colaboración público privada como tendencia en la ejecución de proyectos smart destination. En este caso la colaboración por parte de la administración: Ayuntamiento de palma a través de la Fundación 365 y Smart Office, Policía local y Universidad de las Islas Baleares (UIB). Por otra parte la iniciativa privada MallorcaWifi se encarga de instalar, configurar, gestionar y explotar la red. Este compendio de empresas e instituciones hace posible que esta Smart Wifi Palma sea factible y sostenible económicamente.

OBJETIVOS DEL PROYECTO Y RESULTADOS

Objetivos 2015-20

- Incorporación de acciones tecnológicas en el Plan de márketing de la Fundación 365 para la promoción turística de la ciudad de Palma
- Desarrollo de nuevos servicios digitales públicos y privados.
- Aumento de la competitividad y productividad de las empresas y mejora de la calidad de los servicios municipales y optimización de procesos
- Primer destino turístico 100% Wifi antes del 2020
- Red Wifi de gran usabilidad y de gran impacto en el acceso digital de residentes y turistas , 365 días, 24 horas. Conseguir récords de conexiones en Wifis públicas
- Monitorización a tiempo real del comportamiento digital del turista. interpretación de estadísticas del destino a tiempo real. Big Data
- Desarrollo y consolidación de nuevos servicios digitales públicos y privados. Competitividad empresas y mejora de los servicios municipales
- Escenario piloto de proyectos de I+D+i en destino turístico. Ser referentes europeos
- Acceder a fondos europeos “Horizonte 2020” y fondos regionales para el desarrollo de proyectos
- Atraer inversión mediante proyectos innovadores
- Ser el primer destino turístico inteligente avalado por SEGITTUR y certificado por AENOR.
- Monitorización a tiempo real del comportamiento digital del turista y despliegue de sensores y de proyectos sobre “internet of things” (IoT).
- Ser Zona Wifi turística más grande de Europa dentro de un espacio público

Resultados esperados 2015-20

- Licitación y adjudicación del proyecto de implantación de una infraestructura Wifi innovadora
- Acceso internet gratis para residentes y turistas (Social Wifi)
- Informes de uso para la administración del destino digital.
- Nuevos servicios para empresas y administración: publicidad, marketing geo-localizada: Cuponning, Facebook checking analíticas, email marketing. redes sociales, accesos Wifi premium
- 300 puntos de acceso Wifi instalados
- 2 GB de subida / 2 GB de bajada
- 10 Millones de usuarios únicos
- 50 millones de usuarios recurrentes
- 350 millones de conexiones

- 1 M€ de inversión privada
- 1,54 Km2 superficie cubierta
- Desarrollo de herramientas BIG Data para la explotación de inteligencia de destino

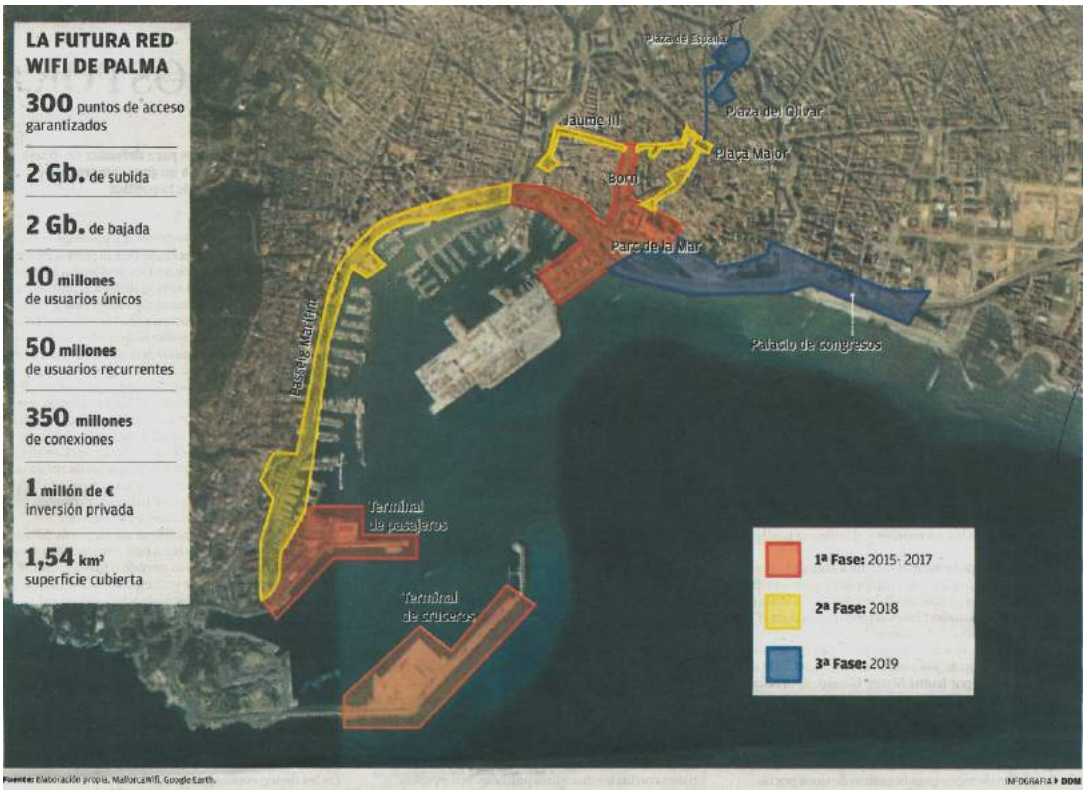

Imagen 4: Principales resultados esperados infraestructura Smart Wifi Palma

AGRADECIMIENTOS

Se agradece la participación en la creación, desarrollo e implantación de este proyecto a todos los compañeros y técnicos del ayuntamiento, en especial énfasis por parte de la Policía local a Xisco Mas (I+D) y Gabriel Escarrer (DETRA), y por parte de la UIB El Doctor Bartomeu Alorda y Ladaria, del Departamento de Física y su grupo de investigación. Agradezco también al anterior y actual gobierno del ayuntamiento de Palma por apostar por la transformación de la ciudad a través de las nuevas tendencias tecnológicas y servicios digitales, y por último a la empresa mallorquina MallorcaWifi por su visión innovadora y por el riesgo asumido.

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ABSTRACT

This paper will explore the use of visual light communication for locating a device (position and orientation) equipped with a camera in an indoor environment. This technology has been proved to be superior to other indoor location technologies explored (mainly RF) in terms of speed and precision.

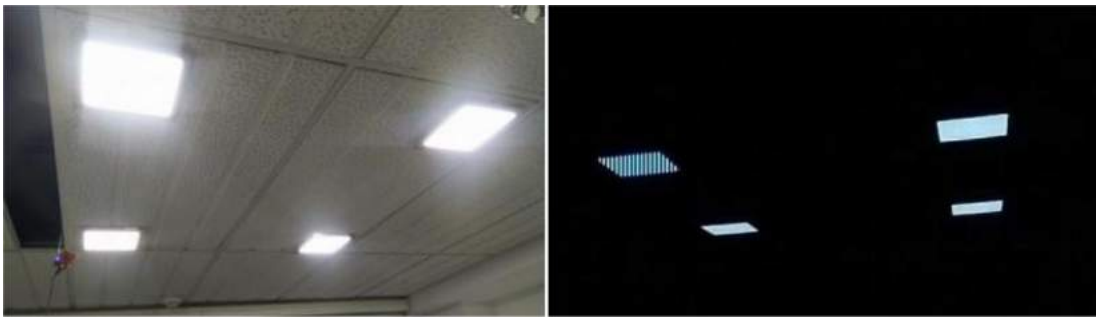
The main components of the technology are transmitting LED panels and a camera to read the information contained by these. If we can get the relation between the 2D points (in the image captured by the camera) and the 3D points (transmitted by the panels using VLC) the location of the device can be obtained with a high precision.

VLC Transmission

Visible light communication is the concept of transmitting information using visible light (780 – 375 nm). In this case, LED panels are used since they have a really fast switching speed, permitting high frequency transmission.

The information is transmitted from the LED panel to the phone by changing the panel's illumination intensity. The modulation used is called On – Off keying, the panel is off when we want to transmit a 0, and it's on when we want to transmit a one. In order to make the flickering invisible to the naked eye, high frequencies of modulation are used

To decode the information transmitted by the panels, a CMOS camera is used as a receptor. CMOS camera sensors (used in the majority of the digital cameras) can read this information thanks to the Rolling Shutter effect. CMOS camera sensors don't take the picture as a whole, instead they scan the camera frame along its width, capturing changes in illumination. This effect can be used to visualize the bits transmitted by the LED panels. In order to capture the data, we need to change the camera settings. If we set the exposure time to a low value, we will see the sent bits as vertical white bars across the image.



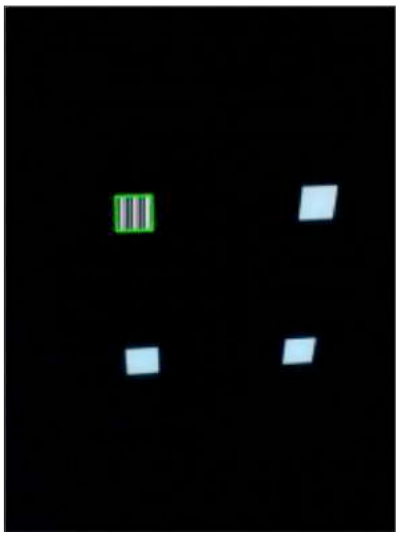
As we can see, the panel in the top left corner is transmitting information while the rest of them are static.

The data sent contains information about the panel itself, such as an identifier or it's 3D location in world coordinates.

Panel differentiation

In order to differentiate between the panels transmitting independent information, we can use different techniques. The simplest one, which is the one that guarantees the

higher frame rate is thresholding the image. That way we can get the lightest locations in the image, where the panels are transmitting the information.



Further techniques are used, such as machine learning, to distinguish between panels that are transmitting information and static ones. These techniques also help to discard other types of illumination in the building (such as solar light, or fluorescent lamps) so that the system can be used in a wide spectrum of buildings.

Device location algorithm

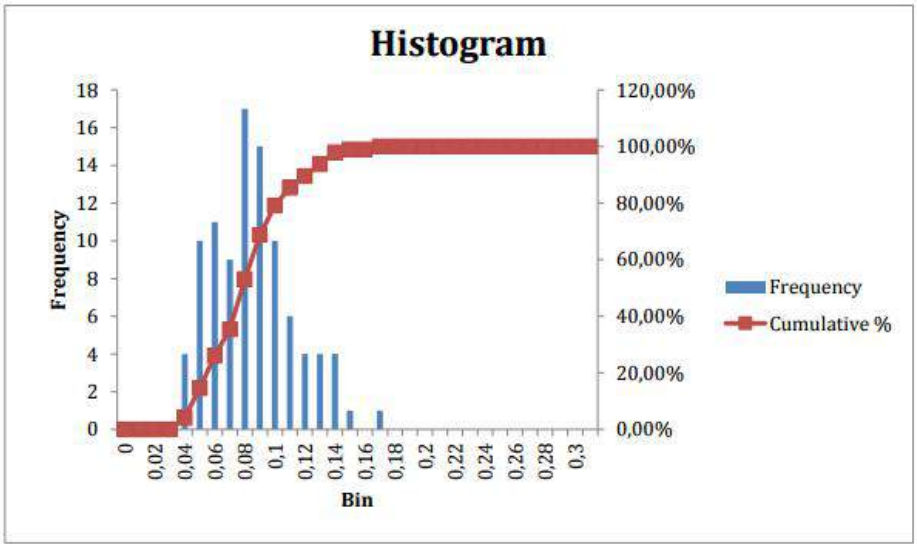
Once both the location in the 3D space and the 2D coordinates of the panels in the camera frame are known the position of the device can be then calculated.

Knowing the deformation from the camera lenses and information about the focal length, the devices position and orientation can be obtained by exploiting the relation between the 3D and 2D points. The projection of each panel is drawn from its 3D point to its 2D point until all the panels in the image fit together. There is not a unique solution of this problem, various algorithms have been explored and details of the implementation are out of the scope of this paper.

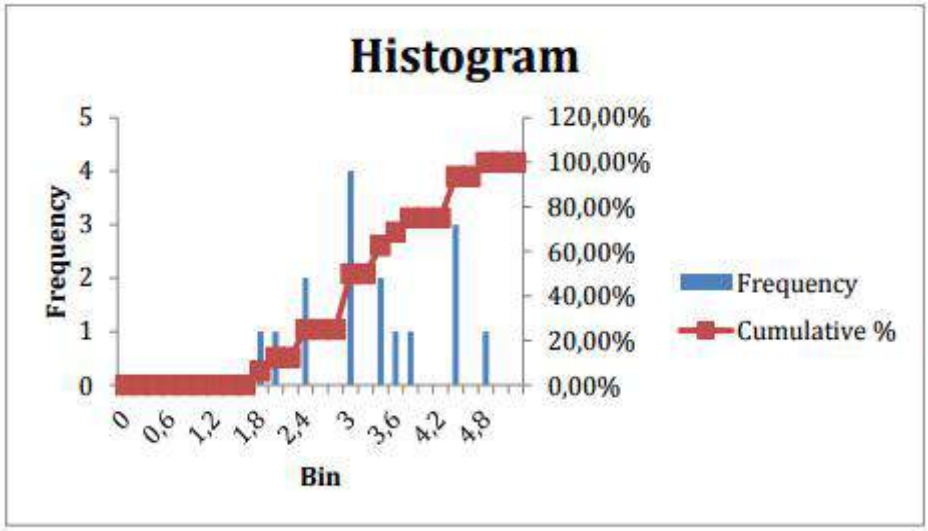
The algorithm chosen can be ran locally on the device, there is no need of external connections nor need for extra computation power. This fact guarantees high speed processing so that it the algorithm can run at maximum frame rate of the camera. Tests on a Nexus 5 demonstrate theoretic speeds up to 100 FPS (Nexus 5's camera only permits up to 30 FPS from the camera).

Precision

In order to determine the precision of the system, multiple measurements have been obtained:



As it can be seen in the above chart, the medium error in position is 0.08 meters, and 90 % of the time the error is under 0.12 meters.



In terms of orientation, the medium error is 3.21 º and never higher than 4.8 º.

The algorithm can be run up to 100 times per second in a Nexus 5 phone.

In the case of not wanting to locate the device in 3D but in XY plane, precision is further improved up to 3 cm.

Applications

These high precision and high speed qualities open a wide range of applications. The first approach of this same technology was shown in the Mobile World Congress 2016. It was used to show contextual advertisements on screen as the user approached the products.

There was also an application used to help blind people navigate through unknown environments. Both use cases received a lot of attention from both general public and companies. Further information can be obtained in this video:

https://www.youtube.com/watch?v=alVp8sVuviw

In the world of IOT we think this technology can provoke a change in the way autonomous vehicles are driven inside factories or warehouses.

Right now, most AGV are guided through magnetic lines on the floor. The AGVs detect the magnetic fields and follow the lines across the building. This system can proportionate a high precision but very little flexibility.

The system proposed in this paper (indoor location based on VLC) would be used by the AGV to locate itself in the building. Once the AGV gets information about his route, it can navigate thought the warehouse thanks to the information send by the lights. The precision of the system permits using this technology in the field of automatic guided vehicles, until this moment, no other indoor location technologies have such a high precision so that it can be used in this field.

The system proposed would provide a new level of flexibility in logistics in indoor buildings, giving the possibility to define new routes for the AGVs on the fly, by software.

Furthermore, it would permit to know the AGVs' location in real time, making it possible to optimize routes or reuse the same AGV for different purposes. These would free logistic in warehouses from the rigidness.

A prototype of a self-driving AGV using this technology was shown on the "1a Jornada de

Innovación Logística SEAT" and won the "Best innovation" prize.

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Vol4All : a volunteering platform to drive innovation and citizens empowerment

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KEYWORDS: volunteering, city apps, social innovation, city platform, participation, citizens empowerment, collective awareness

ABSTRACT:
Cities nowadays have embraced the digital era and continuously strive to merge technological advancements with the benefit of their social capital and communities. A major quest is to place humans and their competences at the center of the efforts towards sustainable and smart cities. Citizen societies have widely accepted and practiced volunteering for years now and already a great number of volunteering actions and networks have flourished, in support and aid to several communities in need. Most popular volunteering networks have greatly capitalized on the rapid advance and spread of Internet and Web technologies, which are ideal for coordinating and monitoring of the volunteering tasks. The *Vol4All* platform advances this trend, since it greatly builds on extended Internet technologies in its aim to support citizens activism towards novel urban social innovation. *Vol4All* enables ideas exchange and crowdsourcing by facilitating citizens involvement in the realization of community projects. Volunteering actors (initiators, participants, stakeholders) can easily interact via the *Vol4All* platform with enables volunteering opportunities dynamic sharing, evolution, and monitoring. Such opportunities can be initiated by any authorized stakeholders, with a publicly open interface which allows citizens commitment assessment, best practices highlights, and a gamification style of interaction such that volunteering becomes a societal and growth asset.

1 Introduction

Most recent and ground-breaking scientific and technological innovations bear significant potential for evolving and redefining people's lives and interactions within cities. Embedding cutting-edge devices, networks and services into cities' centuries-old streets impacts citizens' daily lives in terms of their movement, habits and behavioural patterns (Lenhart 2012). With each generation of technological advancements, cities are given new ways to make the most of their human capital via online platforms which may act as problem solvers and citizens activation engines (Gooch 2015), (Sestini 2012).

Early examples of this endeavour are already prominent in the form of the so called CAPS (Collective Awareness Platforms)[1], i.e. the ICT systems leveraging the network effect (or the "collective intelligence"), in actions related with the use of open data, the social media exploitation, the shared knowledge detection, etc. CAPS offer the ground for environmentally aware, grassroots processes and practices to share knowledge; to achieve changes in lifestyle, production and consumption patterns; and to set up more participatory democratic processes (Sestini, 2012), (Arniani 2012).

In this context, many cities and communities worldwide, have acknowledged the importance of volunteering as the most direct act of driving the society forward (Hodgkinson 2012), (Berntzen 2016). Volunteering applications and platform can largely support digital social innovation by harnessing the power of citizen crowdsourcing, and the immediate interaction capability. Cities can thus enhance public awareness and utilize resources (declared by citizen volunteers) towards a more effective and responsive co-sharing and co-creation (Saunders 2015). Major cities worldwide (like New York, London, Shanghai and Athens) have already taken advantage of such digital tools and have supported the design and development of platforms easily accessible by citizens via Web browser interfaces. Such platforms include functionalities which become effective tools for many volunteering opportunities arising in response to emerging city problems.

Vol4all platform is inspired by earlier efforts, but it further extends the principles required for supporting cities emerging big data production, their flexible organizing and also their publicly open nature (Vakali, 2013). These goals are driven by the need to make volunteering an accessible and enjoyable activity, driven by the desire for common good contribution and for advancing the communities wealth. *Vol4all* components and elements emerge from nowdays societal trends in volunteering applications and with a continuous extension and adaptive process involving :

- *solid display,* of volunteering opportunities in a compact calendar form or via advanced filtered search;
- *a mobile application* implementation such that volunteers and organizations can have access to the platform's features under a "volunteering on-the-go" spirit;
- *a Web accessible administrative platform* for authoritative supervision and coordination purposes.

Furthermore, *Vol4all* platform's volunteering tasks are designed in a user friendly and simple manner with the aim to offer a joyful activity which will attract and engage citizens (Deterding 2011), (Vesco 2015). This is reached by the main following features:

- *direct searching process* : by clickable volunteering category and other features choices at the Vol4All home page;
- *volunteer's and organizer's profiling* : to allow users to view and monitor their progress and history in volunteering;
- *implementation of a point system* : for rewarding and motivating the citizens via an enjoyable gamification processes.

Under the above principles, *Vol4all* aims to empower citizens for becoming volunteers broadcasters and motivators, towards an active and dynamic cities volunteering network, at which volunteers and organizations interact, co-create and co-solve their city's crucial emerging problems (Hodgkinson 2013), (Lorenzi 2015).

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[1] Collective Awareness Platforms for Sustainability and Social Innovation (CAPS) https://ec.europa.eu/programmes/horizon2020/en/h2020-section/collective-awareness-platforms-sustainability-and-social-innovation-caps

1.1 Existing volunteering platforms

Vol4All platform is inspired by earlier volunteering platforms implementations, with a focus on the ones practiced in large scale cities. Earlier such platforms include functionalities which primarily utilize graphical user interfaces, and support similar core functionalities (e.g. search for volunteering opportunities, seek volunteers, registering as volunteers, etc). CAPS principles build on the collective awareness, i.e. the technology driven services which promote social innovation aiming at solving societal issues. Major cities like London (Team London), New York (NYC Service), Athens (Synathina), San Francisco and USA (Volunteer Match), Shanghai (Hands on), Sydney(Go Volunteer) etc. follow this pattern, as summarized in Table 1, which highlights the basic characteristics of these most indicative such volunteering platforms.

	CAPS principle	Crowd sourcing	Geo spotting	Mobile App	Gamification experience	Best practices	Analytics
Team London	✔	✔	✔	✔	-	✔	-
NYC Service	✔	✔	✔	✔	-	✔	-
Hands On	✔	✔	-	-	-	-	-
Volunteer Match	✔	✔	✔	✔	-	-	-
Go Volunteer	✔	✔	✔	-	-	-	-
Synathina	✔	✔	✔	✔	-	✔	-
Vol4All	✔	✔	✔	✔	✔	✔	✔

Table 1. Volunteering platforms comparison and summarization

Out of the most popular indicated volunteering platforms, the most successful ones are in London, New York and Shanghai, addressing the needs for increased responsiveness and usability under attractive user interfaces. These platforms indeed promote and aid volunteering spirit, inline with CAPS principles, focusing on collective awareness and sustainable society. These platforms' most attractive features are highlighted next :

- **Team London(London)[2] and NYC Service(New York)[3] :** are quite similar both in visual and functional aspects, offering a range of features (crowdsourcing, dynamic volunteering content indication, popular social media and online map tools). Their most prominent features are the visual support for volunteering events, and their graphical representations of volunteering actions which further facilitate citizens searching.
- **Hands On(Shanghai)[4].** This platform offers a unique feature in the form of a calendar at which all registered volunteering events are organized over the different time periods. This helps potential volunteers search and seek events based on a timeline.

Such features characterize effective and attractive volunteering platforms capable of supporting emergent online social innovation on a shared virtual space.

2 Vol4All platform : design principles

The core Vol4All design goal is the development of an attractive platform, following the crucial CAPS principles of collective awareness and innovation. Vol4All advances earlier

[2] http://volunteerteam.london.gov.uk/#s
[3] http://www.nycservice.org/
[4] http://handsonshanghai.org/

implementations by focusing on more advanced and citizen-centric functionalities at which social media and online visualization of geo-located volunteering spots converge via gamification practices and analytics. The introduction of gaming related features in the volunteering process targets an enjoyable and attractive experience which will engage all volunteer action stakeholders, while targeted analytics will enable volunteering event location binding and volunteers assessment and rewarding (Table 1). A set of novel features (gamification, analytics, best practices) enables interactivity and volunteering experience as a city's asset. Vol4All platform designing process covers the next important functionalities :

- *maintain dynamic interaction* among separate platform's users types i.e. volunteers, organizers of volunteering events and authoritative administrators, along with registering their demographic profiling information and their social media bridging;
- *offer open versus private features and services* via user-friendly, direct and accessible graphic interfaces (supporting registration, monitoring and searching of volunteering events), according to privileges and rights hierarchies, having the administrators' role being mostly important for the registration and approval of the volunteering activities;
- *aggregate various types of data* processed and managed, under a sophisticated database management system which supports emerging volunteering and city data flows (new and evolving volunteering tasks) and static data (volunteering categories). ;
- *inclusion of gamification practices* in the design process of the platform significantly improves its appealing potential. A city oriented point system is proposed for rewarding participation and collaboration users of intensive and frequent behaviors. This is monitored by having completion of a volunteering task being awarded with points added up to the individual volunteer overall score. This will enable a city's authority to award the "Top-k" volunteers with particular city offers (such as coupons, parking permits, etc) and it will moreover engage volunteers who will have a visible record characterizing their experience and skills;
- *analytics visualization* in a leaderboard format to highlight best practices with the city's most active volunteers, but also most popular volunteering tasks. Vol4all analytics toolbox is designed to encourage and mobilize citizens to practice synergies in a collaborative manner monitored under steady and periodic contributions.

3 Vol4All platform outline

Vol4All platform has its front-end and back-end sides covering Web and mobile applications (for user interacting) as well as remote database and data management implementation. The core platform's components support main tasks such as : user (volunteer) authentication, registration of new users, retrieving volunteering data, administrative monitoring as well as a simple notification system. Depending on the process and functionality requested, the appropriate component is activated for processing through continuous communication with the remote database for the storage, edit, or retrieval of data (as depicted in Figure 1). Among the different tasks, the most typical data flow from the platform to the database and vice versa are summarized in Figure 2. Volunteering data refers to all information relating to volunteering events (event information and its features, geo-location, apply forms, etc.). Retrieval of volunteering data takes place in several cases and typically, retrieval and presentation of data is employed once the user indirectly triggers an event transformed into a dedicated query addressed to the server side. Upon executing the queries, data from the database server side are packaged into a user friendly page which is delivered to the user.

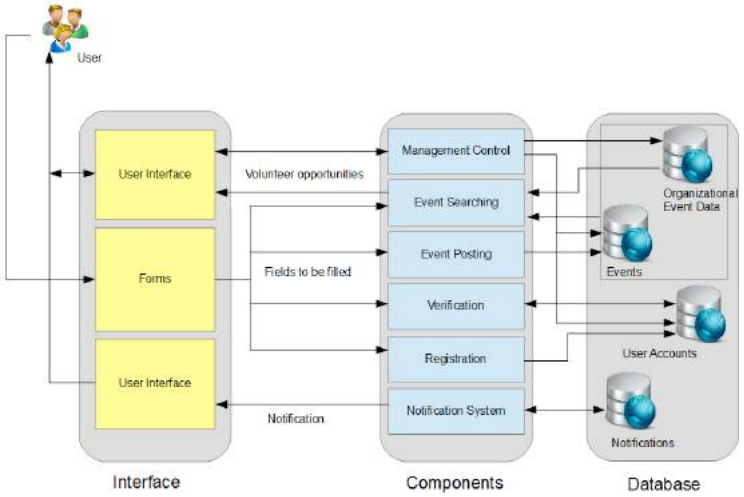

Figure 1. Component architecture of the Vol4All volunteering platform

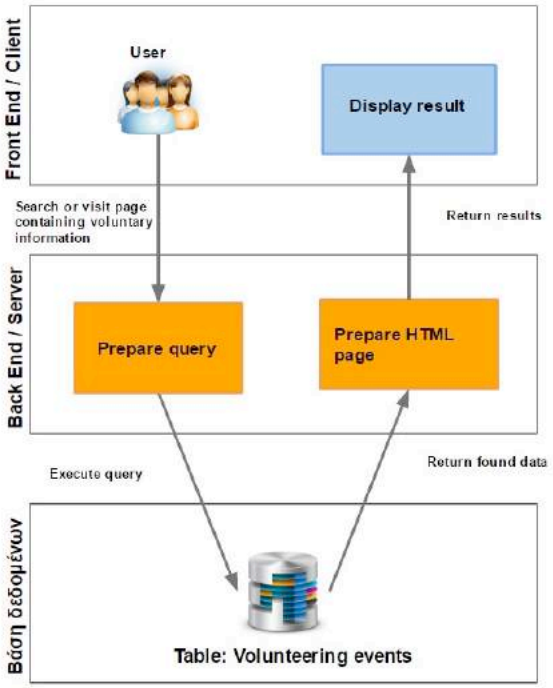

Figure 2. Data retrieval and presentation

4 Vol4All platform : Web and mobile sides

Vol4All Web application side facilitates users of the platform (volunteers, organizers and administrators) accessing and interacting. Users may act based on their privileges boundaries and the tools offered allow easy access to the volunteering content and its metadata. Volunteering events are generated and registered under specific category, with additional features of city coordinates mapping, of timeline declaration, of competencies and skills required etc. The platform's authoritative administrators are responsible for coordinating volunteers and organizers, having the ability to communicate with involved stakeholders and verify the two sided validity.

To enhance the volunteering process and attract more citizens for an on-the-go urban participation, a mobile application was developed, interacting with the Web application. The aim is to offer the appropriate functionalities to citizens and stakeholders on the move, facilitating the platform's interoperability and visibility. Moreover, volunteers have access to their volunteering participation history record and the volunteering digital content in the palms of their hands.

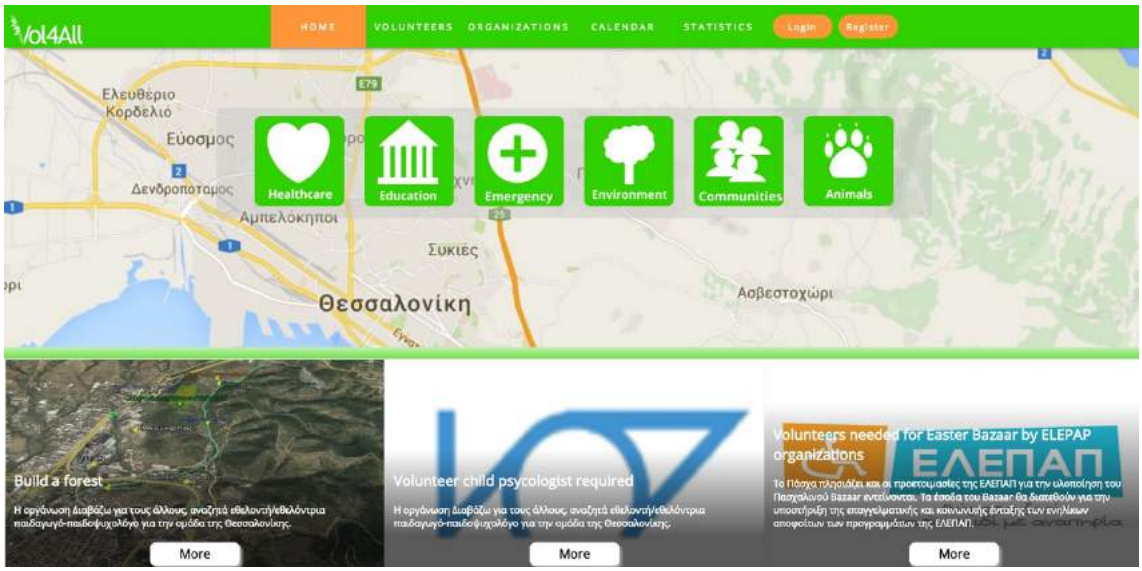

Figure 3. Homepage of the Vol4All volunteering platform

Vol4All Web application interface is depicted in its homepage (Figure 3), accessible via any Web and mobile browser. In summary the most important actions to be followed by this homepage are as next :

Registering of a new volunteering opportunity/event by an organization: this feature is available to users connected through an organization-authorized account. The organizer must fill in the necessary information about the volunteering activity (such as title, short and detailed description, location, date and time, category, suggested volunteering skills etc). Submitting the form, a request is sent to the server for the storage of the information in the database, setting the status as 'Pending for Approval'. Then an administrator must review the data submitted and approve the activity. The activity can only be displayed in the search results once it has been approved as a verified public city authorized content.

Searching for a volunteering opportunity: to find a possible volunteering activity to participate, the potential volunteer may choose a specific category from the home page, or a more extensive filtered search by fill in a form with preferences declaration (such as category, location, age group, suggested skills and dates availability). Volunteering events, meeting the defined criteria, are displayed on the user's interface (Web or mobile) side.

Calendar outline presentation: which is indicated in Figure 4, to offer a timely direct access to the volunteering activities requiring participants organized by month and weeks. The calendar widget offers fluid navigation between months and additional information about the respective volunteering events should the user select any of them.

Volunteering activity application process: At the dedicated volunteering event page, volunteers can find detailed information with and incorporated Google Maps functionality to display the city's geographical location of the event. In this section, users can officially apply as

volunteers for the specific volunteering event organized. Then, the organization that has registered this activity can view the applicants' profiles and select those who seem mostly capable and suited for the volunteering tasks. For the volunteers selection process, earlier analytics on best practices and most experienced volunteers unfolds for the administrators who can proceed to their selections based on qualitative and excellence criteria. Finally, the volunteers selected receive a notification for their approval.

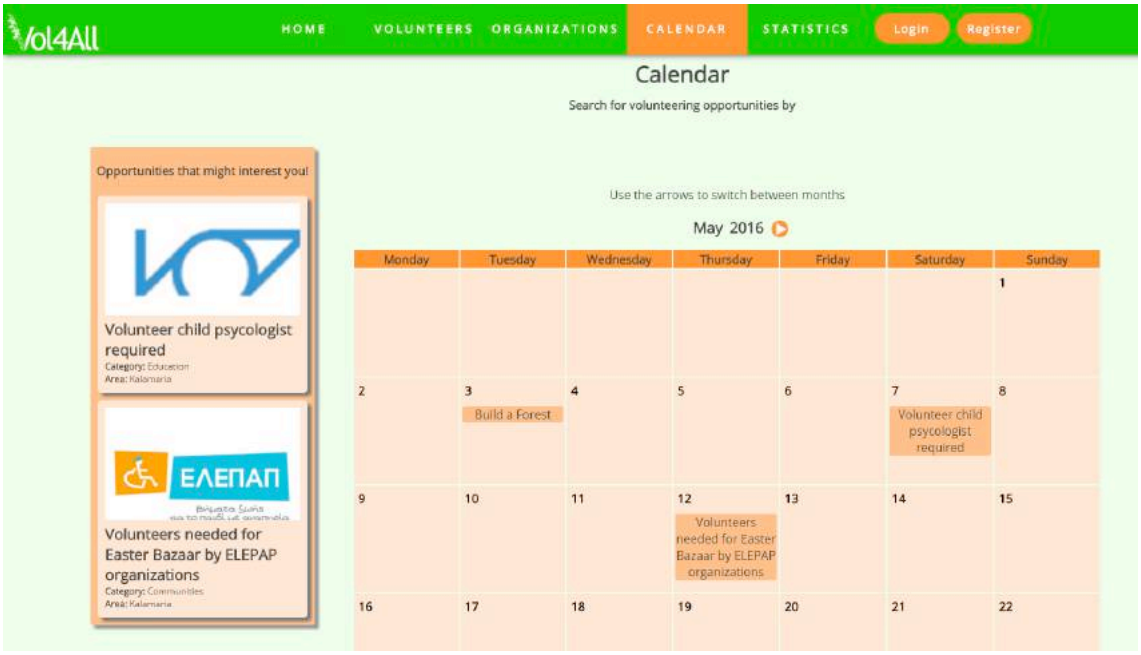

Figure 4. Calendar search functionality

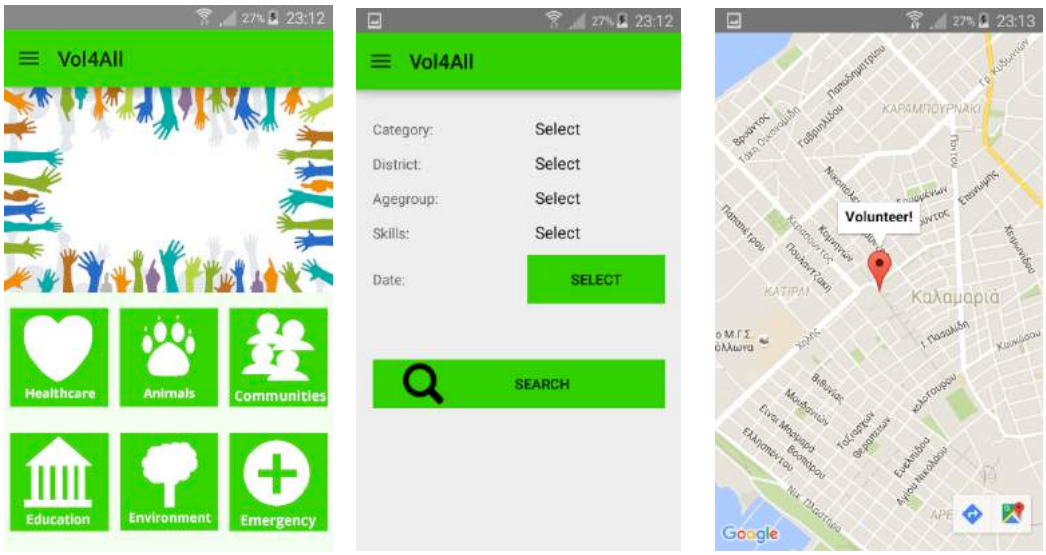

Figure 5. Vol4All mobile application screenshots

The respective mobile-based application complements these functionalities, providing portable, simple and easy to use access to Vol4All from the comfort of mobile device's screen. Mobile platform empowers volunteers with the necessary tools of searching, reviewing and

applying to volunteering events regardless of their geographical location. Organizers in turn, hold a useful tool which enables them to monitor activity on their registered volunteering events with information about applicants and the ability to approve or reject them. Figure 5 summarized some mobile application's screenshots (currently developed in Android operating system version).

At "Statistics" tab the analytics of earlier volunteering tasks are summarized and aggregated such that best practices are indicated and geo-located, revealing hidden city's volunteering "hubs" which exhibit strong volunteering practices and intensities. Social media support is evident at various of the platforms tasks since social media interaction, login, and analytics is also employed with the most popular Web 2.0 platforms (Twitter, facebook, foursquare, etc links) interlinking and interacting.

5. Vol4All Impact potential and adoption feasibility

Vol4All improves a city's innovation capacity and its integration of new knowledge due to its effective social driven design, leveraging the power and the dynamics of collective awareness. Targeting common synergies among cities society can drive "*volunteering as an asset*" with positive impact on city's economy and growth. The benefits are multi-dimensional for all stakeholders involved, as indicated in Table 2 which showcases the level of Vol4All expected impact to each city's stakeholder, per particular city segments. These segments targeted are mostly relevant to the proposed platform since cities services can be complemented by the volunteering activities, city apps can be linked with Vol4All apps, urban planning can be transformed based on Vol4All analytics, social inclusion and urban innovation hubs related to the volunteering best practices can be revealed and showcased. Specifically, impact relates to :

- *Citizens/Communities/entrepreneurship* enhancing due to sharing among platform users and communities, who interact over significant volunteering information and are motivated to behavioural change in response to several city's problems, favouring new crowdsourced knowledge under the best practises exposed and its analytics.
- *Industry/SMEs* competitiveness improvement, by promoting volunteering ideas capable of enhancing competitiveness with ideas which can improve the industrial "Social Profile". Cultivating such industrial Corporate Social Responsibility leads to companies significant direct and indirect benefits (Flammer 2012).
- *Policy Makers* governance improvement by providing a platform which enables volunteering ideas innovation and sharing, and therefore increases their capacity for designing and implementing policies towards beneficial volunteering exploitation.

	Cities Services	City apps	Urban planning	Social inclusion	Urban innovation hubs
Citizens	**	*	*	**	
Organizations	**	***	*	***	**
Authorities; Policy Makers	**	**	**	**	***
Entrepreneurs	**	***	**	*	***
Industry and SMEs	**	***	*	*	***

Table 2. Vol4All stakeholders impact

Vol4All is now under a prototype development of TRL4 to TRL5, accessible via the Web interface at : http://idematis.webpages.auth.gr/CAPS/en/index and *as a proof of concept*, in terms of its impact and future adoption, Vol4All has already been communicated and disseminated to the next two popular SMEs/startups (in Thessaloniki) :

- **Parallaxi** is a grassroot community with a more than 24 years creative presence in the editing landscape of the city, continuously organizing big volunteering events which alter the everyday city life. Such events involve immigrants support, large scale urban experiment for a city under a novel view entitled "Thessaloniki Differently"[5]. From the experiments of this urban activists community, already 28 actions for design, architecture, environment, social inclusion etc. have brought more than 150.000 together.
- **Thessaloniki Walking Tours**[6] team to discover the city of Thessaloniki, its people and their habits, its secrets and legends. This startup invites people to experience authentic aspects of the city through well-designed theme walks specifically aimed at providing the information and the means to spend a fascinating day in the life of this 2 thousand year old city. Connecting past and present, volunteering can be linked to Vol4All volunteering tasks to discover human stories behind city's important monuments, its art and its culture.

As it is evident from the above, citizen ground up groups have already addressed the need to proceed on more humanizing the city efforts, integrating city's needs with active people empowering actions. As is evident from the success of various volunteering platforms around the globe, citizen ground up groups have already addressed the need to proceed on more collaborative community efforts, integrating web technologies and modern standards in their everyday lives and perceptions. Some of the most indicative key measurable indicators are summarized in Table 3, mostly of what is planned and expected in a yearly basis upon acceptance of the platform in the local Thessaloniki's communities and stakeholders.

Performance/success Indicator	Target value
Number of users involved in pilots volunteering cases	2000 newcomers yearly (based on Parallaxi's audience)
Number of volunteering tasks and content uploaded by users	10 events per month; 10 photos/posts per user
Number of Companies activated at the Vol4All platform	100 yearly (based on local active companies outlook)
Volunteering quests resolved (estimated that 30% of Pilot users will solve on average one quest)	at least 60% of volunteering tasks being resolved in less than a set deadline
Number of new volunteering categories submitted at the Vol4All platform	10 new categories or sub-categories yearly in a volunteering topics hierarchy
Number of volunteering ideas approved by the authorities	At least 70% accepted to showcase the qualitative volunteering ideas sharing
Number of volunteering ideas adopted by the Industry and/or SMEs relevant stakeholders	estimated that 30% of the ideas will be adopted yearly

Table 3: Vol4All measurable indicators

[5] http://www.parallaximag.gr/thessaloniki/thessaloniki-allios

[6] http://thessalonikiwalkingtours.com/

Vol4All improves cities innovation capacity by its novel volunteering practices which empower citizens and inspire entrepreneurs and innovators. Its dynamics of collective sharing and synergies among cities communities, build on the principle of "volunteering as an asset" for city's growth.

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ACCESS TO TAXICABS FOR UNBANKED HOUSEHOLDS: AN EXPLORATORY ANALYSIS IN NEW YORK CITY

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ABSTRACT

Taxicabs are a critical aspect of the public transit system in New York City. The yellow cabs that are ubiquitous in Manhattan are as iconic as the city's subway system, and in recent years green taxicabs were introduced by the city to improve taxi service in areas outside of the central business districts and airports. Approximately 500,000 taxi trips are taken daily, carrying about 800,000 passengers, and not including other livery firms such as Uber, Lyft or Carmel. Since 2008 yellow taxis have been able to process fare payments with credit cards, and credits cards are a growing share of total fare payments. However, the use of credit cards to pay for taxi fares varies widely across neighborhoods, and there are strong correlations between cash payments for taxi fares, cash payments for transit fares and the presence of unbanked or underbanked populations. These issues are of concern for policymakers as approximately ten percent of households in the city are unbanked, and in some neighborhoods the share of unbanked households is over 50 percent. In this paper we use multiple datasets to explore taxicab fare payments by neighborhood and examine how access to taxicab services is associated with use of conventional banking services. There is a clear spatial dimension to the propensity of riders

to pay cash, and we find that both immigrant status and being 'unbanked' are strong predictors of cash transactions for taxicabs. These results have implications for local regulations of the for-hire vehicle industry, particularly in the context of the rapid growth of services that require credit cards. Without some type of cash-based payment option taxi services will isolate certain neighborhoods. At the very least, existing and new providers of transit services must consider access to mainstream financial products as part of their equity analyses.

INTRODUCTION

Taxicabs represent an important transit service in urban areas, and the industry undergoing rapid change. In recent years new technologies and private firms have shown substantial interest in growing the taxi industry from niche markets that complement transit systems to full-fledged alternatives auto ownership. Much of the current interest in taxicabs is connected with making taxicabs easier to use through smart phone based e-hail applications and credit card payments. While these innovations have no doubt made taxi services—both conventionally regulated taxicabs and upstart tech-oriented taxi services—easier to use for many travelers, these same innovations may make it harder for certain people to access them. In many U.S. cities large portions of low-income households do not have access to mainstream bank accounts or credit cards. These un- or under-banked households are effectively excluded from new services, fare discounts for transit passes, and other transportation services that require access to credit cards.

The literature on the underbanked rarely mentions transportation. Within the transportation literature, ability to pay is generally considered a function of income or wages. In the case of the underbanked, however, ability to pay must also include the fare payment media. There have been some studies where scholars have examined how the adoption of smart cards for transit fares may be affected by income, immigrant status and other factors (Yoh, Iseki et al. 2006). Within transit payments, low income riders tend to not take advantage of volume discounts or unlimited fares, which is likely caused by their precarious financial straits. But all of these examinations assume that users are at least *able* to access transit services or other transportation facilities. In the case of private taxi and transit services a lack of a formal bank account and credit card (or branded pre-paid debit card) prohibit the use of these services, at least in the United States.

Within the context of the un- and underbanked, there are many reasons why they may stay out of the formal banking system. First, they might not have employment with regular paychecks. If someone works odd jobs for cash they may not need an account for savings. Second, they may have a regular job with a steady paycheck, but the fees charged for bank accounts with a debit card are too high for their income or they receive most of their wages in cash tips. These people are likely to use check cashing stores, and paying check cashing fees may actually be cheaper than using an ATM throughout the week. Third, immigrants—both legally in the country and illegally—are less likely to have formal bank accounts than native born people. The reasons for this are not well understood beyond the obvious factors associated with immigrant status. Together, low income and immigrant status are associated with most of the un-and underbanked populations.

In 2010 New York City estimated that over 10 percent of the adult population was without a bank account (Sarlin and Miller 2010). The share of unbanked varies widely across

the city, however, with nearly 30 percent of the population of the Bronx—the poorest borough—unbanked, while wealthier Staten Island has less than two percent unbanked (Empowerment). Moreover, nearly half of all unbanked live in just ten neighborhoods, all clustered in the poorest parts of the city, and happen to be places that have traditionally been underserved by taxicabs.

In the past few years the city has launched a series of programs with the cooperation of financial institutions to increase access to mainstream services (New York City Department of Consumer Affairs 2008). These programs have had modest success for encouraging saving, even among very low income people, and modest success moving people into mainstream accounts (New York City Department of Consumer Affairs 2013). Under the current Mayor de Blasio administration the city has created a municipal identification card that does not require citizenship to acquire. This new ID card is hoped to assist at least some of the unbanked population to open new accounts. Yet for all of the city's efforts, the evidence is mixed on the overall effectiveness of such "lifeline" services for promoting shifts into formal banking (Doyle, Lopez et al. 1998).

Overall, the concern presented here is that a particular aspect of poverty—whether or not a household has access to a formal bank account and thus potential access to credit cards—is increasingly important for available transportation choices. While some travelers pay cash due to privacy concerns, most who pay cash do not have an option. These can lead to higher fares and worse service, which may further isolate vulnerable communities. To the best of our knowledge access to bank accounts and credit cards has only marginally been addressed in the literature. This exploratory analysis uses taxi data from New York City to identify spatial factors associated with the likelihood of being unbanked and cash fares for taxi trips.

Un-and Under Banked in New York City

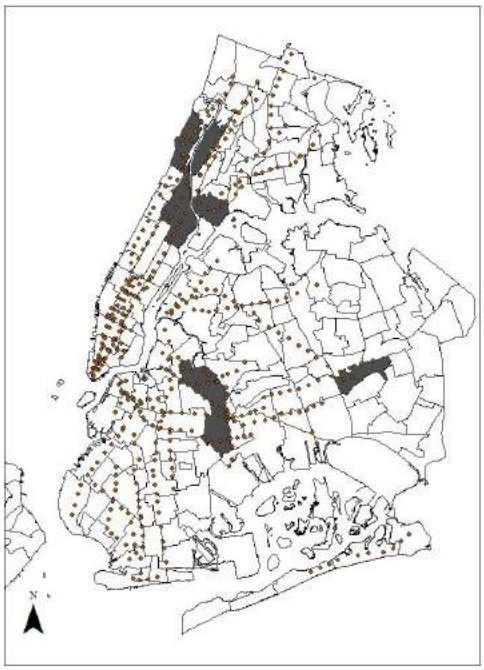
This research uses specific definitions of un- and under-banked households. Unbanked households are those that do not have a checking or savings account in a formal bank. Underbanked may have access to mainstream banking facilities but due to language, physical proximity to bank branches or other reasons may not use bank accounts and products by choice, such as with migrant workers, or circumstance, such as an elderly household who physically can't reach the branch.

Many households go between banked and unbanked depending on their circumstance. In general there are a few factors strongly associated with being unbanked. The largest predictor of becoming unbanked is a steep decline in household income, followed by race and ethnicity factors, marital status and housing characteristics (Rhine and Greene 2013). Most of these factors are found concentrated in particular neighborhoods, which suggests that households on the edge of poverty in certain communities will move in and out of the banking system as they can afford to.

The extent of underbanking has recently been recognized around the world, but both the diagnoses and remedies depend greatly on local context. A few generalized statements about underbanked households can be made. They are more likely to be poor, both by income

and wealth, than households with bank accounts. In the literature, the primary concerns about the unbanked are usually about the high costs of being poor, especially as this relates to the cost of money. Check cashing services can be more expensive than a savings account, for instance, as is getting a money order to pay all bills. Recently there has been some interest in pre-paid debit cards as a financial tool for low income families, but there are few examples of how these may work for transportation in the United States.

Figure 1: Most Unbanked Neighborhoods in New York City



In New York City, studies show that physical proximity to conventional bank branches is unrelated to likelihood of being unbanked. Throughout the city bank branches are ubiquitous, though new bank branches are viewed as a sign of gentrification. While not the focus of this paper, the neighborhoods with high levels of unbanked households have mixed experience with gentrification, however it is defined.

Figure 1 shows the neighborhoods with the highest share of unbanked households shaded in grey along with subway stations throughout the city. There are approximately three clusters of unbanked communities: northern Manhattan and the south Bronx; east-central Brooklyn; and Jamaica, Queens. The neighborhoods in Manhattan and the Bronx are the poorest neighborhoods in these boroughs, but also have fairly good transit access by subway. Table 1 shows the actually share of unbanked households. Together, these ten neighborhoods represent about 450,000 unbanked people, or half of all unbanked in the city.

Table 1: Largest Share of Unbanked Households by Neighborhood

Name	Borough	Unbanked
Mott Haven/ Melrose	Bronx	56%
Morris Heights/University Heights	Bronx	53%
Highbridge/Concourse	Bronx	51%
Ocean Hill/Brownsville	Brooklyn	47%
Bushwick	Brooklyn	47%
Washington Heights/Inwood	Manhattan	46%
West Harlem	Manhattan	38%
East Harlem	Manhattan	37%
Central Harlem	Manhattan	36%
Jamaica	Queens	24%

Source: (Sarlin and Miller 2010)

The High Cost of Being Poor

Poverty is a major urban policy concern. For much of the post-war period in the United States poverty was largely an inner city phenomenon within metropolitan areas. One reason for concentrated poverty in the urban core was the availability of public transportation (Glaeser, Kahn et al. 2008). While poor, these households at least had access to transit networks that may allow for economic mobility, though our knowledge of how transportation affects poverty is limited (Sanchez, Shen et al. 2004, Sanchez 2008). In recent years, in part due to the Great Recession, poverty has suburbanized (Kneebone 2010). This has led to new concerns about the role of transit in suburban locations to prevent economic isolation for those who cannot afford to drive. But the costs associated with poverty are not limited to transportation options.

Poor households face a number of ways that reinforce how expensive it is to be poor. Inner-city neighborhoods pay higher retail prices (Talukdar 2008), for instance, or pay higher transit fares because they can't take advantage of discounts. WNYC, a news radio station in New York City , used data from the Metropolitan Transportation Authority to demonstrate where riders purchases 7-day transit passes for $30 or unlimited transit passes for $112 per month (SChuerman 2015). The MTA data shows that the 7-day passes are used more frequently than the unlimited passes, at 2.3 rides per day versus 1.9. This means that the average fare paid is somewhat less for the typical 7-day pass holder, the higher usage means that these riders would receive substantial discounts simply by switching to a monthly unlimited pass. It is not

known precisely why transit riders purchase 7-day passes when unlimited passes would ultimately save them money, but the most likely explanation is that the travelers simply do not have $112 to commit to transit trips at the beginning of each month. What these riders can do is buy a shorter pass when they are able, and if not they don't travel or find other alternatives. This is a subtle example of how costs of living increase as income drops.

The Informal Transit Market in New York

New York City is the nation's largest transit market, with approximately one-third of all U.S. transit riders (Association 2015). Less well known is the city's large assortment of alternatives to subways, commuter rail and buses. Neighborhoods outside of the Manhattan core have long relied on informal networks of community cars, livery vehicles, commuter vans, dollar vans and other for-hire services. Each of these services tends to serve a particular niche, such as service between the city's three distinct Chinatowns in Manhattan and Queens (Tsai 2010). Yet formalizing these services has been difficult (King and Goldwyn 2014). While there are many reasons that formalizing informal transit is difficult, one factor is that these services are most used by immigrants and low income riders who always pay with cash.

Taxi services in New York City are regulated by the Taxi and Limousine Commission (TLC). In 2004 the TLC initiated a program that required all taxicabs to use technology that allowed for credit card processing, and also collected data about trip characteristics (King, Peters et al. 2012). This program was completed in 2008. In 2012 the city announced a program to increase the number of taxicabs outside of the Manhattan core into traditionally underserved neighborhoods. These new taxis, known as Green Cabs (because of their color) or boro cabs, cannot pick up passengers at the airports or Manhattan south of either 110th Street on the west side of Central Park or 96 th Street on the east, and are available as either a street hail or pre-arranged ride. The full effect of the green cab program is not yet known for overall taxi access or ridership as the program is still new, but preliminary data can be used to assess how trips made in green cabs differ from those made in yellow cabs.[i]

Yellow taxicabs have been criticized for focusing their service on the airports and Manhattan's central business districts rather than serving the city as a whole. For years it was rare to see a taxi on the street of the outer boroughs (Brooklyn, Queens,
Staten Island and the Bronx). This does not mean that these areas were not served. Rather, these areas were served by mix of informal and formal taxi services. Figure 2 is a photograph of a parking lot at a big box Target retail store in a large shopping complex in one of the unbanked neighborhoods in the Bronx. This is a typical scene at retail centers across the city, where a taxi queue forms to take people home once their shopping is complete. One green cab is available, but the balance of cars are licensed by the TLC and available for hire. In this shopping center the building management, the TLC and the licensed liveries worked together to create a queue in the parking structure to ensure orderliness. This arrangement is often provided in a language other than English, and nearly all of these passengers pay cash.

Figure 2: Community Cars at Shopping Center

Source: Photo by author

DATA AND METHODS

This research uses geolocated trip data from October 2014 for all yellow and green taxicabs in New York City, which were provided by request from the Taxi and Limousine Commission. The dataset is rich with trip information and includes trip origin, destination, time, number of passengers, fare paid, tolls paid, method of payment, tips (if paid by credit card) and other information. From the reported data distance traveled can be estimated but is not included in these analyses. These taxi data are combined with neighborhood level socio-economic data for analysis.

Table 2 shows the total trips by green and yellow taxis for the entire city during the study period. Yellow taxis make about ten times the number of paid trips as green taxis. This is for of many reasons, but primarily the yellow taxis are used much more intensively and there are simply thousands more of them. Each yellow taxi is used for two 12 hour shifts daily, and medallion owners are eager to keep drivers in the cabs to make sure they collect revenues. Green taxis, however, are typically owned by someone who drives part time and the leases the taxi for the balance of the week. The Green taxis are thus used for more flexible shifts.

The characteristics of trips by green and yellow can are quite different, as well. Obviously as green taxis cannot pick up in many areas of the city with high taxi demand overall trip characteristics are affected, but more importantly passengers use and pay for taxis differently. Fifty-five percent of all green taxis trips—serving outer boroughs by regulation—are cash fares. For yellow taxis, the likelihood of a cash fare is related to distance and whether the trip is an airport trip (these calculations are not shown).

Table 2: Characteristics for All Trips, October 2014		
	Green Taxi Trips	Yellow Taxi Trips
Total Trips	1,491,266	14,232,488
Cash Trips	820,747	5,684,248
Share of Trips Paid Cash	55%	40%

Overall there are observable differences for cash payments by taxi type, location, trip origin and trip destination. It is impossible to know what characteristics differ between a typical yellow cab passenger and a typical green cab passenger, but something leads green cab passengers to use cash far more often than yellow cab passengers. The results shown on the maps (Figures 4-7) suggest that there is a spatial factor in play.

In Figures 4-7 the relative frequency of payment types by origin and destination for yellow and green taxicabs. In all maps there are stark lines that demarcate where riders predominately use cash (shown in yellow) and where they use credit (shown in blue). The areas marked with yellow are the places where cash is king. With the exception of a credit card hotspot surrounding Columbia University in Morningside Heights (a blue area circled in Figure 4) Manhattan payment types divide cleanly along income lines, where wealthy neighborhoods flanking Central Park (the empty white rectangle in the middle of the map surrounded by blue to the south and yellow to the north) on the Upper West Side and Upper East Side pay for taxi trips mostly with credit cards and poorer neighborhoods to the north in Spanish and Central Harlem are dominated by cash. One interesting aspect is that the socio-demographic characteristics of neighborhoods seemingly play a large role in determining payment type. It is likely that the cash or credit choice is a function of access to a bank account, for which these spatial data are a good proxy. Another takeaway is that much of the city still does not produce a lot of taxi trips and there is not enough data to present primary payment types at all. These areas

Figure 4: Cash and Credit Payment Types for Green Cabs by Origin

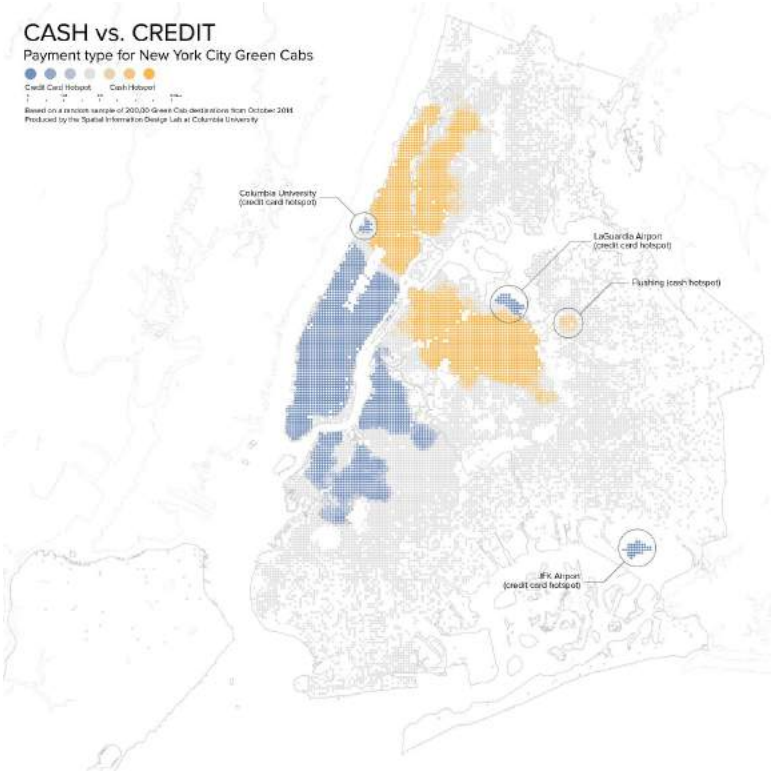


Figure 5: Cash and Credit Payment Types for Yellow Cabs by Origin

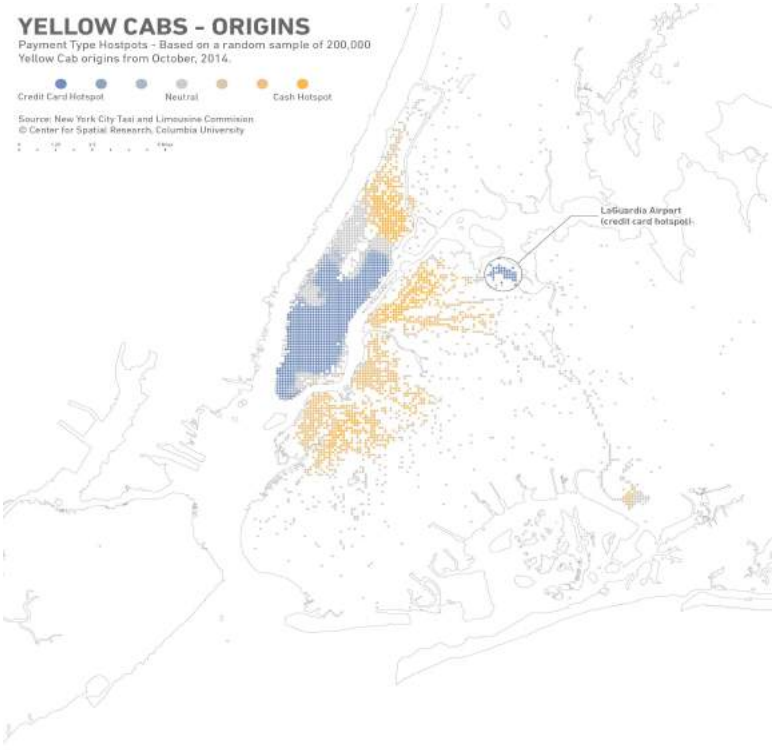


Figure 6: Cash and Credit Payment Types for Green Cabs by Destination

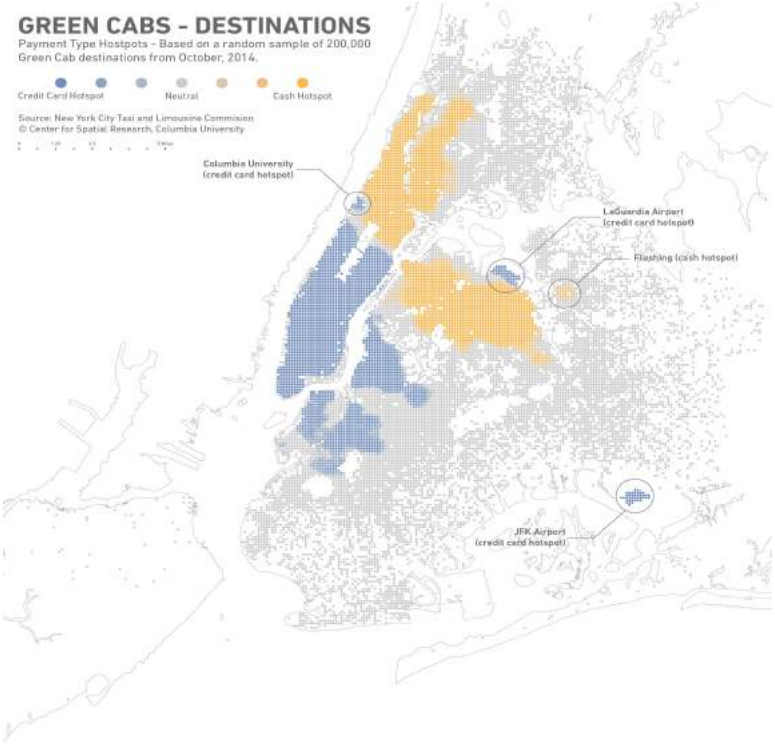
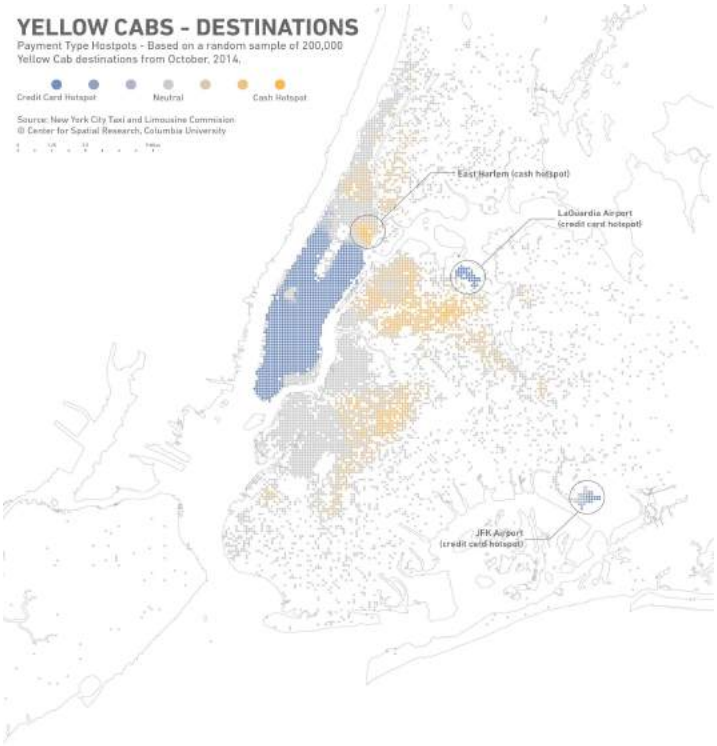


Figure 7: Cash and Credit Payment Types for Yellow Cabs by Destination



Statistical Analysis

In this section statistical analyses of the associations between socio-demographic characteristics and the share of cash fares for taxicabs are presented. The taxi trip data is limited in that it provides origins and destinations along with fare characteristics, but these data are associated with a known vehicle rather than a known passenger. As such, we can make a series of assumptions about a typical rider based on neighborhood factors. The regression analyses shown below used all trip data for the week of October 6-12, 2014, which is assumed to be a "typical week in terms of good weather, lack of holidays and no major school or employment breaks (n=3,217,092 for yellow taxi trips and n=330,024 for green taxi trips). These data are then assumed to represent a close approximation of the average trip, and thus the average trip taker. Taxi trips were aggregated spatially to the neighborhood level, which were the smallest geographies with available demographic data, and then analyzed by trip origins and destinations for cash payments. Origins and destinations were treated separately primarily because people leaving an area and returning to an area by taxicab may represent different groups of people.

Table 3 shows the summary statistics for dependent and independent variables considered for the regression models. These are shares of cash fares by origin (Ocash) and destination (Dcash) by neighborhood for all yellow and green taxi trips, and these are not mutually exclusive. Trips that begin and end in the same neighborhood will be counted as both Ocash

and Dcash. For most of the outer borough neighborhoods the total number of intra-neighborhood trips is small as does not affect the overall results. For 2013, the percent of households in poverty, headed by a foreign born family member and unbanked are included. The unemployment rate in 2013 was also considered but ultimately dropped from the analysis after post-test diagnostics.

Table 3: Summary Statistics by Neighborhood (Percent)

Variable	Mean	Standard Deviation	Minimum	Maximum
Ocash	0.42	0.07	0.35	0.81
Dcash	0.42	0.07	0.35	0.76
Poor2013	0.18	0.10	0.03	0.40
Foreignborn2013	0.38	0.12	0.17	0.64
Unemployment2013	0.10	0.04	0.03	0.18
Unbanked2013	0.13	0.08	0.03	0.31

Tables 5 and 6 show the regression results. The data are organized by neighborhood, and the dependent variable is either the share of cash trip by origin or cash trips by destination. Post-test diagnostics were used to evaluate multicollinearity, and the resulting models represent the best fit for the data. Ordinary least squares (OLS) is used along with generalized linear models (GLM), which accounts for the dependent variable not being normally distributed.

In all cases the strongest predictors of cash fares are the share of foreign born and the share of unbanked, and these effects are largest for taxi trip destinations. . These are large and positive coefficients that are highly statistically significant. The share of households in poverty is not statistically significant. In both OLS and GLM models the direction of effects and approximate magnitudes are similar, suggesting that both models adequately represent the relationships among variables. The r-sq for the OLS models suggest that close to half of the variation of cash fares by destination, which is a fairly high level of explanatory power for the model. It is likely that the reason poverty has an insignificant effect is that poverty is not a perfect predictor of banking status or immigrant status.

Table 4: Regression Results for Cash Trips by Origin by Neighborhood

	OLS	GLM
Poor 2013	-0.431	-1.814
	(.339)	(1.644)
Foreignborn 2013	0.668	2.808
	(.133)	(.461)
Unbanked2013	1.087	4.56
	(.439)	(2.139)
Constant	0.2732	-0.955
	(.061)	(.209)
F	10.31	
r^2	0.39	
n	52	52

Table 5: Regression Results for Cash Trips by Destination by Neighborhood

	OLS	GLM
Poor 2013	-0.548	-2.258
	(.261)	(1.220)
Foreignborn2013	0.587	2.415
	(.102)	(.359)
Unbanked2013	1.390	5.727
	(.337)	(1.602)
Constant	0.241	-1.065
	(.047)	(.144)
F	17.52	
r^2	0.52	
n	52	52

DISCUSSION

Taxicabs and for-hire transportation services are premium services that complement fixed-route transit and supply critical accessibility to people who do not or cannot drive. Ensuring that these services are available to all who need them is a desirable policy goal. What the data shown in this research shows is that in some cases access to bank accounts and credit cards may affect access to certain types of taxi services. There are strong correlations between neighborhoods with high shares of unbanked households and taxi trips—especially green cabs—paid with cash.

These results underscore an important aspect of emerging taxicab technologies, which is that many supporters of expanding taxicab supply base their support on the potential of new services to reach markets previously underserved. As potential can be refuted only through experience, existing firms in the taxi market look comparatively bad as the have a history that can be checked. It is a common claim that smart phone enabled taxi services will not employ the same geographic discrimination as conventional taxis because the drivers will respond to the service request. This is a fine idea, and a nice claim, and it may prove true at some point in the future. But many of the communities that need taxi services have high shares of unbanked households, who by definition cannot participate in a business that requires a credit card for access.

A scholarly example of this is a recent study by the BOTEC Analysis Corporation, where they sent researchers into various neighborhoods to check response times and total trip costs for taxicabs and Uber drivers (Smart, Rowe et al. 2015). The study is methodologically sound and the authors find quite conclusively that Uber cars arrive faster and cost quite a bit less on average. But in the Los Angeles neighborhoods not well served by taxis households have very high rates of being unbanked (Khashadourian and Tom 2007). These households also live in neighborhoods where carpooling acts as taxi services and is far more prevalent than taxis (Liu and Painter 2011), and Uber cars are likely slower and more expensive the taxi service actually used. It is possible that credit card based taxi services are simply out of reach for many of these communities.

Writers for the *Washington Post* collected data from Uber's API and found that Uber services offered faster service—measured by wait times after requests—to whiter and wealthier neighborhoods (Stark and Diakopoulos 2016). Such a claim is by itself not evidence of discrimination—and we want to be clear that is not part of our argument here—but taxicabs have long been subject to regulations in part to ensure access to service without regard to neighborhood, income, or race. While a systematic review of tech-enabled taxi services is beyond the scope of this paper, the studies cited above are suggestive that there may be spatial differences in taxi access even with app-enabled hailing.

The green taxicabs in New York City may have also helped solve one problem—taxi access—but introduced a new one—decline of community cars, which were shown in Figure 2. Community cars used to prowl the streets honking at prospective passengers, then the fare was negotiated for each trip. While this practice was illegal it was common. Through informal

interviews with drivers and passengers of green cabs, some indicated they preferred the old system of negotiated fares—the green taxis have the same fare schedule as the yellow taxis—because drivers would give breaks to certain people, while other paid higher fares. Now the poorest riders, who previous could have negotiated a trip for whatever cash they were willing to pay, now have to pay the meter fare and it is often higher. As these are not data collected systematically through interviews the claims should be treated as speculation, but even as anecdotes they are insightful observations about how at least a few of the very poor riders made use of taxi-type services with cash.

One shortcoming of the taxi GPS data used is there is no specific information about the passenger. We can only assume that high rates of unbanked households is related to high rates of cash payments. While we feel this assumption is sound, the lack of passenger data limits the robustness of this and other analyses of taxi vehicle activities. We cannot say for certain a high share of unbanked households predict demand for cash payments for taxis, and this certainly requires additional surveys and passenger data. We also cannot evaluate these data for potential discrimination against passengers based on personal, locational or payment characteristics. There may be unobserved discrimination that affects the results shown.

With the green cabs in New York, it is not clear that unbanked people are underserved by taxicabs. However, this does not mean that taxi regulations and transportation policy shouldn't seek to protect vulnerable households. As the taxi industry goes through structural changes brought about by the rise of e-hailing applications, the city must consider ways to ensure access to all, not just those with a bank account.

CONCLUSIONS

This research presented an exploratory analysis of how taxi services in New York City exhibit market segmentation by fares payment methods. Overall, the green cabs, which were designed to serve outer boroughs and underserved areas, disproportionately have cash fares. The yellow and green taxi markets exhibit some aspects of market segmentation in that yellow cab trips in unbanked areas are more like yellow trips elsewhere and green cab trips are more like community cars and likely serve different riders. The use of cash to pay for taxi trips is strongly associated with neighborhoods that have high shares of unbanked and immigrant households. Airports and central business district taxi trips are more likely to use credit cards, and these riders likely have different socio-economic characteristics than outerborough riders. Some potential implications from these findings are discussed above, but the key points are worth reiterating. Discrimination in the taxi market is a long-standing concern. Taxi drivers are infamous for avoiding certain types of people and certain neighborhoods, which is a key argument in favor of public regulation against discrimination. Such discrimination should not be tolerated. A worry based on the analysis in this paper is that limiting taxi services to those with a credit card also leaves many households unserved, and may act as a new type of discrimination. Households on the edge of poverty go between having and not having bank accounts, and not having access to mainstream financial services may become a new type of discrimination without thoughtful policies.

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[i] The Green cabs were introduced at the same time Uber, Lyft and other competitors entered the market en masse. Since the growth of smart phone enabled services demand for Green cab medallions has declined and the city has not sold all available licenses.

DE LA PERCEPCIÓN NEGATIVA A LA PARTICIPACIÓN ACTIVA

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Keywords : citizens empowerment, e-government, engagement

DE LA PERCEPCIÓN NEGATIVA A LA PARTICIPACIÓN ACTIVA

Repensando el rol del ciudadano

Las personas en su papel de consumidores, están acostumbradas a hablar y a ser escuchadas; muchas veces y de diferentes maneras forman parte del proceso de toma de decisiones del desarrollo de productos y/o servicios de las compañías de las que son consumidoras.

En cambio en el ejercicio de su rol ciudadano, sobre todo en América Latina, están acostumbradas a expresarse sólo a través del voto y, más recientemente y de forma activa, a través de las redes sociales; pero rara vez forman parte del proceso de toma de decisiones de la gestión de gobierno. A pesar de ello, el ciudadano es cada vez más consciente de que su soberanía no se agota en la elección periódica de representantes políticos que rinden cuentas cada determinado tiempo y los gobiernos deben concientizarse acerca de que la participación ciudadana es la mejor garantía para evitar la resistencia social y la desconfianza hacia las instituciones.

Existe una relación concreta entre falta de participación y el incremento de la percepción negativa ciudadana.

¿Cómo transformar la percepción negativa que los ciudadanos tienen de la gestión en participación activa?

Para comenzar hablemos sobre qué se entiende por percepción. Ésta se define como la imagen mental que se forma con ayuda de la experiencia y las necesidades, resultado de un proceso de selección, organización e interpretación de sensaciones. El mundo tal cual lo conocemos llega a nosotros transmitido por los 5 sentidos (vista, oído, gusto, tacto, olfato). Con lo cual la percepción de un individuo es subjetiva.

Frente a una situación determinada solamente se puede percibir el hecho. Pero el hecho por sí solo no significa nada, para ver un significado en ese hecho en particular, cada persona tiene que interpretarlo a su manera. ¿Cómo? De acuerdo a sus experiencias vividas, su conocimiento, su forma de ver la vida, sus fobias, sus creencias y todo lo que afecte en sus pensamientos y decisiones.

¿Qué respondería ante la pregunta de la imagen 1?

Imagen 1

Si usted fuese una persona optimista vería el vaso lleno de agua, si fuese pesimista lo vería vacío, si fuese banquero se preguntaría si puede prestarle al dueño del vaso un 50% de agua, si fuese ingeniero pensaría que el vaso es el doble de grande de lo que debería ser y así sucesivamente, se sucederían una serie de opiniones o puntos de vista sobre el mismo hecho de acuerdo con la percepción de la persona que lo mire.

Entonces, ¿Cómo puede la gestión ponerse de acuerdo con un ciudadano acerca de la percepción que éste tiene sobre la situación particular de su barrio, su ciudad, su provincia o su país?

Entendemos que primero se debe dejar de discutir sobre las percepciones específicas, pues la gestión se embarcaría en una discusión que nunca tendría fin y cuyo objeto dependería de la configuración mental de cada ciudadano. La percepción de cada uno de los involucrados altera e influye por encima de las razones o decisiones que se deban tomar.

Imagen 2

Si un ciudadano viese la imagen 2, percibirá rápidamente el problema y obviamente su connotación negativa. Si en la imagen 2 hubiese estado todo limpio y ordenado, no hubiese percibido nada en particular, puesto que lo positivo no deja rastro.

Los problemas van a seguir existiendo y no se debe discutir sobre esto y como ocultarlos.

Debemos enfocarnos en entender que es lo que percibe el ciudadano de la gestión de gobierno y que es lo que espera de ésta, puesto que si la gestión no dispone de esa información nunca podrá satisfacer al ciudadano.

Entonces, tanto la percepción de la gestión de gobierno como las expectativas deben ponerse en manifiesto, darse a conocer a través del ejercicio de la participación ciudadana.

¿Cómo se ayuda al ciudadano a ejercer su derecho de participación ciudadana?

Con la creación de espacios de escucha y de diálogo adecuados. Muchos pensarán que la necesidad de ese espacio de participación está cubierta por las diferentes redes sociales, de hecho autores como, Rheingold (2005), o De Ugarte (2007), concuerdan en que los sitios de Redes Sociales están significando un nuevo espacio de expresión social, de reclamos, de unión y de organización ciudadana; pero nuestra experiencia particular de trabajo con redes sociales en el campo del consumo masivo, nos ha demostrado que los gobiernos no están preparados para este tipo de comunicación bidireccional, situación que los deja aún más expuestos ante la percepción negativa del ciudadano y lo que es peor a éste muchas veces sin respuesta a sus reclamos.

Asimismo, observamos que existe una fuerte centralización de todos los problemas en cabeza del municipio, característica bastante presente en la gestión gubernamental de Latinoamérica.

Obviamente sabemos que aunque se reconocen las virtudes de la descentralización, pues vuelve más eficiente la acción del Estado y promueve la satisfacción democrática en la sociedad, su avance siempre está y estará condicionado a las conveniencias e intereses políticos.

Esto nos lleva a concluir que no sólo se debe procurar un espacio de participación ciudadana donde el ciudadano pueda manifestar sus necesidades sino que se debe trabajar también en la descentralización de la gestión y cuando hablamos de ésta entendemos que conceptualmente la misma debe permear en el proceso de resolución de problemáticas. Puesto que el objetivo final de la descentralización más allá de la búsqueda de eficiencia es la búsqueda de proximidad con el vecino.

Este cambio de paradigma que se está dando, nos debe llevar a repensar también en cómo medir el desempeño de este nuevo tipo de gestión.

¿Continuamos pensando que la medida está basada en la cantidad de problemáticas resueltas o en la cantidad de ciudadanos satisfechos?

Imagen 3

Si el gobierno logra comprender la percepción que el ciudadano tiene de su gestión y conoce sus expectativas, entenderá que la nueva unidad de medida de eficiencia/eficacia de su gestión será "cantidad de ciudadanos satisfechos" y para ello debe poner al ciudadano en el centro de la escena y estimular su participación.

Los temas planteados anteriormente, a saber: el ciudadano eje de la gestión, la generación de espacios de participación que faciliten un diálogo profundo con la ciudadanía, la gestión de datos que permitan tomar acciones concretas y la utilización de nuevas medidas de desempeño de la gestión, son algunos de los grandes desafíos que enfrentan los gobiernos y líderes emergentes de Latinoamérica.

Valor social y económico de la participación ciudadana

Nadie puede negar el gran valor que tiene la participación ciudadana en términos sociales. Según la Carta Iberoamericana de Participación Ciudadana en la Gestión Pública, el valor social de la participación es indiscutible pues: "… refuerza la posición activa de los ciudadanos como miembros de sus comunidades, permite la expresión y defensa de sus intereses, el aprovechamiento de sus experiencias y potenciación de sus capacidades, contribuyendo de esta manera a mejorar la calidad de vida de la población".

La cantidad de ciudadanos que actualmente ejercen una participación ciudadana activa, según nuestro conocimiento empírico nos ha demostrado, se puede calcular en un 2% de la población, habiéndose duplicado año tras año según nuestras observaciones iniciadas en el año 2012.

Este porcentual que puede ser pequeño en términos absolutos no resulta tan insignificante en términos económicos.

Si valuásemos económicamente la participación ciudadana podríamos hacerlo de la siguiente manera:

En una ciudad de 100.000 habitantes contaríamos con aproximadamente 2000 "observadores ciudadanos" altamente calificados, teniendo en cuenta el porcentual detallado anteriormente de ciudadanos en el ejercicio de la participación activa.

Características de un observador ciudadano

- Gran compromiso cívico
- Profundo conocimiento del lugar en el que viven
- Busca formar parte de la solución a las problemáticas cotidianas.
- Se interesa en el seguimiento de la evolución de los reportes
- Se comunica con el Municipio y busca una respuesta.
- Participa en las redes sociales y plataformas de la ciudad.

En promedio, según nuestra experiencia, cada uno de estos "observadores" puede estar hasta 4 horas al mes realizando acciones colaborativas que contribuyan a la gestión, con lo cual contaríamos con 8.000 horas de trabajo realizado por la ciudadanía.

Si considerásemos que el valor promedio de la hora de trabajo de un ciudadano latinoamericano ronda los U$S 10, podríamos decir que el valor por el total de horas trabajadas ascendería a U$S 80.000.- mensuales, esto sin tomar en consideración que el valor por hora de trabajo podría ser mayor por las características especiales del observador ciudadano.

Esta suma no es para nada despreciable, más aún si consideramos la cifra anualizada cuyo valor asciende a los U$S 960.000.-

Este 2% de participación activa crecerá indefectiblemente a medida que los Millenials y la Generación Z, que hoy sólo representan el 25,9% de la población mundial comiencen a representar la mayor fuerza laboral; se estima que para el año 2025 representarán el 75 % de ésta.

Solución a los desafíos planteados

Barrios Activos nace para hacer frente a los desafíos que hemos descripto anteriormente. Con el foco puesto en conectar al ciudadano con la gestión, Barrios Activos es un ambiente de comunicación ciudadana y gestión de gobierno donde las expectativas del ciudadano se pueden conocer y la percepción negativa pasar a un segundo plano. Ciudadanos digitales, gobiernos y líderes emergentes podrán en este ambiente ver satisfechos respectivamente, su necesidad de participación, compromiso ciudadano y eficiencia de gestión.

¿Cómo se materializa BARRIOS ACTIVOS?

En una plataforma web y móvil gratuita que a través de un mapa digital, interactivo e intuitivo y una aplicación móvil, como se muestra en la imagen 2, permite al ciudadano reportar problemas y realizar sugerencias acerca del funcionamiento de los servicios municipales.

Para que la comunicación sea fluida y ordenada los servicios han sido agrupados en diferentes categorías respondiendo a temas, agentes, necesidades y objetivos estratégicos con el objetivo de cubrir las diferentes áreas que constituyen un barrio o una ciudad.

Imagen 4

Barrios Activos no sólo permite al ciudadano conectarse al gobierno de manera clara y ordenada para hacerle llegar sus necesidades, propuestas y expectativas, sino que les proporciona a otros miembros de la comunidad la oportunidad de conocer y apoyar otras propuestas, estimulando de esta manera el compromiso ciudadano y promoviendo la mejora de su entorno inmediato.

De esta manera, utilizando el concepto de las redes sociales y valiéndose de éstas, las propuestas y reportes logran ser vistas por todas las personas que interactúan con la plataforma.

Características principales

Crea un nuevo espacio de comunicación entre ciudadanos y gestión gubernamental.

Este espacio es integrador pues no sólo promueve la participación ciudadana sino la escucha activa por parte del gobierno, porque tanto se generarán reclamos y/o propuestas, como también se podrán saber los avances que la gestión hace sobre los mismos.

De esta manera logramos que exista el diálogo y NO la comunicación unidireccional que existe en la actualidad y que se da actualmente en el contexto de las redes sociales entre las partes involucradas.

Provee variables que permiten identificar la percepción ciudadana de la gestión.

La plataforma alimenta un sistema y una base de datos relacionada con necesidades y opiniones. El objetivo que se persigue es realizar un correcto análisis de esta información para comprender la

percepción y mejorar la gestión día a día, enfocándose cada vez más en las expectativas de los ciudadanos y su calidad de vida.

Esta característica es sumamente importante para entender el impacto de cada variable en la reputación de cierto grupo. Es por ello que es esencial que el sistema relacione conceptos y pueda explicar algo tan emocional como la reputación de un grupo determinado, la cual puede ser descripta como admiración, respeto y/o confianza.

Una buena reputación no se logra con la ejecución de acciones aisladas; debe incluir un planeamiento previo en el que se analicen profundamente estrategias y tácticas y se detallen en un plan; sólo entonces acciones consistentes pueden ser implementadas, medidas y evaluadas.

Innova la gestión de gobierno, enfocándose en la resolución de problemáticas específicas del ciudadano.

Barrios Activos promueve la escucha activa de parte de la gestión pública a través de la incorporación de una dinámica participativa que alimenta la plataforma, con lo cual la gestión puede actuar en función a lo que el ciudadano manifiesta y ésta considere que deba ejecutar.

Esto se lleva a cabo a través de la obtención de diferentes indicadores basados en las necesidades de los ciudadanos que facilitan el proceso de toma de decisiones. A través de la actualización y análisis de los reportes con herramientas de gestión y comunicación intuitivas se logra gestionar adecuadamente la participación ciudadana.

Al trabajar sobre las expectativas se promueve que el proceso de toma de decisiones tenga como eje central al ciudadano y se alienta a utilizar una nueva medida de desempeño cuyo foco esta puesto en las necesidades manifiestas y no en la mera resolución de los problemas. De esta manera los gobiernos trabajarán en tareas que tengan real impacto en la comunidad.

Aumenta la eficiencia de la gestión gubernamental.

Tanto la información que genera la plataforma a través de informes automáticos con infinidad de datos y estadísticas, datos demográficos certeros, niveles de satisfacción ciudadana por eje y por región geográfica, como la segmentación de perfiles de los ciudadanos, permite a la gestión lograr una gran eficiencia.

Con Barrios Activos la gestión de un reporte cuesta 14 veces menos que con la gestión tradicional y 8 veces menos que con la gestión telefónica de éstos.

Democratiza la utilización de la tecnología y revoluciona la administración de la infraestructura tecnológica.

Barrios Activos se fundamenta en el concepto de la tercera plataforma a través de la utilización convergente de varias tecnologías.

- Servicio en la Nube
- Tecnologías para análisis de Big Data
- Redes sociales
- Aparatos Móviles

Todas funcionando bajo el concepto de "software as a service" (SAAS), que revoluciona tanto el modo de gestionar la infraestructura de tecnología como la de satisfacer al cliente, en cuestiones tales como:

- Administración de tecnología sencilla: No es necesario instalar el software en ninguna plataforma o dispositivo específico.
- Accesibilidad: La aplicación está disponible siempre, en cualquier momento y en cualquier dispositivo.
- Escalabilidad: A medida que el cliente se expande la aplicación puede escalar para ser utilizada por más usuarios con una mínima inversión o trabajo.
- Ahorro de costos: El servicio en la nube provee de almacenamiento y mantenimiento produciendo un ahorro en los costos de tecnología.
- Seguridad: Vulneraciones o actualizaciones de seguridad pueden ser realizadas en tiempo real.

Logros en el campo de la participación ciudadana

Barrios Activos ha conectado a ciudadanos con la gestión en más de 8500 municipios en 9 países de Latinoamérica (Argentina, Uruguay, Chile, Perú, Colombia, Ecuador, Guatemala, República Dominicana y México) con una población total aproximada de 170 millones de personas.

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Governing the Sharing Economy

Inside the European Commission

Gracia Vara Arribas & Rose Watson

5/1/2016

Among other things, the SE offers the European Union (EU) an opportunity for open governance, citizen empowerment and increased transparency. Nevertheless, the SE can pose problems too. It brings up certain security issues, threatens to dominate markets and can represent unfair competition to traditional market players The current fragmented regulatory landscape surrounding the Sharing Economy (SE) is demanding an EU-level response. Although there has been much research on various aspects of the SE, there is no body of research which examines and evaluates the European Commission‟s (EC) particular response to the phenomenon. This paper fills this gap.

1. Introduction

1.1 Sharing Economy Phenomenon

1.1.1 Sharing Economy Definition

In recent years, we have been witnesses to the fast development of a new way of providing access to goods, services and knowledge. This phenomenon is designated numerous titles (such as peer-to-peer economy, collaborative economy, collaborative consumption, participatory consumption, etc.), which are at times accompanied by slightly different meanings. In order to build on the European Institute of Public Administration‟s (EIPA) existing research, in this report we shall continue to follow the simplified definition selected by Europe Economics (2015: 6):

“The use of digital platforms to reduce the scale for viable hiring transactions or viable participation in consumer hiring markets (i.e. “sharing” in the sense of hiring an asset) and thereby reduce the extent to which assets are under-utilised.”

The important concepts in this definition are: use of digital platforms, increased access and participation as a consumer and entrepreneur, sharing rather than buying, and resource efficiency.

However, in this report, we will amplify this definition with reference to the Dutch knowledge and networking platform for the Sharing Economy‟s (ShareNL) definition:

“The Sharing economy is a broad concept, amongst other things it is about making more efficient use of goods, services and skills. By using online platforms, people can for example exchange, rent and borrow stuff from each other more easily. The consumer is at the centre and gets more affordable and easier access to services and goods.”[1]

Referring to the SE as a “broad concept” is important because the SE is both a philosophy of sharing that can be identified in non-commercial practices in society and a business model built on sharing. Nevertheless, as will be mentioned later in this study, reaching more exact definitions and differentiating between SE forms is advisable when it comes to regulation (see section 3.2).

1.1.2 Opportunities, Challenges and Obstacles

The SE represents a plethora of opportunities, all of which play favourably into existing European Union (EU) objectives, such as those outlined by the Europe 2020 Strategy and the European Commission (EC) president Jean Claude Juncker‟s priorities.

Europe 2020 is a strategy which aims to bring about growth that is smart, sustainable and inclusive. Smart growth will be delivered through more effective investments in education, research and innovation; sustainable growth will be achieved through moving towards a low-carbon economy; and inclusive growth will be brought about by creating jobs

and reducing poverty. The strategy has five main ambitious goals in the areas of: employment, innovation, education, poverty reduction and climate/energy[2].

Meanwhile the Juncker‟s priorities, while supporting Europe 2020 aims, are more varied and detailed. They can be found on the Commission‟s website and shall not be outlined here in their entirety. The authors of this study deem the following priorities to be particularly relevant to the SE:
(1) Jobs, growth and investment: stimulating investment for the purpose of job creation; (2) the Digital Single Market: bringing down barriers to online opportunities; (3) Energy Union and Climate: making energy more secure, affordable and sustainable; (4) Internal Market: deeper and fairer; (5) Justice and Fundamental Rights: upholding the rule of law and linking up European Justice systems; and finally, (6) Democratic change: making the EU more democratic.

The opportunities the SE offers to society are vast, here: those which could enable the above mentioned EU goals are outlined.

1 http://www.sharenl.nl/nieuws/2016/03/09/actionplan-sharing-economy
2 http://ec.europa.eu/europe2020/europe-2020-in-a-nutshell/priorities/index_en.htm

(1) The SE is an **innovative approach** to solving society‟s problems. Using fast developing digital technology, SE platforms provides easier, faster and cheaper solutions to society‟s problems.
(2) The SE is moving the market away from ownership to hiring and sharing products. This leads to **waste reduction, energy efficiency** and a **reduction of our carbon footprint**.
(3) The SE facilitates **poverty reduction**. The more affordable and easier access for consumers to products and services means that people who might not have been able to access these things – for economic or geographical reasons -, are now able to through the use of SE platforms.
(4) The SE creates **jobs and growth**. Citizens are able to make money by renting rooms in their house on Airbnb, by signing up to Uber and driving their own car as a taxi, or by creating their own SE platform to meet a societal need or want.
(5) The SE can make processes more **transparent, inclusive and democratic**. The open, inclusive and transparent aspect of the SE has been adopted by some public authorities. In Seoul, South Korea, the government promotes the SE and has incorporated its principles into its own administration of public affairs. Under the “Seoul Metropolitan Government Act for Promoting Sharing”[3], among other initiatives, City Government data has been opened to the public, municipally owned idle places are shared with the public, and digital apps have been invested in whereby citizens are able to share information and solve societal problems.
(6) The SE represents a **digital single market**. SE platforms could allow users to share and access assets regardless of its or their place of origin.
(7) And finally, the SE can **broaden access to education**. For instance: Wikipedia, a long-established and incredibly popular website, was created and is maintained and updated collaboratively by the public for the public. It opens up information that used to be more difficult and costly to access.

Despite these rich opportunities, the challenges presented by the sharing economy are complex and many, and must be tackled face-on by EU policymakers. Drawing from ShareNL‟s analysis[4], some dangers and challenges represented by the Sharing Economy are as follows:

(1) Unfair competition. As their business models are new and their legal status not clearly defined, SE platforms like Airbnb and Uber can represent unfair competition to traditional market players.
(2) In the same way, SE business models represent a risk of market dominance.
(3) The distinction between a sharing-only platform and a sharing-business platform needs to be made. (SE philosophy versus SE business)

(4) The distinction between a SE platform and a traditional service provider needs to be made.
(5) The SE can pose a threat to social security. For instance, Uber drivers do not undergo any checks before being permitted to provide their services through the platform.
(6) The SE can pose a threat to personal data security and cybersecurity.
(7) Monitoring of quality, safety and disturbance.
(8) The development of the trend and its impacts are difficult to predict

1.1.3 Obstacles

There are a number of barriers preventing the SE from reaching its full potential. The biggest barrier to growth has been the treatment of SE business models as equal to traditional business sectors. The bans or fines that have followed have created market fragmentation within the EU and deterred new initiatives. EIPA‟s 2015 report provides a useful categorisation of these obstacles with corresponding indicators:

[3] https://legal.seoul.go.kr/legal/english/front/page/law.html?pAct=lawView&pPromNo=1191
[4] http://www.sharenl.nl/nieuws/opportunities-and-challenges-for-european-cities-amsterdam-sharing-cit

Table nº 5: Description of the obstacles and their corresponding indicators

High - Obstacles that absolutely prevent the existence of a SE practice, or make it equal to traditional services provision.	• Bans imposed on SE platforms • Financial penalties imposed on SE platforms for the conduct of their users • Regulations to equalize the SE platforms to the traditional provision of services without distinction
Medium - Obstacles that deter marginal transactions, discourage consumers or overcharge providers. The activity is not prevented in itself but its attractiveness and added value is considerably diminished.	• Regulatory restrictions that deter marginal transactions • Insecurity and lack of clear legal framework regarding compliance and enforcement
Low - Obstacles that can be overcome. The activity itself is not prevented, but transnational movements are less likely because of the fragmentation of the law across the territory.	• Laws are simplified, partnership with the platforms is implemented, but difficulties exist for transnational operations due to fragmentation of the law

5

1.1.4 Bottom-up revolution and confused response from MS

This phenomenon, facilitated by digital technologies, represents a bottom-up economic revolution whereby problems are solved not by markets or the state, but by communities themselves. Traditional business sectors across Europe have protested against the new SE business models which threaten their market – the most commonly known and polemical cases of which are Airbnb versus the traditional accommodation sector, and Uber versus the traditional taxi sector. The SE has caused the biggest disruption in cities, where most big businesses reside.

This disruption in the European market place has demanded a response from governments and lacking any advice from above local governments have taken lead. The result is an abundance of approaches, differing from municipality to municipality and according to the type of SE platform at stake. In the 2015 EIPA report, three responses are identified: applying strictly the existing legislation to the SE; complete banning and equalizing to traditional services; and imposing new rules. The confused and fragmented response among the EU member states (MS) makes it clear that a response is needed from above, from the EU itself.

1.2 Definition of governance

In order to analyse the governance of the SE within the European Commission (EC), it is necessary to define the term governance. In this report, we will use the EC‟s own definitions of governance as established in its 2001 white paper on governance, „European Governance: A White Paper“[6]. In this white paper, the EC outlines five principles which underpin good governance and declares that these principles are vital for establishing more democratic governance. The principles are the following: openness, participation, accountability, effectiveness and coherence. The paper references policy-making, decision-making, law-making, and implementation as the different actions that make up governance.

[5] EIPA, „The Cost of Non-Europe in the Sharing Economy", 2015
[6] http://europa.eu/rapid/press-release_DOC-01-10_en.htm

1.3 Research Aims

In this study, we aim to discover and analyse the way in which the SE is being governed from within the EC and to shed light upon how it might be improved. The following questions will be answered:

(1) How is the SE being governed inside the EC? Which DGs are dealing with it and how?
(2) Are the EC"s actions and initiatives well coordinated?
(3) Is the EC governing the SE in accordance with its own good governance principles?

In addition to these three main questions, a series of sub-questions will also be discussed:

(1) Is the EU making the most out of the opportunities offered by the SE?
(2) Is the EU protecting citizens from the dangers posed by the SE?

1.4 Methodology

To write this paper, desk research using primary and secondary sources has been conducted. Because of the novelty of the topic, much information has been sourced from the EC website, online newspapers, and other websites of actors involved in the SE.

This paper will start by outlining and analysing the EU actions and initiatives. To do so, it will explore Juncker"s priorities, the separate DG activities, and the influence of non-EU institutional actors. It will then move on to analyse the existing EU SE legislative framework and the promise of EU guidelines to regulating the SE.

2. A patchwork of EU actions and initiatives 2.1 Juncker's priorities

As outlined above, the SE is relevant to many of President Junker"s priorities and an investigation of them in search for SE governance initiatives reveals their interdependent nature.

As part of the priority area „Jobs, Growth and Investment: Stimulating Investment for Job Creation", the Circular Economy[7] Package is instigated. The package consists of a broad action plan to innovatively address economic and environmental concerns regarding energy and resource efficiency by developing new markets and business models. When talking about the package to journalists, the Commissioner for the Environment, Fisheries and Maritime Affairs states:

"Circular economy is not just a new way of production, but it also promotes new ways of consumption – a sharing economy."[8]

Thus it seems that through actions promoting the Circular Economy (CE), the Commission simultaneously aims to promote and support the Sharing Economy.

Under the priority „Internal Market", the „Single Market Strategy" is launched. In this strategy a European Agenda for the SE is announced (see section 3.3). The Justice and Fundamental Rights priority saw the creation of a European Agenda on Security (adopted on 28th April 2015) which, alongside the EU Cybersecurity Strategy, provides the strategic framework for cybersecurity and cybercrime within the EU. And lastly, under the priority „Democratic Change" and its policy area
„Better Regulation", the EC"s dedication to democratic governance (which mirrors many SE practices, like inclusivity and openness) is outlined. Throughout this paper, different instances of

the EC incorporating SE principles to maximise the democratic nature of its processes will be demonstrated.

[7] The Circular Economy is a new vision for the production and consumption of goods. Inspired by the cyclical process in the natural world, Circular Economists want to see products designed to be recyclable. See the Ellen MacArthur Foundation for more information: https://www.ellenmacarthurfoundation.org/

[8] http://ec.europa.eu/commission/2014-2019/vella/announcements/meeting-dutch-journalists-brussels-0_en

While the SE is touched upon by various priorities, it is mainly under the priority „Digital Single Market" that we find SE issues dealt with. The Digital Single Market strategy is implemented by DG Communications Networks, Content and Technology (CNECT) and in collaboration with other DGs where relevant. As part of it, many challenges and opportunities posed by the SE are addressed indirectly. Some of the strategy"s initiatives and actions that deal with the SE are the following:

Online trust[9]*.* To tackle the issue of online trust, the EC has undertaken a number of actions and employed interesting instruments. For instance, it has launched a "Strategy for Better Internet for Children" which proposes a number of actions to ensure children benefit from digital and media literacy skills and better ways on staying safe online. This is important to the SE because digital literacy and security will make using online platforms more desirable and accessible for people. It is particularly interesting to note the EC"s use of self-regulation as an instrument to implement the strategy as it demonstrates the adoption of a SE practice into the EC administration.

In addition, in July 2014, the Regulation (EU) N°910/2014 on electronic identification and electronic trust services (eIDAS) was adopted. This regulation provides a predictable regulatory environment and facilitates safe and easy electronic interactions between businesses, citizens, and public authorities. This will benefit for-profit SE platforms that rely on payments being made online.

Cybersecurity and ePrivacy.[10] The EU Cybersecurity Strategy was adopted in 2013 and sets out ways to strengthen network and information security across the EU. It aims to protect citizens from intrusion and fraud by strengthening cross-border cooperation and information exchange. On the 7th December 2015, an agreement on a the EC"s proposal for EU-wide legislation on cybersecurity was reached. The directive, entitled Network and Information Security Directive, now needs to be formally approved. Following this, after the 21 month transposition period, it should be implemented across all MS. A public consultation began in December 2015 and was concluded in March this year.

In addition, the Commission has decided to review the ePrivacy directive (last updated in 2009). On the 11th April this year, the Commission declared an upcoming public consultation to ensure public participation in this legislative process.

Moreover, in December last year, the EC declared an EU Data Protection reform[11] (the public consultation for which was held November 2010 to January 2011). The agreement was reached between the EC, the European Parliament and the Council on the EC proposal that will see an end to the patchwork of data protection rules that currently exists in the EU.

Sustainablity and Social Innovation[12]*.* The initiative Collective Awareness Platforms for Sustainability and Social Innovation (CAPS) plans to build online platforms which raise awareness of sustainability problems and which promote social innovation and collaborative networks as solutions. CAPS will support knowledge sharing practices, changes in consumption patterns, and more participatory democratic processes. CAPS has already launched projects through the Horizon 2020 programme[13] which have promoted open democracy, open policy making, collaborative economy, collaborative making, collaborative

consumption and collaborative approaches to inclusion. For instance, these project started in January this year: „Saving Food" 2.0 tackles food waste through collaboration and online networks; „netCommons" studies, supports and promotes community-based networking; and „Crowd4Roads" promotes trip sharing for road sustainability. This initiative demonstrates the EC embracing the SE and recognising the opportunities it offers in terms of solving societal problems. Through this initiative the EC is encouraging the growth of the SE and adopting its philosophy and practises.

[9] https://ec.europa.eu/digital-single-market/en/online-trust
[10] https://ec.europa.eu/digital-single-market/en/cybersecurity-privacy
[11] http://europa.eu/rapid/press-release_IP-15-6321_en.htm
[12] https://ec.europa.eu/digital-single-market/en/collective-awareness
[13] https://ec.europa.eu/digital-single-market/en/news/22-new-caps-projects-horizon-2020

Although some of these actions do not deal with SE industries directly – with the exception of the CAPS initiative -, they do three important things: firstly, they deal with some of the dangers that the SE presents to society; secondly, they address some obstacles SE platforms face; and thirdly, they demonstrate the EC"s incorporation of the SE"s democratic principles into its own administration practices.

Analysing these initiatives, it is clear that the EC"s approach is committed openness and participation. Public consultations are held during the policy-making and decision-making process of each initiative and extensive information is available online However, this dedication to democratic governance unavoidably lengthens the overall legislative process. The introduction of new legislation or reform of old takes years to finalise. These processes are very slow in comparison to the fast-pace of the phenomenon that they are dealing with.

2.2 Directorates-General

Various Directorates-General (DGs) are involved in the management of SE issues. In this section, we will outline and analyse the actions and initiatives undertaken by them.

DG Communications Networks, Content and Technology (CNECT). *As* analysed above, in their implementation of the Digital Single Market strategy, DG CNECT confronts many dangers of the SE and obstacles to the positive development of the SE. Other than the actions mentioned above (see section 2.1), work on the SE was also identified in the meetings DG CNECT holds with advisors. In the minutes from a meeting on 23rd February 2015 with the expert group DSM SG, the fact that the EC sees the SE as an important issue is revealed:

"Another important issue is the transition to the Sharing Economy and whether our regulatory framework is able to capture this important shift in consumer behaviour"

As well as analysing of the suitability of the existing regulatory framework for the SE, the EC also declares that "our approach is bottom-up and we are open to hear MS views". The SE appears on the agenda of various DG CNECT meetings with expert groups, such as: the meeting on the 3rd July 2015 with the expert group on Electronic Commerce[14], and the meeting on the 4th July 2014[15] and 17th February 2016[16] (lead by DG RTD) with the Horizon 2020 Advisory group.

Moreover, a public consultation which included consultation on SE issues was carried out by the DG. It was launched on 24th September 2015 and closed on 6th January this year. The first results are now available and reflect both an enthusiasm for online platforms and the collaborative economy, and a concern for some dangers it poses.[17]

DG Research and Innovation (DG RTD). As well as collaborating with DG CNECT in the implementation of the Digital Single Market strategy, DG RTD has conducted some independent work related to the SE. In their report „Science, research and Innovation

Performance of the EU 2016"[18], the SE is studied. Moreover, through the research and innovation Horizon 2020 programme,

[14] Third topic for discussion: „Platforms and Sharing Economy". European Commission, Minutes of the 3rd meeting of the Horizon 2020 Advisory Group for Societal Challenge 6 „Europe in a changing world- inclusive, innovative and reflective societies", Brussels, 4th July 2014.
[15] Second topic for discussion „Promoting a collaborative, creative and sustainable economy"
[16] The Sharing Economy was identified as an emerging issue in 2014-2017 in the meeting. European Commission, Minutes of the Expert Advisory Group (EAG) for Societal Challenge 6 in Horizon 2020 „Europe in a Changing World – Inclusive, Innovative and Reflective Societies", Brussels, 17th February 2016.
[17] https://ec.europa.eu/digital-single-market/en/news/first-brief-results-public-consultation-regulatory-environment-platforms-online-intermediaries
[18] http://ec.europa.eu/commission/2014-2019/moedas/announcements/science-research-and-innovation-performance-eu-2016_en

funding has been provided to launch the ambitious programme „Sharing Cities". The programme has provided 24,988,759€ to the „Sharing Cities" Greater London Authority-led consortium which will be delivered by a partnership of experts from public and private sector organisations in the lead cities of London, Milan and Lisbon[19].

DG Internal Market, Industry, Entrepreneurship and SMEs (DG GROW). DG GROW is advised by an expert group on the implementation of the Services Directive. Their meeting on 25th January demonstrates coordination between DGs on the issue of the SE. There was a ninety minute slot on the collaborative economy, where the EC made a presentation on the outcome of DG CNECT"s public consultation and where information was provided regarding the results of regulatory mapping, the monitoring framework and the anticipated EC guidelines on governing the SE.

DG GROW is also organising a series of workshops on the SE as part of the Single Market Forum (2015/2016)[20] and was early to research the phenomenon, publishing a Business Innovation Observatory Report ´Sharing Economy: Accessibility Based Business Models for Peer-to-Peer Markets" in September 2013[21].

DG Justice and Consumers (JUST). DG JUST is working with the Consumer Markets Expert Group and in their work together the SE is both discussed and its philosophy appropriated. In their meeting on February this year, a study on the SE is explored; and in their meeting in September 2015, the creation of a Sharing Knowledge platform called „Collaborative Space" is announced. The Sharing Knowledge platform is fascinating because it is a clear example of an EU institution using a SE platform and philosophy to make its own activities more inclusive, transparent and accessible for its stakeholders. It mirrors the efforts of the Seoul government who, as mentioned above, use the SE philosophy and practices in their own administration.

It is clear that the SE is being debated in various DGs, that the question of how to regulate it - while supporting the positive innovative solutions it provides and protecting from its dangers - is on the agenda, and that the SE philosophy is being adopted by the EC. The fact that different DGs are discussing the SE and taking action is logical as the SE affects many different areas of governance.

With regard to coordination between DGs, it is evident that there exists a degree of coordination in the DGs" approach to the SE approach in that they are working together and communicating with each other by co-chairing meetings with expert groups and sharing information.

However, their approach seems somewhat fragmented. The issue of the SE is often tackled indirectly as part of another policy or strategy, and although it is discussed by many

expert groups, there is no expert group dedicated to the SE. Moreover, although there is some evidence of SE collaborative style processes being adopted by the EC with the aim of democratising their administration; it is not yet common practice. It seems that the biggest problem to coordination is that there is no overarching strategy to harmonise the DGs‟ actions. As mentioned in the CE action plan, a
European Agenda on the SE is in the pipeline, but the delay in delivering on this promise is having a detrimental effect on the efficacy of SE governance in the EC.

2.3 Other influential actors

Aside from the Commissioners and their advisory expert groups, there are a number of other actors which influence the way the SE is governed within the EC.

European Economic and Social Committee (EESC). The EESC is a consultative body of the EU which describes itself as “a bridge between Europe and organised civil society”[22]. The

19 https://www.london.gov.uk/decisions/md1574-sharing-cities-horizon-2020-programme-smart-cities

20 http://ec.europa.eu/growth/single-market/forum/2015/index_en.htm

21 European Commission, „Sharing Economy: Accessibility Based Business Models for Peer-to-Peer Markets - case study 12‟ September, 2012.

22 http://www.eesc.europa.eu/?i=portal.en.the-committee

consultative body takes pride in interactive inclusive approach; it has a number of interactive tools on its website and hosts activities to get citizens involved in its work.

At the plenary session attended by the president of the EC (at the time, Jose Manuel Barraso) on 22nd January 2014, the EESC‟s opinion on collaboratory or participatory consumption was adopted. The opinion, entitled „Collaboratory or Participatory Consumption: a Sustainable Model for the 21st Century‟[23] declares that the collaboratory or participatory consumption (or SE) can meet social needs in situations where there is no monetary interest and that, as a for-proft activity, it can help to create jobs, while complying with the rules on taxation, safety, liability, consumer protection and other essential rules. It also calls upon the EC to address the issue of the SE in its work programme. It is important to note that the committee pointed out the potential benefits of the SE, but also highlighted that these benefits would need to be accompanied by a regulatory framework that protects from its potential dangers. As we have seen above, some regulatory action is underway as part of the Digital Single Market Strategy and the EC has promised guidelines as part of a European Agenda on the SE.

Additionally, demonstrating the EC‟s early interest in the SE, the EC requested the EESC to create an organisation dedicated to SE issues. During a public hearing in the EESC on 25th September 2013, the European Sharing Economy Coalition (EURO-SHE) was launched.

Sharing Economy Coalition (EURO-SHE). EURO-SHE describes itself on its mission statement as the “first multi-stakeholder European network to raise a united voice around the Sharing Economy”[24]. The coalition recognises that the SE and the EU have common goals and aims to make sure the chance is taken to combine efforts around joint priorities and the SE opportunities are used to meet the EU2020 objectives. Its members are exploring EU policies and ongoing programmes and facilitating collaboration between EU decision makers and other stakeholders. It aims to lay the necessary policy framework condition and create the enabling environment for the SE to be a success for MS, businesses, consumers and local communities in the EU.

European Collaborative Economy Forum (EUCoLab). EUCoLab is the only SE lobby group that is not a SE service provider registered in the EU‟s transparency register found by this investigation. Its members include SE service providers from various positions in the SE‟s value chain. It was founded in May 2015 after sixteen SE companies united to write an

open letter to the EC in response to the Digital Single Market Strategy. The signatories of the letter asked EC policymakers to ensure that European laws and regulations are not detrimental to the development of the SE, and do in fact support it. The EUCoLab was then formed to continue that discussion and have a say in regulatory landscape of the SE.

Other lobby groups influence the way the EC governs the SE. For instance, Airbnb Ireland which of course lobbies to defend the SE‟s development, and various traditional accommodation and taxi groups which lobby to protect the interests of traditional businesses.

3. Legislative approach 3.1 Existing legislation

In EIPA‟s 2015 report, the EU regulatory framework surrounding the SE is outlined. The amount of existing legislation related to the SE is identified as being extensive; to summarise, the related legislation is: the Services Directive, the eCommerce Directive, consumer legislation, and data protection legislation. The authors of the report conclude that "the existing EU legal framework does not provide a fully satisfactory answer and several elements would benefit from reform".

Since the publication of the previous EIPA report, the EC has indeed launched a number of initiatives which are reviewing existing legislation that affects or is affected by the SE (see section

[23] European Economic and Social Committee, „Collaboratory or Participatory Consumption: a Sustainable Model for the 21st Century", 2014

[24] http://www.euro-freelancers.eu/european-sharing-economy-coalition/

2.1). As mentioned earlier in this paper, the ePrivacy directive is undergoing a review and a proposal for reform is expected in 2017[25] and last December an EU data protection reform was announced.

3.2 Remaining gaps

Although the reforms of existing legislation are promising, two issues remain. Firstly, the continuing divergence in the application of law at national level causes uncertainty for SE businesses and users. Secondly, despite the announced reforms, gaps remain within the SE legal framework. Lack of new legislation means obstacles that hinder the development of the SE remain, as do many of the dangers it poses (such as, unfair competition). Suggestions for new legislation are provided in the 2015 EIPA report; such as:

(1) Define the SE and decide harmonise the terminology used when referring to it.
(2) Differentiating between different forms of SE (e.g. between for-profit and not-for-profit service providers).
(3) Clarify which type of service a SE initiative is (or if it is not a service at all and only an intermediary between provider and consumer).
(4) Obligations of the SE platforms; for example: to inform users of their legal and fiscal responsibilities, labour conditions, clarification of whether a person is a user or an employee.

3.3 A European Agenda on the Sharing Economy and expected EU guidelines

As mentioned above (see section 2.2), the EC has promised to review specifically the regulatory framework surrounding the SE. In the Single Market Strategy, the EC states the following:

"A clear and balanced regulatory environment is needed that allows the development of collaborative economy entrepreneurship; protects workers, consumers and other public

interests; and ensures that no unnecessary regulatory hurdles are imposed on either existing or new market operators, whichever business model they use."[26]

The strategy goes on to acknowledge the influential work under the Digital Single Market Strategy to regulate SE digital platforms and, as was introduced above (see section 2.1), and announces the intention to develop a European agenda for the collaborative economy. The EC states that guidance on how existing EU law applies to collaborative economy business models will be provided and that the EC will assess possible regulatory gaps and monitor the development of the SE.

A European agenda on the SE is exactly what is needed to harmonise the fragmented MS responses and to better coordinate the EU response. It is promising that in the Single Market Strategy that the EC recognises the need for a balanced regulatory environment that both protects from the SE‟s dangers and encourages its positive development.

Although this promise of a European agenda and guidelines on how to govern the SE is promising, a number of issues remain. Firstly, the promised agenda currently only commits to producing guidance on how existing EU law should be applied. Although it envisages an analysis of regulatory gaps, no new legislation is to be expected. As we have seen, new legislation is needed to make the most out of the SE and protect society from certain threats that it poses. Moreover, the guidance was expected to be published in March of this year but has been delayed until the summer.
The EC‟s delay is worrying and detrimental. The gaps in legislation are causing negative effects in the here and now, and the development of digital technologies and platforms will not wait for the EC‟s response. The slow progress of EU bureaucracy is particularly problematic when it comes to an issue as fast-developing as the SE. Its dedication to democratic, open and inclusive processes results in its governance not being as effective and timely as one might hope.

[25] http://www.euractiv.com/section/digital/news/commission-to-propose-reform-of-eprivacy-directive-in-2017/

[26] European Commission, „Single Market Strategy", 2015, p. 4

4. Conclusion

A patchwork of policies and actions across various DGs are governing the SE. With reference to SE issues within the EC, we are seeing research being conducted, meetings being held, advice from experts being sought, public consultations launched, new legislation being proposed (the Network and Information Security Directive – see section 2.1), old legislation being reformed, and investment in SE projects. Despite some problems with coordination due to a lack of an overarching strategy, a great effort to be faithful to other good governance principles is clear in the way SE issues are tackled. Participation and transparency are visible in all EC actions. Moreover SE practices are adopted with the aim of making EC practice more democratic. However, the dedication to participatory processes – with the public and between institutions – leads to the implementation of initiatives to be slow.

The EC is attempting to take advantage of the opportunities the SE offers to innovatively problem solve, create jobs and growth, reduce poverty, reduce our carbon footprint, increase access to education, and make processes more democratic etc.. Notwithstanding, the issues with coordination and the delay on establishing an EU-wide regulatory framework mean that the SE‟s opportunities are not being fully exploited. Some issues – such as cybersecurity - are being tackled; but, other dangers will not be avoided until gaps in the legal framework are filled.

The promise of a European Agenda on the SE is heartening. However, the slow progress to introduce this agenda is detrimental to the development of the SE. What is more, the fact that the Agenda only promises EU guidelines on regulating the SE with reference to existing EU law is worrying on two levels. Firstly, although the guidelines will carry

substantial weight, it is not a binding document. And secondly, the gaps in existing SE legal framework will not be filled.

To conclude, the EC has initiated a detailed response to the SE phenomenon. Yet, for the moment it is too little, too late. The SE is based on fast-developing technology and its popularity is growing and growing. MS cannot wait for the EU to carefully balance its response and will continue to govern respectively in the way they deem fit. Thus, despite EC efforts, currently a fragmented SE landscape continues to be a reality.

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Approaching the Tipping Point: Participation, Connection, and Growth Through Open Data

Aileen Gemma Smith, Founder and CEO
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Abstract

- The margin of success for efforts to proliferate open public data is not technological, but communal. The availability of geo-referenced real-time open data is key to be able to solve citizens' problems in the cloud-computing and smartphone era.
- Cities that hope to exploit open data for political, social, and commercial gain will attract participation and engagement to the extent that they reflect the interests of citizens and communities in their data priorities and technology initiatives, rather than the interests of government per se.
- How open data players proceed is more important than the technology they solicit or create, because the potential of open data sharing and collaboration is nothing less than a realignment and equalization of social and community influence.
- Vizalytics Technology, the New York City data analytics firm built to strengthen the open data connection between governments and their constituent shopkeepers, citizens, and enterprises, has found that the best way to draw a technology roadmap is to ask where its on-street users want to go.
- And the firm's most heartening discovery is the entrepreneurial eagerness of state and local governments to follow that model.

Change is Here

Planet Earth – or many of its major cities, which means significantly more of the globe won't be far behind – is approaching a tipping point in the use of open public data. It's not just early adopters looking to use open data to manage government operations and connect citizens, businesses, and institutions to the information they need to live better, survive and thrive economically, and participate in their communities. It is not a fantasy to believe that citizen participation in government, both quantitatively and qualitatively, is about to dig deep beneath the Facebook surface to plumb the depths of open data and change the way government works.

Vizalytics Technology is a New York City technology company that uses contextual and semantic analytics to strengthen the open data connection between governments and their constituent shopkeepers, citizens, and enterprises. As our business has evolved, we have been struck by the passion with which cities around the world, sometimes by ordinance or mandate, sometimes by simple vision, want to make government two-directional. They want to foster and support communities. They want to equalize access to information, reinvigorate economies, connect with and expand the middle class, and help citizens participate.

The latest Open Data Barometer found that more than half of 92 countries surveyed have open data programs of some sort, although just 10 percent of government data is open and half of the open data sets are found in just the top ten countries. Transparency for citizens and impact on entrepreneurship are increasing. The Economist recently dug into the City of Boston's use of data to monitor city services and performance, noting that the city's efforts reflect "a growing trend among city governments in America."

"Led by Boston, Chicago and New York," the magazine reported, governments "have started to use the ever-increasing amounts of data they collect to improve planning, offer better services and engage citizens."

But here's the Big Idea that is leading us to that tipping point: Start on the ground. Cat Matson, CTO of the City of Brisbane in Australia, recently mulled the context of open data in cities and concluded that the prime mover of data initiatives shouldn't be technology per se but the infinite and changing needs and demands of its citizens – simply building, she wrote, "a city that enables its residents and visitors to do what they want, more easily." Thus the key concept is that word "connection," not "smart" or "digital" – the phenomenon starts with the people.

The Old Way
In the old days, meaning maybe a couple years ago, so-called "Smart Cities" initiatives used data to improve the delivery of public services rather than as an open and accessible resource. While data may have been theoretically "open" it was often uploaded in a portal in a user-unfriendly format, suitable for developers rather than for citizens and businesses.

To make open data useful to the public, solutions need to account for the fact that most of the data is unstructured and continuously evolving. Data sets vary widely in their language, nomenclature, user interfaces, among other characteristics. Without continuous semantic analysis and cloud-based platforms designed to merge, relate, normalize, and interpret massive amounts of disparate changing data, any attempt to present data that was responsive to individual public situations was doomed to fall short.

Vizalytics was created to help enable a new generation of smart cities that use geo-referenced real time open data to solve specific public problems in the cloud-computing and smartphone era.

Birth of Vizalytics
Vizalytics was born in New York City the aftermath of the disastrous Hurricane Sandy in 2012, along the U.S. eastern seaboard. The storm affected thousands of citizens, small businesses, and shopkeepers in New York and underscored two unmet challenges: the need for fast access to government data for those struggling to survive and recover, and the need for governments to distribute information from disparate data sources to their many constituencies. In that situation data was key to saving the people.

The challenge ran deeper than simple access to data, though. If government has a dozen data sets relevant to a shopkeeper, and gives the shopkeeper access to them through the internet, what has it accomplished? A busy business owner looking for information on street repairs,

transit delays, health department inspections, neighborhood events, and citizen complaints isn't likely to explore five separate data sources, let alone do it every day.

To be relevant, meaningful, and actionable to a shopkeeper we needed to find a way to…

- Present data that matters to specific users based on their needs and goals
- Discover relationships among data sets and draw specific conclusions
- Express contextually how, why, and when a particular piece of information matters
- Suggest to the user how to react
- Do all this automatically for different kinds of users – quickly, efficiently, and at scale

To accomplish all this, we built the Vizalytics Knowledge Graph, a cloud-based, continuously updating and evolving spatio-temporal knowledge base. The Knowledge Graph breaks down walls between disparate data streams, normalizes nomenclature and display, and maps events and relationships among them against time and location. Context-driven analytical "lenses" return facts and insights appropriate to the requirements of particular users on their preferred devices – in real time.

How it Works

The audience- and constituent-driven Knowledge Graph analytics begin with facts drawn from two types of data relevant to a particular geography – say a city, a neighborhood, a building, or a vehicle:

- Semi-static Data – the sort of data that would populate a GIS layer such as street addresses, building characteristics, businesses in a building, number of floors, residential/commercial mix, utility installations, mass transit access, distance to parks or schools, topography, real estate information, census data, and the like.
- Dynamic Data – event data such as street closings, 311 requests, inspections, crime reports, transit or traffic changes or delays, scheduled activities, and the like.

The cloud-based Knowledge Graph creates a spatio-temporal model of a given geography at hyperlocal granularity and optimal semantic analysis extracts meaning from disparate data facts as they apply to the attributes of each user. Through dynamic impact analysis and relevance-ranking algorithms, the Knowledge Graph uses machine learning, graph analysis, fuzzy logic, and ontology-driven inference to assess significance of events, whether they are typical or unusual, where related events are clustered, their historical context, and what impact they may have on a user.

Based on its assessment of the data-supplied facts, the Knowledge Graph returns insights, predictions, risks, and scores (such as business viability score, neighborhood ambiance score, "your business has an 87% chance of having a health department inspection"). Based on a user's location, the context of a notification may vary: A rodent was reported next door to your business, around the corner, or in your neighborhood, depending on the governing geographic area – a specified polygon on a map.

Using natural language generation techniques, the Knowledge Graph delivers consumable insights and impact statements in response to user goals, preferences, and characteristics. Along with impact-related insights, the Knowledge Graph – based on triggers aligned with user needs and characteristics – provides context-sensitive tips and suggestions that are not precisely driven by fine-grained events:

- "This regulation changed and you may be affected by it."
- "Here's a new business course that might be relevant to your business."
- "This news article reports on construction in your neighborhood."

The data and content may be delivered as rolled-up statements or as data points suitable for an analytics dashboard on a desktop or mobile device. Having advance or real-time notice of particular events, and understanding their interaction probabilities or impacts, allows for proactive response to mitigate or leverage them.

The Vizalytics Knowledge Graph defines and represents an intent proposition from a user in an abstract way, then generates relevant contextual insight for different classes of users with different needs, and does so at scale. These insights are based on impactful events that have occurred, are occurring, or are expected to occur, in proximity to the user's location of interest. The system computes the potential impact of these events on the user's goals at the time of inquiry – it represents a level of reality that human senses cannot perceive.

Applying the Knowledge Graph

The first offering to use the Vizalytics Knowledge Graph is a mobile app called Mind My Business™, introduced in New York City and now also available in Chicago and Seattle. This city-specific mobile app for shopkeepers collects information from a range of government and public data sources and provides subscribers with real-time alerts about construction, traffic, regulatory issues, health and safety information, fines, events, 311 information, and other concerns. Mind My Business™ displays alerts on neighborhood maps, including locate events, incidents, and reports, and provides money-saving tips and community content. On any given day, a subscriber might receive alerts like these:

- Sewer problems were reported in your area. Watch for flooding. Repairs might impede foot traffic…
- Customers who use public transportation may have trouble reaching your store. The R train is experiencing delays that could last until evening...
- Permits: Your liquor license is set to expire next month. You'll have to complete a renewal form…
- Risk for a fine: Rodents were discovered in your neighborhood…

Mind My Business™ generates nearly a quarter-million notifications a month in all cities. In New York City, by bubbling connection and participation up into city government, Mind My Business™ reflects a fast-growing commitment from Mayor Bill DeBlasio on down to use data in every way possible to increase municipal effectiveness and efficiency. The New York City Red Tape Commission, chaired by City Comptroller Scott Stringer, said in its report that "by harnessing the power of data, the City can help business owners be more aware of rules and regulations and encourage compliance without relying on inspectors and fines."

The Red Tape Commission is made up of small business leaders, regulatory experts, and advocates looking for ways to help business owners cut through the red tape that limits their ability to manage and grow their businesses. Singling out Mind My Business™, the commission's report said that "using data effectively can improve outcomes for the City and business owners alike." Also in New York City, a 2015 report from Manhattan Borough

President Gail Brewer, called Small Business, Big Impact, underscored the need to maintain the storefront life of the city in a time of rising rents and economic pressures from all sides, citing the power of apps like Mind My Business™ to help shopkeepers use data to comply, collaborate, plan, and scale their businesses.

The tidal surge that Mind My Business™ and other technological innovations are driving in New York City owes its power to a simple connection to streets and neighborhoods. Businesses have responded because the app intensifies access to information and saves them money – in some cases $10,000 a year in fines avoided alone.

Neighborhoods and Beyond

Building on the Mind My Business™ model, Vizalytics turned to private citizens and neighborhoods to build a website for the City of New York called neighborhoods.nyc. The Knowledge Graph draws on City data sources to provide traffic, transit, quality of life, health, inspection, event, and other information about each of the more than 400 neighborhoods in the city's five boroughs. The site is both a resource for residents and a catalyst for community organizing and change.

Looking at a neighborhood site, a subscriber might find a notice about an upcoming farmer's market, a pothole report down their street, a taxi driver complaint in the area, a water leak in a building next door, a report on cigarette sales to a minor. Alerts include actionable options for sharing or finding more information – with each alert assembled from several data streams normalized within the Knowledge Graph. Some actual alerts:

- A neighbor reported a dirty sidewalk in front of 2836 Broadway last Tuesday. Residents and shopkeepers are required to keep the area in front of their home or business swept clean. Make sure you know all the rules. DSNY has a brochure that tells you what you need to know. You can download it here.
- A pothole was reported earlier this week at 116 Avenue and 142 Street. Did you know that potholes are characterized by a definable bottom surface such as dirt or gravel? You can report potholes on city streets using this Pothole Form. For potholes on highways or parkways, contact NYC311.
- A sewer backup was reported at 144-11 119 Avenue last Tuesday. This can cause a public health situation. Sewer backups should be reported to NYC311. DEP will respond quickly.
- Gas line repair work is under way on 144 Street between 115 Avenue and 116 Avenue. Expect traffic disruption and construction noise.
- Underage drinking at a licensed establishment was reported at Broadway and Exchange Place last weekend. NYPD and the NY State Liquor Control Board investigate allegations of serving alcohol to minors.

Transit alerts for Metropolitan Transportation Authority services include detailed information on alternate routes. All alerts include a share button so a subscriber can spread the word via email or text message. In all the neighborhoods.nyc site generates more than 1,000 neighborhood-specific transit notifications (delays and other alerts about buses and trains) daily in New York City, along with more than 6,000 neighborhood-specific notifications on other issues.

Moving beyond neighborhoods to apply the Knowledge Graph to government agencies, institutions, and enterprises, Vizalytics created Local Insight, an enterprise-level dashboard that aggregates information from multiple sources of governmental and public data. Local Insight generates custom insights for each user, and produces a multi-layered view of conditions, events, and changes within a specified geography. A total Local Insight solution can include Mind My Business™ and "neighborhoods" elements as required.

Vizalytics also provides Application Programming Interface (API) access to the Vizalytics Knowledge Graph to integrate contextual intelligence analytics into a customer's own applications. In each engagement, the Knowledge Graph instance is built according to the user's data sets and requirements.

Government Entrepreneurs

Not every city is prepared or equipped to implement contextual analytics, but every city we have engaged with – on four continents – is eager to find out how data can revolutionize their connections with citizens. What is most striking about the people we meet is the spirit, an unmistakable entrepreneurial zeal, they bring to our discussions about open data.

At the highest level, consider the City of New York. The Comptroller's Office cites data as a key to the city's economic success. The Manhattan Borough President's Office sees data-churning apps as a competitive and managerial advantage for small businesses. The mayor champions data as a unifying force. New York's first-ever CTO, the community-focused Minerva Tantoco – a technology veteran from start-ups to global enterprises – is charged with gluing New York's technology initiatives and priorities together, busting administrative silos the same way the Vizalytics Knowledge Graph busts technological ones.

Below the top leaders, however, is where the action is. That's where we're seeing government data teams living the entrepreneurial life – they're building from scratch, looking at their constituencies, and finding ways to connect to them directly, based on their particular needs. They're learning how to assemble teams and resources in a constrained environment, helping coordinate and connect siloed government functions even as they compete with them for limited money. They are focused on a concrete vision and evangelizing that vision wherever they can.

With entrepreneurship – in a TEDx Talk, Socrata's Deep Dhillon recently used the e-word to describe many of the people he does business with – you're taking an idea and translating it into a team that creates something to make a difference in people's lives. All at once, you have to think market, scale, traction, finance, listening to customers, and building spirit and energy that make the people around you want to be a part of your team.

And the entrepreneurial spirit so evident in New York is just as intense in other dozens of other cities around the world – Chicago, Seattle, Austin, San Francisco, Singapore, Sydney, Barcelona, Copenhagen, London. That spirit is bringing us to the tipping point – data is leading,

not supporting. Entrepreneurship runs on a sense of audiences and markets; government runs on a sense of its constituencies. Together these spirited data evangelists are building the first hyper-local two-way public communications loop – the data tells government how it's doing, it reveals and furnishes what citizens want and need, it connects both ends via feedback, and it connects constituents through sharing.

Most significantly of all, these urban systems are being built to serve practical, day-to-day, on-the-ground public interests. That's what is attracting public participation – that's what is bringing us to the tipping point, and fast.

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The approval of the legal framework (laws and municipal decrees) we deal in this article began on June 30, 2009, when the City Council in an environment of various political and social nuances, approved Law No. 10.705, establishing the Office of Innovation and Technology (Inovapoa). A public agency with the mission of developing science policy, technology and innovation in the city.

LEGAL FRAMEWORS

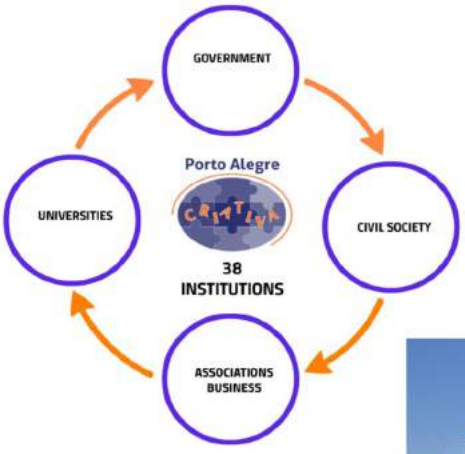
CREATIVE AN INNOVATIVE CITY ENVIRONMENT

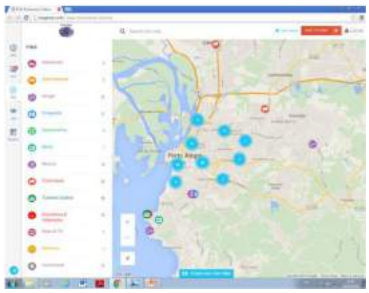
PORTO ALEGRE - RS - BRASIL

In July 2010, the first initiative: the trial UNIPOA program from the Complementary Law 633/2009, stipulating that private educational institutions of Porto Alegre could offer scholarships to low-income city students.

Programe benefited students from low income city

On October 9, 2013, was established by Decree No. 18,422, the Municipal Committee of Creative Economy.





Revitalization of degraded areas of the city
Polo creative community and plan as results

Then, on November 20, 2013, it was signed by the mayor Decree No. 18,461, which established the Municipal Plan of Integrated Solid Waste Management creating, among other initiatives, environmental education.

Project involved city students

The Complementary Law No. 721, (Municipal Law of Innovation) that would become, by its scope, the most important legal framework for the sector.

a. Promoting the interaction between enterprises, governments and educational institutions;
b. Adopting innovative practices and collective intelligence as a strategy for greater participation of the society;
c. Encouraging the expansion of existing projects, as well as the creation and attraction of new ones;
d. Using financial and tax mechanisms as a development strategy of innovation, science and technology;
e. Educating the citizen to good practices of environmental management and encouraging the training and qualification of skilled workmanship.

Supplementary Bill No. 785 granting tax exemption to businesses in the health technology área from 5% to 2%.

Approval of the law by the Town Hall will benefit degraded áreas

Reduction on the services taxes and furthermore, the technology-based companies, and innovative and creative economy businesses would be blessed with full exemption of Annual Property Taxes and Properties Transfer Taxes for a five-year period, and the creation of a fund to promote programs, projects-based technology companies (FIT / POA). Decree No. 19,339 was signed on March 15, 2016, establishing specific rules for the granting benefits.

On April 14, 2015, the Mayor signed the Decree No. 19,125 that created the Forum of High Education Institutions of Porto Alegre. The objective of this joint committee is to promote studies, debates, seminars in the areas of science, technology and innovation, development of actions, projects and proposals to achieve the public policy in this area.

FÓRUM DAS IES

FÓRUM DAS INSTITUIÇÕES DE ENSINO SUPERIOR DE PORTO ALEGRE

Representatives of Porto Alegre Universities

In 2016, the Innovation and Technology Office (Inovapoa), is supporting the idea of creating the Porto Alegre Innovation Ecosystem, composed of all the structures that have the same purpose in this environment. The goal is to improve the links between programs and technology-based projects and innovation, encouraging entrepreneurship, for community benefit, generating new businesses, employment, income and knowledge in town.

Municipal Council of Science and Technology (Comcet), Porto Alegre Data Processing Company (Procempa), Municipal Committee of Creative Econmy, the Forum of High Education Institutions of Porto Alegre e Ensino Superior de Porto Alegre (Fórum das IES)

PARLAMENTO ABIERTO: CÓRDOBA COMO PIONERA EN IMPLEMENTAR OPEN DATA

Ubicada en el corazón de la Republica Argentina, la **Ciudad de Córdoba** que ya supera los 1.300.000 habitantes, es la segunda concentración urbana del país y nudo de intercambio comercial de la región.

El Parlamento de esta ciudad, que es el mismísimo y honorable **CONCEJO DELIBERANTE DE LA CIUDAD DE CORDOBA**, y bajo la presidencia del entonces Viceintendente de la Ciudad, Dr. Marcelo A. Cossar, periodo **2011-2015**, implementó la política pública de **Parlamento Abierto**, **mediante** el **Decreto V0082**, que ha sido pionero en Argentina al abrirse a los ciudadanos, transparentar, acceder a la información pública y fomentar la participación ciudadana en los procesos legislativos, mejorando el desempeño gubernamental, fomentando la participación cívica y elevando la capacidad de respuesta de los Parlamentos hacia sus ciudadanos.

A más de un año y medio de la implementación de **Parlamento Abierto**, el Concejo Deliberante de la Ciudad de Córdoba continúa publicando datos en formato abierto para que medios de comunicación, ciudadanos y organizaciones puedan tener acceso directo a la actividad desarrollada y funcionamiento, con documentos que pueden ser descargados y compartidos. Esta innovación consolida el trabajo de más de tres años de gestión en una serie de iniciativas que contemplan el desarrollo de sistemas de gestión de la calidad en el proceso legislativo, el fortalecimiento de la transparencia y de la rendición de cuentas a partir del desarrollo de un nuevo sitio web, el funcionamiento de la Oficina de Acceso a la Información, y el uso responsable de las redes sociales digitales como medio de comunicación e interacción con la ciudadanía.

Por medio del uso Junar, una de las plataformas líderes a nivel mundial en apertura de datos, fue posible publicar datos y generar distintos recursos de manera rápida y sencilla, para que los mismos puedan ser trabajados, organizados y compartidos por todas las personas a quienes les interese la información del Parlamento y sus Concejales. De esta manera, la publicación y uso de datos abiertos promueve la innovación a través de su reutilización, permite el desarrollo de nuevas aplicaciones y servicios, y genera nuevas vías de colaboración.

En relación a la actividad legislativa, pueden consultarse en **Parlamento Abierto** las asistencias de los concejales a las sesiones legislativas, los proyectos legislativos presentados desde el 2008 hasta la última Sesión, las asistencias a las reuniones de Comisión, las audiencias públicas realizadas, la forma de votación de cada proyecto y los expedientes ingresados diariamente. También están disponibles las declaraciones juradas de Concejales y Funcionarios, la planta política y de personal actualizada, así como el personal a cargo del Viceintendente y de los Concejales. En materia presupuestaria, pueden consultarse el listado de proveedores y las ejecuciones.

En **Parlamento Abierto**, se puede acceder a los siguientes recursos: Conjuntos de datos (recopilaciones de datos que pueden ser abiertos y presentados en distintos formatos, lo cual permite su reprocesamiento y retrabajo por parte de quien los utiliza); vistas de datos (recursos creados a partir de un conjunto de datos, que muestran la información a manera de tablas, filas o columnas, presentándola de manera más amigable y clara); y visualizaciones (representaciones gráficas de los datos).

Desde su lanzamiento en diciembre de 2014, **Parlamento Abierto** ha triplicado la información publicada, contando actualmente con más de 200 recursos que pueden ser descargados y reutilizados: 117 conjuntos de datos, 150 vistas, 6 colecciones destacadas de datos, además de visualizaciones y gráficos de la información disponible.

Esta novedosa iniciativa fue reconocida a nivel internacional, con la invitación para presentar la experiencia de **Parlamento Abierto** en la VX Conferencia del OIDP (Observatorio Internacional de Democracia Participativa):

“Gobierno Abierto: Transparencia y Participación Ciudadana”, realizada en la ciudad de Madrid del 24 al 26 de marzo de este año. El evento reunió a alcaldes y funcionarios de Iberoamérica, académicos y representantes de la sociedad civil. Durante la Conferencia, se destacó la importancia de Parlamento Abierto para abrir y acercar el Concejo Deliberante a los vecinos.

A nivel local también se participó del "II Congreso Internacional de Parlamentarios Locales", realizado en la Ciudad de Carlos Paz del 28 al 30 de abril. En dicha oportunidad, se destacó la importancia de abrir las instituciones legislativas a los vecinos, ya que éstas son el corazón y el pilar de la democracia, y allí tienen representación la pluralidad de fuerzas políticas. "Es por ello que nuestro desafío, como instituciones legislativas, es volver a amigarnos con los vecinos", "Nuestro deber es que el vecino vuelva a creer y a participar en estos.

El 18 de mayo de 2015 se organizó en el Cabildo Histórico de la Ciudad de Córdoba la "Primera Jornada de **Parlamento Abierto**" la cual tuvo como objetivo promover la discusión y el debate alrededor del concepto de **Parlamento Abierto** y de la apertura de datos como herramienta para promover la transparencia, la participación y la colaboración de los ciudadanos en los asuntos públicos. La jornada contó con la participación de destacados expositores: representantes de la academia, del sector público, y del ámbito tecnológico.

El 17 y 20 de octubre, se organizó las Jornadas GoberNET, conjuntamente con el Consejo de Planificación de la provincia, el ICDA, Junar y Open Data Cba, que tuvieron como fin promover nuevos espacios de transparencia, colaboración y participación ciudadana. En estas se desarrolló el Hackathon que tuvo tres desafíos:

- Plataforma virtual de Políticas Públicas: Construir una plataforma que propicie la participación ciudadana en la elaboración de Agenda Pública, incentivando la generación de nuevas ideas de proyectos, aprovechando el conocimiento y la experiencia de los ciudadanos para ayudar en el diseño de políticas públicas
- Datos abiertos del Concejo Deliberante: Construir plataformas, desarrollos y visualizaciones a partir de los Datos Abiertos publicados del Concejo Deliberante de la Ciudad de Córdoba
- Transparencia de compras públicas: Escalar el desarrollo de "Medusapp", una herramienta electrónica para favorecer la difusión de información en los procesos de compras públicas. El desarrollo busca generar compromisos con la transparencia por parte de las empresas proveedoras.

En Marzo de 2016 se participó del Foro Argentino de Transformación Digital organizado por la Cámara de la Industria Argentina del Software donde expusimos sobre **Parlamento Abierto** local en el panel de experiencias locales.

smart city expo WORLD CONGRESS
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CITIES FOR CITIZENS

Fira Barcelona

SMART CITIES ASSESSMENT of TURKEY
A VIEW FROM AN EMERGING MARKET

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KEYWORDS:
Smart Cities, Sustainable Development, ICT, Energy, Transportation, Water, Open Data, Open Innovation, Smart Cities Strategy, Governance, Collaboration, Finance.

ABSTRACT:

Turkey Informatics Association (TBV) has started the Turkey Smart Cities Strategy Initiative that is expected to serve as a reference to all organizations that deal with smart cities. The initiative has two phases of which the first has been completed. The outcome of the first phase 'Turkey Smart Cities Assessment Report' has been published in March 2016.

OBJECTIVE AND APPROACH

The study covering transportation, energy, and water areas aimed to portray the current situation of smart cities in Turkey and shed light to the development of a nationwide strategy and roadmap for smart cities projects in Turkey.

The study was conducted between June 2015 and January 2016 among Turkey's 30 Metropolitan Municipalities and its subsidiaries (representing 77% of total population), energy and distribution organizations with the collaboration of TBV, İstanbul Technical University Computer Engineering Department, design and implementation of Novusens Smart Cities Institute and sponsorship of MasterCard and Intel Turkey. In total 105 organizations have participated to the study

During the Project a series of face to face interviews has been made with organizations involved and a survey has been designed and conducted to gather information on their smart city applications. The results were then analyzed at depth and current approaches, challenges and factors seen as critical for the success of smart city projects have been reported.

MAIN FINDINGS

Although smart cities provide a lot of benefits with the help of technology it is important that the focus of these solutions are citizens rather than technology itself. Use of technology as a tool

to improve the quality of life of its citizens is of critical importance for the success of smart city applications.

The main findings of the study include the below:

1) The most important challenge in smart city applications was reported as financial capability where 60% of the respondents indicated use of Municipality resources.
2) Lack of collaboration among organizations was another imported obstacle to smart city applications. It was also among the most important success factors for such applications. Especially the collaboration between NGOs, universities and other municipalities were in need of improvement.
3) Innovative approaches in smart city applications was reported to be the most important critical success factor for such applications. The institutions need to follow technological developments in smart cities closely and internalize them in order to adapt them quickly to the needs of the city, while caring for change and innovation management.
4) Experience in Information and Communication Technologies was another critical success factor for smart city applications. Combined with lack of skills and information in smart cities, the importance of skilled human resorces becomes evident.
5) The inclusion of citizens into smart city implementation processes is considered very important in realization of such projects. Meanwhile, the improvement of citizen's life and and increase of living standards was reported as the top choice among smart city application objectives.
6) It was observed that the current smart city applications did not make use cloud technologies and big data analytics as much as one would expect especially compared to other technologies. On the other hand mobile applications are used widely.
7) Infrastructure for Geographic Information Systems (GIS) was reported both as one of the most critical success factors and also one of the most important barriers for smart city applications.
8) Smart cards and smart devices are used by a quarter of the respondents for payment purposes and the majority of such applications are in the area of transportation.
9) Nearly 90% of the respondents indicated that they find the opening of local data produced by the smart city applications to public use for developing ICT leveraged innovative solutions as beneficial provided that the privacy and security concerns are taken into consideration.
10) The most common smart applications in transportation area are traffic monitoring systems, electronic payment systems and smart bus stops.
11) In the energy area, smart street lighting, electricty distribution, smart grids and smart electric meters are the commonly observed smart applications.
12) Electronic payment systems is reported as the top smart application in the water area followed by smart water meters, and smart demand management.
13) Every 2 metropolitan municipalities out of 3 plan smart applications in the transportation area, followed by energy and water.

As a follow-up of the first phase of the initiative, the second phase is planned to depict Turkey's Smart City Road Map and Strategy followed by a final report.

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SMART CITIES ONLINE REPUTATION QUANTITATIVE SURVEY

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KEYWORDS: smart city, smart cities, online reputation management (ORM), e-reputation, city rankings, competing cities

ABSTRACT:

Many cities have recently chosen to become a smart city. A number of smart city rankings have been created and rank the cities around the world according to smart cities criteria. However, from a reputation point of view, it is not clear which parts of the world shine the most regarding its smart cities initiatives. Higher reputation may attract more investors or startups in the field and contribute to the business development of the territory. It is the reason that in this study we have applied commercially available online reputation tools in order to know which countries in the world have the highest e-reputation with regards to smart cities and may therefore benefit the most from their smart city initiatives. We have found that India has quantitatively the highest online reputation regarding smart cities. More generally, our study has shown that current online reputation management tools can be applied to smart cities and can be used to continuously monitor a smart city e-reputation as well as its potential smart cities competitors aiming at becoming the most attractive smart city in the world.

1 INTRODUCTION

Online reputation, also called e-reputation, has been getting momentum with now more than 200 online reputation management (ORM) tools and services, e.g., Digimind[1], Sysomos[2] or Synthesio[3]. Online reputation corresponds to the online representation of the human concept of reputation as known in the physical world (Seigneur, 2013). It may be applied to different types of entities: politicians, products, brands, companies, restaurants, hotels, territories such as countries and cities… Rather than trying to estimate the reputation of an entity based on traditional content like printed articles in newspapers, general public surveys, expert surveys, manual analysis of business and financial reports…, any online data (online news, blogs, forums, social networks…) in relation to the subject of the reputation enquiry is harvested and analyzed. The online outcome is often an aggregated rating such as a percentage between 0% meaning having a very bad reputation to 100% having a very good reputation or through a number of stars… Details of the data used for computing the online reputation score may be available, for example, TripAdvisor provides the list of the different reviews that have led to the final score of a particular hotel, even if the validity of some reviews is not certified. The overall ratings of all the hotels of a city may be used to estimate the overall rating of the city. Citizens may also leave their comments about the city or its parts like hotels in various online sources such as forums or social networks

[1] http://www.digimind.com
[2] http://www.sysomos.com
[3] http://www.synthesio.com

comments. That engagement of the citizen regarding its city and its parts is also interesting to be captured and online reputation management tools can be used for that. We teach territory online reputation management as part of the new Smart City Digital Management[4] course at the University of Geneva. In this study, we have applied online reputation management in order to find which country in the world seems to have the highest online reputation regarding smart cities and is therefore likely to attract more smart city investors and startup for its business development: "the good reputation of a city strongly correlates with an increase in the supportive behaviors shown towards the city, such as visiting the city, living or working in the city, or deciding to invest in the city" (Prado, 2015). Having enough communication about a country smart city initiatives may also help the citizens to understand why investing in these initiatives are good for them because it seems still difficult for them to understand, e.g., as it has been recently found in UK at time of writing: "only 18% of the UK public has heard of a 'smart city', according to research carried out by the Institution of Engineering and Technology (IET) […] In spite of substantial investment in smart cities from the Government, local authorities and businesses, most people don't understand the concept" (Wilson, 2016).

In the remainder of this paper, first, in Section 2 we present the related work. Then, Section 3 describes the methodology that we have used in our smart cities online reputation quantitative study and its results. Section 4 concludes and discusses future work.

2 RELATED WORK

In this section, we first explain the different types of existing online reputation management tools. Then, we discuss existing smart cities rankings.

2.1 Online Reputation Management (ORM)

Reputation is an old human notion. Romans named it "reputatio": "reputatio est vulgaris opinio ubi non est veritas." (Bouvier, 1856), which translates to reputation is a vulgar opinion where there is no truth. We define reputation as follows: "reputation is the subjective aggregated value, as perceived by the requester, of the assessments by other people, who are not exactly identified, of some quality, character, characteristic or ability of a specific entity with whom the requester has never interacted with previously" (Seigneur, 2013). Online reputation or e-reputation is the digital representation of the computed reputation based on aggregated online evidence such as user ratings or comments. The e-reputation is often represented with a number of stars from 0 to 5 stars. To be able to perceive the reputation of an entity is only one aspect of reputation management. The other aspects of reputation management lifecycle for an entity consist of:

- Monitoring the entity reputation as broadly as possible in a proactive way;
- Analyzing the sources spreading the entity reputation;
- Influencing the number and content of these sources to spread an improved reputation.

In 1995, eBay[5] has been the first online service to use a reputation ranking for sellers and buyers to facilitate online auctions. In 2008, Klout[6] was created in order to compute

[4] http://www.smart-city-management.com
[5] http://www.ebay.com

the influence aspect of the reputation of a person in specific subjects such as Web marketing or company communication. Initially, the Klout score between 0 and 100 was based on the following Twitter criterions and then has included evidence from other social networks:

- True Reach: the number of followers of the user's Twitter account and following the user's tweets;
- Amplification: the number of people who share a post (who distribute it to other users);
- Network: the influence of the users composing the True Reach themselves.

Since 2008, as written in the introduction section of this paper, lots of online services (Digimind, Sysomos, Synthesio…) have been created to analyze and monitor the Web and other online sources such as social networks. One of the main e-reputation services that users check on the Web concerns hotels ratings such as on TripAdvisor[7] and Booking[8]. In order to help the hotels owners and other owners of local businesses in the travel industry to manage those ratings and thus their e-reputation, different services have been created. TrustYou[9] or GuestApp[10] monitor the hotel ratings on TripAdvisor and other hotel ratings services. TrustYou and GuestApp also provide tools to more easily collect ratings form their customers, such as a feedback form on a mobile app, and distribute it to the relevant ratings services automatically. There is no ORM service that covers all steps of the reputation management lifecycle (monitoring, analyzing and influencing). However, we show in Section 3 of this paper how we have applied ORM monitoring tools to the field of smart city online reputation.

2.2 Smart Cities and Countries Rankings

Leff and Petersen argue that the first city ranking was created in 1970: "Swiss bank UBS released its first Prices and Earnings Survey in 1970 to compare the purchasing power of citizens in 72 cities around the world" (Leff and Petersen, 2015). In 2013, Moonen and Clark review 150 city rankings (Moonen and Clark, 2013). Giffinger et al. underline that the number of cities rankings have increased a lot because cities use them to compare and improve their competitiveness. Although they survey a good number of rankings, they still introduce their own new smart city ranking based on 6 characteristics: "smart economy, smart mobility, smart governance, smart environment, smart people and smart living" (Giffinger et al., 2010). Another smart city example is Juniper Research's one, which has released a report ranking the top smart cities in the world according to 5 components: "technologies, buildings, utilities, transportation and road infrastructure, the smart city itself" (High, 2015). The Reputation Institute ranks cities based on their reputation calculated according to their "City RepTrak" (Prado, 2015), which aggregates the answers of more than 22 000 consumers who live in the G8 countries based on levels of trust, esteem, admiration and respect. Perceptions regarding 13 attributes are grouped into three dimensions: "Advanced Economy, Effective Government and Appealing Environment" (Prado, 2015). None of these previous city rankings have mined the Web, social networks and other media sources in order to estimate the city reputation as we do in this study.

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[6] http://www.klout.com
[7] http://www.tripadvisor.com
[8] http://www.booking.com
[9] http://www.trustyou.com
[10] https://www.guestapp.me

3 OUR SMART CITIES ONLINE REPUTATION QUANTITATIVE SURVEY AND ITS RESULTS

In this section, we first explain the methodology that we have used for our survey and then discuss its results.

3.1 Methodology

We have followed the standard methodology of an online reputation monitoring audit (Seigneur, 2014). The first step was therefore to define the search keywords. As the ORM tools that we have used understand Boolean queries, we thus defined and applied to all of them the following Boolean query: “smart city” OR “smart cities”. Although we target worldwide searches and a smart city has often a different translation in different languages, we assumed that countries should use the term “smart city” or “smart cities” if they want to refer to their smart cities efforts and be recognized worldwide. The results show that in fact several non-English countries known to invest in the smart city approach still appear in the results. For example, France is found to have a good share of the worldwide mentions of our Boolean query “smart city” OR “smart cities” although smart city in French would rather translate to “ville intelligente”.
After having defined the search keywords, we then carried out the search in two main ORM archive tools: Google and Synthesio. Although their results may not be exhaustive or vary between users, i.e., a Google search may give different results based on the user configuration (location, browser configurations…), even when searched in a Chrome incognito window, the results between the countries can be compared relatively because they are based on the same tool database. We limited our search to the past year, i.e., from May 2015 to May 2016. All sources were considered including Web pages, news, blogs, forums, social networks, videos… Each time a result is found on a source, it is added to the number of results found along with its location. If the location is not found, it is marked as unknown. A result may be a tweet or an online newspaper article. Of course, an online newspaper article is worth more than a tweet most of the time because it is better elaborated and the newspaper is read by many more people. We write most of the time because some Twitter accounts have a high influence, e.g., the Twitter account of Barack Obama has more than 74 million of followers at time of writing. An online reputation audit starts usually by a quantitative analysis of the mentions and then delve into the qualitative analysis of these mentions. The qualitative analysis tries to estimate if a mention has more impact than another or if it is positive, neutral or negative. We leave the qualitative analysis for future work.

3.2 Quantitative Results

The Table 1 below lists the number of mentions found worldwide for our Boolean search query defined above from May 2015 to May 2016. It is interesting to note that 70% of the Google results are considered as from recognized news sources, which shows that smart cities are considered as an important subject for journalists. There is also a good number of videos, around 5%. Regarding Synthesio results, more than 87% concern tweets and around 67% of mentions have been successfully located in the world.

Source	Number of Mentions
Google (All)	2 470 000

Google News	1 750 000
Google Videos	125 000
Synthesio (All)	1 149 400
Synthesio Twitter	1 010 137
Synthesio Unkown Location	380 383

Table 1. Number of Smart City Mentions Worldwide from May 2015 to May 2016

The Figure 1 below represents the heat map of the smart city number of mentions worldwide from May 2015 to May 2016 according to Synthesio. In red are the parts with more than 85000 mentions, in orange parts totalizing between 18000 and 85000 mentions, and in yellow parts with less than 18000 mentions. North America, Europe and Asia are the parts with the most mentions. However, when looking closer at the countries inside these regions in Figure 2, the number of mentions is not evenly distributed across countries and a few countries have a much bigger share of the total mentions than other countries in the same region.

Figure 1. Heat Map of the Smart City Number of Mentions Worldwide

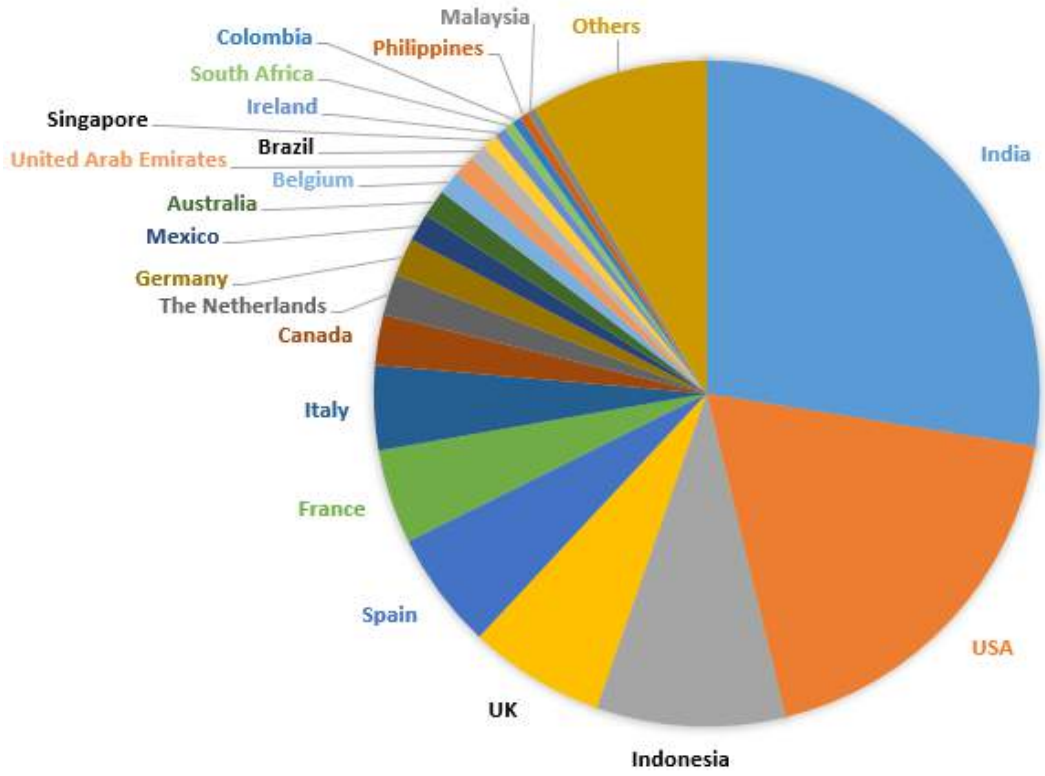

Figure 2. Share of Voice of Smart City Mentions per Country in the World

In Figure 2, we see that India has the biggest share of the total smart city mentions in the world. It is in line with the fact that India is known to have launched many major smart cities projects. In general, we also see in this Figure 2 the names of the other countries known to have launched important smart cities initiatives with also big shares of the total smart cities mentions. However, some countries have clearly more mentions than others and therefore, from a quantitative point of view, have a higher online reputation than others.

Figure 3 shows the evolution of the number of mentions resulting from our Boolean search query defined in Section 2, worldwide from May 2015 to May 2016 according to Synthesio. We see that there is a visible increase in the number of mentions of around 30%. That increase in the interest in smart cities is also visible on Figure 4, which this time corresponds to the search volume corresponding to our Boolean search query defined in Section 2 and by users searching online information about smart cities using Google search engine. The search volume clearly increases from the beginning of 2015 and shows that many more users than before search about smart cities. Thus, not only more people mention smart cities in their posts online but also more people search about smart cities online.

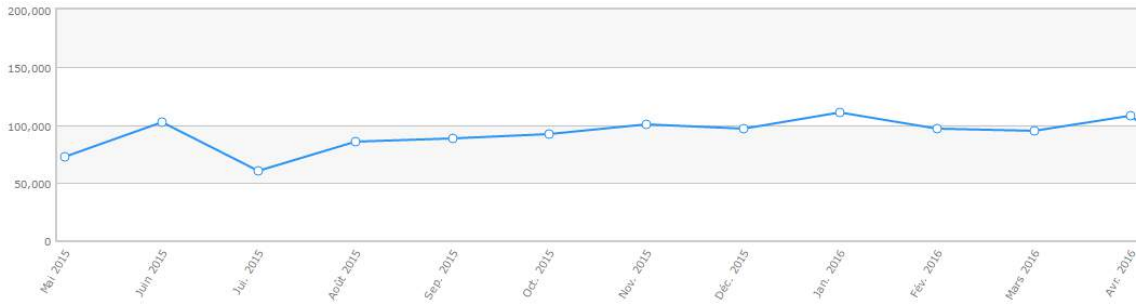

Figure 3. Evolution of the Smart City Number of Mentions from May 2015 to April 2016

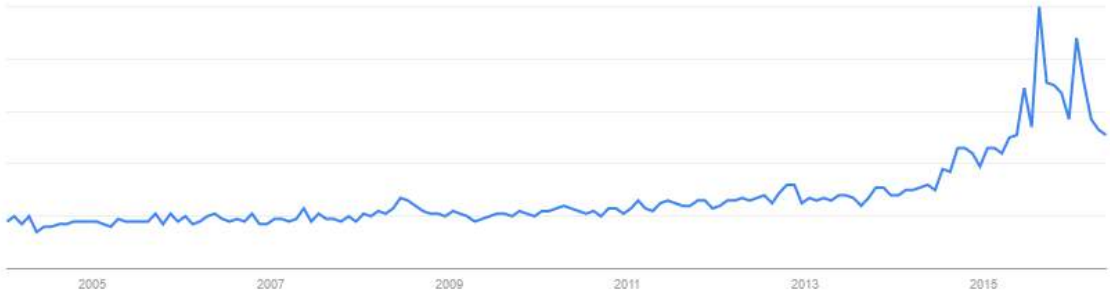

Figure 4. Smart City Search Volume on Google from 2005 to 2016

The final figure of our paper, Figure 5 below, shows the evolution of the number of negative mentions resulting from our Boolean search query defined in Section 2, worldwide from May 2015 to May 2016 according to Synthesio. The negative ton of a mention is based on the automatic sentiment analysis of Synthesio. We see this time that the increase is much bigger than for the overall number of mentions independently of their tone (positive, negative and neutral). Generally, there is an increase of mentions of around 30% but specifically regarding negative mentions, the increase seems rather of around 100%. Although a more thorough qualitative check of these negative mentions would be necessary for a complete follow-up qualitative survey, automatic sentiment analysis now works much better than in the past and a quick check of those negative mentions showed that they were indeed negative. For example, mentions were questioning the real worth of those smart cities technologies and if they were really going to improve the quality of life of their inhabitants.

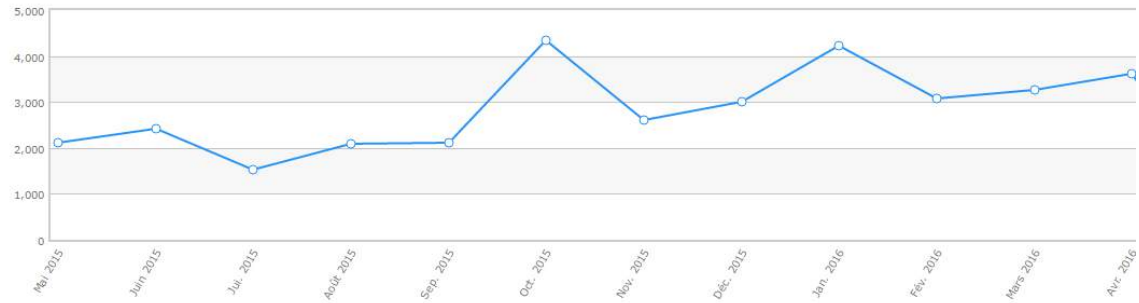

Figure 5. Evolution of the Smart City Number of Negative Mentions from May 2015 to April 2016

4 CONCLUSION

Our quantitative study has shown that at time of writing more people mention smart cities in their posts online than a year ago and that a few countries have a bigger share of these mentions. To fully reap the fruits of their smart cities investments, every smart city should try to increase its online reputation. ORM tools can help them not only to see if they are doing better or worse than others but also to check if their inhabitants understand well why those smart cities investments are made. We plan as future work a qualitative analysis of the found mentions and the identification of the main influencers for smart cities worldwide across media (bloggers, forums, online press, YouTube channels, Twitter and other social networks accounts).

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Big Data solution for decreasing traffic fatalities

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KEYWORDS: Big Data, Machine Learning, Mobility, Traffic accidents, Predictive, Prescriptive, Advance Analytics

ABSTRACT:

Big Data and Machine learning solution for decreasing traffic fatalities: Advances in data analytics and machine learning now allow the data silos to be analyzed, supporting mobility, security and emergency city services pinpoint not only where traffic accident is likely to occur, but when and under what circumstances.
By leveraging computer models that take into consideration historical accident trends, climatology, geospatial information, roadworks, events, festivities, bank holidays, demographics, economic activity, occupancy of tourist accommodation establishments, and other data sets, city managers can better plan where to deploy their resources.
The aim of the project is to provide a machine learning service that predicts:
- The traffic accidents amount.
- In each geographic point.
- For the next period of time.
Depending on the environmental conditions at the time the prediction is made. The solution prescribes actions to minimize the number and impact of such accidents minimizing the needed resources.
Data can hold secrets, especially if you have lots of it. With lots of data about something, you can examine that data in intelligent ways to find patterns. And those patterns, which are typically too complex for you to detect yourself, can tell you how to solve a problem. Machine learning examines large amounts of data looking for patterns, then generates code that lets you recognize those patterns in new data. Applications can use this generated code to make better predictions. In other words, machine learning can help you create smarter applications.
Machine learning starts with data—the more you have, the better your results are likely to be. Because we live in the big data era, machine learning has become much more popular in the last few years.

The machine learning process starts with raw data and ends up with a model derived from that data:

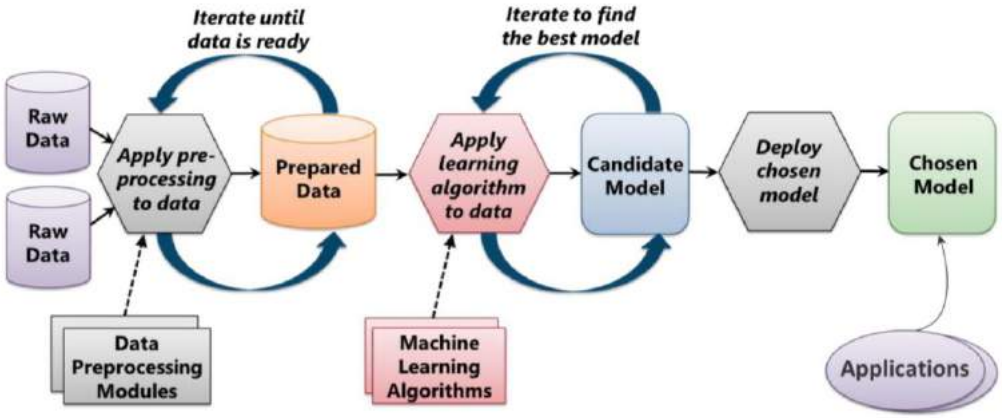

Figure 1. Machine Learning Process
Source: Microsoft Introducing_Azure_Machine_Learning

1. Determining the most relevant data
2. Data preprocessing
3. Machine learning algorithms are applied
4. An experiment is every attempt of different combinations of machine learning algorithms and prepared data, searching the best model to solve the problem.
5. The result is referred to as a model. It's the implementation of an algorithm for recognizing a pattern. It returns a probability between 0 and 1
6. Deciding what to do with this probability is a management decision
7. Deploying that model: This allows applications to use the algorithm the model implements..

INNOVATIVE CHARACTERISTICS OF THE PROPOSAL
From data to intelligent action: The state-of-the-art in smart cities is predictive analytics. Enhance your business applications with machine intelligence to evolve from simple descriptive analytics to prescriptive recommendations. Take action ahead of your city challenges by predicting what's next

RESULTS/IMPACT OF THE PROPOSAL
This solution prescribes actions to reduce traffic accidents minimizing public resources.
The decreasing trends in fatal accidents in Catalonia has inverted last 2015. Catalonia is fully committed to meet the EU objectives: 50% reduction in traffic accident fatalities by 2020 compared to 2010

FEASIBILITY OF THE PROPOSAL
It is a public-private-partnership. The startup phase is a pilot: Microsoft, Bismart are investing funds for innovative solutions focused on smart cities, to accelerate management initiatives

based on data-driven decisions. This innovative solution has broader market potential to be reused.

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COMBINING GPS TRACES WITH PERMANENT COUNTING TO MANAGE AND DEVELOP A CYCLING NETWORK

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KEYWORDS: bicycle planning, bicycle infrastructure, management of a cycling network, bicycle mobility trends, network performance, active transportation monitoring, innovative tool, GPS traces, automatic counters

ABSTRACT:

More and more cities around the world are promoting cycling through the implementation of bicycle infrastructure and policy. However, to make investments more effective, thorough insight into bicycle behavior and network performance is needed.

Whether it is automatic counting devices, GPS tracking systems, or individual surveys, means available to understand bicycle usage are plenty, but they often give only one part of the global answer to properly plan bicycle infrastructure. Automatic counting give indeed accurate figures for one specific location, but no information on the trip purpose, rider's experience, or gender split. On the other hand, individual surveys can provide this type of information, but are only declarative and do not really say much about what is happening on the field.

In order to understand better bicycle usage, Eco-Counter and a Canadian-based start-up Brisk Synergies have co-developed an innovative tool that reveals how cyclists move in the city, and analyzes qualitative and quantitative bicycling data. Eco-Visio Maps service enables a simple combination of GPS traces and external data sources as well as count data in a cloud-based data collection and mapping analysis platform. This application brings to active transportation managers indicators which are as powerful as what is already available for car-oriented transit. It provides very powerful information to policy makers, such as:

- GPS traces mapped on cycling infrastructure;
- Origin-destination matrix (figure 1);
- Identification of preferred routes and gridlocks (figure 2);
- Segmentation of cyclist flows;
- Commuter and recreational travel patterns comparison;
- Estimation of the number of cyclists per day;
- Level of risks assessments;
- Trip duration and speed map.

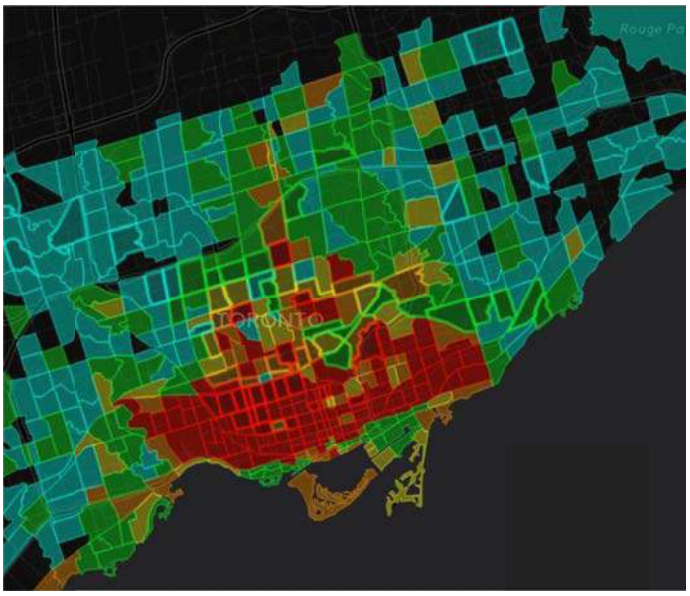

Figure 1. Origin-destination matrix

Figure 2. Cylists flow segmentation (preferred routes, gridlock)

For more than 3 years, three Canadian cities have been using Eco-Visio Maps: Toronto, Quebec, and Montreal. In Toronto, within a couple of months, and thanks to a massive interest from its citizens, the city was able to gather a significant GPS data set (figure 3). Combining it with data from Eco-Counter's automatic counters enabled local authorities to justify investments for past and present infrastructures such as bicycle tracks, secured bicycle parking or relay parking. They were even able to build an origin-destination matrix to identify city-wide bicycle mobility trends.

Figure 3. Mobile app to collect and visualize tracks gathered by the city of Toronto

Extensive GPS tracking of cyclists combined with quantitative and qualitative data gives thorough insight into bicycle usage. Information such as preferred and avoided routes, speeds, delays and accessibility can help bicycle planning and contribute to support the development of cities of the future.

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Traffic Management 3.0 – Progress towards Utopia?

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KEYWORDS: Traffic Management, TM 2.0, Mobility as a Service, MaaS, Traffic Analytics, Floating Car Data, FCD, Congestion, Traffic, Vehicle automation, Self-driving cars, Vehicle sharing.

ABSTRACT:

Traffic congestion is a growing and global problem, impacting the majority of people traveling and goods moving. Governments are challenged to keep the traffic flowing, to reduce pollution and decrease the economic damage caused by this congestion. Highly accurate traffic information helps governments reach their goal of empowering both their economy and society in using smart and sustainable mobility systems. Today Traffic Management as conducted by public authorities is not linked to the individual routing advice that mobility service providers provide. Traffic Management 2.0 is in the process of addressing this issue and integrating the different information pieces of the puzzle into one holistic information loop. However, with the current developments in vehicle automation and vehicle sharing, the field of transportation starts experiencing a dramatic transformation. The paper sets the scene of the evolutionary process taking place in Traffic Management and examines possible scenarios and impacts on Traffic Management.

1 LEVEL 1 HEADING

Traffic Management 1.0, how traffic is managed today

Traffic Management falls under the responsibility of road operators. They, on behalf of public authorities, deliver a service to the driver that is using their road network. The aim of Traffic Management 1.0 is to ensure the optimization of the road network and the efficiency of the infrastructure in providing a safe passage to its users, the drivers. Traffic Management in its 1.0 form consists of detection and control. Traffic Management 1.0 has long depended on the use of hardware to detect and control traffic. A wide range of inductive loops, cameras, Bluetooth detectors, Wi-Fi sniffers and ANPR cameras are deployed around the road network for detecting what is going on. With regard to controlling the traffic, this stems from the fusion of all data collected during the detection process into traffic information. This information is used by the Traffic Control Centres (TCC's), for the purpose of informing, and hence advising, the driver on the road. The driver is addressed via radio bulletins, TMC Traffic broadcasting or Variable Message Signs (VMS) displays.

Traffic Management 1.0 is the traffic management system used by the majority of TCC's today. Its limitations include the high costs of maintaining the infrastructure and the hardware installed on it (inductive loops, cameras etc.) coupled with the limited coverage of the road network. After all, TCC's only know what is going on where sensors are deployed. Even with more recent

technologies such as Bluetooth detection for example, the system only knows what is going on after a car has passed the second detection point. The data collected in this way is, in most countries, limited to highway locations and major secondary routes. All other roads are not included. On the other hand, the information part of this traffic management version addresses the bulk of drivers on the road network without distinguishing between their various destinations, making information generic and not serving individual needs.

The information includes general announcements on incidents in the network, travel times and delay times. Research[2] confirms that from the drivers notified via Radio, VMS etc., only 20 to 30% of them will follow up on the advice. What is more, due to the increase in the use of navigation systems and relevant smartphone applications by drivers, the percentage of road network users who will adjust their decisions based on the information announced by road operators using the 1.0 traffic management method further decreased over the last years.

Revolution in Traffic Information Services

When GPS was released for commercial use in the beginning of the millennium, it allowed commercial organisations to start exploiting and developing software and applications for navigation. This proved to be a major push for innovation in the field of data collection and related services. Navigation devices, first unconnected (offering static maps only) and later connected (receiving and sending real-time information from a server) were products resulting from the above-mentioned push for innovation. At the same time the rapid development of the Smartphone, which was progressively enhanced with GPS, enabled even more ways of navigation based on data collection. The data collected which is extracted from the vehicle while in motion is known as Floating Car Data (FCD) and that helped revolutionised traffic information. FCD can be collected via a vehicle built-in system or via standalone devices, such as for example a connected navigation device.

Real-Time Traffic

TomTom took advantage of the new 'wave' in technology and the possibility to be able to receive data from millions of vehicles each day and exploited the possibilities offered by the new data (FCD). Leading the revolution in traffic information, TomTom became market leader in collecting and aggregating FCD into its location and navigation products and services for its customers around the world. FCD data can be collected from a wide range of different vehicle fleets and types of devices

By collecting GPS data from so many different sources, TomTom has at its disposal a fleet of connected devices driving around the world that is unsurpassed by any other floating car data (FCD) fleet. As 'connected navigation' is nowadays the popular choice for navigation, the combined fleet of GPS devices has been growing day-by-day with impressive speed. As a result, the quality and coverage of the traffic information has also considerably increased. Hundreds of millions of connected devices around the globe are able to send back data to the server highly accurate and anonymous GPS probe data upon the consent of the user of the device. Examples of users of TomTom real-time traffic services in the automotive market, for instance, include in-dash and on-dash connected navigation devices for Renault, Mercedes-Benz, Toyota, Mazda, Fiat, Alfa Romeo, Audi, Hyundai, Kia, Peugeot and Citroën. TomTom also licenses traffic information to a number of key mobile phone handset manufacturers, enhancing its FCD information quality and quantity even more as it receives data back as well as sending it out to them.

All these source devices monitor road traffic conditions continuously and when each of them contacts the servers for traffic information they exchange intelligence on the congestion they have experienced in the past few minutes on their journey. This congestion information is fused (integrated) into the traffic services anonymously, so that this intelligence can be passed to other connected customers and as a result, improve their journey as well.

Image 1; different sources of accurate GPS data

Thanks to the continuous sampling of very precise GPS measurements, the data coming from all groups of connected devices contribute to the accuracy of the travel time information. In order to ensure that only the appropriate information is being taken into account by the central server when producing traffic services and products, a special filter is implemented that takes bicycle, public transportation and pedestrian data out of the fusion procedure. The new GPS breadcrumbs are generated every few seconds on the device, facilitating the accurate understanding of road network conditions. With just a few devices reporting anonymously to the central server on a specific road stretch it is nowadays possible to generate high quality traffic information which includes very detailed speed and travel time information with confidence.

Traffic Incidents and Traffic Flow

Real-Time traffic data can be divided into Traffic Incidents and Traffic Flow, and both are the resulting products of this traffic fusion procedure. Both services provide highly accurate real time speed information as well as information on travel times on individual road stretches. Traffic Incidents is a traffic service that is mainly being used by navigation products such as satellite navigation devices. Using Traffic Incidents, delays and journalistic information are delivered on all affected roads in the area requested by the customer (please see example in image 3). On the other hand, the Traffic Flow service is mainly used by public authorities for traffic monitoring purposes. The Traffic Flow service helps traffic authorities assess the entire

road network since the real time speeds and travel times delivered by the service cover all road segments (please see example in image 2). Both of these traffic solutions are available immediately and require no infrastructural changes to be implemented by the traffic authorities on the road network. As a result there is no extra time required for developing or installing these solutions as they can be implemented immediately via the available products.

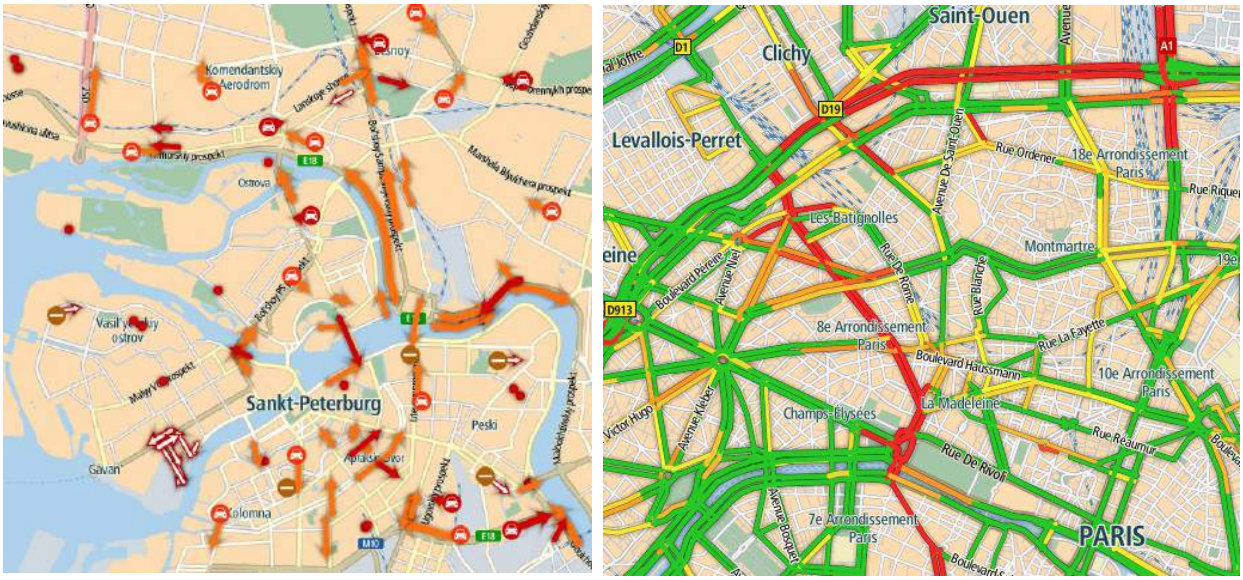

Image 2; Traffic Incident information service on the left, on the right the TomTom Flow data service

The Connected Navigation

With regards to individual drivers, routing is provided by the navigation app accessed via the (in car or portable) navigation device. The app becomes aware of the destination when the user enters it in the device and will constantly download real-time traffic data valid in the location where the user is found at that moment. When traffic delays are reported on the route selected by the driver, (s)he will be alerted and the travel time indicated by the navigation app will be automatically adjusted by the navigation system. With every arrival of traffic data from the central server, route calculations are performed. When the device 'sees' that a faster route is available, due to a traffic delay in the initial planned route for instance, the driver will be asked by the navigation system (the device) if (s)he wishes to take an alternative route and avoid the delay. By means of this method drivers will always be able to take cleverer and faster routes in order to reach their destination.

Traffic Management 2.0, how it will work tomorrow

There is little doubt that innovation is key to Traffic Management and that an efficient transport system is the basis of a functional economy. As the first part of this paper discussed, FCD is not only the core ingredient of traffic information as provided to drivers and public authorities responsible for the road network but it also forms the basis for more than just monitoring and informing. It is key to the development of advanced Traffic Management systems.

As discussed in this paper, Traffic Management as conducted by public authorities today (TM 1.0) presents some key challenges that need to be addressed:

- Traffic Management Plans are not part of the dynamic traffic information delivered to vehicles on the road network;
- Individual vehicle behaviour is not made available to the traffic management systems covering the area where the vehicle is being used;
- The traffic control strategy as this is decided by the Traffic Management Centre is not able to address individual travellers using the road network and beyond.

A European-wide discussion forum was created at the ITS Europe Congress in Helsinki in 2014, focusing on the topic of interactive Traffic Management and its members come from all relevant stakeholder groups along the entire Traffic Management procedure value chain (ranging from public authorities to research centres to automotive companies and service providers). This is what is called the TM 2.0 ERTICO Innovation Platform. TM 2.0 is both a concept and a platform. The TM 2.0 concept focuses on enabling vehicle interaction with traffic management plans and procedures. By discussing business models and "enablers", the TM 2.0 Platform aims to pave the way for the TM 2.0 concept to be implemented in various cities and regions around Europe based on the win-win of its actors. By way of issuing a series of recommendations the TM 2.0 serves as a catalyst that accelerates the current activities in the field of Traffic Management by both the industry and public authorities towards providing innovative Traffic Management solutions.

The 26 members of the TM 2.0 Platform believe in cooperation among traffic stakeholders and in adapting the organizational architecture of traffic management to be deployed to the specific region or city in focus. Individualities are important when one aims for functional- tailor-made traffic management. Minimum required sets of data to be used in providing TM 2.0 services to drivers and traffic management centres along with reliability and quality of data used in the process are issues being tackled by the Task Forces of the Platform. The TM 2.0 Platform members are in the process of agreeing on common interfaces which can facilitate the exchange of data and information from the road vehicles and the traffic management centre and back, improving the total value chain for consistent traffic management and mobility services as well as avoiding conflicting guidance information on the road and in the vehicles themselves.

As the different priorities of the actors involved are being balanced, the roles and responsibilities of the stakeholders align in making the traffic information that reaches the vehicle consistent with that on the VMS on the road network. For example when there is a football game in the area where the vehicle user is driving to and the navigation system is aware of it and also of the measures (including timings) the local Traffic Management Centre will be implementing in order to de-congest the area, the win-win is shared among all traffic partners. Safety on the road network is coupled with the efficiency of traffic information provision via the navigation system in the vehicle. As a result, there is also convergence between the actions of the individual driver's objectives (for fast and efficient travel) and those of the public authorities (for adherence to set collective/societal objectives such as CO2 emissions), prioritization of one road user group over the other (pedestrians over cars depending on policy) or other.

TM 2.0 solutions

Traffic Management could benefit directly from the available tools built around Floating Car Data and can instantly bring Traffic Management to a next level. The TM 2.0 Platform members are in the process of deploying the concept in a number of cities and regions including those of Barcelona, Verona, Thessaloniki, Saltsburg, Trondheim, Eindhoven, and Vigo. Services and

products by the Traffic Information Service providers are already in the market and what needs to be specified for every location is the viable business model agreed between all stakeholders involved. Below you find an overview of Traffic Information solutions that form part of the TM 2.0 concept and are already available in the market.

1. Traffic Moderation

Navigation devices and navigation applications can reach thousands of drivers both immediately and directly. Specifically in the case of incidents, e.g. a road is closed due to an accident, it is key for everyone's safety to re-route other drivers as soon as possible. Re-routing can be implemented via VMS messages or radio bulletins, but the number of drivers that will actually read the VMS or listen to this information on the radio is minimal and the ratio of those who end up passing the closed road will still be high. Also, not all the drivers on the wider road network are heading to the same destination. A better approach is to address only those drivers that are heading to the destination of the closed road. This can only be done by using the in-vehicle navigation functionality. Also, by providing the road-closure information to traffic information service providers it is possible to broadcast this information

Immediately and directly to all drivers who will pass this location- since the vehicle destination is known at the traffic information service provider's end. The navigation engine will then take the road-closure into account while recalculating the optimal route suggested to the driver in order to reach her destination. As connected navigation is nowadays standard, this means that instantly thousands of cars can be re-routed around the incident location safely and efficiently. Road operators and public authorities responsible for the road network can provide this type of traffic data via standardized DATEX2 feeds or use available moderation consoles to relay the information.

2. Historical Travel Time Analytics

By collecting Floating Car Data the Traffic Information providers such as TomTom can create an archive with actual driven trips for analysis purposes. As road operators are responsible to provide a service to the car drivers, they are keen on the stability of the travel times as set on their road network. Obviously there can be extreme situations on the road network due to weather or accidents, but the generic travel times are expected to be stable. By using the aggregated statistics provided by Traffic Information Service providers, it is possible to perform reliability studies for any location in the road network. The great benefit of this type of travel-time based analysis compared to Bluetooth or ANPR statistics is that this is location independent and lacks the financial and safety risks posed by the actual placement and maintenance of such technology (e.g. Bluetooth or ANPR). This kind of information, basically a wide FCD database, is readily available by traffic information service providers and can be queried instantly by public authorities and road operators. In image 3 there is an example of the travel time percentiles between Brussels and Antwerp in the month of November 2015 during the evening rush hour.

Public authorities responsible for the Brussels-Antwerp network can use this information when agreeing on their traffic management plans for this specific time slot and de-congest the route by cooperating with traffic information service providers who can reach drivers immediately and directly. They can monitor the stability month-on-month to assess the impact.

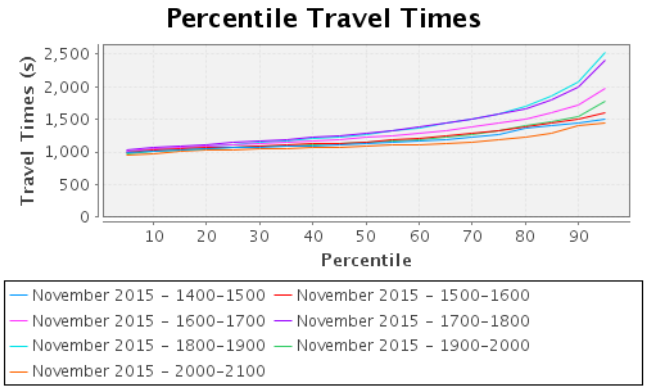

Image 3. Between 1800 and 1900 travel times are the least reliable

3. Historical Traffic Bottleneck Studies.

As already discussed above, FCD can be used in the analysis of travel time reliability, however it can also be used for analysis of traffic bottleneck locations. By comparing the travel times exhibited during peak hours with those exhibited under conditions in freeflow state it is possible to identify congestion hotspots throughout the road network. More to that, by calculating the ratio between both values it is possible to compare different hotspots with each other and draw valuable conclusions on traffic measures and plans that need to be implemented by the responsible traffic authorities. The use of FCD in this type of analysis makes it possible to assess all road categories throughout the entire road network. Finally, as the FCD data is already archived, it is possible to perform this type of analysis retrospectively. In image 4 you find an analysis for the city of Amsterdam and its congestion hotspots for November 2015.

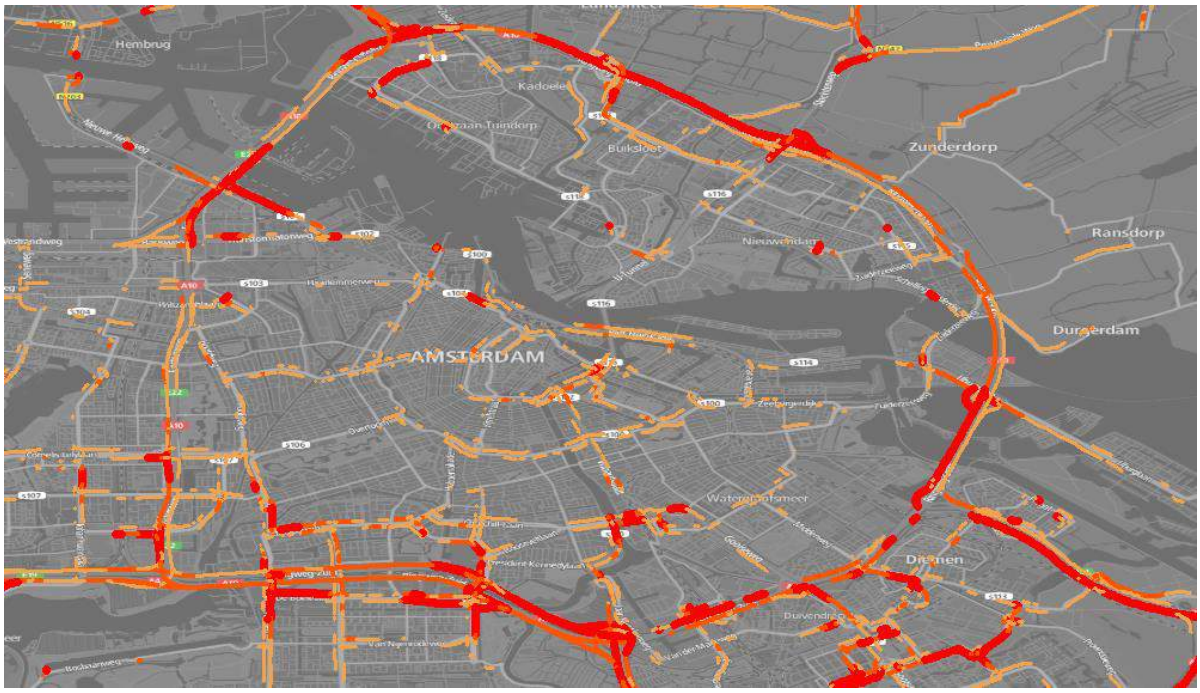

Image 4. November 2015 evening rush hour congestion hotspots.

Traffic Management 3.0 - a step to the future

The future of mobility has a lot of uncertainties to face. The current development and discussions around the self-driving car movement makes it very likely that the world we live in will change in fast pace. However, we can already now envision the different possible mobility scenarios and try and sketch the different impacts these will have on how we travel, how traffic management is executed and how public space will evolve.

The KiM Netherlands Institute for Transport Policy Analysis (http://www.kimnet.nl/en/) has recently conducted an analysis[3] on the most plausible scenarios of traffic and transport systems of the future and their impact on mobility and society. They summarized four feasible scenarios that represent the different levels of automation and economy sharing our society will reach in the next coming years:

- *Mobility as a Service: Any Time, Any Place.*

Technology has evolved to fully automated vehicles and users are prepared to share their vehicles. Mobility becomes a service and self-driving cars are available everywhere.

- *Fully Automated Private Luxury*

Consumers demand their own vehicle and the technology has evolved up to a fully automated car. Everyone has their own automated car.

- *Letting go on Highways*

Technology is less evolved and in the city you have to drive your own car. On the highway the driver can enable auto pilot. The majority of car owners prefer owning their car instead of sharing. Everyone has their own half-automated car.

- *Multimodal and Shared Automation.*

Sharing your car is the default and cars are half automated, so on the highway you can enable auto pilot and in the city you are driving the car yourself.

The four scenarios all have their own impact on public transport systems, sustainability objectives, available public space and societal needs. Business models behind car manufacturing, car sharing or public transport for example will be greatly impacted. However, only time can tell with certainty how the mix of scenarios will look like in 2020 and beyond.

Road capacity and Traffic Management are going to follow suit on being impacted by the rapid change in technology and in all four possible scenarios cooperative systems and exchange of important information among the vehicles (V2V) and between them and the infrastructure and general environment (V2X) are seen by the study as mandatory for the future of mobility. According to the KiM study, road capacity is expected to increase in all four scenarios on Traffic and Transport systems of the future. Specifically with regards to Traffic Management the impact will differ according to the scenario:

In the Mobility as a Service scenario the world will evolve from owning cars to sharing self-driving cars. According to this scenario the amount of kilometres driven per person is likely to increase. As a result, Mobility as a Service providers will have to work on setting up a clever demand system for mobility services, otherwise congestion is likely to increase. Controlling what routes these self-driving vehicles should drive and when to depart will be a key task for the traffic manager and will enable better control of vehicle availability while at the same time it will force Traffic Management to shift its action focus from the ‘now’ to the immediate short future. Better use of the road network over the day will be a key objective for public authorities and traffic managers responsible for maintaining low congestion. Already schemes such as MaaS in

Finland[4], led by the ITS Finland organization and the MaaS parents in the country are pointing at the future with enthusiasm. MaaS may not be corresponding to the dictionary description of what Mobility as a Service is, as the latter is exclusively based on self-driving vehicles but it is a first step towards a new market approach and a new Traffic Management level, that of TM 3.0.

With the Fully Automated Private Luxury scenario there will be an increase in volume of cars. Not only people who own a driver's license but everyone will be able to own and use a private car. Along with the expected increase of kilometres driven per person there will be a key challenge for Traffic Management. Compared to the MaaS scenario there will not be a central hub where origin and destination is registered. The user will use their car when they need this. In order to manage the increase in car volume and mobility, advance demand and traffic management is required. Traffic Managers will require knowledge about destinations and routes taken along with the ability to control routes driven in order to minimize congestion.

The scenario Letting go on Highways will increase the capacity of cars on the highway. By fully automated platoons driving on the highway, the distance between vehicles can decrease with a positive impact on congestion levels. For Traffic Management the impact is limited. A proper integration of Floating Car Data into the controlling tools is required to measure and influence traffic. Compared to Traffic Management 2.0 there is low added value.

In the last scenario Multimodal and Shared Automation, people will heavily rely on shared half automated vehicles and public transport. However, compared to the first scenario, the automated vehicle is not accessible by everyone. Only those with a driver's license will be able to utilize the automated car opportunities. Traffic Management will have to be multi-modal, offering an end-to-end multimodal experience with integrating all modes of transport. As MaaS is forcing travellers to submit their destination in order to request travel, this provides new opportunities for Traffic Management evolving to Transport Management, Influence demand, routes and transport mode choice in order to make the most efficient transportation model.

Conclusion

As discussed in this paper, we are currently enjoying the benefits of the new technology revolution in navigation and location services which took advantage of FCD and enabled traffic information service providers such as TomTom, to further advance traffic services and products for its private users, automotive customers and public authorities responsible for traffic alike. TomTom continues to be a leader in the field of traffic management and as such is heavily involved in the deliberations and work of the TM 2.0 ERTICO Innovation Platform on interactive Traffic Management (TM 2.0), dynamically contributing to the next steps of evolving traffic management practices around the world. Services and products based on the use of FCD, such as the TomTom Traffic Incidents and the TomTom Traffic Flow are already available in the market while the tools they provide traffic managers will bare great potential for the transition from TM 1.0 to TM 2.0.

Nonetheless, TM 3.0 is near. The reality of self-driving vehicles is approaching and as the KiM study scenarios show, the impact on traffic management is taken for granted. The sooner our industry and policy decision makers face the challenges together, the more successful the future of mobility will be.

It is not easy to predict the future and what direction the mobility and traffic management will evolve to. But what is certain is that change is here and the forecoming developments will provide new opportunities for both governmental entities such as public authorities and road operators as well as service providers working in the field of traffic management. Improved incident management and more reliable mobility systems bring a win-win to both society and business and that is the best way to proceed towards making a reality out of utopia.

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APP&TOWN COMPAGNON

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Mass Factory Urban Accessible Mobility, S.L.

KEYWORDS: quality of life, inclusive, ageing population

1 OBJECTIVES

The goal of the App&Town Compagnon is to market a disruptive Smart City solution to reduce accessibility barriers for people with special needs. App&Town Compagnon serves as an assisted transport platform for people with special needs (people who require assistance in travel due to disability, age or contextual disability) in order to travel safely and self-sufficiently, retaining their personal autonomy and reducing the risk of disorientation, conflict or exclusion.

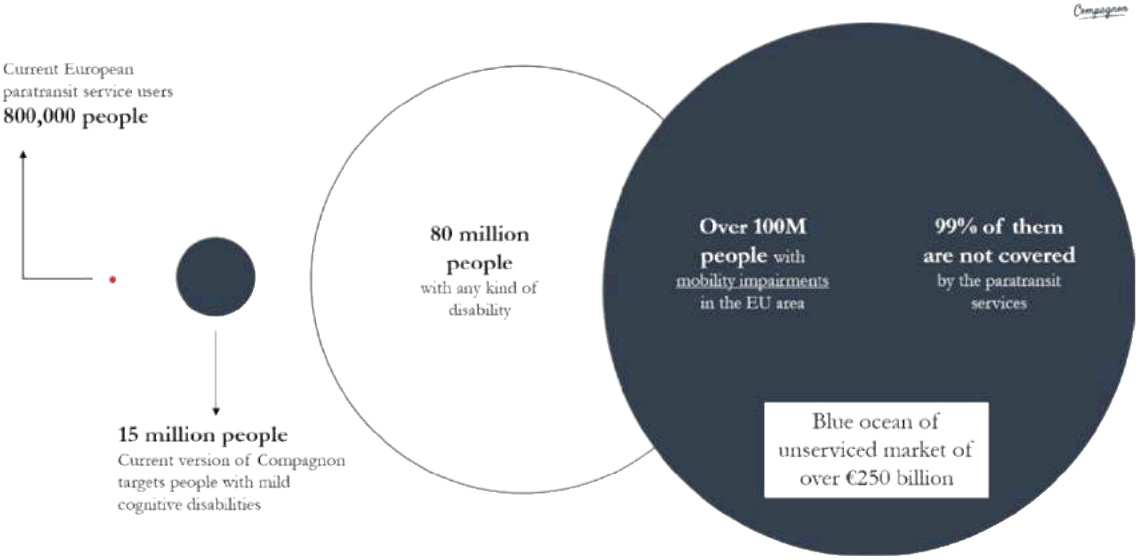
App&Town Compagnon is an end-to-end software solution for assisted transport focused on three technological disruptions:

a) **Guidance,** through the development of a high-precision guidance and route planning system that combines state-of-the-art GPS location monitoring and a newly designed indication system for indoors facilities and no-connectivity environments, so as to ensure that the user can reach their destination autonomously.
b) **Accessibility**, through the design of interfaces intended for providing route indications and accessible interactions to every demographic with special needs: such as people with mild cognitive disabilities, elderly people who have mobility impairments and also people with contextual disabilities (such as children, tourists or immigrants).
c) **Safety,** the user's location is transmitted in real time to either specialized Control Centres or to a relative of the user in order to respond to alerts, track their advancements and ensure their safety. App&Town Compagnon includes a collaborative social network where citizens are able to volunteer to help the users in response to emergencies such as disorientation and loss, City Angels.

App&Town Compagnon includes a cutting-edge high precision guidance system based on a Polygon-Driven Guidance algorithm and an Indoor guidance system, as well as a collaborative citizen platform (City Angels) for people to volunteer in the assistance of people with mobility impairments when lost or disoriented. A full set of Interfaces designed in order to offer an accessible tool to the majority of people with special needs or mobility impairments: elderly people, children, people with cognitive disabilities and immigrants or tourists.

App&Town Compagnon has already been deployed internationally and the company has signed agreements with paratransit operators in Lyon (France), Quebec (Canada), Barcelona (Spain) and Columbus (USA) generating over €100k in revenues in 2015. The analysis of the service has allowed the company to assess the benefits of the solution (increase in autonomy and self-esteem of the users and a reduction of cost for paratransit service operators of up to 50%) and to conclude that the solution **is potentially fit for a mass and global market implantation, by both a) expanding the solution worldwide and b) widening the range of potential users** from people with mild cognitive disabilities (nearly 15 million) to people with special needs or mobility impairments (over 100 million), aiming at the B2C channels.

APP&TOWN Compagnon



App&Town Compagnon has already been validated as a high-potential solution by organisations for the support of the people with disabilities such as Fundación ONCE in Spain, Fundación Vodafone (international) and React Technologies, a technological company which is partnered with the Royal National Institute of Blind People in the United Kingdom.

2 THE PROBLEM

Over 10% of the world's population, that is over 1.000 million people, suffer from some form of disability[1] and require assistance in everyday trips through the city or the area they live. In the EU area, over 100 million people are in this situation. Limited access to transportation is considered to be one of the causes of exclusion, discrimination and lower access to employment and, as a result, reduced income and a higher risk of poverty, according to the World Report on Disability[2].

However, **less than 1% of people with disabilities are eligible or serviced by assisted transport or paratransit service operators**.

2.1 The Problem in Paratransit

Paratransit represents an accessible means of transport funded by public administrations and provided by transport companies in the form of fleets of accessible buses or cars with predetermined routes. These services are targeted to people with severe disabilities[3]. As a result, **people with mild disabilities, elders with mobility impairment due to ageing or people in risk of disorientation or loss (contextual disabilities) such as children, immigrants or tourists, are left unattended.**

Recent budgetary cuts in the European area have reduced the capacity of the paratransit service, such as in Spain, with a 34% budget reduction, or in the United Kingdom, with a 37% less public investment in transport infrastructure. Due to the significant cost of servicing a paratransit user (over 6.000€ per user per year), **the sustainability of the service has forced operators to reduce the number of eligible users** in order to meet the budget.

Additionally, paratransit is far from being a definite solution. While paratransit can be an effective solution for people with severe disabilities, it can be harmful to people with mild disabilities or

[1] POLLACK, M.: *Intelligent Technology for an Aging Population*, AI Magazine Volume 26 Number 2, American Association for Artificial Intelligence, 2005
[2] World Health Organization and World Bank – *World Report on Disability*, p.10, 2011
[3] People with a disability of grade 3 or 4, according to ICF

mobility impairments, since predetermined routes and controlled environments can lead to a reduction of autonomy and higher dependency. That can also lead to a hindered social inclusion, as it shields and separates the users from the community, and a potential lower self-esteem.

2.2 The Problem with Assisted Transport Technological Solutions

The advancements in GPS tracking and the rise of mobile devices have induced the development of technological solutions that offer assistance in transport, such as guidance mobile applications.

These solutions, however, are not designed for people who require assisted transport due to:

a) **Lack of precision**: their guidance systems are based on predefined milestones within the provided route. When the user arrives to the milestone, an indication is provided. However, if the user never arrives to the milestone, the system recalculates and offers a new route, causing possible confusion and disorientation.
b) **Lack of accessibility**: interfaces and applications are developed without considering the accessibility requirements or the needs of people with disabilities, effectively considering them not a target.
c) **Lack of supervision**: route planners do not provide effective supervision by a third party, thus leaving the user unattended and not offering effective assistance when lost.

3 THE SOLUTION

Mass Factory has developes App&Town Compagnon, an innovative end-to-end guidance system for assisted transport with built-in remote supervision functionalities.

App&Town Compagnon comprises **1) accessible mobile applications for providing users with high precision guidance** during their trips through the city, even when walking, using public transportation or accessing indoor facilities, and **2) web-based control panels for expert supervisors (i.e. paratransit specialists), relatives or assistance volunteers** to monitor their position, receive alerts when the user leaves the defined route or faces some sort of problem or emergency.

App&Town Compagnon fulfils three main principles:

- offer high-precision **guidance,**
- ensure the **safety** of the users through remote supervision and
- maximize the **accessibility** of the system for people with every kind of disability**.**

As such, App&Town Compagnon is based on six modules:

1) Route planning and high precision guidance

Extending open source framework Open Trip Planner, App&Town Compagnon provides supervisors and relatives the functionality to set custom routes for the assisted users, such as main routes from Home to usual destinations such as Work or Hospital. Concurrently, the route planning engine allows users to obtain the quickest route home when faced with conflict, feel lost or disoriented. Routes are integrated within the public transportation of the area or the city and inform about inclination, accessibility points and estimated times of arrival.

When the trip has started, guidance is based on the monitoring of the location of the user based on the data provided by the GPS(USA)/GLONASS(Russia)/Galileo(EU)/Beidou(China) and Wi-Fi/4G/3G/2.5G sensors. Due to the known margin of error of these devices, Mass Factory has devised the development of a cutting-edge algorithm in order to ensure high precision guidance.

The company has designed a **Polygon-Driven Guidance Algorithm** which will autonomously generate, using geomapping technologies such as Java Topology Suite and GeoTools, a set of concentric polygons around the designated route (see image 1).

Image 1: Mock-up of the Polygon Driven Guidance Algorithm

These polygons serve as containers for acceptable locations within the route and every polygon is overlapped by the next one in order to successfully track the advancement of the trip. When the users leaves a polygon, the system triggers an alert including the exact position and direction of movement (combining coordinates and the relative position of the polygon) in order to offer a new guidance for the user to come back to the designated route and thus avoid loss or disorientation.

This system ensures a continuous stream of guidance for the user, allowing the platform to automatically reset the indications considering the user's position and direction of movement and offer a more precise indication to be back on the route. For example, if the users misses a right turn, the platform will be able to know that the user is still moving forward and instead of issuing an indication such as "please turn right in 80m", it is able to send "please turn around and go left in the first street you see".

2) Indoor guidance

In order to ensure highly precise guidance within the public transportation system, Mass Factory has devised the development of an indoor guidance system. Due to the lack of GPS monitoring and the possible lack of Wi-Fi or 3G coverage, **indoor guidance is based on a dictionary of indications standards that is developed in collaboration with public administration entities**, such as Transports Metropolitans de Barcelona (Spain), Keolis (Lyon, France) or Societé de Transport de Laval (Quebec, Canada), with which the company have signed collaboration agreements.

Guidance standards are focused on obtaining simple language indications based on spatial and visual references. Instructions are presented in accessible interfaces in a step-by-step manner in order to accommodate to the walking speed of the user.

3) Remote supervision

Location monitoring based on the Polygon Driven Guidance algorithm enables the collection and transmission of location data for the user to Paratransit Control Centres or relatives.

Web-based control panels are developed in order to provide supervisors with a management tool to: **a) design custom routes** for the user, considering slope, potential hazards and the public transportation opportunities, **b) receive alerts** when the users leave the route or use the Help button in their mobile app, **c) contact the users** in order to provide help by phone and **d) monitor the movements** of the users in a map.

Control panels are adapted in order to enable Control Centres, which are responsible of groups of users, to monitor multiple users at the same time and establish responsible agents or supervisors. Cloud web applications have been chosen for the control panels in order to ensure a cross-platform accessibility to the supervision interfaces and to provide these tools to relatives of users who are not eligible of Paratransit services and thus are not monitored by Control Centres.

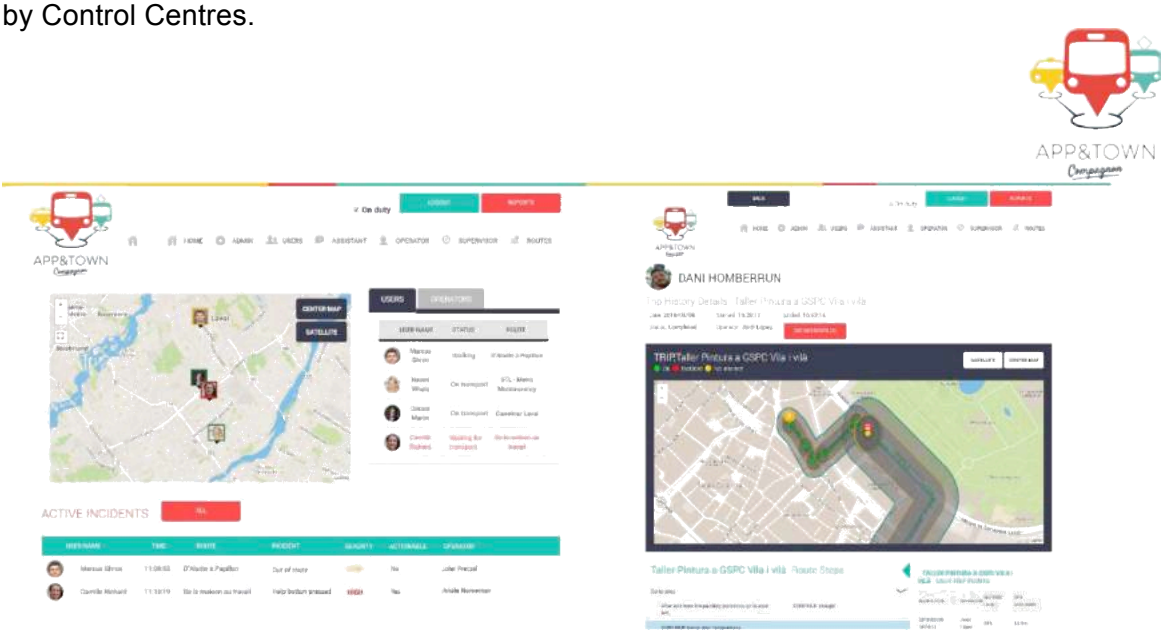


Image 2: Current Control Panel interface for user supervision and route monitoring

4) City Angels supervision

App&Town Compagnon establishes an innovative collaborative platform of citizen volunteers who offer their assistance to users who are lost or disoriented (need assistance). It includes the development of a social network-like platform based on open source software Oxwall, a PHP social networking framework.

Citizen volunteers are able to receive alerts when a App&Town Compagnon user (registered in the City Angels platform) is in need of help, either because they used the Help button or left the predesigned route. The volunteer is able to offer their help in order to reach the lost user, contact emergency numbers or the user's contacts in order to provide more information.

A subset of interfaces are developed within App&Town Compagnon intended for City Angels volunteers and assisted users (see Image 3). City Angels platform not only serve as an additional supervision layer when Control Center assistance is not available (due to the user not being eligible to paratransit support) but also provide an assistance tool to elders with mobility impairments people with contextual disabilities (tourists, children or immigrants).

Image 3: City Angels interface

5) Interfaces

A full set of interfaces have been developed with regards to accessibility requirements and guidelines, such as the Web Content Accessibility Guidelines (WCAG), and in collaboration with associations in support of people with disabilities such as Grup Sant Pere Claver, Institut Municipal de persones amb Discapacitat (Barcelona), Fundación ONCE (Spain) and the Royal National Institute of Blind People (United Kingdom).

These interfaces have been developed initially for three key demographics in the App&Town Compagnon user reach:

a) Fragile population: who have difficulty to freely travel through the city or urban areas, such as children or immigrants, due their contextual disability regarding language or orientation.
b) Elder population: who needs a system to feel more confidence in their trips, with which they can return home in case of emergency and which will alert their relatives when the uses goes out of a predesignated zone.
c) People with mild cognitive disabilities: who can perform predefined routes on their own, with guidance and monitoring, but also arbitrary routes (i.e.: go to the zoo).

Each interface has different features, which can be enabled or disabled depending on the user needs and/or the decision of the supervisor/relative:

a) Easy call-to-action buttons such as Home or Emergency.
b) Predefined routes set by their supervisor or relative using the Control Panel described before (ex: home-to-school for cognitive or children, “visit Sagrada Familia” for tourists, go to “Consulado” for immigrants).
c) Active monitoring from a Control Center, which is alerted in case of emergency or problems (i.e.: the user is standing still for a long period of time, he left the route, etc.).
d) Passive monitoring that can be read when necessary by a relative/supervisor, without explicit alerts.
e) Bounding box to ensure the user doesn’t go off and get lost, alerting relative/supervisor.

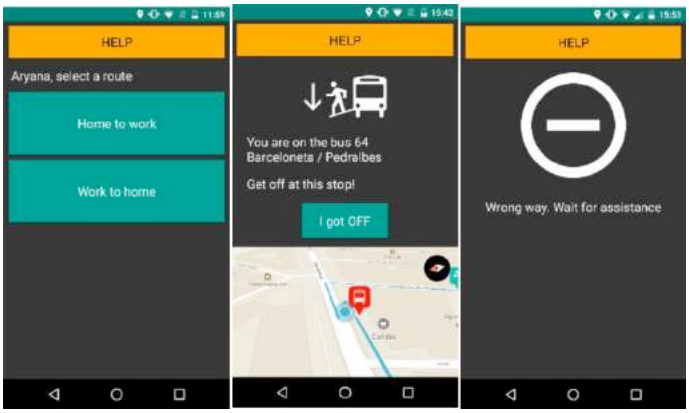


Image 4: Current user interfaces example focused on accessibility

The interfaces have been developed as native mobile applications for Android, iOS and Windows 10 Mobile in order to be compatible with the majority of smartphone devices in the market.

6) Data analysis and Business Intelligence

A Big Data analysis module have been developed in order to identify trends through the analysis of the data provided by the location monitoring module, the control panels, the City Angels module and the interfaces. The objective is to detect potential conflicts within the routes, the indications provided or the interfaces, as well as identifying problematic points within the city, the area or the public administration network if multiple alerts coincide in location.

Business Intelligence unit also serves as a supervisor review tool for Paratransit operators in order to ensure the proper supervision of the assisted users and also an analysis tool of the route planning system in order to include modifications within the route planner to avoid conflicts.

Collected data through the BI unit also serves as research data for therapy specialists for the different collectives with disabilities in order analyse conduct on autonomy, travel, elements or places that trigger confusion and learning curves.

4 THE GOAL

The goal of App&Town Compagnon is to offer a tool for assisted transport to people with disabilities and mobility impairments. The solution adopts ICT in order to reduce the accessibility barriers that hinder the personal autonomy of these citizens, a factor that has been linked to a reduced access to employment, increasing the risk of poverty and reducing the quality of life. Concurrently, App&Town Compagnon provides to paratransit service operators with an ICT platform through which plan the routes and supervise the movements of the users. As a result, App&Town Compagnon improves the sustainability of the service, with a reduction of cost of up to 50%, as paratransit operators nowadays rely on costly fleets of cars and accessible buses. By enhancing the sustainability of the paratransit service operators and reducing the dependency on fleets of cars and buses, App&Town Compagnon causes a reduction of CO_2. Additionally, it fosters the adoption among B2C users of the public transportation, thus reducing the dependency on relatives' cars as main mean of transport. The reduction of the CO_2 emissions can be over 50% due to the reduction of cost and usage of the vehicles.

4.1 Ambition

App&Town Compagnon main ambition is the establishment of an ICT infrastructure for assisted transport in every major city in the EU, North America and APAC in order to give precise guidance, support and accessibility to every citizen with disabilities and mobility impairments. The proposed technology is paired with commercial and policy efforts in order to attract the collaboration of paratransit service operators, other municipal transport service operators and Control Centres, as well as developing and nourishing a City Angels program in every major city.

4.2 Applications

B2B – Paratransit operators:

a. Route planning for multiple users through a centralized control panel
b. Location supervision of multiple users at the same time
c. Alerts and notification when the user leaves the designated route or asks for Help in their device
d. Assigning specialists and controllers to group of users
e. Visualize and analyse historical data regarding users, alerts, supervisors and routes

B2C – contains a range of users with light, mild or severe disabilities:

a. Users with mild cognitive disabilities will receive high-precision guidance in order to follow the route predesigned by the Control Centre or paratransit service operator, through an accessible interface in their smartphone device with Emergency buttons and a "Home" feature that will offer a quick route back home.
b. Elder users will receive high precision guidance for usual or customized routes through accessible interfaces. Their location can be monitored either by Control Centre or a relative and they have Emergency buttons in case of loss, disorientation or conflict. Their data can be sent to a City Angels if the user is registered in the platform.
c. Users with contextual disabilities will receive a city navigation tool with high-precision guidance integrated with the public transportation network. They will be able to set custom routes and send emergency notifications if lost or in conflict to the City Angels platform.
d. Relatives of the aforementioned users will be able to monitor their location through a web-based control panels or a mobile application, receiving notification when an alert is issued and contacting the user to their phone in order to offer assistance.
e. Volunteers of the City Angels platform will be able to register and offer their help, receiving notification when a user in the area is in an emergency, receiving their contact info and location in order to provide assistance.

4.3 Advantages with Respect to Competing Technologies

a) **High precision through the Polygon-driven guidance algorithm and indoors guidance:** Users receive precise indications regarding their current location and the position where they left the predefined route, allowing them to return to the route to avoid confusion and loss. The indoor guidance standard provides indications and spatial reference in an accessibility compliant manner in order to ensure navigation through indoor facilities such as metro or train stations.
b) **Supervision via Control Centre or web-based control panel:** Users are able to rely on remote supervision either via Control centre or paratransit operators or by their own relatives, using the web-based control panel, in order to track their advancements through the route, respond to every alert and emergency and offer remote assistance.
c) **City Angels platform:** Citizens to volunteer when a user of the platform is lost or in trouble. As
a result, citizens who register in the platform are able to act as City Angels to respond to emergencies or alerts and offer assistance to the users.

5 IMPACT

5.1 Users/Market

More than one billion people in the world and 80 million in Europe (15% of the population) live with some form of disability, of whom nearly 200 million experience considerable difficulties in functioning. And its prevalence is expected to grow considerable due to the worldwide ageing population and the rising incidence of chronic diseases such as diabetes, cardiovascular disease, cancer and mental health disorders[4]

The absence of an intermediate and versatile solution causes that, due to economic recession, offering paratransit service to every potential user would be unsustainable from a budget point of view, hence leaving people unattended and with a reduced autonomy.

Consequently, Mass Factory has performed an extended analysis on the different user needs, from the point of view of both individuals and entities or public administrations, in order to design an effective solution.

App&Town Compagnon addresses three kinds of users: transport service providers (B2B), people with disabilities and relatives (B2C) and public administrations or associations (B2G).

- **Transport service providers (B2B)** are public or private companies that offer local or regional governments the assisted transport service within their portfolio, allocating special fleets of accessible vehicles.
- **People with disabilities (and their relatives) (B2C)** comprise over 15% of the global population. There are currently 80 million people with disabilities in the EU, of which 80% is considered not to be considerably restricted[5]. Due to the different levels of impairment regarding mobility and autonomy, a single paratransit solution is not applicable.

[4] World Report on Dissability 2011, World Health Organization and The World Bank.
[5] European Commission: *European Disability Strategy 2010-2020: A Renewed Commitment to a Barrier-Free Europe*, Nov 2011

- **Public administrations or associations (B2G),** including public-funded institutes or organisations that support people with disabilities (such as the Royal National Institute of Blind People in the United Kingdom or Fundación ONCE in Spain), are responsible of the design and enforcement of the accessibility policies and strategies and also the funding of the assisted transportation services.

5.2 Market Size

App&Town Compagnon's potential market has been measured as the combination of the B2B –i.e. the current cost of paratransit systems and the correspondent funding in the different countries– and the B2C channels, including the customer expenditures on technological solutions for assistance and quality of life.

The average yearly paratransit cost per user, taking into account both public and personal expenditure, is €3.400. Considering there are 80 million people with disabilities living in the EU area, there is a potential market of over **€272 billion** if every citizen had access to paratransit services.

However, existing coverage of paratransit services only reaches 1% of the population with disabilities, thus leaving an unexploited need with a huge social benefit and market potential. Especially considering that the annual disposable income of persons with disabilities and their relatives represents $9 trillion worldwide[6].

In addition, people with disabilities have extra care costs to cover. According to several studies [78], the estimated cost of disability can be around 100€ per week in order to maintain a decent quality of life. Assuming only a mere 1% of those extra costs is devoted to technological solutions, the **potential market for technological solutions for assistance and quality of life would be over €4.200 million** in the EU area.

Furthermore, the rapid growth of the mobile applications sector, estimated to reach €63 billion in the EU by 2018, establishes the trend in which these technological solutions are going to maximize adoption among the users. Moreover, according *to The ICT opportunity for a disability-inclusive development framework,* mobile services and devices are the major factor to provide independent living to people with disabilities.

[6] The ICT Opportunity for a Disability-Inclusive Development Framework, United Nations General Assembly, September 2013,

[7] LYONS, S., CULLINAN, J., AND GANNON, B.: *Estimating the Extra Cost of Living for People with Disabilities*,
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[8] BERTHOUD, R.: "Meeting the costs of disability*"*, *The Economics Problems of Disabled People*, Policy Studies Institute, 1993

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CITIES FOR CITIZENS

Fira Barcelona

Citizenship awareness, active learning and vocational orientation: St. Peter's School curriculum proposal.

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KEYWORDS: education, collaboration, culture

ABSTRACT:

This paper presents a pedagogical proposal to introduce the concept of Smart Cities in the curriculum of secondary education. It proposes an innovative educational framework that relates citizenship awareness, active learning and vocational orientation establishing a parallelism with the idea of COI (Community of Inquiry) commonly used in online education.

St Peter's School in Barcelona, Spain has created an educational experience for its students with the goal of fulfilling their need of knowledge within this area of expertise.

1 INTRODUCTION

One of the most important duties of Middle and High Schools is to provide students with tools, knowledge and skills that could help them to be successful during their future. Innovative schools should be aware of next generations' issues providing a vision of the future and suggesting educational paths for the students, however the reality is that during the early years of schooling students do not have the opportunity to be exposed to current research and experts' voices. Particularly, the concept of Smart Cities is one that does not exist in the Spanish current curriculum.

This paper aims to share a pedagogical proposal to introduce Smart Cities as a key concept in any STEM (Science, Technology, Engineering, Mathematics) curriculum for Middle and High School.

2 METHODOLOGY

Following the idea of establishing a parallelism with the COI framework and our proposal for a new Smart Cities curriculum, we would like to introduce the COI concept. This pedagogical approach states that constructivist-learning experiences occur when three key components are present: teaching, cognitive and social presence (Ferrer-Mico, 2016).

"Teaching presence" refers to how the instructor is involved in the design and use of cognitive and social presence with the goal of facilitating learning (Anderson, Rourke, Garrison, & Archer, 2001). Similarly, "social presence" refers to student's ability to present themselves to the group and interact with the other members (Rourke, Anderson, Garrison & Archer, 2001), and "cognitive presence" refers to the ability of

participants to construct knowledge and interact with content through discourse and communication (Garrison, Anderson, & Archer, 2001), see Figure 1.

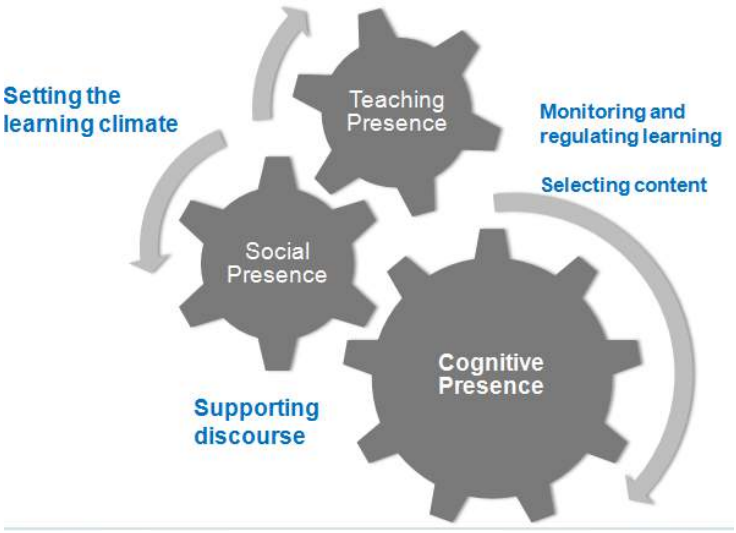

Figure 1. COI framework
Source: (Ferrer-Mico, 2016)

2.2 Curriculum Proposal

Similarly to the described framework, we are proposing a three-leg based curriculum to introduce Smart Cities within the current STEM curriculum. We highlight three main key elements that we find are fundamental in order to provide the students with the necessary information. These key elements are as follow:

2.2.1 Citizenship Awareness
Students should be aware of their role within society and how they are a key element for the future. Schools should provide training and alert the student on the issues we will face in the 21st century.

2.2.2.Active Learning
The tasks and units within this curriculum will take place as projects following PBL (Project Based Learning) methodology

2.2.3 Vocational Orientation

When designing this new curriculum we followed the background design methodology (Wiggins & McTighe, 2011; Bransford, Brown, & Cocking, 1999). This methodology, and how we are applying it at St Peter's School is explained in the next section.

2.3 Backward design for the Curriculum

We have chosen to use the background design methodology. We defined objectives for each of the lessons, select tasks and assessment methodologies and create the materials and resources students will need in order to reach the outcomes for each of the projects, see Figure 2.

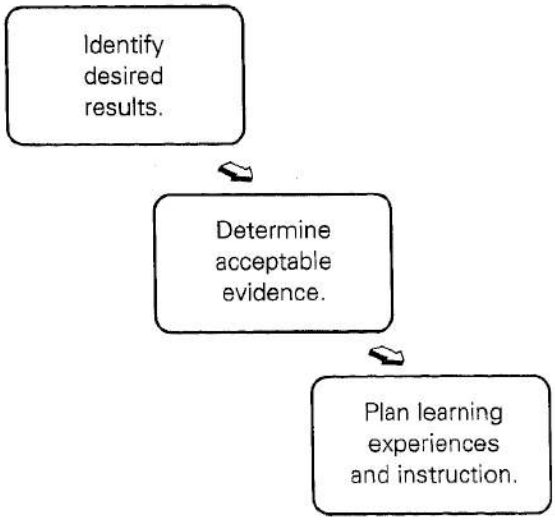

Figure 2. Background design methodology
Source: Design steps from Wiggins & McTighe, (2011)

Within the topic of Smart Cities we will develop a curriculum similar to the following one:

1. Energy
2. Automatics
3. Domotics
4. Webs and security
5. Domotic buildings and cities
6. Final Project

As an example of a project within the first section of Energy we provide the next section and share the outline for the assessment and evaluation

2.4 Project Sample

This project could be developed for term 3 in 3rd of ESO. It relates environmental technology, energy and forces and measure systems, and this project will emphasize all these concepts, relate them with the engineering process and give them the opportunity of performing a hands on activity and use real data. Also, students will use their already acquired knowledge and apply mathematic ideas and show competence in the area. The project will have the following outline:

Objectives

At the end of the lesson students will be able to:
1.Differenciate between monitoring systems
2. Evaluate different systems with the goal of selecting appropriate ones

3.Develop arguments for choosing each of the system for the appropriate situation

Assessment: Instruments and methodology

Assessing students will give us information on their understanding and performing levels. For this particular project we have chosen to use a rubric as an instrument and an oral presentation.

Goal one and two will be evaluated using a rubric, and goals number three will be evaluated with their performance during the oral presentation. Some criteria will be developed to evaluate student's oral performance: clarity, focusing on the point, selection of appropriate reasons and others.

Connection with mathematic concepts

This project will help students apply their previous knowledge on data handling and representation while using real data from the activities. Students will connect some ideas with the information extracted from the experiments and performed labs.

Student tasks

Students will have to become familiar with the different types of technologies used to retrieve data from the oceans, research each of them an chose which one would be the best option in each of the suggested situations.

Materials

Students will work with the resources provided by the *medclic* project and workshops created by the STEM teachers

Unit Planning

This project will have duration of three weeks approximately. Each week one of the initial goals will be fulfilled and students will be assessing their knowledge and understanding.

3 CONCLUSIONS LIMITATIONS AND FUTURE RESEARCH

Our suggestion for future research would be to study and compare this project with the traditional classes performed and offered to the student until now.

We are aware that some of the Smart Cities concepts are not in current curriculums, but the comparative could be done matching outcomes in Science or technology current classes.

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CYBERVIEW

Cyberjaya : Smart City Through Collaboration

Tengku Azrul
Innovation and Commercialisation,
Cyberview Sdn Bhd

Cyberview is a tech hub enabler

1996	2005	2011	2015
Landowner	Facilitator	Cybercity Manager	Tech Hub Enabler
Develop basic infrastructure to enhance attractiveness in Cyberjaya	Sell and lease land, construct buildings, support government certified ICT companies via Cyberjaya development	Drive growth of Cyberjaya as a premier ICT Hub	**Cyberview to transform Cyberjaya into a Global Technology Hub**

As a Tech Hub Enabler, we believe in the power of collaborations to unlock the potential of technology for both Malaysia, and the world.

Investor relations services
- Tailor-made incentives
- Facilitation in regulatory matters
- Business matching and strategic partnerships
- Site selection assistance
- Talent facilitation

Industry development initiatives
- Enterprise development
- Talent development and retention
- Clusters development

Tech hub development & management services
- Consultancy services
- Township management
- Planning and physical development
- Properties and facilities management

Smart City and Living Lab:
Key Initiatives towards Global Tech Hub

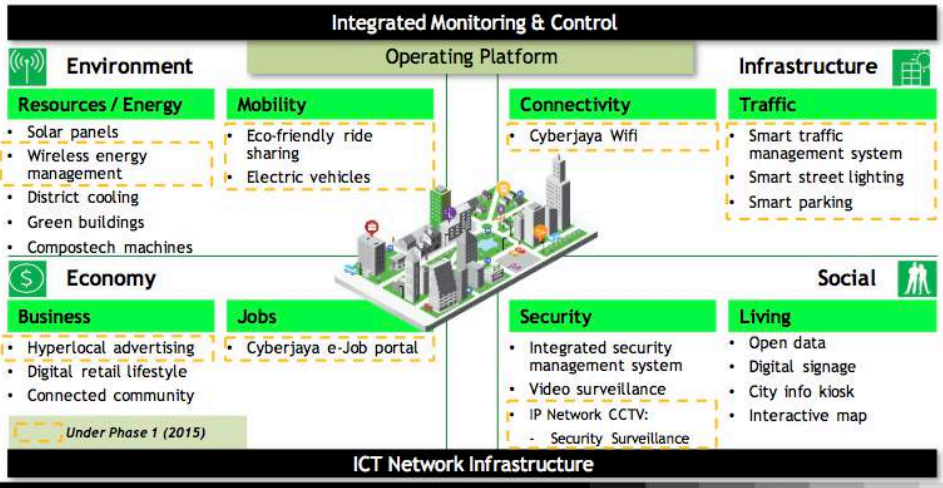
Cyberjaya Smart City:
The Objectives

Cyberjaya as a Smart City involves the development and testing of intelligent technologies to provide valuable solutions and services aimed at:

1. Increasing efficiency of public services and city living;
2. Improving quality of life and creating a safe city; and
3. Improving standard of environmental sustainability, in line with Cyberjaya's Low Carbon City Framework.

The testing of smart solutions in Cyberjaya also enhances the Living Lab proposition of Cyberjaya, i.e. using Cyberjaya as a test bed for new and innovative technologies

Cyberjaya Smart City framework concentrates on collaborative efforts and partnerships within 4 main focus areas



Cyberjaya Smart City Roadmap: 2015 - 2020

	Phase 1 (2015) Introduction of smart city foundation	Phase 2 (2016) Promoting consumption of smart city solutions	Phase 3 (2017-2018) Integrating solutions for control and monitoring	Phase 4 (2019-2020) Promoting widespread access and adoption
Infrastructure	• Wi-Fi infrastructure • Smart traffic management • Smart parking • Smart street lighting	• Wi-Fi infrastructure expansion in newly developed areas • Smart traffic management • Smart street lighting	• Wi-Fi infrastructure expansion in newly developed areas • Integrated Township Management System	• *New smart infrastructure applications*
Environment	• Wireless energy management • Eco-friendly ride sharing • Electric vehicles	• Smart sensors for environmental monitoring (e.g. water, heat, carbon sensors)	• Energy Monitoring & Control • Facility Management • Waste Management	• *New smart environment applications*
Economy	• Hyperlocal advertising • Cyberjaya e-Job portal	• Digital retail lifestyle • Connected community	• *New smart economy applications*	• *New smart economy applications*
Social	• IP Network CCTV: - Security Surveillance - Traffic Monitoring	• Cyberjaya open data (at least 3 data categories) • City info kiosk • Digital signage • Interactive map	• Cyberjaya open data (at least 5 data categories) • Integrated Security Management System	• *New smart social applications* • Cyberjaya open data (10-20 data categories)
Operating Platform	• Identification of possible systems for integrated platform	• Evaluation & selection of operating platform	• Implementation of integrated platform	• Continued adoption of integrated platform

Pilot projects

Several partnerships have already been established for Smart City projects in Cyberjaya and are in various stages of development

1 Preliminary

In discussion phase - terms of parnership are still to be defined

- REDtone · Smart infrastructure
- MDEC · Internet of Things
- TENAGA NASIONAL · Renewable energy and integration · Smart Grid
- MCMC · Interactive map
- QUEST · Quest mobile app
- MCMC SPAD · Smart Mobility

2 Pilot

Pilot of solutions are ongoing or recently completed

- MCMC · Carbon emmission tracking tools
- RENEON · Wireless energy management
- tumpang · Eco-friendly ride-sharing
- b · Hyperlocal advertising
- CREST · Hyve bluetooth tracking

3 Commercialisation

Smart city solutions are being commercialised or implemented

- TM · Cyberjaya Wireless
- · COMOS electric vehicles
- COFELY MEGAJANA · District cooling system
- TM · Smart Traffic Management
- MDEC · Smart Parking

Cyberjaya Smart Traffic Management System: A Collaborative Project

CYBERVIEW

1. PROJECT OWNER:
Cyberview as the Cybercity Manager for Cyberjaya

Enhanced Integrated Command Centre with real time sensory monitoring, control and management of city's critical services.

SEPANG

2. MUNICIPAL COUNCIL

City facilities and traffic remote control management

Benefits

- Increases the efficiency and productivity of the city
- Centralized data gathering provides higher degree of situational awareness of the city
- Provides platform for new service creation and new playground for Startups

Partners MDEC TM

3. FUNDING OF CATALYST

Technology & industry development in smart city projects

4. PROJECT IMPLEMENTER: INFRA PROVIDER

Smart traffic infrastructure

Cyberjaya Smart Service Cloud Infrastructure

Smart Traffic Management System

Smart Parking

4. OTHER PROJECT IMPLEMENTERS: INFRA PROVIDER

Integrated Network

Smart Street Lighting

CYBERVIEW Living Lab

City Apps Service

Create a strong tech ecosystem through our Connecting Cyberjaya Partnership

Let's collaborate!

Our synergistic Partnerships across all segments

- National ICT Agency
- National Green Technology Agency
- National Biotechnology Agency
- Small Enterprise Development Agency
- National Telecommunications Provider
- Cyberjaya's Master Developer
- City Hall
- Cradle
- National Innovation & Entrepreneurship Development Agency
- National Human Capital Development Agency
- National Investment Development Authority
- KL Investment Promotion Agency
- National R&D Centre in ICT
- Agency for SMEs
- Communications and Multimedia Regulator

CYBERVIEW

Thank you

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CITIES FOR CITIZENS

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LOS TELECENTROS COMO HERRAMIENTA EN EL DESARROLLO DE UNA ESTRATEGIA SMART EN ZONAS RURALES.

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KEYWORDS:
smart rural area, smart ecosystems, smart regions, digital divide, regional development, rural grids, strategic planning, public services, rural living labs, eGovernment.

RESUMEN:

La definición de las necesidades de las grandes ciudades en relación a la gestión de los recursos en función de su crecimiento en las estrategias denominadas Smart City diverge de las requeridas para regiones rurales con poblaciones más pequeñas. Para éstas será necesario concretar nuevos enfoques estratégicos para que con el soporte de la tecnología se puedan resolver o mitigar los problemas que se presentan en estas zonas, y que son diferentes a los existentes en grandes urbes.

Para ello se plantea en el presente artículo el papel de los telecentros en la definición y desarrollo de estas iniciativas en las zonas rurales, por su capilaridad territorial así como su capacidad de relación directa con el ciudadano, para de esta forma hacerle partícipe de este proceso. Además, se presenta a los telecentros son una herramienta fundamental para garantizar el acceso universal a los servicios públicos redefinidos tecnológicamente así como capacitar a los usuarios de las herramientas dispuestas para tal fin.

1 INTRODUCCIÓN

El desarrollo actual de las políticas y tecnologías relacionadas con las smart cities está alcanzando un alto grado de madurez. Tanto en Europa como en el resto del mundo son muchas las ciudades que, de una u otra forma implementan ya soluciones de este tipo en alguna de las áreas de interés. No son tantas las que han definido una estrategia global, pero cada día son más.

Este desarrollo de las ciudades no se está viendo acompañado por un desarrollo similar en las zonas rurales. Aunque se esté llevando a cabo, de forma global, una transferencia de

población de las zonas rurales a las ciudades, son aún muchas las regiones en las que esa casuística no es tan acusada, o las transferencias de población se producen a ciudades de tamaño medio, situadas en zonas rurales o en el cinturón de las grandes ciudades. Es este el caso de Andalucía, región situada al sur de España, la mayor en cuanto a población y con aún un porcentaje de población en las zonas rurales alto, que se ha estabilizado a lo largo de los últimos años.

Es por tanto necesario tener en cuenta los conceptos de smart rural y smart region para que no se repitan situaciones pasadas y las zonas rurales pierdan el tren de la tecnología. Ya pasó, a finales del siglo pasado, que se abrió una brecha digital entre las zonas rurales y las urbanas en cuanto a la posibilidad de acceso a internet y nuevas tecnologías. Es necesaria la actuación desde las administraciones públicas, garantes de los derechos de toda la población, de tal forma que la redefinición de los servicios públicos sea accesible a todos los ciudadanos.

Para ello, se presenta en este artículo el papel esencial de los centros Guadalinfo, como ejemplo de red de telecentros, en la estrategia que se va a desarrollar en Andalucía, entre los años 2016 y 2020, por parte del Consorcio Fernando de los Ríos, entidad creada para promover el fortalecimiento de la Sociedad de la Información y favorecer su puesta en valor al servicio del interés público y el bienestar y calidad de vida de la ciudadanía. Esta entidad gestiona actualmente el programa Guadalinfo, creado por la Consejería de Empleo, Empresa y Comercio, junto con las ocho diputaciones Provinciales y los Ayuntamientos en el año 2004, con el objetivo inicial de disminuir la brecha digital en el entorno rural de la Comunidad Autónoma Andaluza.

El Consorcio Fernando de los Ríos pertenece a la red europea de telecentros (Telecentre Europe), a la red de living labs europea (ENOLL) y, actualmente, ostenta como entidad gestora de Guadalinfo, la presidencia de la entidad nacional Comunidad de redes de Telecentros.

En los siguientes apartados se detalla la estrategia y las iniciativas llevadas a cabo por parte del Consorcio Fernando de los Ríos y la red de telecentros Guadalinfo para luchar contra la brecha digital que puede suponer la aplicación de políticas y tecnologías relacionadas con las smart cities con respecto a zonas rurales de Andalucía.

2 LOS TELECENTROS COMO LIVING LAB PARA LUCHAR CONTRA UNA NUEVA BRECHA DIGITAL - SMART CITIES

El principal objetivo por el que se inició el programa Guadalinfo, la disminución de la brecha digital, vuelve a aparecer en el horizonte de nuestra sociedad, esta vez enmarcado dentro de las políticas y tecnologías que se definen y se engloban dentro del concepto de Smart City. Las grandes ciudades de nuestra comunidad ya llevan estrategias y acciones destinadas a implantar estas políticas, servicios y tecnologías. No podemos dejar atrás a las zonas rurales.

Actualmente, la red de telecentros Guadalinfo, tiene localizados más de 800 centros distribuidos por toda Andalucía. Se encuentran en todos los municipios de menos de 20.000 habitantes, en las Entidades Locales Autónomas y, en las ciudades de más de 20.000 habitantes, en los barrios con riesgo de exclusión social. Todos los centros cuentan con

equipamiento informático, internet de banda ancha y un Agente de Innovación Local que gestiona el centro y dinamiza el municipio.

Imagen 1. Distribución centros Guadalinfo en Andalucía
Fuente: Elaboración Propia

Los Centros Guadalinfo:

- Sirven como un entorno corporativo donde la organización puede realizar un modelo estratégico para el desarrollo de un proyecto.
- Tienen como objetivo el desarrollo de las competencias digitales, transferir herramientas para innovar, adquirir capacidades y desarrollar habilidades en torno a las TIC.
- Trabajan el desarrollo local y la participación ciudadana a través de la integración de la comunidad, desde el crecimiento, con actuaciones que impulsan nuevas soluciones tecnológicas y facilitando canales de comunicación a la ciudadanía.
- Actúan como nexo entre la ciudadanía y las administraciones utilizando como herramientas las TIC.
- Impulsan la participación de las personas de la organización (ayuntamiento) a través de actividades de formación y capacitación y favorecen el trabajo cooperativo con el resto de áreas municipales, así como con los diferentes agentes sociales en los municipios.
- La cooperación de los centros de la red con el sector público y privado, la colaboración social sin exclusiones y el desarrollo del trabajo en la red, son elementos sustanciales al proyecto Guadalinfo que lo ha convertido en un espacio innovador que fomenta e impulsa el talento, las oportunidades y la calidad de vida en el entorno urbano.
- Mejoran la eficacia y eficiencia de las Entidades Locales en la prestación de los servicios públicos a través del uso de las TIC.

- El nivel de coordinación e interacción transversal existente entre las administraciones local, provincial y autonómica dentro de este proyecto, sumado al contacto permanente y cercano con la ciudadanía y los responsables políticos, hace del proyecto Guadalinfo un ecosistema ideal en el que desarrollar un diagnóstico de necesidades y un acertado catálogo de servicios y políticas públicas.
- Todos los centros funcionan y se gestionan con software libre, siendo esta una de sus características esenciales y fomentando el uso y conocimiento del mismo a todos los ciudadanos.

Evidencia lo indicado anteriormente el papel tan importante que pueden y deben desarrollar los telecentros en uno de los aspectos esenciales en cualquier estrategia de Smart City: la participación ciudadana en su definición y desarrollo. De esta forma, cualquier iniciativa en la que el ciudadano esté implicado podrá tener una mayor probabilidad de adaptación al nuevo entorno y una utilización intensiva del nuevo servicio, siendo además el telecentro la garantía del acceso de cualquier ciudadano a la tecnología subyacente a las iniciativas asociadas a la estrategia Smart.

Siguiendo lo anterior, se constata uno de los elementos quizá menos evaluados hasta el momento en las iniciativas llevadas a cabo en torno al concepto Smart City, y es el de tener en cuenta a todos aquellos ciudadanos, por una u otra razón, tienen menos capacidad de acceso a la tecnología. Resultado de ésta deberá concluirse que han de establecerse las estrategias adecuadas en lo relativo a la formación o capacitación y la accesibilidad universal propia de los servicios públicos. En los centros Guadalinfo se establecen como prioritarias las líneas de adaptación del equipamiento para cualquier tipo de discapacidad funcional de los usuarios, permitiendo de esta forma la inclusión de todos los ciudadanos en iniciativas como esta.

Imagen 2. Usuarios en un centro Guadalinfo
Fuente: Elaboración propia

3 INICIATIVAS SMART EN LAS ZONAS RURALES

El proyecto Guadalinfo se desarrolla principalmente, aunque no únicamente, en poblaciones pequeñas, con menos de veinte mil habitantes. Teniendo en cuenta esto además de la pertenencia al mismo de casi ochocientos municipios de Andalucía, se puede colegir su despliegue por casi todo el territorio andaluz. Por tanto, tiene un papel importante en la participación del despliegue de la estrategia denominada AndaluciaSmart, que ha diseñado la Junta de Andalucía para su implantación en el periodo 2015-2020.

Como bien se indica en el estudio realizado por el Instituto Fraunhofer “Villages on the road to the future with Smart Ecosystems”, es importante reflejar que las necesidades o problemáticas que se han de resolver en las zonas rurales no tienen porqué coincidir con las establecidas en grandes urbes, siendo necesaria la adaptación de la estrategia a las necesidades de cada una de esas regiones. Esto es precisamente lo que se ha diseñado en esta estrategia AndaluciaSmart, y en la que planteamos a los telecentros como nodos de una red de soporte esencial en su definición y desarrollo.

Las iniciativas que se están desarrollando para la promoción, estudio, análisis e implementación de políticas y tecnologías smart cities en las zonas rurales orbitan alrededor de cuatro ejes:

- Participación y capacitación.

- Redes para el desarrollo inteligente.
- Living Lab: AndaluciaSmart Lab.
- Apoyo en el desarrollo de Administración electrónica y eGovernment.

3.1 Participación y capacitación.

Los centros son percibidos por los ciudadanos como recursos tecnológicos en los que además del acceso a internet se pueden desarrollar iniciativas innovadoras de cualquier tipo. Esto supone una ayuda fundamental en la captación de la participación de estos ciudadanos tanto en el conocimiento de los fines de una estrategia Smart, así como la definición de los principales problemas y necesidades que tiene la población del municipio y que la tecnología puede ayudar a resolver. Esto incrementará su implicación y posibilitará una mejor aplicación de los recursos públicos en relación a la mejora de los servicios y la vida de la ciudad, municipio o región.

La formación recibida por el personal de los centros y por los responsables de su coordinación, son un valor añadido a la puesta en marcha de cualquier iniciativa que quiera llevarse con éxito al territorio, esta formación engloba todo lo relacionado con el catálogo europeo de competencias digitales, pasando por actuaciones formativas concretas en disciplinas tales como: Liderazgo, creatividad, trabajo en equipo, generación de proyectos de innovación social, gamificación, social mentoring, design thinking, digitalización de modelos de negocio, participación activa, etc.

Será por tanto necesario un esfuerzo en la definición y desarrollo de las estrategias formativas y de capacitación necesarias para que los ciudadanos puedan conocer y utilizar las diferentes herramientas, tecnologías y significado de las políticas y soluciones denominadas Smart. Por ello, los telecentros son recursos esenciales para el despliegue de las mismas, sobre todo teniendo en cuenta su capilaridad territorial y su cercanía con el ciudadano.

3.2 Redes para el desarrollo inteligente.

La capacidad de trabajo en red de los centros Guadalinfo, como ejemplo de cualquier otra red de telecentros, es uno de los activos más importante con los que se cuenta. Es en este proyecto uno de sus grandes potenciales, con una gran capacidad de difusión y de coordinación de iniciativas. Ello supone un potencial enorme en el desarrollo de tareas que puedan servir en diferentes ámbitos territoriales, con el consecuente resultado de ahorro económico y de mejora de los procesos.

La generación de grupos de trabajo, tanto de los gestores de los centros como de los propios usuarios/ciudadanos y responsables municipales, que a través de las diferentes herramientas disponibles puedan desarrollar acciones coordinadas para una mejora de los resultados de las iniciativas Smart, es una consecuencia directa de la disponibilidad de la red, tanto física comoo digital. Como consecuencia de esto, se obtendrán guías de buenas prácticas tan importantes en el desarrollo de estrategias tan innovadoras como la que se trata en este artículo.

Otro aspecto importante es el hecho de que, para poder tener proyectos de implantación de políticas y tecnologías Smart viables en los municipios pequeños, se hace necesario realizar agrupamientos teniendo en cuenta las características físicas, sociales, económicas, medioambientales, poblaciones, etc. Tomar, como coordinadores de estos grupos, a las

poblaciones mayores que son cabeceras de sus comarcas y agrupar entorno a ellas al resto de municipios satélites. El éxito vendrá determinado por la consideración de la agrupación basada en datos objetivos, buscando el mayor aprovechamiento de los recursos y no basados en agrupaciones políticas o en divisiones administrativas, como pueden ser el hecho no contemplar agrupamientos entre municipios de diferentes provincias.

3.3 Linving Lab: AndaluciaSmart Lab

En esta iniciativa se plantea diseñar un espacio en el que tanto las empresas privadas como la administración puedan llevar a cabo las pruebas de prototipos y aplicaciones, siendo de especial importancia su despliegue en una región concreta.

En este punto, el Consorcio Fernando de los Ríos pretende tanto diseñar como colaborar en la implementación del citado laboratorio, teniendo en cuenta la experiencia que tiene en diferentes proyectos europeos como “Living Lab”, formando parte de la “European Network of Living Labs” - Enoll, por la gran capilaridad que se alcanza a través de los Centros Guadalinfo en un territorio tan diverso y extenso como es Andalucía.

Con el objetivo principal de obtener una mayor aproximación a la realidad, se propone la posibilidad de incluir en la estrategia de diseño del “Laboratorio Urbano” una zona que no sea propiamente una gran ciudad, esto es, planteando la inclusión en el concepto un territorio rural. Siguiendo el modelo establecido por el proyecto Guadalinfo, se conseguirían varios objetivos importantes:

1. Que las poblaciones más pequeñas sean tenidas en cuenta en la planificación de las diferentes aplicaciones y diseños tecnológicos relacionados con el concepto “Smart City” consiguiendo la integración de todos los ciudadanos andaluces en una estrategia de modernización y mejora de los servicios públicos, teniendo en cuenta que los problemas que resolver son de diferente naturaleza según el tamaño de la ciudad.
2. Como consecuencia del anterior, se consiga resolver mediante la tecnología los principales problemas de este tipo de municipios, y así contribuir al mantenimiento o incluso el crecimiento de su población.
3. Se sumaría a este laboratorio la capacidad de los centros Guadalinfo, ya que en estas zonas rurales es uno de los referentes fundamentales en la dinámica de capacitación e integración tecnológica. Tendrían en esta estrategia un papel elemental en su capacidad de difusión entre los ciudadanos en lo relativo a tareas de colaboración de los proyectos puestos en marcha tanto por entes privados como públicos. Además, actúan como pequeños espacios de co-working o de innovación de tal forma que los ciudadanos o las empresas de estos municipios podrían usar los recursos puestos en marcha en el proyecto, promoviendo el espíritu emprendedor que es objetivo principal de la estrategia de “Smart City”.

Se propone, abundando en lo citado anteriormente, que una parte del laboratorio sea lo que podríamos denominar un “Rural Smart Lab”, desarrollado en una comarca representativa del territorio andaluz. Como ejemplo de ello proponemos su desarrollo en la Comarca de Guadix, por diferentes razones expuestas a continuación:

- Sus características hacen posible el desarrollo de actividades en diferentes ámbitos territoriales representativos del resto de Andalucía. Esta comarca está compuesta por 32 municipios, con una población variable desde los 19.000 habitantes de Guadix hasta los menos de 1.000 de municipios como Albuñán.

- Se pueden plantear soluciones a problemáticas comunes de estas zonas, como pueden ser el transporte entre pueblos y pueblos-ciudad principal o referencia (Granada-Guadix), recogida y tratamiento de residuos, problemas de logística o transporte, envejecimiento activo y propuestas de aplicaciones relacionadas con la sanidad (eHealth), etc.
- Otra característica de esta zona es su patrimonio, tanto histórico-arquitectónico, etnológico-cultural así como natural. Dispone de restos arqueológicos megalíticos de gran importancia, catedrales e iglesias, además de que parte de su territorio pertenece a dos de los parques naturales más importantes de Andalucía: Sierra Nevada y Sierra de Baza. Ello supone un reto para el planteamiento de soluciones tecnológicas, tanto en la difusión como en la gestión o aprovechamiento sostenible del mismo. Además, se deberán tener en cuenta las actividades económicas y empresariales asociadas a este entorno y cómo puede la tecnología ayudar en su promoción, desarrollo y mantenimiento.
- Tiene recursos naturales de interés, como un pantano y las minas de Alquife, además de varias iniciativas de obtención de energía como la mayor planta solar térmica (Andasol), que indica la buena ubicación para proyectos de eficiencia y ahorro energético.

El desarrollo de las diferentes iniciativas del laboratorio contarían con el apoyo del equipo de Dinamización Territorial del Consorcio, que mantiene contacto directo con todos los alcaldes de los municipios. Además, se podrían coordinar las tareas de los Agentes de Innovación Local (gestores de los centros Guadalinfo) para la difusión y participación ciudadana en la consecución de unos buenos resultados de la pruebas que se han de realizar.

3.4 Apoyo en el desarrollo de la administración electrónica y eGovernment

Teniendo presente la realidad social del tiempo en el que nos encontramos y en base a los principios de racionalidad, economía y eficiencia, las redes de telecentros, con el ejemplo de la red Guadalinfo como pionera, tienen la oportunidad de servir como apoyo fundamental en el proceso del desarrollo de las políticas de implantación de la administración electrónica.

La red de telecentros Guadalinfo, como apoyo al desarrollo de la administración electrónica:

- Coadyuvan a desarrollar la cultura de promoción del conocimiento en administración electrónica dentro de la propia organización.
- Generan la posibilidad de organizar adecuadamente el espacio físico en el canal presencial y el espacio telemático.
- Trabajan por y para el fomento de la utilización de herramientas que proporcionan las nuevas tecnologías para aplicarlas a la prestación de servicios públicos y a su digitalización.
- Favorecen el trabajo cooperativo con las áreas municipales, así como con los diferentes agentes sociales en los municipios.
- Promueven la participación del personal de la administración pública a través de actividades dirigidas a los propios trabajadores de los ayuntamientos.

Los Agentes de Innovación Local están sirviendo de enlace entre las diferentes plataformas tecnológicas que las administraciones ponen a disposición y los ciudadanos. Actualmente en la programación de la red de centros se dedican horas exclusivamente destinadas a ayudar a los ciudadanos a realizar trámites con las administraciones a todos los niveles, tanto provincial como autonómico y estatal. En muchos casos son centros acreditadores de certificado digital, hecho que por sí mismo los acerca a la administración electrónica.

Por otro lado, se trabaja desde la transversalidad con las diferentes áreas de los ayuntamientos y administraciones, facilitando el acceso, la comunicación y la relación, en función de las necesidades del ciudadano con los servicios municipales.

En la mayoría de ayuntamientos del territorio andaluz, los Agentes de Innovación Local de la red Guadalinfo, son la referencia en sus ayuntamientos para cualquier cuestión relacionada la tecnología y el acceso a los servicios telemáticos, tanto es así que en numerosas ocasiones son los encargados de realizar talleres y cursos de reciclaje y actualización de conocimientos a los técnicos de las diferentes áreas de los ayuntamientos y a los responsables políticos y municipales en temáticas relacionadas con el acceso a la sociedad de la información y el conocimiento y herramientas de participación ciudadana.

Los centros y la propia red están sirviendo de soporte para la implantación y desarrollo del MOAD (Modelo de Ayuntamiento Digital) en toda Andalucía. El MOAD es es la plataforma de tramitación digital que impulsa la Junta de Andalucía en colaboración con las diputaciones provinciales para la plena prestación de servicios públicos electrónicos de las administraciones locales. Los centros Guadalinfo sirven tanto de soporte para la capacitación como para el uso de la plataforma. Sirve esta iniciativa como ejemplo del apoyo que las redes de telecentros pueden dar al desarrollo de las acciones relacionadas con la implantación de la administración electrónica.

4 CONCLUSIONES

La experiencia acumulada en los últimos años en la gestión de la red de telecentros Guadalinfo por parte del Consorcio Fernando de los Ríos nos permite presentar a los telecentros y a las redes que forman como herramientas imprescindibles en el desarrollo e implantación de estrategias smart cities en las áreas y regiones rurales.

Las iniciativas que actualmente se están llevando a cabo y las programadas para los próximos años centran su foco en el ciudadano para que su participación en el diseño de su localidad y entorno sean el eje fundamental de las políticas a implementar. Son cuatro las iniciativas descritas en este artículo y que conforman el grueso de las acciones desplegadas a raíz de las estrategia smart para Andalucía.

La participación y capacitación del ciudadano, para que comprenda, entienda y sea un elemento activo en el desarrollo de la estrategia smart de su municipio y región, de forma que sus necesidades, visión y opinión sean tenidas en cuenta a la hora del desarrollo e implantación de soluciones que satisfagan sus necesidades. Esta iniciativa ha de ser la punta de lanza, porque coloca al ciudadano en el centro de todo lo demás. A continuación, la formación de redes, tanto físicas como digitales, que permitan la compartición de soluciones, aprovechamiento y uso racional de los recursos y establecimiento de sinergias. La creación, uso, explotación y acción de estas redes por parte de los ciudadanos ya capacitados permite un mejor desarrollo de la lucha contra la brecha digital en el área de las smart cities. Las redes de telecentros como living labs posibilitan el desarrollo de las soluciones de una forma más efectiva, permitiendo la monitorización y testeo con personas y recursos que directamente tienen el problema o necesidad que la solución implementada intenta cubrir. Por último, el desarrollo de la administración electrónica como vía de comunicación entre los ciudadanos y la administración, imprescindible para conseguir una administración pública más eficiente esté al servicio de los ciudadanos y cumpla con sus obligaciones por y hacia éstos.

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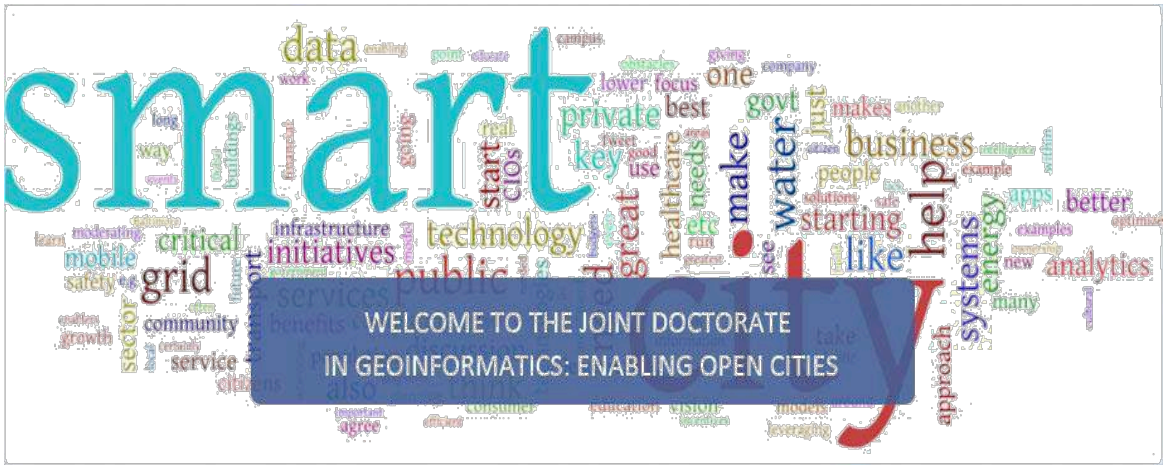


DIEGO FABIAN PAJARITO GRAJALES
ESR NO.07: MOBILE SERVICES FOR GREEN LIVING

SUPERVISOR: MICHAEL GOULD CARLSON

DRAFT VERSION 1.1
MAY 5, 2016

ABSTRACT

Mobile information systems (apps) hold the potential of assisting citizens to live a greener lifestyle, including but not limited to improved eating habits, mobility, learning, and social behaviour. This project aims to design and test effective tools to encourage green living actions and environmental awareness with tailored feedback from personal activities.

We define green living actions taking into consideration experiments for personal sensor data collection, data analysis and gamification strategies, and produce prototype systems and guidelines for future application in other contexts. Connection to existing city information systems (especially GIS) will also be described, as it supposes cost savings. Expected outputs will be included in the Geo-C Open City Toolkit.

RESEARCH QUESTIONS

Research questions are used to focus our activity on real problems, on one hand, and on generalizable concepts (lessons learned) that might be applied later by urban planners, app developers, citizens groups, or city governments.

> **Question 1**
> *Can we learn valuable lessons about citizens' urban travel behaviour using a combination of geospatial technologies, open data sources, environmental sensors and mobile apps?*

A better understanding of how citizens move across urban environments is needed to improve green living actions and environmental awareness with a personalized perspective. This understanding should consider personal schedules, preferences, landmarks, origins, destinations, frequencies, and modes of transportation used (i.e. walking, biking, driving, bus, train). Detailed information about citizens' movements is surely being measured indirectly by multiple devices and sensors but its compilation and analysis is just beginning.

This research aims to design improved architectures for city and personal scale analysis that support data integration from mobile devices and environmental and movement sensors, open data sources and environmental measurements that can be integrated using geospatial technologies; as shown at Figure 1.

Figure 1 Conceptual definition of expected combination

Question 2

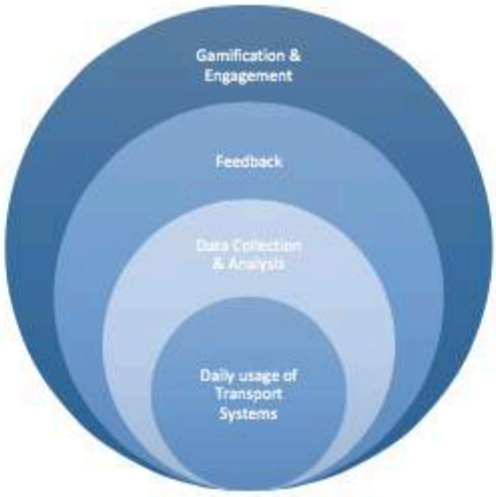
How to provide gentle and efficient feedback on urban transport behaviour using gamification strategies to improve environmental awareness and green living actions?

To have a global comprehension of urban transport dynamics operational data is not enough. User-level information could complement the analysis and provide feedback to improve commuting behaviour. Promotion of behavioural changes towards environmental friendly practices is not new, and multiple approaches have been considered [1].

Gamification is one engagement strategy commonly used by environmental psychologists [2]–[4] that aims to constantly challenge citizens, interacting with them through rewarded activities and personalized messages, to keep their attention and deliver memorable messages. Those experiences could be more attractive when local knowledge or daily activities are considered for challenges included, and incentives like virtual resources, comparable table scores or third party benefits could also improve user experience. Previous mentioned features, seen at Figure 2, could support personal or city tailored gamification and engagement strategies to promote 'greener' behaviour.

Figure 2 Citizen engagement features

Figure 2 Citizen engagement features



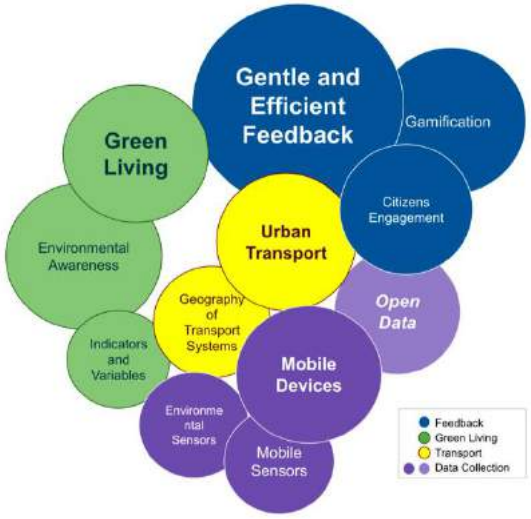
METHODOLOGY

This section describes main research activities and its relations with GEO-C project. This research is mainly developed under a *quantitative* approach where measurable and objective validations are proposed [1][2]. A set of indicators and variables that could objectively measure environmental conditions for smart cities will be selected, then open datasets and sensor data will be used to calculate behaviour and provide feedback to citizens via gentle notifications.

Some activities are clearly unmeasurable, so different approaches are needed to analyse them and discuss the way that they impact on research results [49][50]. A *qualitative* approach is also considered with multi-criteria analysis and expert panels for selecting devices, sensors and variables, also for identifying key factors of green living actions and environmental awareness. This mixed conception is compatible with GEO-C project approach where researchers with multiple backgrounds are part of OCT development.

A conceptual framework is proposed, based on an extensive literature review on Green Living Actions, Urban Transport Systems, Geospatial Data Collection, Gamification and Feedback Provision across mobile or web environments. As seen in in Figure 3 several conceptual relationships, shared initiatives, commonly used indicators and variables will be identified. Finally a short evaluation of current sensors, mobile devices, and applications is used to identify those which will be considered here.

Figure 3 Themes and concepts to be considered at introduction phase.



- Conceptual definitions and relationships among identified key concepts.
- Commonly used variables and indicators to support city scale analysis and provide feedback.
- A description of selected mobile devices and sensors for supporting data collection, personal monitoring and self-reported environmental conditions.
- Main features and limitations of current open data sources related to urban transport systems and environmental conditions.
- Principal considerations for green living actions promotion, environmental awareness campaigns and feedback from urban transport systems.

The *exploration* phase will consider research scope and concepts from previous phase for defining an experimental framework to support data exploration, integration, validation and co-validation over web and mobile platforms; experiments for combining open data sources with data collected from mobile devices will be designed and tested by UJI members; indicators and variables will be selected to be included in the Open City Toolkit – OCT; moreover design of experiments to test different gentle and efficient feedback from urban transport systems will support of general guidelines oriented to cities.

Some of the deliverables from exploration phase are listed below:

- Experimental Framework for data, indicators, services, applications and feedback testing.
- UJI test community for campus and city experiments.
- Experiments documentation and results of data exploration, integration, validation, estimation, etc.
- Defined indicators to be included in the OCT.
- General guidelines for delivering gentle and efficient feedback from urban transport systems.

Considering the exchange semester at University of Münster some of the experiments could be also performed within that semester, then selected indicators and variables would be also validated there, however detailed plan and activities need to be defined.

The *implementation* phase is the most time consuming, not only for the technical complexity but also for all external dependencies that it implies, therefore it will start with *exploration* phase. This phase will include all software and hardware tasks to perform experiments over web and mobile platforms, collect testing results and implement relevant artefacts; tasks will follow agile development principles.

Experiments will be oriented to medium-size cities like Castellón considering the active participation of its City Council and its interests on considering real conditions for research. Experimental framework results will be documented and will include:

- Artefacts design and source code.
- Mobile and Web Applications delivered for test
- Tools to be included in the OCT

The final *wrap-up* phase includes conferences and journal submissions, OCT tools' specification, thesis synopsis and final document.

A quick view of proposed methodology is presented as in Figure 4, it shows the sequence of phases and activities and also shows that experimental and implementation phases run on parallel.

Figure 4 Methodology, schema, phases and expected deliverables.

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PSL METHODOLOGY AS A CO-CREATION TOOL FOR BUSINESS-ORIENTED INNOVATION

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KEYWORDS: Living Lab, Co-creation, Engagement, Collaboration, Social innovation, Ageing population, e-health, Lean Startup, Idea Life Cycle, Business Model.

ABSTRACT:

The tools and methodologies related to community empowerment and engagement are essential when designing scenarios, innovating and changing, building and implementing solid business and non business solutions, testing and monitoring performances and impacts.
These generally concern institutional or economic organizations and, in particular, social, environmental and economic aspects through which define system of objectives and identify means and actions to be compatible with available resources to reach the objectives in medium/long term.
In that respect, the startup beMINT has developed a methodology to co-create new services and solutions for public and private organizations, on the basis of the experience of PugliaSmartLab (Living Lab created by the team of the Project Puglia@Service and member of ENoLL since the 7th wave in August 2013).
That methodology (PSL) is proposed as a reference to co-create high value added business scenarios able to rapidly reach competitiveness and market awareness, by combining the classic Living Lab approach and principles from the Lean Startup methodology.
This paper explores the main features and peculiarities of PSL Methodology in an analytical and in-depth way, and introducing a case study of its implementation. The case study, coming from health sector, is a first practical attempt to experiment PSL Methodology and a concrete possibility to improve and reinforce it.

1. BEMINT AND PSL METHODOLOGY

beMINT is an innovative Italian startup founded in 2015 and focused on service engineering by designing innovative solutions mainly in health field and by providing consultancy through Research activities.
beMINT based its Research and Innovation process on Puglia@Service Project experience focused on the co-creation of innovative solutions with citizens, companies and public administrations. Puglia@Service was a two-years project supervised by the Apulian Technological District, Dhitech Scarl, and co-funded by the Italian Ministry of Education, Universities and Research as a part of the Research&Development Piano Operativo Nazionale 2007/2013. The Project's scope was to achieve a structural change in the Region of Apulia, focusing on innovation, advanced tertiary and "Knowledge Intensive Service" (KIS) development.
PSL Methodology represents an appropriate and tested method for the systematic co-design and co-development of new services; it comes from the two-year's experience of PugliaSmartLab, the Living Lab created by Puglia@Service's team in March 2013, member of ENoLL since the 7th wave in August 2013.
During PugliaSmartLab's experience, PSL Methodology was tested and improved with the aim of combining the Living Lab methodology (LL) with the principles of the Lean Startup (LS) one, trying to highlight the best of both.
On the one hand, LL is defined as user-centered, open innovation ecosystem based on a systematic user co-creation approach integrating Research and Innovation processes in real life communities and settings (ENoLL, 2016); on the other hand, the LS provides a scientific approach to creating and managing startups and get a desired product to customers' hands faster; this method teaches entrepreneurs how to drive a startup and grow a business with maximum acceleration. (Ries, 2008).
This paper highlights PSL methodology stages as the result of this process. In addition, the case study of AdviSex project is presented.

2. PUGLIASMARTLAB AND THE IDEA LIFE CYCLE

The inspiration for PSL Methodology has been the co-creation process of PugliaSmartLab, developed and refined during the Puglia@Service project and designed on the Idea Life Cycle (ILC).
PugliaSmartLab is a LL based approach to co-create innovative solutions with citizens, public administrations and companies throughout the entire ILC[1].
PugliaSmartLab has its foundation based on the Open Innovation paradigm: "openness" refers to the approach where a variety of bodies collaborates towards a common goal while following their own objectives (Chesbrough, 2003).
One of the main characteristics of PugliaSmartLab consisted in the shift from a PPP cooperation (Public-Private-Partnership) to a PPPP model (People-Public-Private-Partnership) intended to provide new services, products and social model throughout a co-creation

[1] PugliaSmartLab is composed of a network of public partners (Municipalities, Province and Local Health Authority of Lecce, Chamber of commerce, Firefighters, University of Salento, University of Bari, Polytechnic of Bari, San Raffaele Hospital), public-private partners (Dhitech Scarl, X-Net Lab) and private partners (Engineering Ingegneria Informatica and Exprivia). PugliaSmartLab also includes the citizens association "Vivere Lecce".

processes. In this innovative PPPP model, citizens are the core of the innovation process (Arnkil et al., 2010). In fact, PPPP model's main advantage lies in the non-linearity of the innovation process itself, which adds value to cooperative aspects, based on sharing among the different contributors.

During the Puglia@Service project (2013-2015), the network of PugliaSmartLab cooperated in all phases of the ILC, from the identification of needs (co-experience) to the design of the service (co-development), from the analysis of advancement of solutions (co-delivery) to the monitoring of the final results (co-evaluation), through an iterative approach.

The ILC of PugliaSmartLab has followed these steps (Alessi et al., 2016), as illustrated in fig. 1:

- Idea Generation - Initial dialogue with citizens to collect ideas and possible solutions.
- Idea Improvement - Improvement of the initial ideas and initial project design.
- Selection - Selection of the best ideas responding to community needs.
- Opportunity identification - Feasibility studies and stakeholders involvement.
- Refinement - Detail of the project and further improvements.
- Implementation - Project implementation.
- Execution and Monitoring - Monitoring implementation and project outcomes/goals.

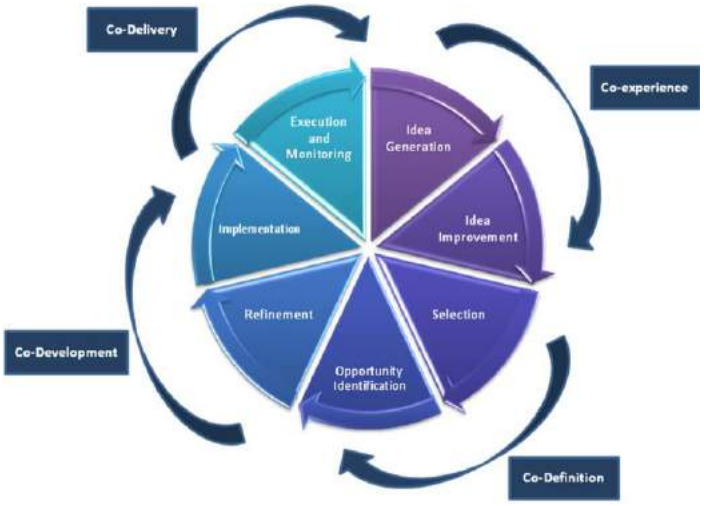

Figure 1. Idea Life Cycle of PugliaSmartLab
Source: Alessi et al. (2016)

In just two years, PugliaSmartLab has achieved several goals: it has collaborated with many local institutions (municipalities of Lecce, Brindisi, Melpignano, Castel del Monte), Italian Metropolitan cities (Milan and Turin) and international ones (San Leandro, California) for the strategic planning of the city in line with the 2014-2020 programming period; it has deepened several Smart City topics, such as Digital Health, Open Data, social impact measurement, etc. Moreover, regarding the city of Lecce, PugliaSmartLab has played a fundamental role in collaboration with the Public Administration, supporting its path towards a social model in which a direct participation and collaboration of the citizens is included.

3. METHOD

PSL Methodology was born from PugliaSmartLab, as inherits its pillars, such as Open Innovation Paradigm, PPPP Model, and co-creation approach along the ILC.
Its differentiation compared to PugliaSmartLab firstly consists in its main objective: whereas PugliaSmartLab has successfully become a point of reference for the city regeneration and for the Public Administration of the city of Lecce as a Social Innovation tool where citizens play an active role in the user-driven innovation process, PSL Methodology is more business-oriented.
In particular, PugliaSmartLab is oriented to empower citizens and co-create projects which are very context-specific, while PSL methodology aims to co-create project with scalability potential.
However, PSL Methodology satisfies the original definition of the co-creation process, by which products, services and experiences are developed jointly by companies, their stakeholders, and final customers, opening up a new world of value (Ramaswamy, 2009).
In particular, the co-creation process has the following phases, as illustrated in figure 2:

3.1 Co-Thinking

Co-thinking is the first phase of the process during which participants identify community problems and common potential solutions addressing those problems.
The topic of the discussion is decided in advance by the team to narrow the focus to specific and interesting fields. In particular, topics are selected depending on a preliminary analysis aimed at identifying user problems, needs, or sectors that could benefit from innovation. Each topic is discussed in 3-4 sessions during which participants are about 50 per session and are chosen in a random way, both per age and per gender. Each session is composed by two sub-phases:
Brainstorming: general public interacts to highlight the most relevant problems in the community: the participants discuss and affix a post-it for each problem on a board; the facilitators cluster similar issues and list the emerged problems; each participant votes the problem that he/she considers most urgent/interesting to be solved; the most voted problem is the “Top-Problem”.
Ideation: the same public collaborates to find potentially effective solutions to the Top Problem: the participants discuss and affix a post-it for relevant and effective solutions on a board; the facilitator tries to cluster similar solutions; at this point, solutions can be voted; the “Top Solution” is the more voted one and can include similar proposals with germinal innovation, sustainability and feasibility characteristics.

3.1.1 Peculiarities

PSL methodology combines LL and LS approaches as follows:
- on the one hand, according to the typical bottom-up approach of LL, user opinions and collaboration are considered essential to start from a concrete problem or need;
- on the other hand, the team propose an interesting field to be discussed at the beginning of each project, because potential users may not have a clear market, technology or product vision. This point lightly differs from LL approach, as the starting point is a specific topic or field, and moves closer to LS, which starts from the entrepreneurial idea.

3.1.2 *Experience*

During its experience, the team has conducted several flows of LL to explore community problems on different fields, such as health, art&culture, tourism, environment, mobility, etc. The more interesting issues resulted in the health field both for the relevance of its structural problems and its potential room for improvement. Regarding solutions, although participants often proposed technology-based ideas, they could rarely estimate the real potential of technological innovations.

3.2 Co-Building

During the Co-building phase, the team crosses user needs and preliminary proposals with sustainability models and technological disruptive innovation. After a feasibility study of the "Top Solution", the team presents its results and refinements to a selected public. Participants (about 100) are selected according to age, gender and specialization crossing characteristics of potential users and are involved in 1-2 sessions. This phase includes two sub-phases:
Desk research: the team analyses the market, existing best practices, sustainability models and technological disruptive innovations and defines a concept answering the needs of the community; the research is supported by scientific reviews and participation to national and international summit on the specific topic.
Field research: the team collaborates with engaged participants to refine the concept: at this point the participants can be considered stakeholders (users, providers, collaborators, partners) as they answer to specific characteristics of the potential public of the solution; in particular, the team discuss separately with each category of participants to individuate the added value per each one, to present innovative ideas that they could not imagine before and to improve proposal through the experts opinion.

3.2.1 Peculiarities

In this stage PSL Methodology merges LL and LS as the visions from the final users are challenged by market, technology and feasibility studies. In fact, on the one hand, the LS starts from an idea coming from the intuition of the entrepreneur, already responding to a feasibility study and then determines refinements with customers perspective; on the other hand, in LL ideas are selected from final users' community itself. In PSL methodology, differently, ideas come from users and then are analyzed by the entrepreneurial team in order to select the most attractive on a global and multicultural perspective.

3.2.2 *Experience*

Thanks to its experience, the team has tested that the two phases are fundamental because disruptive innovation could be spotted just through the desk research (as "Top solutions" are not very innovative), but disruptive innovation can be applied just if they are adapted to the real context. As an example, regarding sessions on the health field, some innovative technologies, e.g. wearable devices, have been rejected two years ago because of their poor diffusion and are being reconsidered nowadays both by medical specialists and by users/patients thanks to their progressive uptake.

3.3 Co-Making

Thanks to the Co-making phase the team involves users and collaborators in the building of the user experience and in the development of the solution.
In particular, the User Experience Design (UXD) is an approach that aims to create products that are as close as possible to the world of users. Build an user "experience" means investigating mental models and connections and offer an useful, easy to use and visually appealing solution.
The participants to this phase are selected on the basis of "personas" characteristics; personas are relatable snapshots of the target audience that highlight demographics, behaviors, needs and motivations through the creation of a fictional character; the sessions (2-3) are conducted with about 10 personas and the collaboration of technical and creative designers to understand user experience characteristics. This phase includes two sub-phases:
Design: the team collaborates with personas to design the functional, management, technological and visual architecture of the solution; at the end of this phase a User Requirement Specification Document, an User Experience Design Documents and a Functional and Prototype Design Document are drafted with the collaboration of technical and creative designers. Moreover, moodboards, scenarios, paper sketches, wireframes and mockups are designed to represent a visual guide for the development of the solution.
Development: the team develops the solution while facing stakeholders' needs; during this phase the team, technical and creative designers collaborates to develop the solution and continuously submit the solution to the personas to improve their user experience. At this point, according with the results of the consultations, advices and experiences of personas, the team makes changes and refinement of the solution.

3.3.1 Peculiarities

In this stage, PSL methodologies differ from the LS approach as users are not involved in the latter. However, user involvement during the design and development stages are considered essential because there are many variables affecting this stages that may affect the success of the solution as well. To show some examples, an ICT product/service, even though having a concrete market potential, may not be successful due to usability or graphic issues. LL and PSL reduce consistently these risks, while LS approach includes the adaptation of the solution depending on usability metrics.

3.3.2 *Experience*

Thanks to this phase, the team usually includes and/or modifies several features and characteristics in its solutions responding to specific needs of users and facilitating the navigation path of users. In particular, as the solution are usually technological some Rapid Prototyping sessions on mockups through the "tree testing" method[2] are conducted to evaluate and improve the prototype definition.

[2] This approach aims to organize information structure in a optimal manner, according with users mental models. In particular, it is a simple, cheap, fast and very powerful instrument to test the information structure of a website through the usability of site's mockup, with an immediate analysis of the data.

3.4 Co-Testing

Co-testing is the last phase of the process during which the prototype of the solution is launched, users test the product performances on-line and off-line and the team improve its functionalities and characteristics. This phase includes two sub-phases:
Take-off: the solution is introduced in the ecosystem and addressed to the public specifically interested. This phase is boosted through marketing campaigns via web, social network and press release, pre-launch with important influencers, as friendly customers, prospects, bloggers, or partners, and involvement of users through tutorial video and infographics;
Monitoring: the team assesses effectiveness and efficiency of the solution on the context, in collaboration with the whole community. This phase is conducted both off-line and on-line:
- off-line with about 50 people corresponding to personas characteristics in a final session, continuing to drive product refinement through subsequent iterations and upgrades;
- on-line with a larger community, collecting feedback data, such as support tickets, bug reports, and other analytics through on-line interviews, surveys and community discussions.

3.4.1 Peculiarities

This stage is expected to be similar in LL, LS and PSL Methodology as well: in fact, the approach and the goal is monitoring the interaction of the users with the solution in order to perform continuous improvement.

3.4.2 *Experience*

This is the on-going phase for almost all products of beMINT; for this reason, some KPIs have been supposed to test products after their launch.

Figure 2. PSL Methodology
Source: beMINT elaboration

4. CASE STUDY: ADVISEX

beMINT uses PSL Methodology to analyze several solutions and to develop sustainable, effective and functional services and products, with a focus on the fields of health.
As an example, during a series of LL sessions about the health-innovation related topic, an issue often ignored for various socio-cultural reasons emerged: sexual well-being (co-thinking).
Following LL sessions, held in particular with specialists of sexual health (andrologists, gynecologists, urologists, dermatologists and psychologists) and users looking after their sexual wellbeing, have identified the key issues for developing an innovative solution in this field, Advisex (co-building and co-making) .
AdviSex is a web application focused on sexual wellbeing and prevention. It supports users in becoming more aware about sex-related issues and encourages them in deciding to contact a Specialist by offering secure and private ways to do that. It has resulted the winner of a European tender for prototype development.
Currently Advisex is being prototyped and the team will test mock-ups with specialists and a sample of end users for the definitive establishment of the features (co-testing).
The methodology has been conducted as follows:

Co-thinking has been done at the beginning of the project, launching the topic "Health and Innovation" to assess how health-related topics could benefit from innovation.
The potential users involved amounted to 216 people, randomly selected and divided in 4 different LL sessions. As result of the **Brainstorming** sub-phase, several health problems and Health System branches have been deepened; sexual health was one of the most selected topics and for this reason it has been selected as "Top problem". In particular, people reported that sexual sphere is still affected by taboos and stereotypes, and it is a topic which is difficult to talk about. As result of the **Ideation** sub-phase, several proposals have been discussed to understand the best way to solve the issues identified in the Brainstorming. The most voted proposal was a tool supporting a first contact between users and specialists in a private and secure way; for this reason, it is been selected as "Top Solution". The importance of prevention and awareness were well considered too; for this reason, these proposals were not completely excluded from the following steps of the co-creation process.

Co-building has been done firstly consulting authoritative papers and publications of dedicated Research Centres and then in collaboration with users and doctors. As result of the **Desk Research** sub-phase, the team found that a considerable share of the Italian adult population aged from 18 to 55 (70%) are dissatisfied with their sexual life; among these, only 10% decide to consult a specialist to solve their doubts, while the remaining part mostly searches the Web to find a solution or explanation (ANSA, 2015). The team has also confirmed the importance of prevention and awareness in health: in fact, WHO points out that health costs due to lack of prevention and information are growing. With regards to sexually transmitted diseases, WHO estimates a 340 billion dollars annual bearing on national health systems, with a growing trend (Epicentro, 2013). Regarding technological aspect, the team has identified the Mobile Application as the most suitable channel for the solution (European Commission, 2014); moreover, the total value of Mobile Health Market will be approximately $ 23 billion and 1.7 billion people will use it within three years.
For the **Field Research** sub-phase, the participants have been selected according to gender and age for final users and according to age and to different disciplines of sexual sphere for specialists. During this LL sessions, the results of the Desk Research have been submitted to

the participants: Web Application resulted the favorite channel to address the challenge, compared to the Mobile Application; the reason for that is mainly because people would not be comfortable with having an application about sexual health on smartphone due to privacy concerns.

In the **Co-making** phase, user and software/technological state of art requirements and the user experience design for the AdviSex project have been set. The LL sessions were carried out with 8 personas, selected on the basis of the different characteristics of the target. During the **Design** sub-phase, an User Requirement Document[3] (URD), an User Experience Design[4] (UXD) and a Functional and Prototype Design[5] (FPD) have been drafted.
Moreover, mockups were designed with the collaboration of personas, a technical developer and a creative designer to represent a visual guide for the development of the solution.
In the **Development** sub-phase, the technical developer and the creative designer have developed firstly interactive mockups and then the prototype of the solution.
Meanwhile, some Rapid Prototyping sessions with personas on web site's interactive mockups through the "tree testing" method have been conducted to evaluate and improve the prototype definition. At this point of the analysis it has been easy to identify any structural problems, just observing the search path of users to end each task, and it has been easy to make improvements on the entire structure.

Finally, the **co-testing** of AdviSex will be performed with the users when the prototype will be completed, to test the product performances and improve its functionalities. Meanwhile, concerning the **Take-off** sub-phase, a Communication and Marketing Plan[6] (CMP) has been set.
Concerning the **Monitoring** sub-phase, the team will conduct off-line tests through some Rapid Prototyping sessions on the prototype with a larger number of potential final users, corresponding to personas characteristics; several KPIs have been already identified in order to define significant methodologies and metrics.

CONCLUSION

PSL Methodology addresses the ambitious objective of defining a platform, a standard for the intersection between supply and demand of open innovation, for the transformation of ideas, research and technology into value for a multi-actor and multistakeholder system.
Thus, PSL Methodology represents an attempt to experiment an analytical and common language between public and private, between innovation and tradition with the ultimate goal of increasing the potential for economic, social and technological innovation of ideas, solutions, territories and future investments.

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[3] URD to illustrate the terms of reference for design, development and realization of the technical component of the software product.
[4] UXD to create a product as close as possible to the world of users.
[5] FPD to define the prototype design through the detailed description of each feature, the definition of software architecture of the system and the ER diagram.
[6] CMP defines user targets, competitive positioning and Unique Selling Proposition, partnership and collaboration, business and revenue model and price strategy, marketing materials, conversion strategy and financial projections.

Regarding the method, PSL Methodology combines the classical Living Lab approach and the Lean Startup paradigm, in intersection with the Idea Life Cycle, delivering an experimental and analytical tool for the creation of innovative scenarios, user and business oriented.
Although the paper has presented the practical application of the Methodology on a scenario related to e-health issues, PSL Methodology has been designed to further future experiments in the classic areas related to the domain of smart communities (mobility, energy, government, living, etc).
In conclusion, PSL Methodology is an analytical and experimental tool for raising community awareness on innovative issues related to service engineering and social innovation, for generating innovative ideas and solutions by applying multidisciplinary approaches and contamination knowledge, for accelerating and facilitating the development of business projects, for building local ecosystems in order to promote multi-actor connections and the internationalization of the innovation clusters.

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Digi-Tel – A Personalized, Interest and Location-based City for You

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Abstract

The chapter describes a unique technology developed by the Tel Aviv Municipality, Israel called Digi-Tel. It aims to engage, involve and connect city residents directly to municipal departments, and enable them to benefit from the efficient two-way use of Information Communication Technologies. Digi-Tel delivers updated information in a variety of domains, providing municipal services, encouraging residents' engagement, transparency and mobility, with the aim to improve their quality of life.

Digi-Tel composes three elements – the people (citizens, residents and visitors), the second is friendly city (quality of life) and the third is data (technology). These essential elements are integrated into the city's vision to create a city for all its residents.

Digi-Tel operates as a two-way street. The local municipality promotes a policy of transparency of the information provided to the general public, enabling residents to access the municipal database on one hand. This encourages residents to proactively engage the municipality, while additionally reporting on events, activities and concerns on the other hand. It manages a variety of components divided into three main classifications – applications, logistical infrastructure and physical infrastructure.

Digi-Tel raises two questions: (1) what is new and original with this endeavor in comparison to past and present endeavors and (2) what are the actual impacts in terms of effective involvement of ordinary citizens in knowledge production and creation processes.

Key words: Civic Engagement; Urban Innovation; Resident-Led Government; Open Data; Public Participation in Decision Making Policy; Citizen to Citizen approach

INTRODUCTION

The Digi-Tel innovation was conceived in the year 2012 as a result of the local municipality's .understanding that there was a need to establish personal contact with the residents of the city, and to inform them on the activities that take place in the city by means of information communication technologies (ICT). Like in most cities around the globe, residents criticize their city hall for not paying enough attention to their daily needs and problems. In most cases, the relationships between the two entities – city and residents – are maintained through tax collection or parking tickets, legislation and de-legislation, or top-down influence of policy decision. In other words, a kind of dissonance exists between what the citizens think about the city and what they really think about the local municipality's managerial level. This was expressed through petitions, protests and appealing to court by residents from different neighborhoods of Tel – Aviv. This internal insight encouraged the city hall of Tel Aviv to change its attitude toward resident-led participatory policy, and to re-structuring the approach of building sustainable processes of decision making where residents become important partners in these processes.

The question raised was: How will the local municipality be able to activate a change which was never before implemented? To reach this unprecedented and fundamental point, the local municipality began to invite citizens from mixed neighborhoods and regions, different peer-groups and stakeholders, to participate in focus groups discussions. These groups discussed different issues that concern them in their daily lives, and their relationships with the city. The main purpose of that activity was to discuss and understand the sources of conflicts existing in the relationships between various city hall departments and the residents, and how to improve them. This process lasted about a year, and at the end of the day, a new idea of start-up concept began to develop through business-like thinking.

There is no similar duplicate city start-up project in existence elsewhere in the world like this one. Thus, this innovation is considered original in its aspirations and conceptualization to change old policy and perceptions of the relationships between the city and its residents with the aim to bring about a significant change.

The solution was shaped from a concept derived from the business sector. It is as follows:

The residents will become clients of the city with open and free access to its multiple services. Residents will become members of a unique and inclusive club which provides personal information, benefits, and offers advance and innovative e-services. Close relationships on a personal basis will be established between the city's residents and the municipality. A municipality that actually has a monopoly on providing services to its residents does not maintain a conservative approach. It adopts tools from the commercial world to establish a cohesive city that enables its

subjects to enjoy and benefit from the large variety of the municipality's personalized services and products.

To launch the project, the municipality initiated a marketing campaign in the city. The fact that more than 50 per cent of Tel Aviv's eligible population registered (as of January 2016) to join the club demonstrates the effectiveness of the campaign and proved that Digi-Tel was seen as a useful tool – for both the municipality and the residents – to share a mutual goal and to bring about a real, positive change in their relationships.

OPERATION

The very first step to joining the Digi-Tel Club is to fill a registration form with personal details such as ID, postal and e-mail addresses, necessary to identify that he/she is a resident of Tel Aviv. All Tel Aviv residents, eligible from age 13 and up, can come to one of the many registration locations centers in the city such as: community centers, daycare centers, social services and education departments, city libraries, or sport centers. All are located in the neighborhoods and can be easily accessed. Each applicant is asked about his/her priorities and domain of interests according to the list of services and benefits the municipality offers him/her. The resident receives the Digi-Tel City Card and can use it to enjoy benefits at places outside of the city's services domain, including cafes, shops, museums, restaurants and more.

The personalized information for every citizen is available in a "personalized area" on the city's official website. The municipality can use this personalization data for its app to actively notify the resident card-holder of events and promotions through posts, e-mails, text messages. For example, Digi-Tel professionals and technical staff will inform resident that the bridge he normally crosses is closed, suggesting that he take an alternative route to reach his destination on time; Digi-Tel will inform another resident that the deadline for registering her child for kindergarten is approaching and she can easily register online; Digi-Tel will keep yet another resident, who loves music, posted about discounted tickets for tonight's performance. The above examples are a few among many of how the network operates, based on the unique profile of each Digi-Tel Club member.

There are several principles (*) and features that are keys to the operation of the Digi-Tel program:

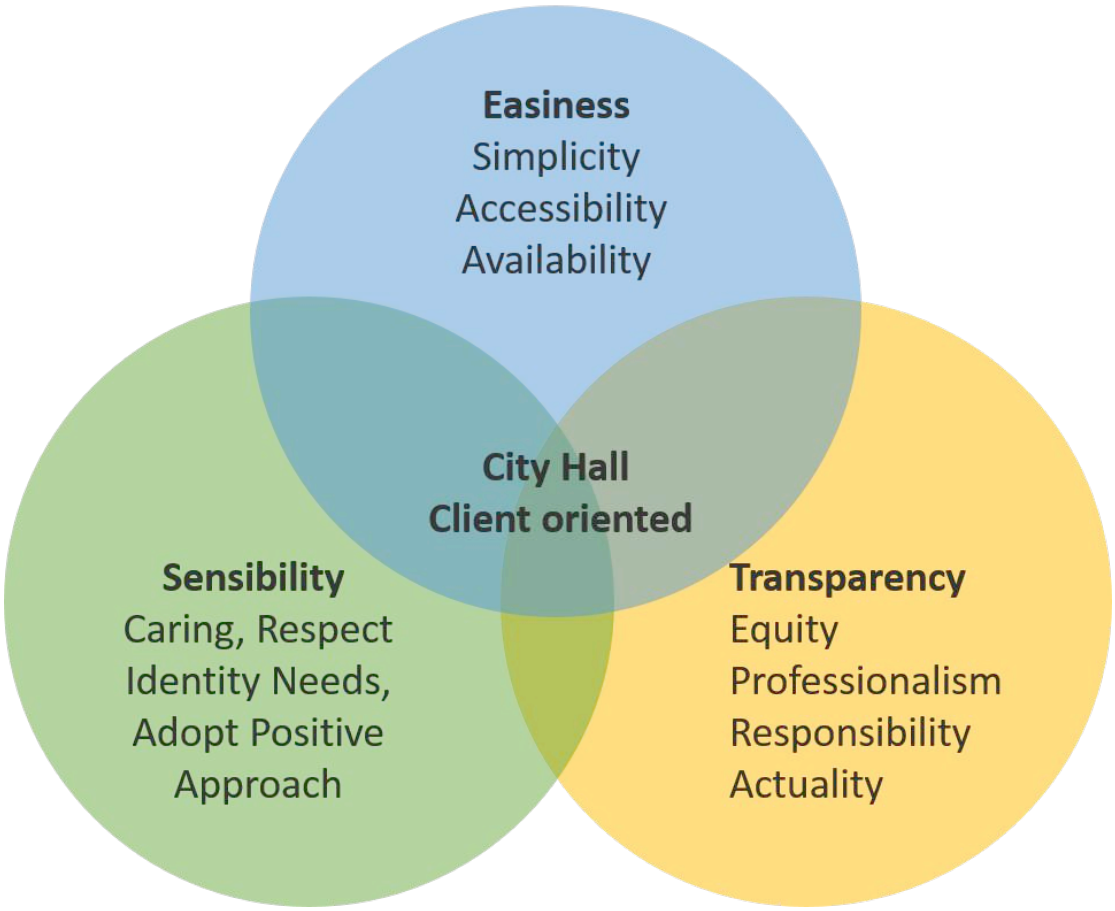
1. Digi-Tel delivers information and services are specific to the requests and demands of each resident.
2. Digi-Tel provides direct and active notifications to the resident according to his / her personalize profile.
3. Digi-Tel takes an active and proactive attitude towards Tel Aviv residents.
4. Digi-Tel promotes openness, transparency and information-participatory.

(*) The principles are explained in the course of the paper.

Digi-Tel is using the platform of cultural organization change, the central and most important result of the focus groups discussions. One of the most significant outcomes is the service revolution among all municipal departments that deliver information to the residents. This crucial change is executed through improving service centers, where residents come for assistance on anything from consultancy on issues like child enrollment to educational institutions, improving physical infrastructure in their neighborhood, or for updates on community events and public works in their street.

The second one is an improvement in the efficiency of working processes that emphasize the motto "with the face to the community and the residents" by means of the ICT tools. This change is expressed in making service appointment more time efficiency, and answering calls and handling application processes better. A collective organizational language that works toward improving services began to take hold in the municipality’s personnel and employyees on all infrastructural levels, something that is a vital first step in overall improvement. Interestingly it was driven by the adoption of shared set of values as expressed in Figure 1 that in turn drove technological and managerial changes.

Figure 1: Service Values
Managing Direct Contact with the Citizen (Client)



Source: Smart City Tel-Aviv, 2014 (Hebrew)

All municipality employees participated in special training workshops to raise awareness in order to achieve the optimal levels of services (and changes in attitude) when dealing with the residents. The Venn diagram of service values presented in figure 1 became ingrained into each employee on all levels of the city's administration and bureaucracy. Adopting these services values is the new approach, inevitably leading toward more citizen engagement and closer participation in a more bottom-up process.

The other factor which led to the implementation of Digi-Tel Club was data and information management among the managerial ranks and employees in other municipal departments. In this process, they learned how to document information

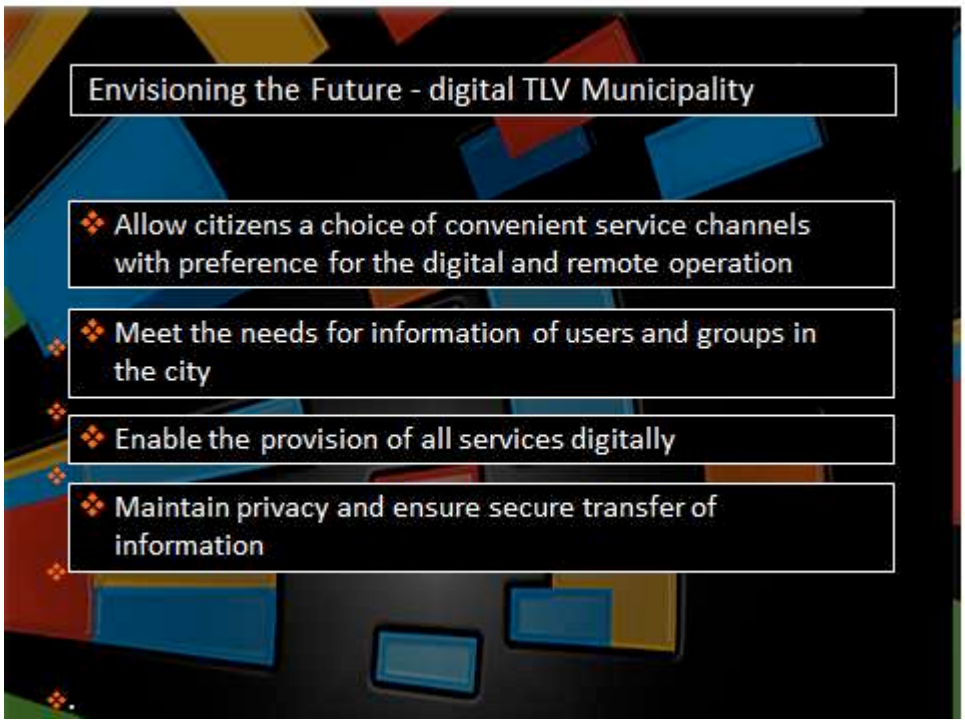
and deliver it to others by means of internal information management and communication tools.

The result of these processes was a paradigm transformation from "knowledge is power" to "participation is the power". City Hall supported it and guided the organizational culture change from reactive to proactive, by providing the resident with information, services and benefits suited to the individual's lifestyle.

The Digi-Tel Vision

The Digi-Tel vision complements the designation of Tel Aviv as the Smart City. Tel Aviv, the "Nonstop City", considers engagement a key value in implementing Smart City principles. It actively involves residents in the urban experience and urban development, while at the same time emphasizes engagement in decision making processes in the modern era.

Figure 2: Digi-Tel Vision



Source: Tel-Aviv ICT Unit, 2012

Digi-Tel, the technological and social tool available to the city's residents, offers better use of communication and ICT to streamline the management of existing resources and assets in the city. This is expected to enhance the quality of life. The target criteria for making Tel Aviv-Yafo to be a city for all demographics of residents through the Digi-Tel program are as follows: An appealing city to live in; a city for lifetime; quality and egalitarian education; equal opportunity and bridging social gaps

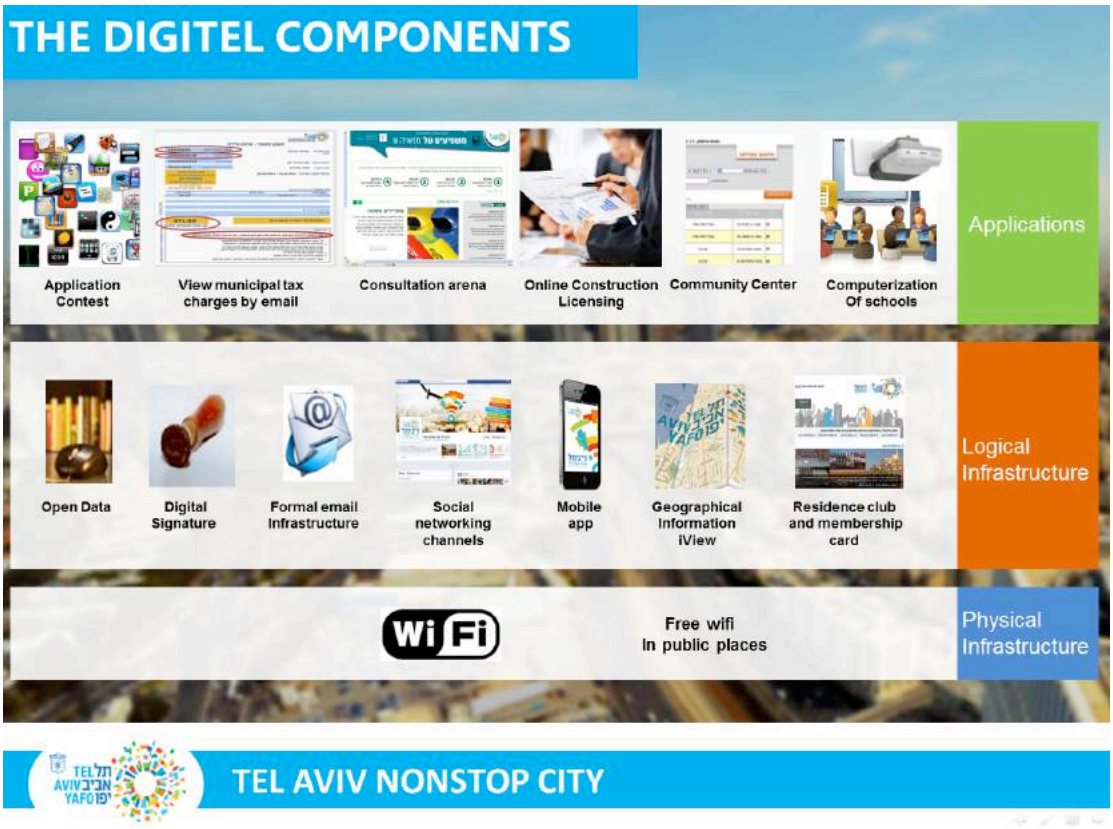
between the north and south parts of the city; strengthening the sense of community; and fostering pluralism.

The Digi-Tel Concept

The Tel Aviv Municipality has set in motion a unique and innovative digital transformation. The Municipality's aim was to strengthen the contacts, sense of participation and satisfaction of the city's residents and the success of Digi-Tel is reflected in the growing numbers registering for its services.

For example, many projects that combine the Digi-Tel approach divided into three sections of applications, logical infrastructure and physical infrastructure are presented in Figure 3.

Figure 3: The Digi-Tel Components



Source: Tel – Aviv ICT Unit 2014

The network, or physical layer, aims just to connect people to the internet, like the **WIFI** project, which aims to cover all the main public areas in the city; all the beaches, the boulevards, and the public squares.

Eighty zones of WIFI were established around the city. Reports already have shown that there are approximately 50,000 unique users per month on average.

There is no need to register for the service. Each user is redirected to a landing page, which displays the main current events that are taking place in the city.

The logical layer contains infrastructure app's like the **City App**, which offers location-based information about the city; leisure, culture and art (outdoor community events, arts); traffic and parking (bicycle stations & availability, closed roads, parking lots); and so on.

Another tool is the geographic information system (GIS), the **iView**, which makes spatial information available to the public in a variety of areas: engineering, transportation, community, tourism, education, art, and more.
As a resident of the city, one can view all the geographic information relevant to his/her neighborhood: preschools, schools, public parks, pharmacies, community centers, outdoor sculptures etc. Engineers can find blocs parcels, electricity and water infrastructures, and view a particular zoning plan and its accompanying documents.

As part of the city's policy to promote the accessibility and transparency of the information provided to the general public, the municipality allows **direct access to municipal databases and archives** that are not of a confidential nature. For example, the building archive is open online to the public, free of charge. The archive includes planning information about all the housing in the city. The Open Data environment enables the public and application developers to make use of the information in municipal databases that deal with community affairs, culture, public health, budgets, statistical data and security.

The **Application layer** contains applications and systems that aim to address a specific task/need. The latter includes, for instance, management and exportation of the information about community centers. Community centers are an important link in the connection between residents and city management where neighborhood's residents meet together and exchange views on topics and issues that concerned them. Tel Aviv residents can view the list of classes offered at the local community center online and general information about a particular class, such as cost, the instructor, etc.

Digital registration and online payment for the classes will be available in the near future, meaning that every resident will be able to perform all the tasks associated with class registration in a simple and effortless manner. Upcoming projects include computerization of schools, and online requests for construction and building.

The variety of innovative and advanced services offered through Digi-Tel has a direct influence on the relationship between the municipality and its residents.

One of the most important tools of Digi-Tel is the enhancement and empowering of public participation. Public participation has been part of the Tel Aviv municipality's organizational culture for decades since the 1980s. It began with Project Renewal’s bottom-up principle to share decision making policies with local residents, creating an

even playing field. Over the past three years, this process has also been carried out through the Digi-Tel program. For example:

- Including residents in conducting a dialogue with them about the design of the beach strip
- Involving the public in a municipal master plan for young adults
- The municipality allocating funds to improve quality of life in particular neighborhood (participatory budget). Its residents are engaged in deciding how to allocate the designated funds, whether on renovation of public institutions, development of public spaces, planting trees or sidewalks repairs, or something else. Their proposals are prioritized and implemented by the local government.
- Digi-Tel allows residents to participate in open public planning discussions on plans about redevelopments construction regarding their neighborhood, choosing among alternative plans such as public institutions, open spaces, parking lots as well as city master plans to give their comments.

After two years of Digi-Tel operation, a report by the Tel-Aviv Center for Social and Economic Research was published in March of 2015 to analyze different aspects of using this network. The following figures demonstrate the success of this modern innovation.

For example, Figure 4 describes the distribution of the main domains chosen by the residents as the most beneficial services for them, using the Digi-Tel technology communication network. The most important priorities for the residents are: firstly, environmental efficiency (green-ness) nearly 44% of the residents that wish their city will maintain sustainable environment policy such as walkability street, less air pollution, open spaces; secondly, leisure, culture and art with 30% supporters; thirdly, education parenthood with 21%.

Figure 4: Important priorities quality of life for the residents in Digi-Tel

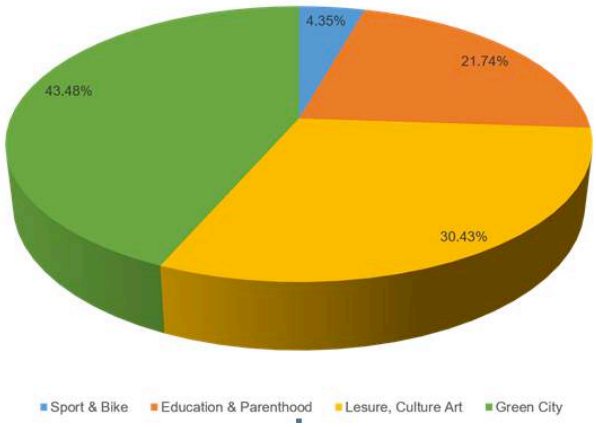
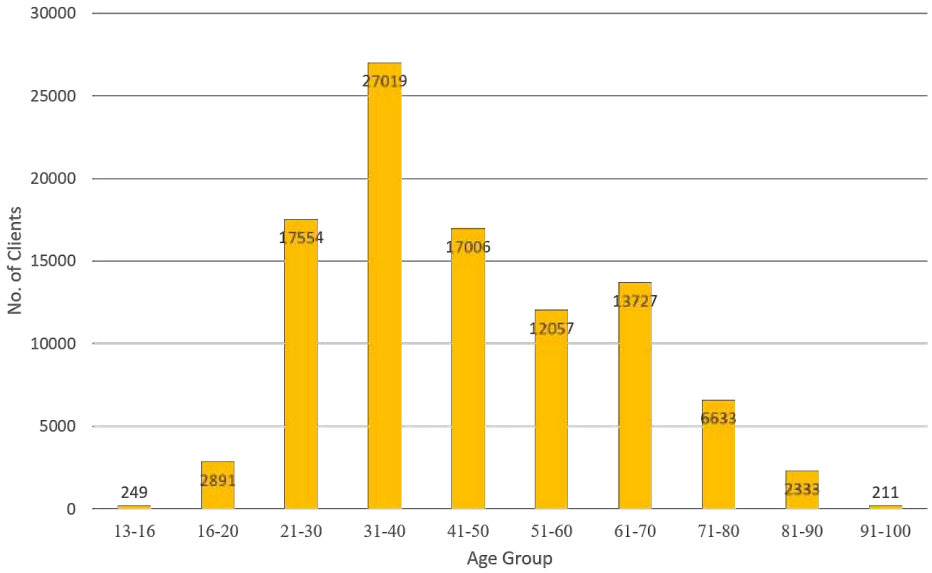


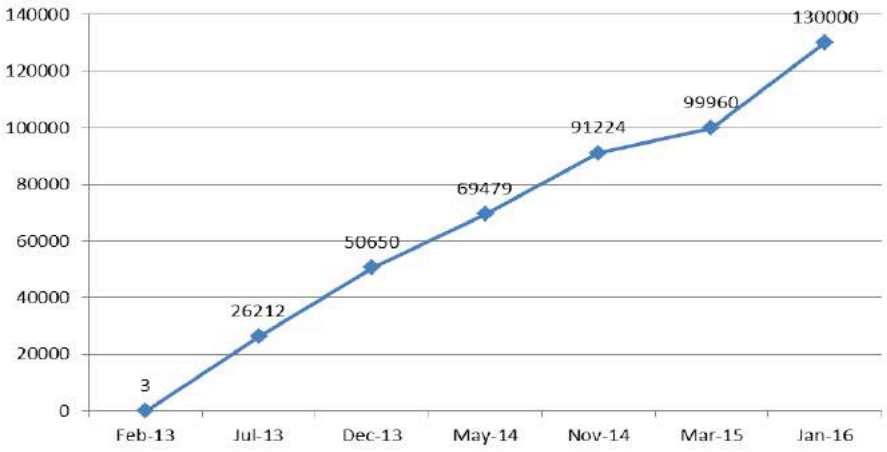
Figure 5 describes the distribution of Digi-Tel age demographics. The most prominent demographic belongs to the age group of 31-40. They comprise 27 per cent of the total eligible population and are characterized as the young residents in Tel Aviv, many of whom work in the Hi-Tech industry. They strongly influence the nature of the city's performance in the leisure, culture, and art domains.

Figure 5: Distribution of Digi-Tel Age Groups Clients



Lastly, Figure 6 shows the dramatic growth of residents registering for the Digi-Tel direct communication between the period 2013 and 2015. The applications from residents are most surprising, considering the relatively short period the program has existed. It is expected that the numbers will climax in less than a two-year period.

Figure 6: Accumulation of Registered Citizens



The Center for Economic and Social Research Unit for the local municipality conducted a feedback survey, in January 2015, to analyze the residents' habits using the Digi-Tel card and their level of satisfaction with the services they received. A questionnaire was digitally sent to 6,550 participants, who registered during the period of March 2013 and November 2014. Seventeen per cent of residents replied, which geographically covered the nine boroughs of Tel Aviv.

The statistical analysis team concluded the following:

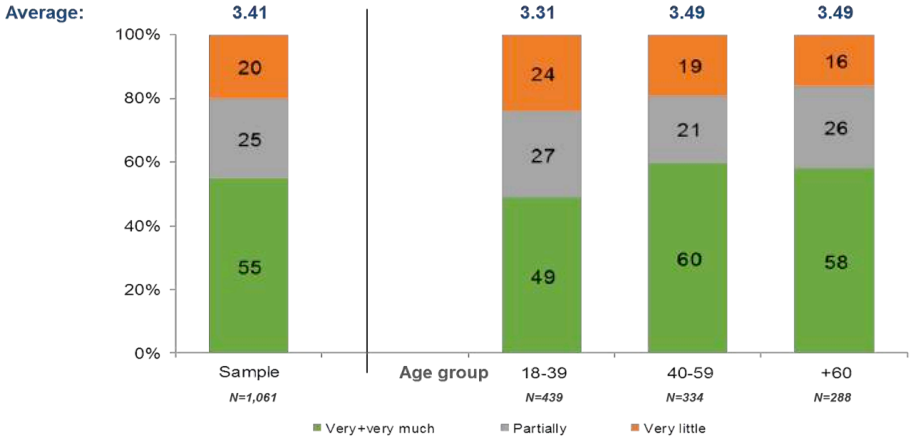
- The profiles of the residents showed that the greater numbers of people aged 40+ used the Digi-Tel Card as a communication tool with the local municipality's different departments.
- Couples with children, or families in general, were much more satisfied with the services offered with regard to their personalized orientation compared to couples without children. This is understood to be due to the abundance of services, benefits and activities aimed at young children and their convenient use.
- Nearly 80 per cent perceived Digi-Tel as an effective communication channel between residents and local municipality departments.
- Adults people in the aged group of 40 to 59 (69%) and 60+ (74%) are more satisfied with Digi-Tel services compared to younger people (only 60%). This is understood to be due the fact that elderly people who have retired have more free time and better reason to benefit from cultural and community events.
- As a whole, young teenage adults are a minority in Digi-Tel platform (2.79 and 3.49 respectively).

Following the feedback survey, the Center for Economic and Social Research recommended several improvements to be considered: (1) To use suitable and uniform terminology which will differentiate it from other services and define it whether as a club card, a service or an umbrella of services ; (2) To promote the 'added value' of Digi-Tel as a resident card, and update its relevancy; (3) To develop new digit services specially for under-served populations; (4) To strengthen the personalized feature online through content development and broaden the consumer awareness on the available options of using it.

The following two figures - Figure 7 and Figure 8 – are further evidences that the Digi-Tel platform is perceived to be an effective and useful tool by the majority of the card-holders. Furthermore, an overwhelmingly apparent intention to join Digi-Tel platform becomes a reality with over 130,000 residents already being registered as for January 2016 (Tel Aviv ICT Unit). The issue of attracting young people to Digi-Tel is still under investigation since this group age does not use mails as mean of communication. The municipality is studying it to find out how they can be part of the Digi-Tel club.

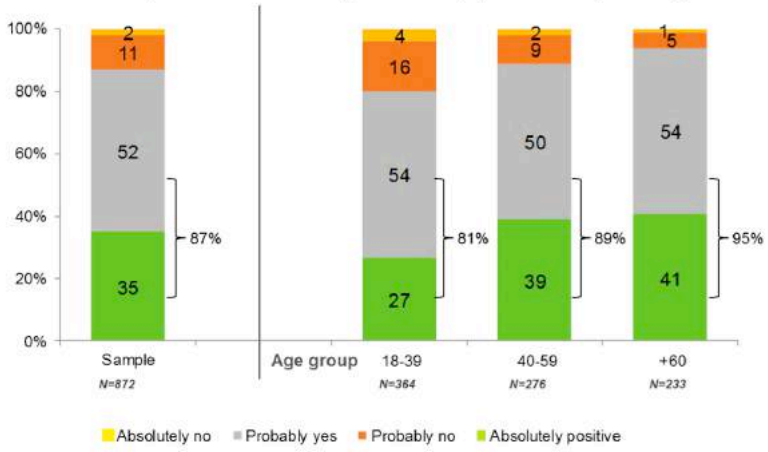
The data provides by the Tel-Aviv Center for Economic and Social Research for 2015 emphasizes the importance and relevant of Digi-Tel platform for the citizens of Tel-Aviv: The popular age range to register is 30-39 years old; 190 employees in municipal services, and community centers, feed contents to the Digi-Tel website; The most field of interests are leisure, culture and arts including: theater shows, museums, entrance to beaches, biking; marathon race; There are - 84K activated citizens, 74K citizens who watch Digi-Tel content; One out of five citizens realize the proposed benefits by Digi-Tel.

Figure 7: To which extent Digi-Tel is perceived a communication channel with the local municipality



source: City of Tel Aviv Center for Economic and Social Research

Figure 8: Would you recommend your family / friend to join Digi-Tel?



source: City of Tel Aviv Center for Economic and Social Research

Stages of change

The involvement of ordinary citizen in knowledge production and creation places in the city of Tel-Aviv has passed through four distinguished stages in the relationship framework between local government and its citizen. They are as follow: local government to local government; local government to local citizen; local citizen to local government; and local citizen to local citizen. These stages represent the fundamental change in the networks between these two entities from top- down to bottom-up participation approach.

Stage one: local government to local government: Stage one deal with Tel- Aviv municipality initiative to establish an effective and efficient new type of organization structure focused on culture as service to its citizens received the political commitment of the city hall. The state of mind of the municipality changed to emphasize the service awareness.

Tel-Aviv municipality began a process of building democratic partnership with its residents by taking inter-organizational steps among all levels of employees aiming to improve services skills, one language communication with the citizens of the city as well as visitors from outside, measuring quality of top-down relationships and fostering accessibility and connectivity. Evolving Digi-Tel could not be achieved without deep process of management culture among the departments of services suppliers such as engineering, town planning, environmental, welfare and social services, municipal call centers, city tax unit just to mention few.

The preparation of the people employed in the city different departments demands lots of resources, knowledge management skills, infrastructure organization of data, documentation knowledge in portals, feeding information from the city units according to multi characters of the clients such as: type of event, targeted population, classification of age, gender, religion, income, personal priorities, citizen consuming habits and location. Following these steps citizen established stronger trust with the municipality.

Stage two: local government to local citizens: This stage represents the top-down relationships between the city and its citizens.

Investing in citizen empowerment and increasing transparency as well as enhancing participatory democracy are integral part of Tel Aviv municipality official policy. It asks and encourages citizen to send their opinions on every issue whether it is urban policy on the agenda or local one. Widening the connections between local government and its inhabitants causes the shift and encouragement to using ICT tools and apps mediums. The new networks enable changes both in democratic relationships and the notion of participation with more than 50% eligible citizen registered to Digi-Tel (Center for Social and Economic Research, January, 2016).

The implementation of Digi-Tel enables citizen to access directly and openly to

knowledge information and municipal data individually. This transparency aims to strengthen the connectivity between city hall departments and citizen needs in their daily life agenda.

Stage three: local citizen to local government: This stage became Tel-Aviv Digi-Tel platform for bottom-up civic engagement in the context of communication, data sharing, application developments, open data and especially personalized-led resulted in collaborative governance. This is the place to point out that the paragraphs of the "Tel Aviv Independence Scroll" dealing with citizen participation were written by the author for the present elected mayor who already serves in his position twelve years.

Digi-Tel enables civic engagement to jump a step ahead in playing an active role in the creation and sharing of information in two-ways directions which we termed "pull and push". The "pull" way is deployed by active citizen who report about problems and events to the information centers of the local municipality regarding roads, waste, sewage, street lighting, parking, traffic jam, public gardens and parks, unsocial behavior, public spaces and institutions. The "push" way is the respond manner delivered by the information centers to the city departments to take the steps necessary to treat the issue given from the citizen as soon as possible. That kind of respond is taken place by the local management zones wardens. The usual quick respond of the city is expressed and translate with more support from the citizen who achieve more confidence and strengthen trust towards the issue of how their city reacts coping with residents reports.

Stage four: citizen to citizen: This stage represent the local democracy approach. The citizen to citizen idea aims to create and enable better well-being conditions for the benefit of local citizen in their neighborhoods among themselves and to build a strong community. One example is Digi-Tel demonstration of a democratic tool when discussing participatory budget. Every year the city of Tel-Aviv allocates sum of budget to each neighborhood allowing it to manage an independent decision making process to prioritized actions and programs concerning investments by the local municipality. The sum of money is usually between 130,000 up to 250,000 Euros. The action and program aim to improve infrastructures and community activities for the well- being and quality of life of the citizens. For example: play grounds, sport facilities, community building renovation, planting trees, bike tracks, benches in public spaces, community activities etc. This process is activated by the municipality. It sends SMS announcements to all neighborhood inhabitants registered in Digi-Tel platform to participate and prioritize the action or program they would like to be implemented and seen in their neighborhood. The discussions are executed among the citizen of the neighborhood themselves in places such as community center, public institutions, community events and citizen local committees. Their decisions are sent back to the city hall. When the results are gathered, Digi-Tel staff declares the priority of the item elected by the majority of the citizens and begin its execution through its relevant departments.

A second example is the creation of neighborhood community coin to develop intensive and active actions among the neighborhood's inhabitants with the businesses and private services suppliers, to connect between consumers of products, to develop community life in variety of aspects such as local leadership, social mobility and human development. These are part of the notion called "citizens make a city".

In the era of "crowd wisdom" partnership among neighborhood citizen might be creative and innovative tool in the relationships between citizen to citizen as well as between them to local government.

The Digi-Tel platform was developed by the City's IT branch. The Municipality of Tel Aviv has invested 4.5 million US$ to enable its creation and development. This department developed all the applications that residents currently use. The nature of the system is extremely complex and requires integration of different tools like CRM (Customer Relationship Management), campaign tools, distribution tool, Mobile Platform, GIS Platform, and Information Security tools to create an integrated platform. The in-house development was an important factor in the design to create a complex platform in a very short time (the base capabilities were developed in only one year). It enabled the city of Tel Aviv to create the technology to make the Digi-Tel a reality, and likely faster than if the process had been outsourced.

In essence, Digi-Tel initiative aims to improve municipal services, enhances resident's quality of life, and forges the condition for sustainable urban development. Above all, it exemplifies the city's active and intelligent role in employing technology to strengthen civic engagement and ensure that the city is accessible and responsive to all concerns.

Digi-Tel platform facilitates a direct and holistic connection between the city and the residents, whether it is alerting residents to neighborhood construction, informing them of the nearest bicycle-sharing station, sending specific reminders for school registration, or cultural events taking place in the city. Digi-Tel encourages residents to proactively engage with the municipality as well. Residents can find cultural events and activities as well as report communal hazard or concerns, and follow their review.

CONCLUSIONS

The city of Tel Aviv is named as "The State of Tel Aviv" due to the fact it is the economic, cultural and educational center for many institutions of government, private and business sectors for the whole state of Israel. It leads the list of start-ups numbered more than one thousand. As such, there is no surprise Tel Aviv became a living laboratory environment where communication and joint citizen decision making are embedded within the vision of the city.

In the last three years, the city of Tel Aviv underwent a digital revolution, providing its residents with the unique Digi-Tel platform. The Digi-Tel platform allows residents to access services and information via mail, text message, or personalized web address, which can be customized according to location, preferences, marital status and more. As a leading technology hub, Tel Aviv has developed advanced solutions for urban administration and, more importantly, civic engagement.

Perhaps of greater interest is the overall approach taken by Tel Aviv municipality and the use of shared values to drive innovation. In the case of Digi-Tel the overall approach was inspired by the business sector with the creation of a club style organization where residents could join without charge. This club style organization focused initially on improving the delivery of services already provided by the municipality. Only later in the project did the municipality engage with residents in shared decision making by identifying specific projects such as the beach improvement scheme. This was an example of collaborative urbanism but fell short of full empowerment that would allow the residents to identify priorities for future development of the city's hard and soft infrastructure. Instead it is an example of modularized collaboration where the citizens are given directionality.

The other important characteristic of Digi-Tel was the use of shared values to drive innovation. All too often in smart city initiatives subjective value systems for individuals and communities is demoted below technological challenges where the development of sensors and neutral networks can be seen of higher priority or challenge. In the case of Digi-Tel shared values as expressed in Figure 1 were given priority early on in the project and guided future actions. This means that the rational for deploying digital platforms can be checked against the shared values to justify the investment in time and money.

Nevertheless, several questions still exist about the effectiveness of Digi-Tel. The first query is the low uptake by teenage adults as shown in Figure 5. The City's Social and Economic Research Center recognized this but it is still unresolved. Another query is the different importance attached to different services as shown in figure 4. In this case a "Green City" received highest priority. The meaning of "Green" is related to standards of green building, walkability streets, priority to bike tracks, public gardens and it was the highest priority for all demographic age groups. These might seem minor criticism but success is often dependent on detail especially when attempting to attract engagement 0from all demographic groups. One of the significant critics is that Digi-Tel does not produce enough interaction between the city and its citizens but deliver more of the "push" way. Another critic is the uneven number of residents registered from among the neighborhoods of Tel Aviv. More residents from the northern parts of the city joined Digi-Tel compared to the southern parts due to social and economic inequality. To overcome it Digi-Tel enabled citizens to ask questions and added a new interface to respond to all information that appears on the city web. Besides, a face book was issued to create successive interaction with Digi-Tel clients.

Nevertheless, Tel Aviv as justification for claiming itself as a leading technology hub, with developed advanced solutions for urban administration and more importantly, civic engagement.

Lastly, as part of the effort to increase accessibility and transparency of information along with the civic engagement, municipal databases were opened to the public, followed by a competition in which residents developed mobile apps for public use based on the open databases. The city actively employs social media as a platform for involving the public in municipal decision-making and community improvement initiatives. The IView system renders geo-spatial information readily available and easily useable for all. All these initiatives are facilitated by free city-wide Wi-Fi in public places. This is the best system, compared to other cities in Israel which share for all the Wi-Fi. As is well known, public spheres create a platform for people to communicate, to share common interests, to discuss daily issues aimed at improving all residents' quality of life.

In summarize, Digi-Tel became a social media tool engaging major part of Tel Aviv population. The more Digi-Tel apps are provided, improved, delivered and accessed to the citizen they become more empowered, responders and care to receive better services of education, community, transportation, infrastructure, local neighborhood services and more.

Digi-Tel is an excellent model to develop institutional framework that support tools and resources empowering people. Tel Aviv municipality is acting and performing an open government regulations due to its integrated open data policy facilitating direct data collection on issues such as building files, master plans, constructions, policy decisions by the city departments, leisure, community events, infrastructure works and other information sources to keep high level residents quality of life in the city.

In other words, we can describe Digi-Tel tool as the E-CITY portal that enables citizen to access data, to share applications program interfaces in order to create added value expressed in raising their quality of life in a complex city like Tel Aviv. Digi-Tel as a smart technological tool accessible to every citizen plays an important function in limiting inequalities between the south and the north neighborhood sections of Tel Aviv. It enables different classes to take part in a wide variety of activities in accordance to age, gender, income level and field of interests. In addition, it establishes generativity that leverages technology in ways which inherently open up policy to widen citizen participation.

More than 25% of Tel Aviv inhabitants are young people up to the age of 30 years. As such, they represent the technological, sophisticated and connected individuals living in urban environment who use the Information Communication Technologies (ICT) that help them to be updated. These youngsters play an important function in civic engagement as urban citizenry.

We can label Digi-Tel platform as an ambitious program that succeeded to fully realize itself and to fulfill its vision: "Afford citizens the option of convenient service channels; meet the needs of users and different demographics in the city; form provisions of all services digitally and maintain privacy and ensure secure transfer of information".

The greatest proof of Digi-Tel's successful government-oriented citizen program is the enrollment numbers of 130,000 inhabitants out of 250,000 eligible, in a matter of three years. It proves that residents recognize the importance and significance of being connected to the local government's multi-service products available through ICT digital tools.

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- Sharon Zohar, CKO Tel-Aviv-Jaffa Municipality. E-mail: Sharon@mail.tel-aviv.gov.il

Links for additional information:

This is Digi-Tel

http://www.cost.eu/COST_Actions TU 1204

Digi-Tel - Tel Aviv Digital revolution - Part A

Digi-Tel - Tel Aviv Digital revolution - Part B

http:www.cost.eu/Cost Action TU 1204

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UNFOLDING URBAN DYNAMICS: FOOD SYSTEMS AND RESPONSIVE TECHNOLOGIES

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KEYWORDS: built environment, urban design, urban farming, responsive environments, food systems

ABSTRACT:

The promise of new technologies in the built environment is to enhance and better the experience of living in cities. To this end, the 'smart city' model employs technology as a strategy to optimize processes and operations, increase efficiency of systems, and monitor urban dynamics to ultimately get control over the whole city. Drawing from an ongoing research initiative between the University of Bergamo and the Responsive Environments and Artifacts Lab at Harvard University, this paper counters this digitally-driven, routine-inducing approach by employing the concept of urban glitches as a trigger for creativity, opening up spaces otherwise unexplored, making for a better ambiance, and leading to pleasant and unexpected repercussions throughout the whole city.
The local food system of Bergamo (Italy) is offered as a case study to experiment with glitch-oriented design strategies that make use of responsive technologies. Being one of the most fascinating and yet complex urban systems, local food networks and supply chains are analyzed to unfold the relationship between food and cultural identity and to study their implications at economic, social, and urban levels. This research on Bergamo food systems served as framework for the development of design concepts that speculate on the role of interactive and augmenting technologies in creating novel food environments and mindful experiences. In particular, the paper presents four proposals − ranging from the artifactural to the urban scale − that aim at breaking routine patterns and sparking vitality in the city by leveraging on the interplay between people, food, and technology.

1 INTRODUCTION: THE RESEARCH FRAMEWORK

The presented study is part of "REAL Cities | Bergamo 2.035", a research initiative between the University of Bergamo (UNIBG) and the Responsive Environments and Artifacts Lab (REAL) at the Harvard Graduate School of Design. The initiative adopts a multidisciplinary and multi-perspective approach, involving researchers from a variety fields – including engineering, management, economics, anthropology, sociology, psychology, geography, language, etc. − and engages with major stakeholders and key players, from both the public and the private sectors. In fact they participate in the research work by sharing their vision, plans and interests, as well as offering feedback to the proposed design solutions and in some case facilitating their actual development and implementation.

Putting the human being at the center and forefront, researchers at REAL and UNIBG investigate how emerging technologies can leverage the qualities and characteristics of the city in order to enhance the relationship between the individuals and the urban environment, eventually creating more pleasant and mindful experiences for citizens within their everyday life.

The methodology adopted by the initiative is the result of an action research case developed within the City of Bergamo (Italy). Given its size, cultural richness, spatial morphology, diverse urban morphology, and established academic setting, Bergamo represents the typical characteristics of mid-size cities in Europe. Yet Bergamo is also expression of many of the challenges that most European cities face today, such as aging population, economic difficulties, mobility and transportation issues, technological prudence, and aging infrastructures.

Action research is aimed at taking action on a specific problem while creating theory about that action (Rapoport, 1970). It also studies the resolution of an issue using a scientific approach, together with those who experience that issue directly, thus leading to an active participation of the system's members. Moreover, action research can be seen as a cyclical process performed through the following steps: (Coughlan, 2002)

- Diagnosing: analysis of research problems within the urban context.
- Planning action: evaluating alternative methods of solving the problems and analysing already existing solutions.
- Taking action: implementation of the chosen method.
- Evaluating: analysis of obtained results.
- Specifying learning: identification of the general findings and consolidation of the method.

Bergamo is thus considered as the focus for the development of a new paradigm of urban innovation that might potentially become a model for other European cities too. To this end, the research team structured the study as a participatory foresight activity where the action research methodology acted as a guide for the development of the research (Voros, 2003). The resulting model includes a theoretical framework for addressing relevant areas of research in the city, strategies for involving stakeholders in both the analysis and the design phases, methods for devising technologically-driven design solutions, and processes for engaging the community in both creating and testing the design proposals.

2 URBAN GLITCHES: A RECIPE FOR SMART CITIES

The promise of new technologies in the built environment is to enhance and better the experience of living in cities. And one of the highly anticipated outcomes of the advancements in digital technologies in recent years has been to improve today's quality of life of city-dwellers with making their cities "smarter" (Picon, 2015). The 'smart city' model enters the debate by employing technology as a strategy to optimize processes and operations, increase efficiency of systems, and monitor urban dynamics to ultimately get a precise control over the whole city (Townsend, 2013). The assumption of the presented research is that the implementation of the smart city concept, as it is commonly described, understood and deployed, would reinforce the current tendency of shaping and evolving cities as digitally-driven, routine-inducing built environments (Koolhaas, 2015), eventually leading to even more technology-centered, un-eventful, and standardized patterns of living. To counter this approach, the presented study proposes an alternative take on the framing and creative potentials of situated and connected environmental technologies. In particular, it employs the concept of Urban Glitches (Sayegh, 2015) as a new paradigm for the use of technology as a mediator in the relationship between individuals and the built environment. The research leverages on the notion of 'glitches' (Menkman, 2011) as a trigger for creativity and articulates how they can translate to urban spaces. Urban glitches, caused in particular by human-nonhuman interactions within the built environment, become important elements to help create technologically driven conditions other than efficiency.

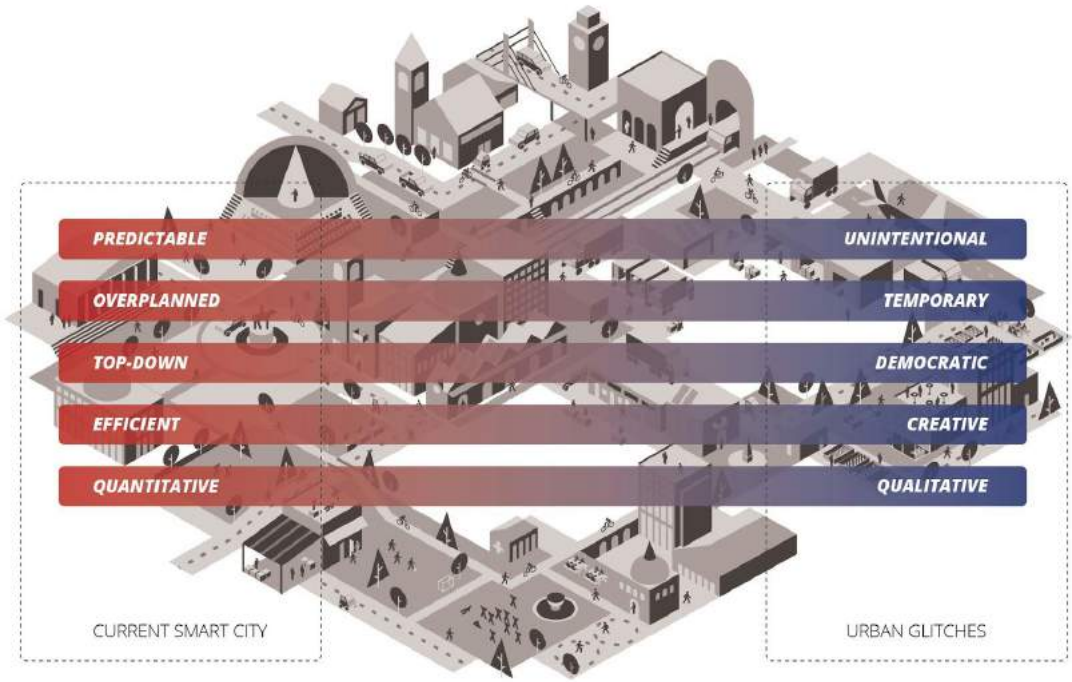

Figure 1. Current Smart City vs. Urban Glitches
Source: Harvard GSD + University of Bergamo (2015)

An urban glitch, as defined here, is an unexpected slippage in the functioning of the smart city. It is the spatial equivalent of a Freudian slip – or slip of the tongue – that unveils some "unspoken truths" that lurk behind a person's rational discourse. This paper argues that creating a healthy tension through the introduction of the notion of urban glitches helps counter the current smart city discourse, and thus encourages designers to imagine and develop artifacts, buildings, and environments that foster creativity, open up spaces otherwise unexplored, make for a better ambiance (Borch, 2015), and lead to pleasant and unexpected repercussions throughout the whole city.
Urban glitches thus become a recipe for the design of technologically augmented cities that are able to "outwit" their own smarts. Said otherwise, what makes today's metropolis "livable and enjoyable" can only emerge as a balance between the rationalizing characteristic of smart cities – i.e., predictable, overplanned, top-down, efficient, and quantitative – and generative qualities of urban glitches – i.e., unintentional, temporary and ephemeral, democratic, creative, and qualitative. This paper ultimately suggests that the built environment should be designed in ways that foster the emergence of states of urban glitches, creating the conditions for "post-smart cities" to be developed.

3 THE CITY AND ITS TERRITORY: A CASE STUDY ON LOCAL FOOD SYSTEMS

In order to experiment with the concept of urban glitches, researchers at UNIBG and REAL narrowed down their investigation to one of the most significant systems that operate both within and outside the city: the food network.
Food is, in fact, a multifaceted topic. It involves cultures, places, atmospheres and traditions, and is embedded in many aspects of people's lives. Food creates narratives, shapes environments, and frames experiences. However, besides this almost romantic view, food is regulated by a series of very rigorous processes and activities enabled by well defined infrastructures, spaces, and machines. The journey of food products from farms to tables is what we usually refer to as 'food system' (Schanbacher, 2014). Food systems can be seen as the result of very complex interplays between processes, people, and products, and can be divided into distinct phases: 1. farming/harvesting/production, 2. processing, 3. distribution, 4. marketing and retailing, 5. consumption, and 6. waste management.
This research explores the topic of local food system from two main perspectives: first, as a way to understand the complexity of urban systems, highlighting problems and issues as well as unveiling hidden qualities; second, as a framework to support the development of glitch-oriented design concepts through the creative use of responsive technologies.
Concerning the first analytical phase, the traditional dish of *casoncelli* was used as a case study in Bergamo and as a research strategy to: a. question the concept of 'local food', b. investigate the relationship between food and cultural identity, c. discover the role of food in shaping the built environment, d. study the implications of the food supply chain at economic, social, and urban levels. The ultimate objective of this phase was to highlight the role of local food in articulating qualities, narratives, and experiences in the City of Bergamo and in its territory. For this purpose, four main research themes were pursued by dedicated research groups.

3.1 The recipe evolution and contexts

This first part of the research investigates the history of casoncelli and its evolution in relation to contexts, people, and spaces. The study addresses the origins of the dish, of its ingredients, and of its making processes, spaces, and tools. It highlights how the dish has evolved through history, reaching the diversity and richness it is famous for today. A 'taxonomy' of casoncelli shows the dish variations in relation to its ingredients, shape, and making process. The study questions if those types have particular connections with places, buildings or villages, and explores the relationship with the people who inhabit them. Stories, anecdotes, metaphors, habits, and traditions complement the study. The ultimate objective is to unveil a few 'secrets' of the dish by interviewing both chefs and grandmas, by documenting their making process, by studying the context, and by understanding the meanings of the dish for both cookers and consumers.

3.2 The 'industrial' supply chain

Although casoncelli is a very traditional dish in Bergamo, over the last fifty years changes in the food production and distribution have deeply affected the making process of this pasta. This second part of the research addresses the food system of 'industrial' casoncelli by studying artisanal and industrial-like pasta producers that make large quantities of casoncelli in Bergamo and its province. Through interviews and analysis, this investigation highlights the principles and modes of operation of their work. Mapping out the supply chain of those producers and documenting the places where the ingredients are made and how they are acquired also offer valuable insights on the dish. The actual making process of casoncelli, the packaging method, the distribution and transportation systems, the marketing strategies and tools, and the retailing places and modalities were studied as well.

Figure 2. The traditional dish of *casoncelli* in Bergamo
Source: Luca Casonato (2015)

3.3 The 'local' supply chain

Through the strategic analysis of three case studies, this theme tackles the food system of 'home-made' casoncelli. The case studies include a restaurant, a traditional festival, and a typical 'home-made' situation. The research mapped out the supply chain of key ingredients of the dish, finding out where they are purchased. The team visited the places where those are made, interviewed the people who make them, and studied how they are delivered or distributed. A comparative analysis of the three case studies highlighted differences, pros&cons, and peculiarities of each. The comparison of the research results focused on the 'local' factor, so as to better understand how the ingredients available in the territory of Bergamo are being used to make such a traditional dish.

Figure 3. Local food supply chain mapping
Source: Harvard GSD + University of Bergamo (2015)

3.4 The meaning of local food

With the widespread use of 'local food', the very meaning of the term itself is becoming unclear and even misleading. Over the last forty years, agro-food systems have gradually shifted towards responsible production and consumption paradigms, and alternative food networks (AFN) have spread all over the world in order to endorse local resources and to meet new customer needs. This means that the food realm has started a "re-localisation" process based on sustainable shortened supply chains, as a response to industrialised networks. Still, the terms "short" or rather "local" are linked to a geographical connotation, which is not the one and only possible way to define local food.

The team researched the origins and evolution of the concept at the scale of the country, investigating how the multifaceted aspects of the term has changed over time. It then studied key facts, data and insights of the local food industry at the national level, for then focusing on the Bergamo territory. The economic growth of the local food market and its future trends were also investigated. Finally the research identified the different stakeholders and key players, highlighting their constraints, difficulties or opportunities in relation to more established food practices, as well as questioned the role of consumers in the local food realm, studying typical categories and behaviors.

4 AUGMENTED FOOD PLACES AND EXPERIENCES: DESIGN CONCEPTS

The research on Bergamo food systems served as framework for the development of design concepts − ranging from the artifactural to the urban scale − that explore the role of responsive technologies in creating novel food environments and augmented experiences. In particular, this research proposes alternative design strategies that aim at breaking routine patterns and sparking creativity in the city. Such strategies include: adopting the concept of 'portals' as a way to test the uncanny ability of food to transcend space and time; using sensing and interactive technologies for augmenting the experiential qualities of food to activate and to revitalize abandoned and unused spaces in cities; exploring the 'makers' movement to create conditions for users "to get what they didn't want they wanted" through engineering-serendipity methods; and creating new opportunities for people to engage with food by digitally augmenting the user/dish connection.

4.1 Food portals: a glitchy dining experience

This project proposes a playful, theatrical dining experience that attempts a juxtaposition between the slow and fast, and the ancient and contemporary. It starts off by observing that the social ritual of dining has not really changed very much for centuries, or even millennia. Today, perhaps the biggest transformation in dining is the advent of what some call "the Skype dinner." This project looks in fact at the concept of remote dining while sharing the same meal because it demonstrates the ability of food and the mutual enjoyment of food to transcend space and time. At the same time, research on glitches explores the idea of black holes, or portals − a magical shortcut through the space/time continuum.
The project site is an abandoned building in downtown Bergamo, a subterranean bomb shelter below Piazza Dante referred to as "Diurno." It first existed as a WWII bomb shelter after which it became a "day hotel" abandoned in 1978. The entrance to the site is below a groin-vaulted portico that also provides a gateway from the street to the park.
The concept proposes a food hall/cave where different local vendors can complete the aging/fermentation/storage process before being eaten in the same location, in a sense fulfilling the promise of "0 kilometer food." After you have gathered your food and drink, you or your party of up to six other people are assigned to a Food Portal. Here you will be paired with another portal for a virtual 1:1 formal dining experience.
The project has several layers of impact on the region. First, it attempts to re-activate an abandoned building, a problem throughout many medium sized cities in Europe. The project also creates a marketplace for food items that might not usually appear in traditional farmers markets which are centered around produce. It generates awareness of local food and culinary traditions of Bergamo. Finally, Food Portals present a new program type that

hybridizes a museum, restaurant, food hall and performance space, with the potential to become a cultural hub. Given the modularity nature of those portals, the project can also be expanded beyond the proposed site.

Figure 4. "Food portals" design concept
Source: Harvard GSD + University of Bergamo (2015)

4.2 Adopt a crop: community wheat

Food is what we put into our bodies 3 times a day, and yet we are so disconnected from it. The goal of this project is to make food personal again through the development of interfaces and experiences that educate and inspire. This concept is first a revitalization of underused and neglected urban parts of Bergamo through their re-use as stages for urban-farming. Second, it targets community engagement creating opportunities for members to work together towards the promotion of Zero-Kilometer food and for a better understanding of the groundwork of food production.
Through a web application that serves as a nerve center, members can administer their engagement and monitor the status of their produce, creating a new type of consumer. Joining the community means that the user becomes part of a Do-It-Yourself reform plan. It is a reform against the chemical fertilizers, dangerous pesticides and all the shady practices that promise producers higher profit.
Adopt-a-Crop fosters a new relationship with food by reconnecting to the growing procedure, monitoring the evolution and consuming healthy and delicious products, and supporting local production by adopting plants. Some other features include: fine-tuning environmental factors that support growth by trying out little tweaks to see if they make the plants "happier," sharing feedback on the results of the growing plan, and using crowd-sourced guides for full seasons of garden care. Urban gardens across Bergamo could also run collaborative experiments to see which farm produces the tastiest food!

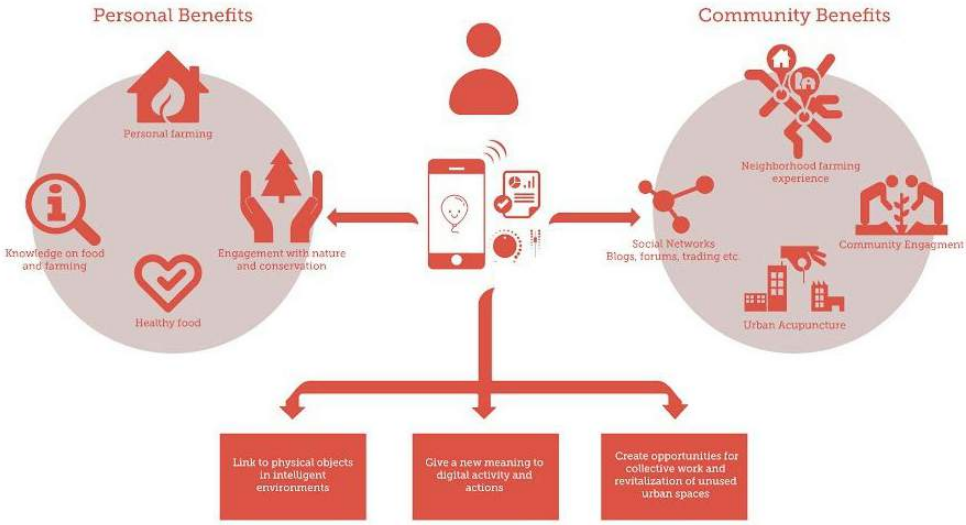

Figure 5. "Adopt a crop" design concept
Source: Harvard GSD + University of Bergamo (2015)

4.3 Maker Sphere

This project leverages on the idea that a glitch can create the conditions for users 'to get what they didn't want they wanted' through engineering-serendipity methods that spark creativity and innovation. MakerSphere is a new online platform for linking individuals who might otherwise not have a means of connecting with each other. The platform is designed to lower the barrier to entry to personal fabrication ("anyone can be a maker"), while propagating public interest through higher visibility and exposure to previous maker projects.
MakerSphere is designed to expand the impact of the maker movement through various modes of engagement, such as make-athons and individual project listings. It is built with algorithms designed to engineer serendipity. Rather than relying on a reductive approach of finding someone's most "accurate" matches, the concept promotes the idea of "Getting What You Didn't Know You Wanted" by intelligently suggesting new and unexpected working relationships. Engineering serendipity involves using techniques to reveal the unknown unknowns and then fill organizational gaps by introducing externalities into an individual's self associative patterns. The platform provides an engaging exploratory experience which introduces users to new project ideas and makers across a broad scope of industries. Through the use of a recommendation algorithm, users are exposed to new ideas, people, and projects which may have previously been outside their scope of vision.

4.4 Uncork

In the territory of Bergamo there are numerous local food markets, but the sector of agriculture represents a small percentage of employment and economic benefits. In spite of this, it has enormous value in terms of territory and society, as well as representing a high

standard of excellence. It has a strategic role in the economy of the province and embraces 6,622 farms, mainly located in the plain.
Focusing on the individual, taste has long been considered the lowest of the senses. Given little credit, it is understood now as a mix of smell, genetics, and environmental factors such as temperature, mood, and the specifics of any given tasting experience. This project aims to exploit this glitch as it relates to a larger understanding of preferences, each person building a profile based on their own glitchy taste in an immersive responsive environment.
The goal is to use experiential qualities of food as a way of activating and revitalizing abandoned and unused spaces around the city. Through a better understanding of the needs of distributors and local-level producers, as well as the desires of their audience, the aim is to unite the two parties with a technological solution. The solution is an interactive wine tasting experience, which responds to the successful union of creator and consumer. Addressing issues of local food visibility, distribution and exposure of a growing wine region, sustainability of spaces and lingering notions of usable space, Uncork rewards the social outcomes of consumption with extraordinary reactions from the environment.

Figure 6. “Adopt a crop” and “Uncork” design concepts
Source: Harvard GSD + University of Bergamo (2015)

5 CONCLUSIONS

The current efficiency-driven, routine-inducing concept of smart city − as it is currently described, understood and deployed − does not reflect the intrinsic dynamics of cities, characterized by urban vitality, spontaneous activities, and collective creativeness. This paper offers an alternative look at the use of technology in city environments by employing the concept of urban glitches to break routine patterns and standardized modes of living. The focus on local food systems is used as a research strategy and design framework for the development of concepts employing responsive technologies for the creation of novel food places and experiences.
The study is part of an action research that engaged a variety of knowledges and skills from numerous actors. Stakeholder from both the private and public sectors provided competences that are complementary to each others and offered different perspectives to the challenges that were posed. The local administration facilitated the research and gave political support to the proposed initiatives. Finally, the University acted not only as the promoter of the whole research initiative, but also as a link between the public institutions, the private sector, and the community. Eventually this strong multidisciplinary approach

turned out to be a key factor in both the research and the design endeavors.

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CHARACTERIZATION OF CITIES AS STRATEGY FOR URBAN PLANNING: METHODOLOGY APPLIED IN THE REMOURBAN PROJECT

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ABSTRACT

This paper aims at describing the methodology deployed in the Project REMOURBAN for the characterization of European middle size cities which allows identifying their potential characteristics and adverse conditions as starting point for addressing their sustainable urban transformation. The methodology comprises a selection of suitable indicators for each application domain identified in the project (both technical - energy, mobility and ICTs- and non-technical –people, governance, finance), benchmarking of the data available at city level in the selected data sources and the employment of statistical methods for clustering cities with homogenous characteristic.

The approach has been applied in 41 European cities from 18 countries and different cluster methods were employed in order to determine which was the most appropriate for our analysis. In addition, for a better interpretation of the results and a more accurate classification of the cities, diverse analysis were performed in each domain for concluding with a global analysis which group all the indicators and domain.

Relevant information has been obtained for the cities analysed regarding the sector which has a better opportunity for the urban transformation (energy, mobility and ICT) as well as the most proper strategies around the Smart City enablers (people, governance and financing issues). Furthermore, the statistical analysis led to build 5 different typologies of cities in each one of the field analysed and other 5 groups of cities with homogenous features were defined

with the global analysis. The location of clusters in certain geographic areas (North, South, East and Centre of Europe) was only obtained in the global analysis, not obtaining a clear picture in the single analysis.

The replication strategy of REMOURBAN will continue with the evaluation of the replicability of interventions and innovative solutions performed in the three lighthouse cities of REMOURBAN through a model built on non-technological barriers, citizen engagement and financial innovative schemes. Some of the cities analysed in the characterization study will take part in the analysis.

1. INTRODUCTION: THE REMOURBAN PROJECT

REMOURBAN is a large scale demonstration project, whose purpose is to accelerate the urban transformation towards the smart city concept taking into account all aspects of sustainability. Several objectives will be achieved, being the most relevant the development of a holistic and replicable model for sustainable urban regeneration, with a jointly approach in the sectors of energy, mobility and ICTs.

This urban regeneration model will be developed and validated in three lighthouse cities (Valladolid-Spain, Nottingham-UK and Tepebasi/Eskisehir-Turkey) accelerating the deployment of innovative technologies, organisational and economic solutions to significantly increase resource and energy efficiency, improve the sustainability of urban transport and drastically reduce greenhouse gas emissions.

Besides the lighthouse cities, two cities are involved in the project with the role of follower, Seraing in Belgium and Miskolc in Hungary. These cities allow increasing the European dimension of the project and its replication potential. In order to achieve this objective, a methodology for the replication of this urban regeneration model is being developed from the three main lighthouses to the follower cities and from there, to any other city in Europe, as a holistic strategy for city transformation and planning, integrating all the existing strategies for energy, mobility, ICTs and citizen engagement.

2. URBAN REGENERATION MODEL AND REPLICATION POTENTIAL

The main goal in REMOURBAN is to provide a Sustainable Urban Regeneration Model that defines a holistic process for urban transformation with a jointly approach in the fields of Sustainable Buildings and Districts, Sustainable Urban Mobility, and Integrated Infrastructures and Process. This model provides solutions in both technical and non-technical fields addressing the temporal goals, the main Smart City enablers within the transformation process –towards a more sustainable and smarter environment– and innovations in the priority actions of energy, mobility and ICTs.

This toolkit of solutions, integrated through the model, is able to be adapted and implemented in a wide range of European Cities, focusing on their specific goals and targets, and the boundary conditions that characterise their ecosystem.

The Urban Regeneration model covers the four main phases of the city transformation process, which are linked to the specific actions and the Smart City enablers. These main phases are:

- **City audit** is the first phase of this model, aiming at implementing a set of integrated existing methods and tools that can support the evaluation of the current conditions of the cities in which the Sustainable Urban Regeneration Model will be implemented.
- **Actions design**. The objective of this second phase is the definition of the specific interventions or actions that will be undertaken in the city. After the analysis of the information collected in the first phase, it will be proposed a solution according with the expectations about energy savings and costs. This is a decision-making process.
- **Implementation.** The actions designed in the second phase will be implemented and commissioned, covering all fields involved in this urban transformation. In this phase, the deployment of the monitoring program will be key to allow gather the necessary information for assessing the impact of the intervention in the following phase.
- **Assessment.** This last phase is in charge of assessing the impact of the interventions following evaluation protocols and using the information gathered during the implementation phase. For this evaluation, the most appropriate KPIs will be selected in order to assess the sustainability and the smartness and some specific parameters as the energy consumption, CO_2 emissions reduction, reduction of the journey delays, even the social acceptance of the final users and citizens.

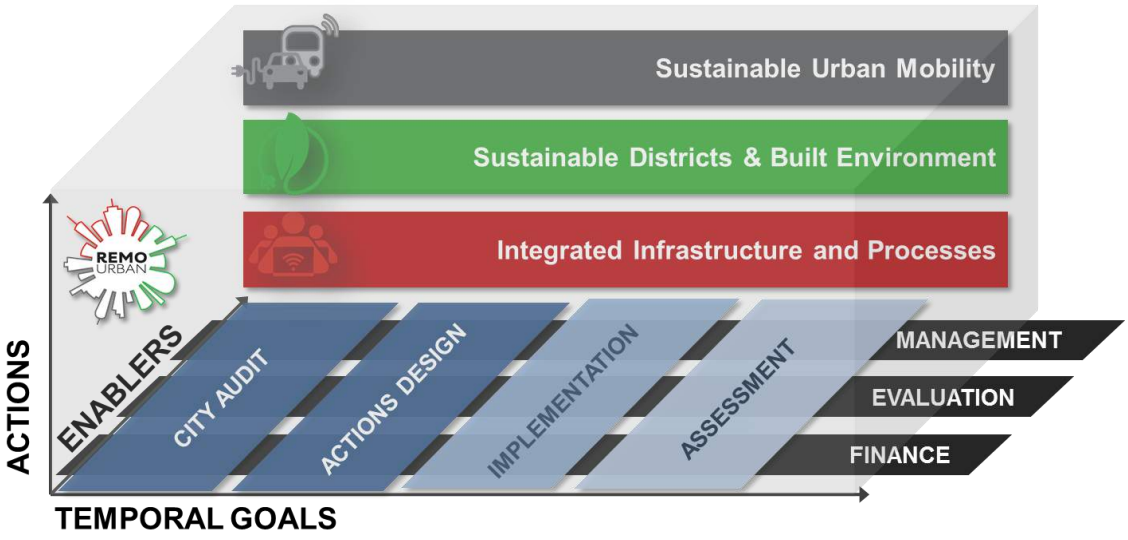

Figure 1. Sustainable urban regeneration model
Source: prepared by the authors

REMOURBAN aims at not only implementing this model in the three lighthouse cities where the main benefits and suitability of the model will be tested and demonstrate its replication potential and ability to be adapted to these different conditions. A first replication stage will be tested in the follower cities of Seraing (Belgium) and Miskolc (Hungary); but also a wider replicability plan to European Cities is being defined and will be validated.

This replicability plan is based on the characterisation of the European Cities, and grouping of them into specific target areas according to a set of indicators in the main fields of work of this model.

3. METHODOLOGY DEPLOYED FOR THE CITY CHARACTERIZATION

The methodology developed intends to categorize cities in five layers according to the REMOURBAN domains for a final generation of groups of cities which show same profile according to an aggregated scheme of indicators.

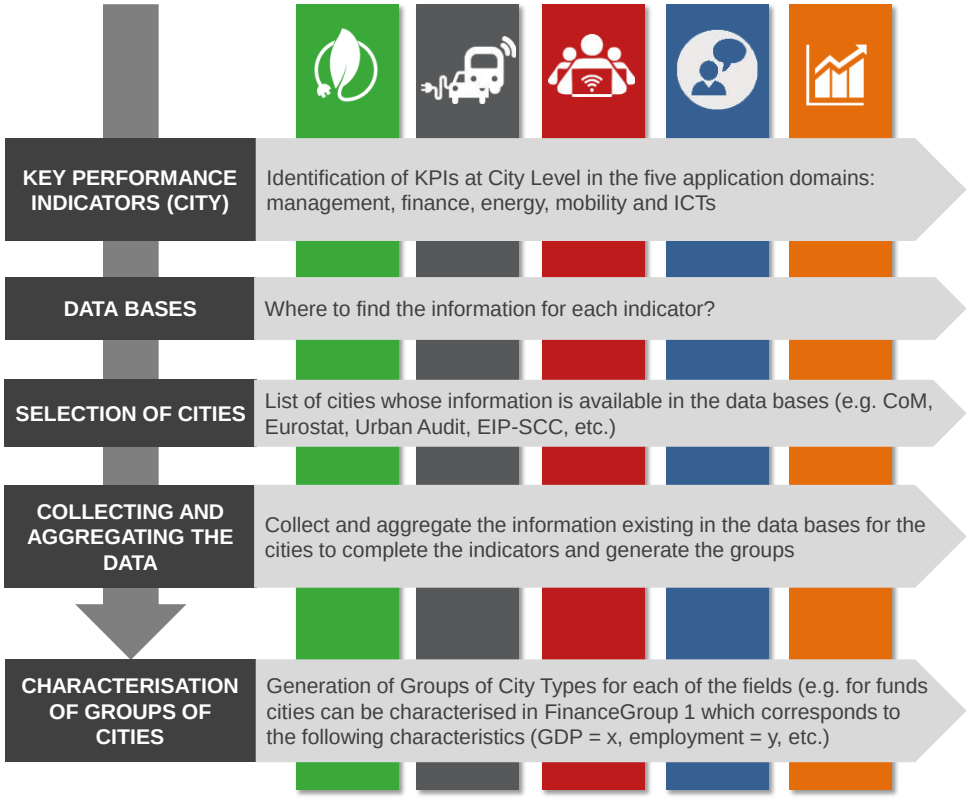

Figure 2. Overall scheme of the methodology
Source: prepared by the authors

The methodology comprises 5 steps which are briefly explained below:

- Selection of indicators for each REMOURBAN domain (management, finance, energy, mobility and ICTs) at city level. The choice will be based on their representativeness and availability in the existing sources.
- Exploration of database where find information for each indicator.
- Selection of cities which count with information for all the indicators in the databases.
- Collection of data for each city to complete indicators and generate groups of cities with similar features.
- Characterization of groups of cities in basis on range of values for each analysed field.

Therefore, the scope of the replicability is delimited to those cities with detailed information in databases (boundary condition).

4. RESULTS AND DISCUSION

With the application of the methodology, it is contemplated to narrow the study to 41 European cities of a certain size and establish groups of cities with homogenous characteristics in each domain. Within each of these groups of cities, the representative value will be calculated for each indicator in order to have the most representative values for a city within that cluster.

In a second interaction, the relationship among the different layers is analysed, leading to a cross-field characterisation at a higher level than the detailed classification by layer. The combination of both analyses allows different levels of detail in the clustering, which will deal to the identification of how the urban regeneration model can be adapted to the specific city characteristics of each group, ensuring therefore its replicability.

The radar graph below show some of the results obtained with the analysis:

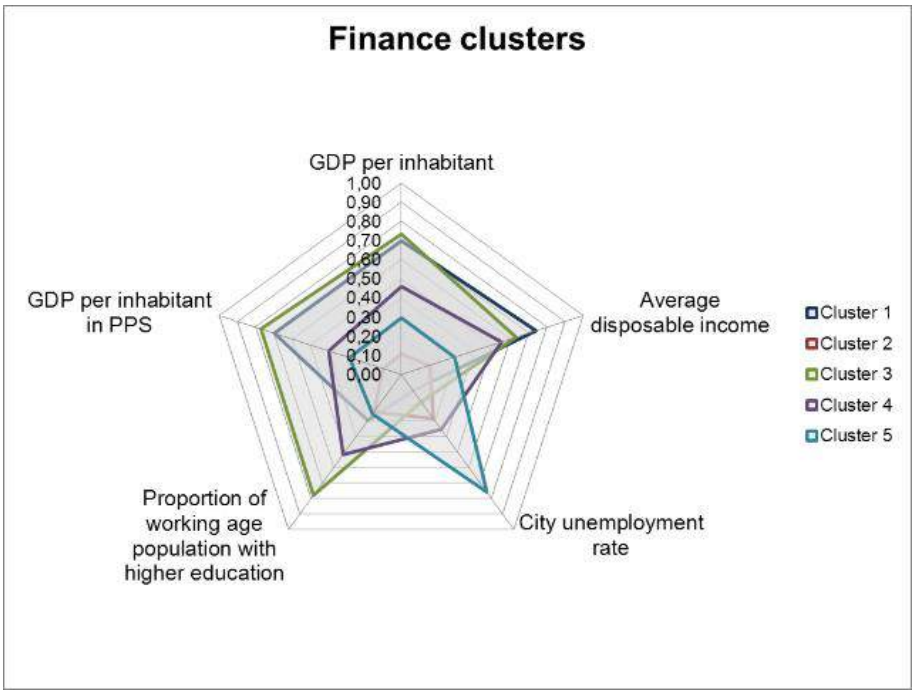

Figure 3. Results of the finance clustering
Source: prepared by the authors

The characterization of the cities revealed for each city the sectors which have a better opportunity for the urban transformation (energy, mobility and ICT) as well as the most proper strategies around the Smart City enablers (people, governance and financing issues).

Some interesting conclusions related to the urban planning have been obtained:

- Strategies based on citizen engagement can work in those cities which have a high rate of recycling and a high level participation in elections. However it can be assumed that these strategies should not be applied for an immediate result in each cities far of this scenario.

- Cities with a modal split based on private vehicle and a high number of cars probably present problems of traffic. If policy makers know the exact figure of the city in this issue could overcome better the problem.

However, it is required to make a joint analysis which includes all the indicators and domains in order to take into account the influence of all the factors. For example, it is not sure that cities with good position in financial issues present a higher potential for implementing efficient energy solutions than others.

The result obtained with the global analysis is represented in table below where the minimum and maximum values for each indicator have been identified in each cluster with the objective of finding the potential and failures of the cities analysed.

	People	Governance	Finance	Mobility	Energy	Infrastructures
Cluster 1						
Cluster 2						
Cluster 3						
Cluster 4						
Cluster 5						

Most positive values
Intermediate values
Less positive values

As it can be observed, any city analysed have totally secured the implementation of energy efficiency solutions. In some cases, the financial schemes are the main restrain (cities belong to cluster 1 and cluster 3) whereas the people profile can be the main responsible for other cities.

On the other hand, it has been detected a connection of the clusters with certain geographical areas as it is shown in the picture below.

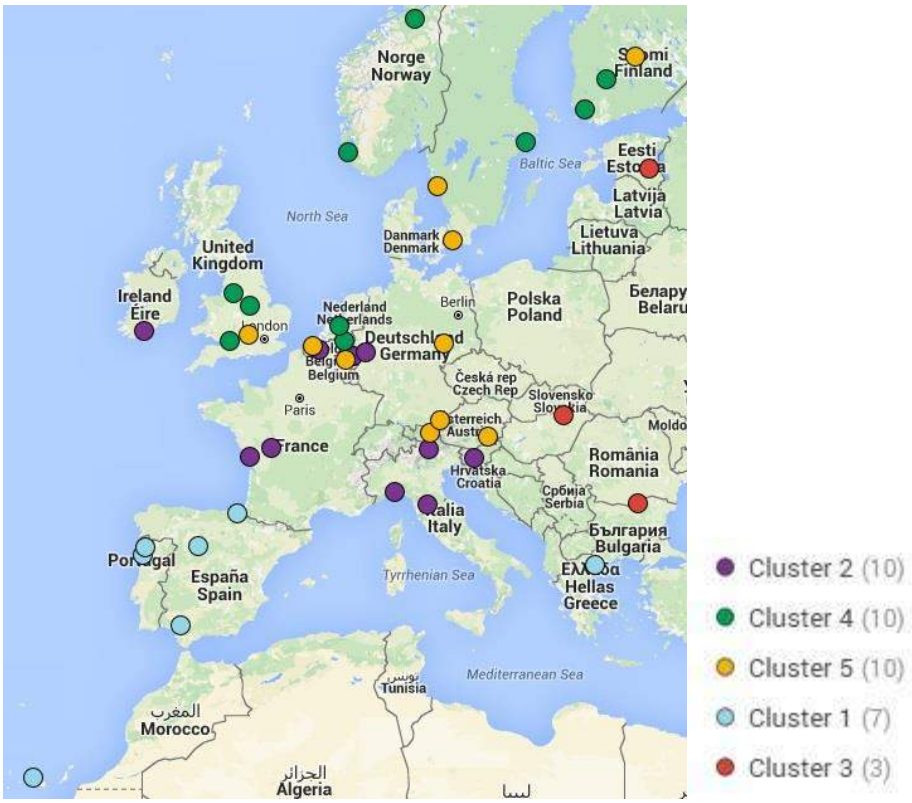

Figure 4. Map of cities characterised and their related cluster
Source: prepared by the authors

- Cluster 1 corresponds with cities located in countries of the South of Europe (Greece, Portugal and Spain).
- Cluster 2 corresponds with cities located mainly in countries of the Centre of Europe (France, Italy, Slovenia, and Belgium). This cluster also involves other countries such as Germany and Ireland.
- Cluster 3 corresponds with cities located in countries of the East of Europe (Bulgaria, Estonia and Hungary).
- Cluster 4 corresponds with cities located in Scandinavian countries (Finland, Norway, Sweden), UK and Netherlands.
- Cluster 5 corresponds with cities located in diverse geographic zones. North countries (Austria, Germany), Scandinavian area (Sweden, Finland), Belgium and UK.

5. FUTURE DIRECTIONS

The first step of the replicability strategy of REMOURBAN project has been the characterization of the European cities following the methodology described above. This characterisation provides the basis for supporting the development and facilitating the replication of the urban regeneration model developed in REMOURBAN project in order to improve the sustainability and smartness of European cities.

Taking advantage of this characterization and considering the innovative technologies and methodologies that are being analysed and deployed within REMOURBAN, the second phase of this strategy is the development of a model for replication potential that will be evaluated at the follower cities, taking into account the stakeholders involved in the process, the technical and non-technical barriers and the needed business models and financial schemes for the application of the urban regeneration model in the European cities.

This model will include necessary adaptations in order to make the REMOURBAN model applicable for each group of cities identified within the characterization of cities.

6. CONCLUSIONS

REMOURBAN will take account of this characterisation of the EU cities, as one complimentary tool for better understanding the urban dynamics and creating a replication framework for its findings. This characterization provides the overview of which cities have adverse conditions in meeting their energy, transport and climate change targets.

The 41 selected European cities have been characterised obtaining different typologies of cities for each layer analysed in the application domain of the REMOURBAN regeneration model: management, finance, mobility, energy and ICTs.
As a result, it is possible to identify which are the adverse conditions and potential features of these cities by each domain (energy, mobility, ICT) and enablers (people, governance and finance).

Further to the layer-by-layer analysis, a second analysis has been performed where five geographic areas have been detected in Europe as a result of applying a clustering approach for characterising the cities in a global analysis in which all the indicators are considered: North, Centre, South, East and Scandinavian countries (UK and Ireland are not included in these identified areas). Contrary to the outcomes obtained in the analysis by layers, in the global evaluation cities have been grouped into regions with a clear correlation with their location.

As a result of crossing both analyses, it can be easily identified the correlation among the global cluster and the layer-by-layer evaluation, where it is clearly shown how although cities belong to the same global cluster (which is mostly distributed in clear geographical areas), they usually have different conditions for some of the layers, which makes more precise the layer-by-layer evaluation in order to define how the urban regeneration model can be adapted to these existing conditions.

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INTEGRATING CLIMATE RESILIENCE IN SMART CITIES: CASE STUDY OF AHMEDABAD CITY

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KEYWORDS: Climate Change, Climate Resilience, Urban Infrastructure, Smart City, Basic Services, Urban Development

ABSTRACT

The frequency and intensity of extreme weather events is likely to increase due to climate change. Climate change could also become a strategic economic and political concern as it starts to erode India's economic performance and affect the lives and livelihoods of millions of people. Cities are the engines of economic growth; Indian cities are currently contributing around 58 per cent to its GDP, which is expected to grow to 70 per cent by 2030. In absence of appropriate strategies for addressing impacts of Climate Change the suffering of the cities can be colossal. Ahmedabad is chosen under the smart city mission of Government of India and is on the way of developing its smart city plan. Considering the vulnerability of Ahmedabad to Multiple natural hazards it is imperative that disaster management and resilience be the key focus area for all urban development initiatives in the city. We find that Ahmedabad has been actively striving towards buildings smart city; while its efforts are appreciated it is observed that the city still requires a sound integrated climate resilience smart city framework. As no smart city can afford so much loss that wipe away decades of progress, this calls for the need of systemic response that looks at engineering, design and technical solutions to ensure resilient cities. After analysing the climate resilience status of the city we have put forth a set of recommendations that may serve Ahmedabad and other cities in mainstreaming climate resilience in their smart city plans.

1. INTRODUCTION

Cities in the 21st century are facing enormous changes – growing populations, physical expansion, new infrastructure investments, shifting governance parameters, and increasing citizen demand for

Date; May, 2016

infrastructure services. Nowhere is this truer than in urban India, which will swell to 600 million by 2030, adding an additional 223 million new inhabitants and building, 70 per cent of the infrastructure of these future cities over the same period of time. Cities currently contribute around 58 per cent to India's GDP, which is expected to grow to 70 per cent by 2030

The IPCC SREX-2012 report establishes strong link between Climate Change and extreme/weather events like storms, cyclones, floods, droughts and heat waves., moreover it has been predicted that the frequency of extreme weather events have considerably increased and so the related disasters (ACCCRN, 2013; MoUD, 2014; Parikh et al, 2013, Parikh et al, 2015). Such hazards may further aggravate the strains that cities face like poverty, inadequate services, infrastructure deficits, and environmental stress. It is a known fact that climate change is expected to worsen the situation in India; it not only will increase the burden of social and economic losses on its people but also degrades the resilience and coping capacities of poor and vulnerable communities.

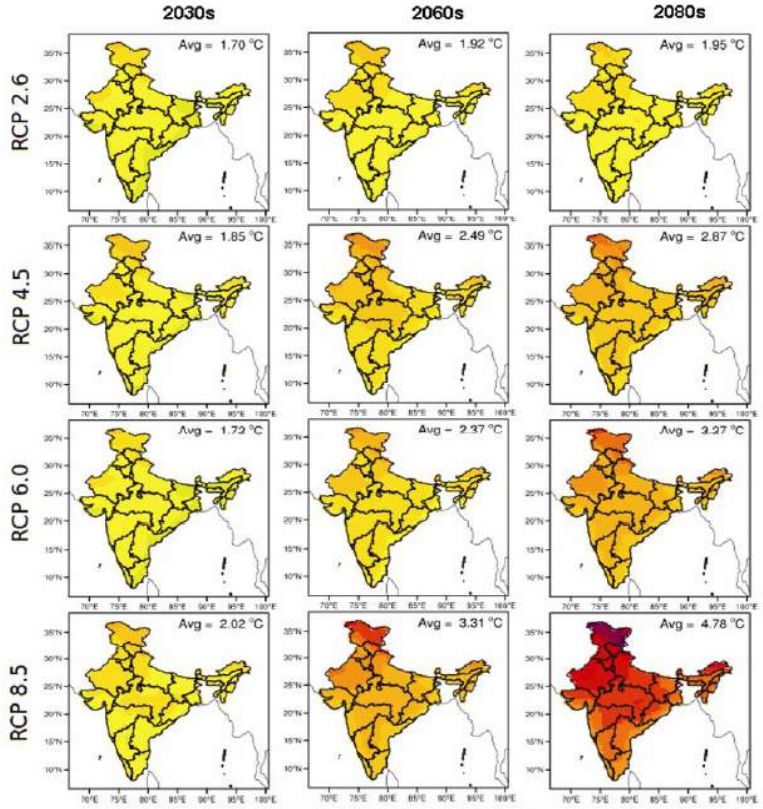


Figure 1 of RCP scenarios affecting India, CMIP5 model ensemble mean temperature change (°C) projected

Source: Chaturvedi et al., 2012

On the temperature front, not much change is anticipated under RCP 2.6 scenario (figure 1) in either 2060s or 2080s, whereas under RCP 4.5 scenario, an increase of 0.5-1-degree C is likely in 2080s relative to 2030s. RCP6.0 predicts a change of 2-degree C in 2080s relative to 2030s. Under RCP 8.5 scenarios, around 3-degree C change is anticipated in 2080srelative to 2030s.

Recent events of disasters experience by Indian cities like Cyclone in Visakhapatnam, devastating floods in Srinagar and Chennai have brought forth the vulnerability of Indian cities to multiple hazards. Cities have to bear heavy economic losses due to the hazards for example the floods in Jammu and Kashmir resulted in economic losses of 16 USD, and affected 3.6 million people in the state, the disaster was cited as the worst economic disaster of the world in the year 2014, the state

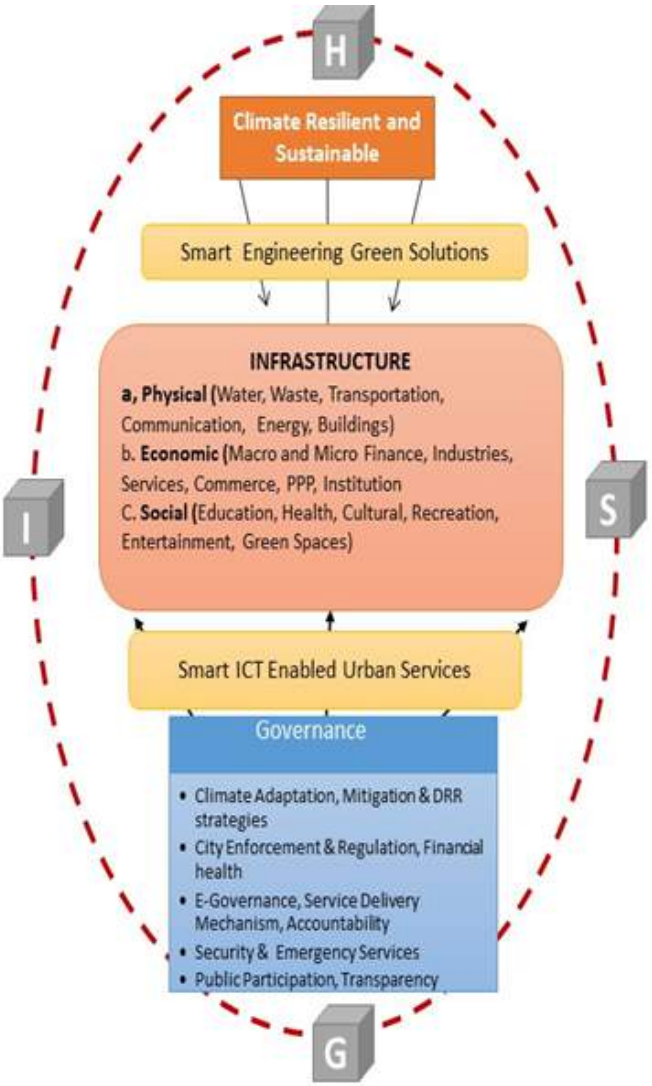
of Andhra Pradesh incurred total losses of 7 billion USD due to Cyclone Hudhud, wherein city of Visakhapatnam was the worst affected and lately Chennai has also joined the list with around USD 3 billion losses due to floods in 2015**(CRED, IRSS- 2014)**.

Climate change could also become a strategic economic and political concern as it starts to erode India's economic performance and affect the lives and livelihoods of millions of people. It is evident that city governments can no longer afford to ignore the huge economic impact of disasters on the cities will further aggravate. No smart city can afford so much loss that wipe away decades of progress. Climate change will result in increasing frequency and magnitudes of extreme events and there is a need of systemic response that looks at engineering, design and technical solutions to ensure disaster resilient cities. Minimising risks to the citizens and city infrastructure needs to be prioritised. Smart cities need to develop climate resilience at fast pace as huge economic losses occur even if cities do not function for a week.To meet future challenges with effective solutions and sufficient levels of preparedness, cities must begin today to devise mitigation and adaptation strategies which will lead way to development of climate resilient cities. A range of risks and impacts extend far beyond physical risks posed by climate change. The Indian Government launched the Smart Cities Mission which provides an opportunity to design and develop climate resilient cities. Ahmedabad is the largest city in the state of Gujarat and has emerged as a major economic and industrial hub in India. Ahmedabad has been chosen to be a smart city and is on the way of developing its smart city plan. The objective of the study is to provide guidance for Ahmedabad city to become disaster and climate resilient.

2. METHODOLOGY

The study analysed the state of climate resilience of Ahmedabad city by using a holistic framework; **HIGS (Figure 2);** described by Parikh et al (2013),having four dynamic parameters that serve basis for analysing the status of the city in terms of its resilience to climate change and disaster risk reduction strategies and preparedness taking into account various local/regional diversifications, flexibility and interdependency (flow of information with clarity) to be customized for the use in other regions/cities. The four different parameters of the framework are **a) Hazard vulnerability** (list of hazards on past history and their frequency and magnitude of impact (on socio-economic fabric, infrastructure and human life), **b) Evaluation of existing critical infrastructure** (status of the infrastructure, maintenance, coverage and access, extent of use of Information and Communication Technology and Green solutions for devising Smart & Sustainable infrastructure), **c) Governance (**response, recovery system and evaluation of city management in the context of disaster proneness, financial status/independence of the city ULB, and efficiency in delivering the basic services. Smart initiatives like: E-Governance, ICT), **d) Socio-economic status** (slum population, population below poorty line, availability of basic services to urban poor).

The study approach **(figure 2)** revolved around collecting updated information for various indicators (on past hazards & losses City governance, its ULB's performance, preparedness, financial status and SLB data etc) from Ahmedabad City and analysing them with respect to the above given parameters, the lacunae so observed were made basis for providing recommendations for Climate Resilient framework of Ahmedabad City. Moreover the authors have also prepared Digital Elevation Model (DEM) of the cities and highlighted the flood prone areas and critical infrastructure. The **Disaster Prone Area maps** are prepared through superimposition of the hazard assessment layers over the critical urban components which are highly exposed and vulnerable in times of disasters. DEM is obtained from Cartosat-1: DEM - Version 1.1R1 with resolution 1 arc Sec (~ 32 m) 2008-12 available data from NRSC data centre (NDC). Arc Hydro tool in Arc GIS Desktop 10.1 is used to



estimate the hydrological parameters such as flow direction, flow accumulation, catchment areas, drainage lines and drainage points.

3. AHMEDABAD CITY PROFILE

Ahmedabad is a riverine city located at 23.0300° N, 72.5800° E and is 446 sq km in area located in a hot climate zone. According to the 2011 Census the population is 5.6 million within the Ahmedabad Municipal Corporation (AMC) area. The city holds a special status for financial efficiency and has shown operating surplus even after several developmental activities yet the gross domestic product for the year 2013-14 of the city alone was calculated to be 64 billion USD.

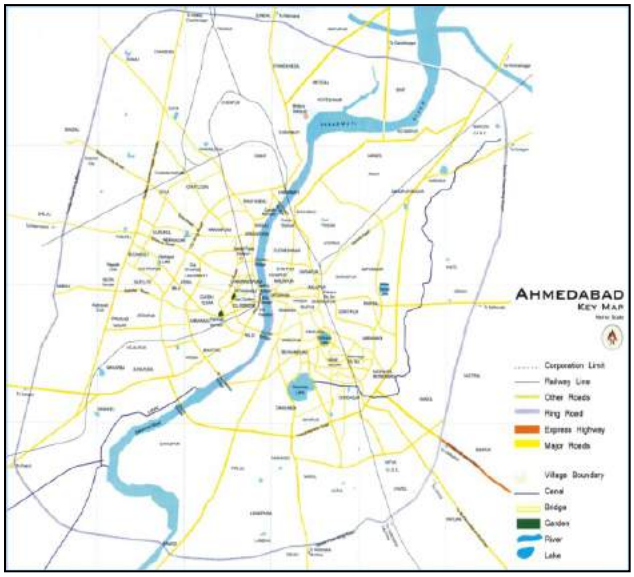


Figure 3 Ahmedabad City Report
Source: www.Ahmedabadblog.com

Owing to its geo-climatic, geological and physical features, Ahmedabad is vulnerable to major natural hazards whose impact gets aggravated in times of climate change. The city particularly faces two major hazards- Urban Floods and Heat Waves. Ahmedabad being situated on the flat alluvial plains of Sabarmati River is extremely prone to flooding. Rainfall in Ahmedabad occurs for a short period of time, with high intensity, in the months of July to September. This kind of infrequent heavy torrential rain leads to the flooding of River Sabarmati. The carrying capacity of the drainage system is less than the storm water that the city is generating leading to floods in the city. The impact in terms of area affected in urban flooding and the population staying in these areas is an alarming numberin Ahmedabad.

During summer the maximum temperature often peaks to 45 degrees Celsius leading to severe heat wave conditions. This results in loss of life of many people particularly, homeless, gardeners, daily wagers who work out under direct sun, auto drivers, etc. Existing records indicate that average summer temperatures for Ahmedabad have been increasing over the last several years. In May 2010, about 51 persons in Ahmedabad, mostly senior citizens, died of sunstroke when the mercury rose to 46.5°C. In 2013, AMC introduced a “Heat Action Plan” to tackle the perils of heat wave to provide a framework for the implementation, coordination, and evaluation of extreme heat response activities in the city to mitigate the impacts of extreme heat. This is said to be the “first comprehensive early warning system and preparedness plan for extreme heat events in India

4. DISCUSSION & RECOMMENDATIONS

4.1. Socio-Economic: Urban Environment

A total geographic area of 446 sq km falls under the Ahmedabad Municipal Corporation (AMC) and an extended area of 1294.65 sq km inclusive of AMC area falls under the jurisdiction of Ahmedabad Urban Development Authority (AUDA). The city population is 5.6 million with density of 11,948 persons per sq.km.

Land use is a one of the most critical elements in planning of the city especially when it is the matter of urban climate resilience and efficient infrastructure. Unplanned and uncontrolled growth coupled with rapid population possesses risk to the natural resources. Also, urban sprawl results in increased public expenditure on transport, infrastructure and other social services. There are certain planning tools which are available with ULB to implement the intervention viz. Development Plan, General Development Building Regulations, Byelaws to control pollutions, Property / Service Taxes.

The Master Plan/Development Planning and Town Planning Scheme mechanisms are instrumental in keeping the city compact and it is essential that the Urban Development Plans Formulation & Implementation (UDPFI) guidelines are followed while planning new areas and intensive urban forestry activities to be encouraged in and around Ahmedabad. **Our analysis indicate that additional focus must be directed towards transportation, air pollution, vegetation and housing for all in the city of Ahmedabad.**

Public Private Partnership model where ULB's parks are maintained by Resident Welfare Associations have been successfully implemented and accepted by the public. This can be used as an example model that can be followed in other parts of the city. Further, Slum Networking Projects with resident dwellers should be encouraged to participate as partners towards improving the city environment. Investments for improving storm-water drainage should be prioritized under the Smart City Mission to build disaster resilience. It is recommended that the proposed Ahmedabad Smart city plan should be augmented with disaster vulnerability maps to build an informed city development plan which includes spatial interface as planning instruments. Drought and floods can be addressed simultaneously if water bodies like urban lakes, ponds and wetlands are managed properly.

4.2. Infrastructure and its management

Critical Infrastructure includes the resources and structures which are necessary for a well-working society and economy and are responsible to act and provide assistance in wake of any accident or disaster. Currently there is no availability of common map/ database on critical infrastructure. Absence of a common database on services like health centre, fire station, police station, disaster management centre leads to delays in responding to disasters. Also, some of them lie in low lying areas, making it difficult to access them in case of flooding. In line with these factors, it is recommended that mandating rain water harvesting in General Development Control Regulations (GDCR) for all residential buildings along with authorized meters for water connections that will increase accountability and strengthen the water monitoring and storage system. Levying consumption based or metered monthly water fees is suggested to initiate a measurement structure which will related to reduced water wastage.

Digitization and Mapping of critical infrastructure on GIS is now essential. Qualified experts to plot maps and conduct analysis have to be formed and further share the data with the disaster response team. To this end, a single central office is required to oversee consolidated Database Management System (DBMS). Various agencies to be put in conference and data should be shared for effective and efficient plan. The data gathering and sharing system will not only improve the awareness level across the city but assist in designing appropriate plans and solutions. Uploading routes and related information online with smart card options for AMTS, BRTS and MEGA will ensure integrated land use transportation development. Responsibility should be assigned to update the hazard/disaster data with loss figures (impact). There is an urgent need to integrate disaster resilience with revised development plans to increase efficiency in investment utilisation.

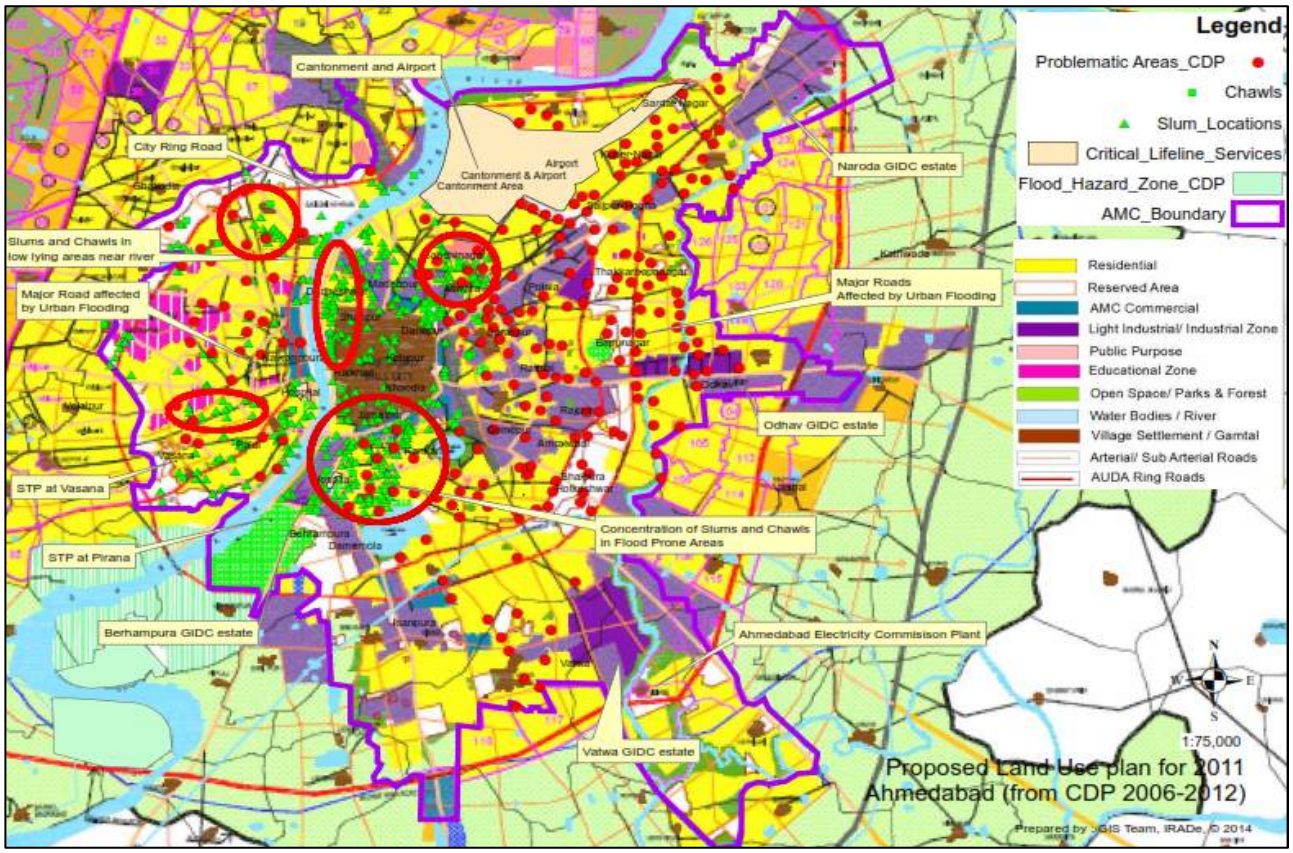


Figure 4: Map shows the parts of the city highly vulnerable to disasters
Source: IRADe analysis, 2014

It is suggested that City Resilience Plan should be prepared for Ahmedabad considering its exposure to hazards and potential to emerge as a major metropolitan city. Though a high flood hazard zone has been identified in the proposed plan (figure 4), the vulnerability of the city's critical infrastructure should be reflected while planning for the city. There is need for close collaboration between AUDA, the Municipal Corporation and Gujarat State Disaster Management Authority. The development plan should be made dynamic with lessons from each city hazard/disaster to be integrated for better land use planning, governance and response mechanisms. The city can strengthen its resilience by having good financial health. The financial capacity of the ULBs should be further strengthened. To strengthen the revenues and financing mechanisms, there is need for capacity building programmes for ULB staff. Training need assessments should be conducted and the staff trained accordingly.

4.3. Disaster Risk Reduction

Ahmedabad city has high exposure to a number of hazards and is most prone to - urban floods, heat waves & earthquakes as impacts of climate change. A fair share of the city population is living in the flood prone area (figure 5). It is imperative that disaster management and resilience be the key focus area for future urban growth and development. Though Ahmedabad city is in Seismic Zone III, the city has to be well prepared to face any disaster which may strike the city without any early warning and can cause great loss of the lives and property and erode the economic growth of the city. Provisions have been found in the existing planning instruments for building earthquake resistant infrastructure. The enforcement and monitoring of the existing provisions for building earthquake resistant infrastructure and disaster resilient systems need to be strengthened. It should be mandatory for buildings to obtain a certificate of structural safety before approval by a local body. The Emergency Operation Center should be strong and active and ensure that the physical space is setup in a safe zone. Early Warning systems for floods should be set up to coordinate and facilitate pre and post disaster operations. Records related to history of hazards, infrastructure details of health centers should be maintained updated on regular basis. Detailed GIS maps from ULB should be shared with ward committees. A comprehensive Geographical Information System (GIS) plotting all the features of the city and its environs with necessary data to be developed which will act as a tool in development planning.

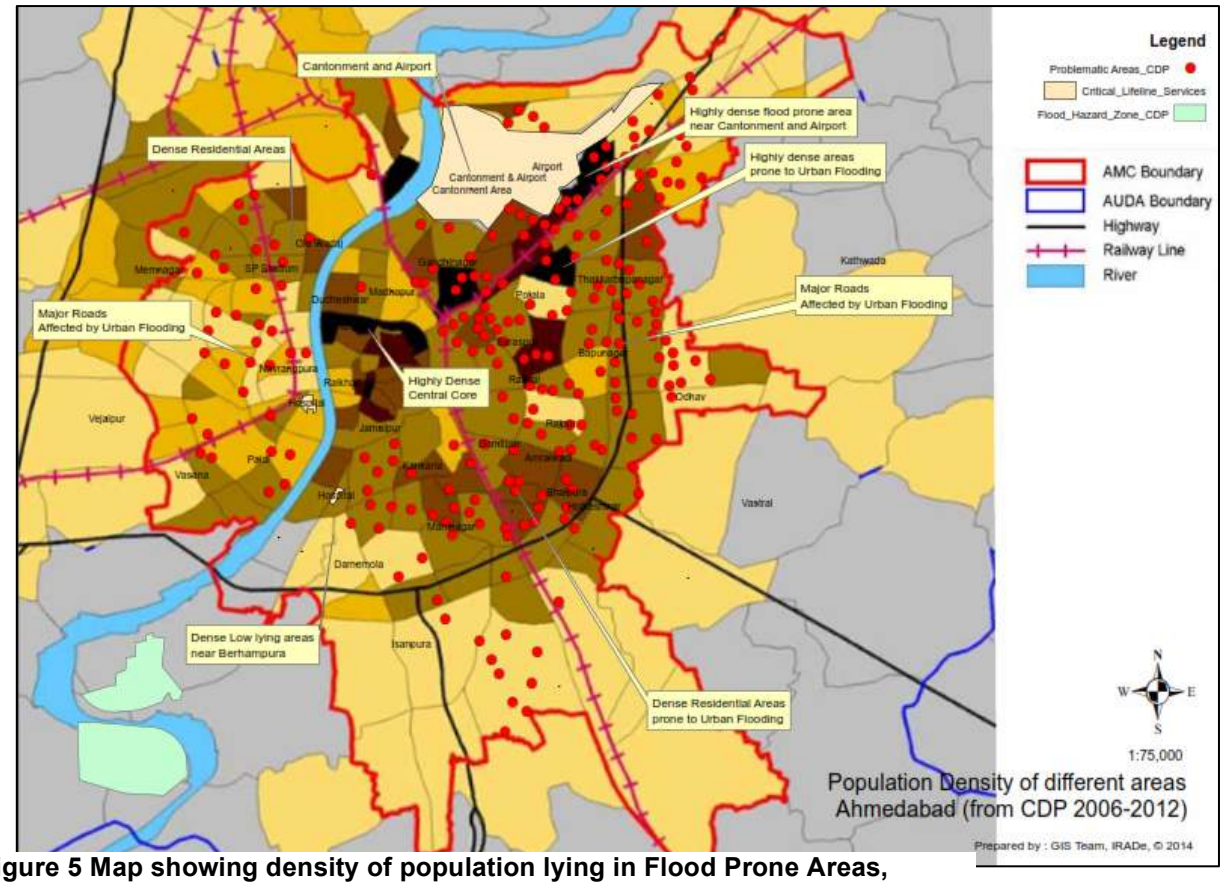


Figure 5 Map showing density of population lying in Flood Prone Areas, Source: CDP 2006-2012

5. CONCLUSION

Considering the vulnerability of Ahmedabad city to multiple hazards (given in section 3) and the above discussed impacts of the Climate Change on cities it is important for Ahmedabad to follow a proactive approach in terms of devising strategies for climate adaptation and mitigation. Although Ahmedabad has been actively striving towards buildings smart city; while their efforts

are appreciated it is observed that the city still requires a sound integrated climate resilience smart city framework. The current study has tried to emphasize on the need for such integration and has tried to devise a set of recommendations (table 1, based on the analysis done in section 3 and 4) which may guide the city in mobilizing the necessary actions needed for being climate resilient smart city

Key Focus Areas	Solutions needed for Climate Resilience
Urban Floods: • **Ahmedabad is experiencing urban floods once in 2 years. Incidents of water logging keep increasing every year.** • **City Disaster Management Plan (CDMP), a comprehensive document is not present.**	Upgrading the infrastructure (storm water drainage network). Early Warning systems for floods to be set up to coordinate and facilitate pre and post disaster operations. A need for CDMP according to updated guidelines mandated under DMA, 2005. There is a need for City Emergency Operating Centre (EOC) with well-equipped control room as well as trained staff.
Heat Waves: • The Heat Action Plan has been launched in 2013. Apart from keeping citizens informed, plan also calls for monitoring various heat wave induced health ailments.	Records related to history of hazards, infrastructure details of health centres should be maintained updated on regular basis. Detailed GIS maps from ULB should be shared with ward committees.
Water supply: • Increasing pressure on the existing ground water sources resulting in drastic depletion of ground water levels (90 m below ground level) • In water supply services, distribution losses or NRW accounts for more than 20%.	• Mandating Rain water harvesting in General Development Control Regulations (GDCR) for all residential buildings. • Mandating meters for every water connection thereby increasing accountability.
Storm water Drainage: • Poor coverage and inefficient drainage results in loss of rainwater as well as spill over on major roads. • Presently sufficient measures are not available to conserve the surface runoff water from roof top buildings, road surfaces and parks to recharge the water resources.	• Improving the storm water drainage network and linking them to water bodies. • Standards to be made for treating and reusing the rainwater.
Solid Waste Management: • There is a need for efficient facility to treat and recover waste as the current capacity is inadequate. • Despite allocating maximum fund to this sector by the ULB, it falters in recovering service charges.	• Upgrading the scientific treatment plant for effective treatment of Municipal Solid Waste (MSW) • Involving and integrating the informal sector, giving them technical training and forming area/ward wise association at the neighbourhood level to handle the
Critical Infrastructure: Absence of common platform for information about services like health centre, fire station, police station delays in responding to disasters.	Digitization / Mapping of critical infrastructure on GIS. Upload and share the data on a common platform accessible to all the agencies.
Management: Multiple agencies are involved and there is lack of co-ordination among various agencies for service delivery.	Single central office is needed for consolidated Database Management System (DBMS). Various agencies to be put in conference and data should be shared for effective and efficient plan.
Development Plans / Smart City Plans: Urban sprawl results in increased public expenditure on transport, infrastructure and other social services.	Master Plan/Development Planning and Town Planning Scheme mechanisms are instrumental for local level actions. To address climate change, urban resilience factor should also be incorporated in Smart Action Plans.

Table 1 Prioritized Areas of work for developing Climate Resilient Framework

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RenewIT tool, the online tool to reach Net Zero Energy Data Centres in smart cities environments

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KEYWORDS: Data centre, online tool, renewable energy, energy efficiency strategies.

ABSTRACT

The interest in data centres energy consumption and carbon footprint has become more urgent with the rapid increase in cloud computing, high powered computing and the vast growth in internet use. Moreover, due to the integration of these unique facilities in smart cities environment, it also is crucial to design facilities better integrated into various energy grids, in particular into smart electrical grids and district cooling/heating networks. The RenewIT tool, a free online web-based tool, developed in the framework of the European funded project RenewIT project, helps different data centre industry stakeholders to evaluate the implementation of energy efficiency strategies and the use of renewable energy in the data centre portfolio. This paper presents the functionality and advantages of the tool as well as the research process performed during the development of the tool.

1 INTRODUCTION

The continuous growth in size, complexity and energy density of data centres due to the increasing demand for storage, networking and computation has become a worldwide energetic problem. Moreover, these facilities run 24 h a day, the 365 days of the year while they have to provide high redundancy levels to prevent any failure. These phenomenon tend to over-engineer mechanical and cooling system and over-provision data centre IT capacity while under-utilizing it to safeguard the delivery of compute power. These practises lead, obviously, to waste energy and inefficiencies. The emergent awareness of the negative impact that the uncontrolled energy consumption has on natural environment, the predicted limitation of fossil fuels production in the upcoming decades and the growing associated costs have strongly influenced the data centre industry in the last decades. Therefore, the implementation of well-known and advanced energy efficiency measures to reduce energy consumption, the integration into smart networks to turn their energy use and waste heat into a benefit for the whole energy system, and the use of renewable energy play an important role not only to a supportable growth but also to reduce its operational cost.

The data centre industry [1][2] has taken consciousness of this problem not only to show their environmental commitment, but also to reduce the operational cost. In that sense, Oró et al. [3] presented a literature review on the implementation of energy efficiency strategies and the integration of RES into data centres portfolio. In the framework of the European funded project RenewIT project [4], holistic and dynamic energy models to characterize the overall

energy performance after the implementation of advanced energy efficiency strategies and the use of renewable systems to provide green electricity and cooling to the facility have been developed. The approach also considers the life-cycle economic impact of these strategies into the data centre portfolio. Other works have been focusing on studying the location as an energy efficiency and renewable energy supply measure [6]; the use of free cooling strategies [7], the implementation of thermal energy storage [8][9], heat reuse strategies [10][11], hybrid renewable energy systems using hydrogen storage technology and fuel cell-based combined cooling [12], heating and power system for data centre industry [13]. Recently, Shuja [5] examined sustainable cloud data centres from various aspects to survey the enabling techniques and technologies. They presented real data centres to demonstrate favourable results for sustainable measures in terms of:

- On/off-site renewable energy generation to reduce GHG emission.
- Waste heat recovery and free cooling techniques to lower cooling costs.
- Transportable modular data centre designs that facilitate exploitation of renewable energy, waste heat, and free cooling opportunities in geo-dispersed data centres.
- Virtualization based workload migrations that enable workload and resource management across geo-dispersed data centres.

The present paper presents the development of the RenewIT tool, a public web-site platform that allows evaluating the energy and economic feasibility of the implementation of different energy efficiency strategies and renewable-based supply energy systems in data centres located in Europe. The computational engine is based on metamodels in order to process the calculations as fast as possible in order to enhance the user experience without compromising the reliability of the results. Metamodels are simplified models generated by surface-response methods from the detailed energy models developed in TRNSYS [14].

2 ENERGY EFFICIENCY STRATEGIES AND TECHNICAL SOLUTIONS SELECTED

2.1 Energy efficiency strategies

Because of the high energy density nature of data centres, it is essential to implement energy efficiency measures and reduce consumption before introducing any renewable energy source. Initially, many different advanced Information Technology (IT), cooling, and power energy efficiency strategies to reduce as much as possible the load demand where evaluated [15] and here the most promising measures are presented.

2.1.1 Efficient IT management

Here, two advanced technical concepts for efficient IT management were selected:

- **Consolidation strategy.** The objective of this strategy is to allocate the virtual machines, necessaries to satisfy the IT workload demand, in the minimum number of servers. Therefore some servers are working at full load and the rest are kept in an idle state.
- **Turn-off idle servers**. Is a complementary strategy to the consolidation method, where the servers that are not being used are turned off, instead of being in an idle state.

2.1.2 Efficient power distribution

Here, two advanced technical concepts for efficient electric power distribution were selected:

- **Modular Uninterruptible Power Supply (UPS)**. This strategy proposes to use a modular UPS so that the number of modules connected can vary depending on the workload conditions. Each module can be activated or deactivated separately depending on workload to maximise the efficiency.
- **Bypassed UPS in normal operating conditions**. Depending on the power grid quality and UPS characteristics, the UPS will be working in normal conditions or partially bypassed. It is assumed that the converter downstream of the UPS will be always energized when the UPS is working in the partially bypassed mode.

2.1.3 Efficient cooling distribution

Here, five advanced technical concepts for efficient thermal power distribution were selected:

- **Free cooling**. Indirect air free cooling operating through air-to-air heat exchangers. Direct air free cooling is also considered in some situations.
- **Cold aisle containment**. The objective is to prevent air mixing and therefore enhance air management efficiency inside the whitespace.
- **Increasing the deltaT through the whitespace**. Increasing the air temperature difference between rack outlet and rack inlet reducing the air flow rate through the whitespace.
- **Variable air flow**. A variable airflow system is based on the actually required cooling, not on the maximum required cooling. Reducing the airflow implies reduced pressure drop inside the ventilation units. Consequently, running in partial operation gives a significant reduction in the energy usage.
- **High energy efficiency components**. High energy efficiency components, in particular vapour compression chillers, are implemented.

2.2 Technical solutions for cooling and power supply

In previous work [15], the authors developed a number of the technical solutions to provide cooling and power supply to data centres with the goal to increase the amount of renewable energy used, decrease the CO_2 emissions, and minimize the operational cost of the system. The different advanced concepts were modelled and evaluated through dynamic simulation using TRNSYS. In the process of modelling the time dependent energy models, the components (types) that were not available in the standard TRNSYS library were also developed for the authors (mainly types for calculating IT load consumption, power distribution and whitespace air distribution). For each concept, a unique energy model was developed and the main parameters and inputs were identified. Different scenarios in terms of location, sizing, IT capacity, IT workload type, electricity price, etc. were simulated using a multi-dimensional analysis. For this, a Monte Carlo sampling [16] of the parameter space and 100 simulations with one year duration were performed for each concept. The performances of the concepts were evaluated through environmental and economic indicators. The most important metres used were: non-renewable primary energy consumption, total cost of ownership (TCO), power usage effectiveness (PUE), operating expenditure (OPEX), net energy import, and CO_2

emission. Finally, the most promising technical concepts were selected with both quantitative results for the simulation and qualitative analysis of data centre industry and trends [17]:

- **Conventional data centre (Figure 1)**. This system represents the conventional configuration of a data centre where cooling is provided by vapour compression chillers with Computer Room Air Handling (CRAH) units.
- **Conventional data centre with free cooling (Figure 2)**. A standard vapour-compression chiller with CRAH units with the implementation of indirect air free cooling.
- **District cooling and heat reuse system (Figure 3)**. This system was though for liquid cooled data centres. During summer, chilled water from the district cooling system is used to cool the air flowing into the data centre and during winter, indirect free air-cooling is conducted. The water for direct liquid cooling is cooled by a heat pump, which provides heat for space heating and domestic hot water. A dry cooler could be used if there is no heat demand.
- **Grid-fed wet cooling tower without chiller (Figure 4)**. The main idea is to use wet cooling towers (without chillers) to produce cooling energy. When this evaporative free cooling is not possible, backup vapour-compression chillers along with cooling towers are used. The electrical power required to drive the cooling towers and the backup chillers can be purchased from the national grid. In winter, direct air free cooling is performed for efficient cooling supply to the data centre.
- **Grid-fed vapour-compression chiller with chilled water storage and second life electric batteries (Figure 5)**. During winter, indirect air free cooling is performed for efficient cooling supply to the data centre. In this concept, vapour-compression chillers along with wet cooling towers are used to produce cooling energy during summer. The electrical power required to drive the chiller can be purchased from the national grid. For thermal storage, a large chilled water storage tank is used for decoupling cooling generation from cooling demand. Thus, chilled water can be generated when cheap electricity or a high share of renewable power is available from the grid. For electrical storage, Li-Ion batteries are used for decoupling power generation from power consumption and cooling demand and following same approach than thermal storage.
- **Biogas fuel cell with absorption chiller (Figure 6)**. Here, a biogas-fed fuel cell is applied for generating both power and heat, which is used for driving an absorption chiller during summer. In winter, indirect air free cooling avoids the operation of the chillers. Then, the waste heat from the fuel cell can be recovered for space heating or might also be dissipated by a wet cooling tower. Because of the high temperature and pressure of the hot water, shell and tube heat exchanger is used for transferring the heat between the cooling tower and the fuel cell hot water circuit.
- **Reciprocating engine CHP with absorption chiller (Figure 7)**. This concept is based on biogas-fed tri-generation by means of a reciprocating engine Cooling Heating and Power (CHP) plant. The heat from this plant is used for driving a single-effect absorption chiller during summer and supplying space heating for offices or buildings close to the Data Centre during winter. Additionally, indirect air free cooling is implemented for efficient cooling supply to the Data Centre especially during winter.

Then, the heat from the CHP plant should be used for space heating and producing domestic hot water if required.

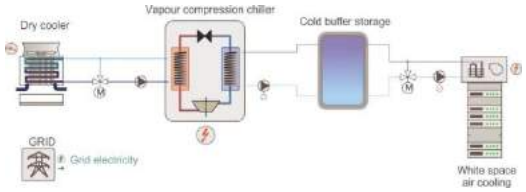

Figure 1. Thermal system of a conventional data centre.

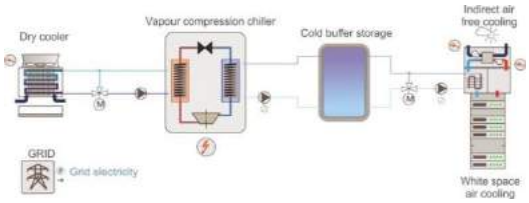

Figure 2. Thermal system of a conventional data centre incorporating indirect air free cooling.

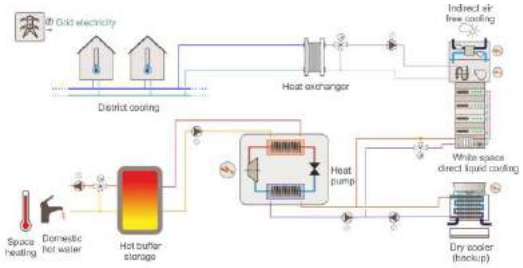

Figure 3. Thermal system of a data centre connected to the district cooling and heat reuse.

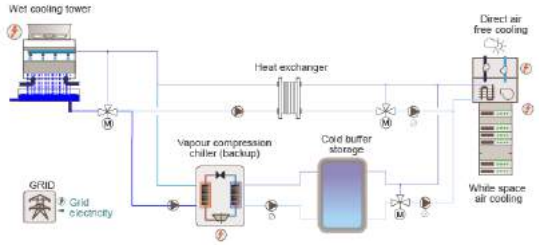

Figure 4. Thermal system of a data centre with a wet cooling tower.

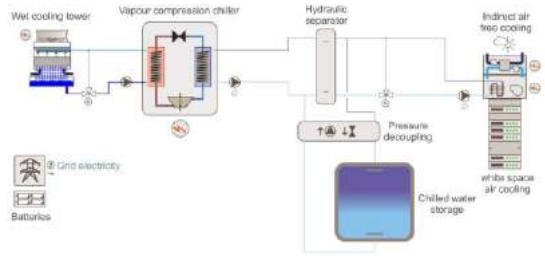

Figure 5. Thermal system of a data centre with thermal and electrical energy storage.

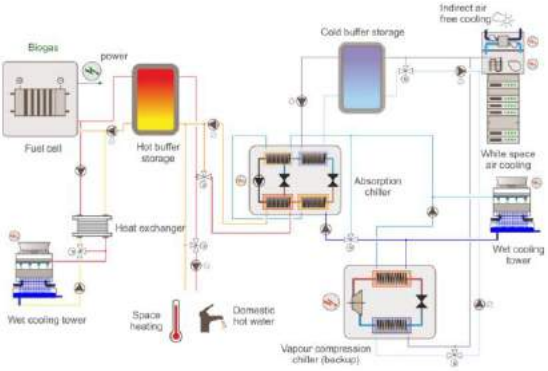

Figure 6. Thermal scheme of the biogas fuel cell with absorption chiller for a data centre

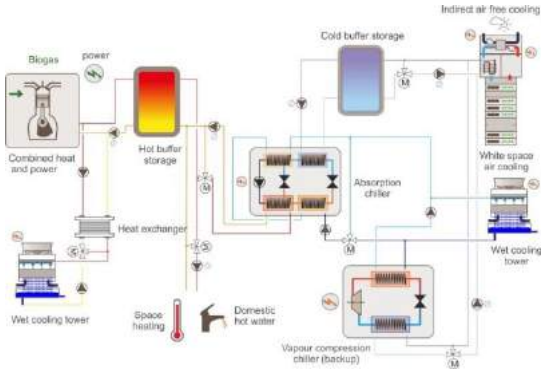

Figure 7. Thermal scheme of the combined heat and power engine with absorption chiller for a data centre.

3 METAMODELS DEVELOPMENT

In order to develop the metamodels (simplified models generated by surface-response methods from detailed dynamic models) it is needed a sensitivity analysis along the input parameters space for the selected concepts. The objective of this process is to detect those parameters of negligible relevance in the simulations results (same metrics as described before) and to remove them from the sampling before proceeding with metamodeling, minimizing the simulations needed and maintaining the simulation time within a reasonable scale. Here, a Morris method, which gives rough estimations with a limited number of calculations, is used. Once the most influent parameters for each concept are known, the metamodeling phase starts with the aim to obtain a final model with a good predictive behaviour. The methodology consisted to test several functional transformations for the initial parameters and to perform an iteratively and interactively handmade variable selection (introducing new parameters one by one and considering new transformations based on the results). The variables used to validate the behaviour of the metamodels were:

- The R-square coefficients, as a goodness-of-fit measure.
- The t-statistics of the fits.
- The analysis of the relative residuals.

Finally, only statistically significant variables were introduced in the final model. Multicollinearity was taken into account and some redundant variables were also eliminated, but some collinear variables were kept in the final equation because they do not reduce the reliability of the model and, moreover, it is observed that coefficients do not change erratically with small data changes. In order to calculate all the outputs included in the RenewIT tool up to 100 metamodels were developed and validated.

4 RENEWIT TOOL

4.1 Description

The RenewIT tool is oriented to planners, managers, investors, owners and designers of the data centres interested to evaluate the implementation of energy efficiency strategies and renewable energies in their facilities. The tool allows evaluate the performance of different data centre configurations in different European locations, and compare the results of up to five different scenarios. The results are provided from an energetic and economic point of view, where a variety of metrics and visualization methodologies are used to understand the differences between scenarios.

The Graphical User Interface (GUI) is divided in six different sections: general information, IT infrastructure, power and cooling characterization, selected options and results page. Figure 8 shows an image of the different sections and the most relevant information requested in each stage. Behind the GUI there is the engine which processes the information introduced by the user combined with data from data bases and calculates the results for each scenario using the metamodels library.

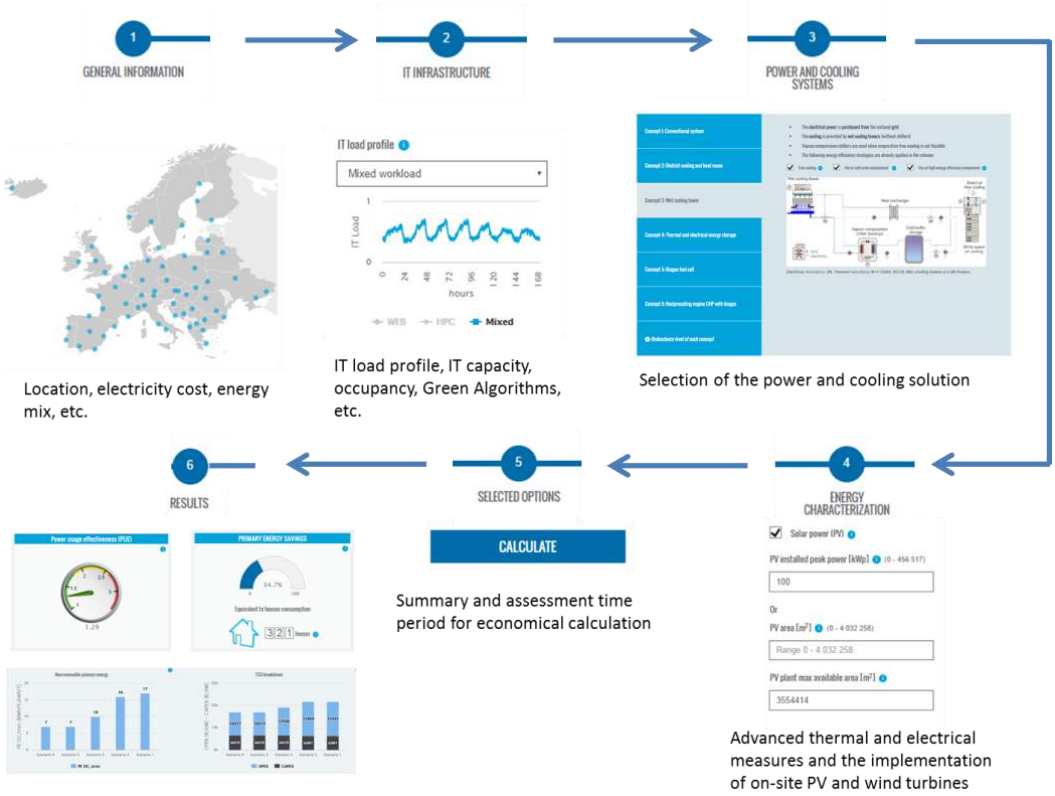

Figure 8. Scheme of the RenewIT tool functionality and layout.

4.2 Case study

The functionality of the RenewIT tool allows the user to study many different situations and scenarios. Even though there are many other possible comparisons and it will depend on what the user is looking for, the authors want to highlight these:

- To evaluate the effect of the location in the same data centre configuration.
- To evaluate the potential benefits introduced by some of the advanced energy efficiency measures and on-site renewable generation available in the tool.
- To evaluate different power and cooling solutions between each other.

As an example, the first case study is the evaluation a conventional data centre using free cooling of 1MW IT capacity (HPC profile) with an occupancy ratio of 80% in different locations: Barcelona (scenario 1), London (scenario 2), Dublin (scenario 3), Frankfurt (scenario 4) and Stockholm (scenario 5). The assessment period for the economical calculations is set to 15 years. On one hand, Figure 9 shows the non-renewable primary energy ($PE_{DC,nren}$) and the Total Cost of Ownership (TCO) for the different scenarios analysed. The results show clearly that locating the data centre in Stockholm the non-renewable primary energy consumption is much lower as well as the TCO. In terms of economic impact, Frankfurt will be the second preferable option. On the other hand, Figure 10 shows the PUE values of each scenario, showing that Barcelona (scenario 1) is the facility with higher PUE.

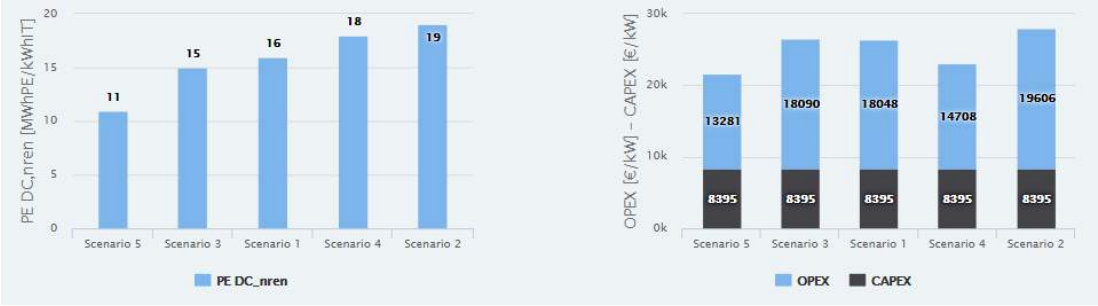

Figure 9. Non-renewable primary energy consumption and TCO for the different scenarios.

Figure 10. PUE results for the different scenarios.

Another possible evaluation can be studying the benefits of the implementation of advanced energy efficiency strategies. Here, a data centre of 1MW IT capacity (HPC profile) with an occupancy ratio of 80% located in Stockholm is evaluated (scenario 1). Scenario 2 will be the use of indirect air free cooling as well as the use of cold aisle containments. Then variable air flow and high temperature different between outlet and inlet strategies are implemented (scenario 3). In scenario 4, high energy efficiency components are implemented and the inlet air temperature is increased from 20 to 27 ºC. Finally, modular UPS is installed instead of standard UPS system (scenario 5). Figure 11 shows the non-primary energy consumption of each of the scenario, showing that as long as we implement thermal and electrical advanced concepts, the energy consumption is lower. Moreover, it's also shown that when comparing scenario 5 with scenario 1 (reference system) the TCO is being reduced 9.3% which means savings up to 157,000 € annually.

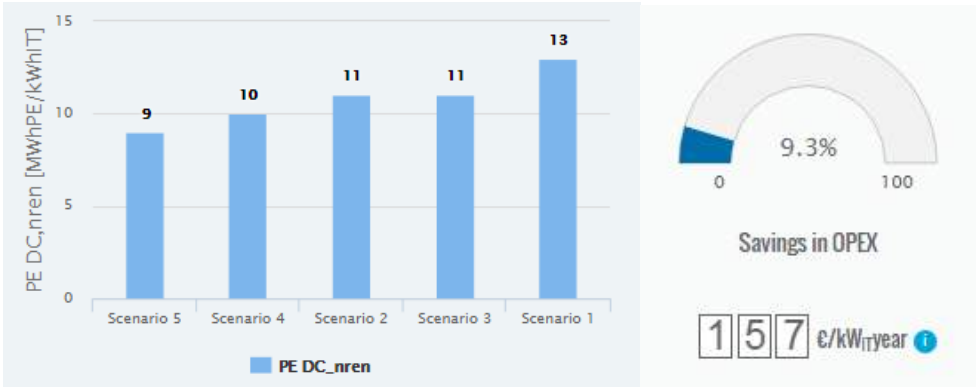

Figure 11. Non-renewable primary energy consumption for the different scenarios and TCO savings in scenario 5.

Finally, another case study can be the evaluation of different power and cooling concepts for a data centre of 1MW IT capacity (HPC profile) with an occupancy ratio of 80% at Barcelona: conventional data centre (scenario 1), data centre connected to the district cooling network (scenario 2), wet cooling tower system (scenario 3), biogas fuel cell solution (scenario 4) and

reciprocating engine CHP with biogas (scenario 5). The assessment period for the economical calculations is also set to 15 years. On one hand, Figure 12 shows $PE_{DC,nren}$ and TCO for the different scenarios analysed where the solution of connecting the data centre to the district cooling is seen more economical feasible followed by the wet cooling tower solution while the biogas fuel cell and CHP solutions shows higher TCO values than the reference system. This fact demonstrates that the cost of the biogas and biomass is still too high to be competitive. On the other hand, Figure 13 shows the renewable energy ratio (RER), showing that the use of fuel cells and CHP systems with absorption chillers can reach values up to 70 % of renewable use.

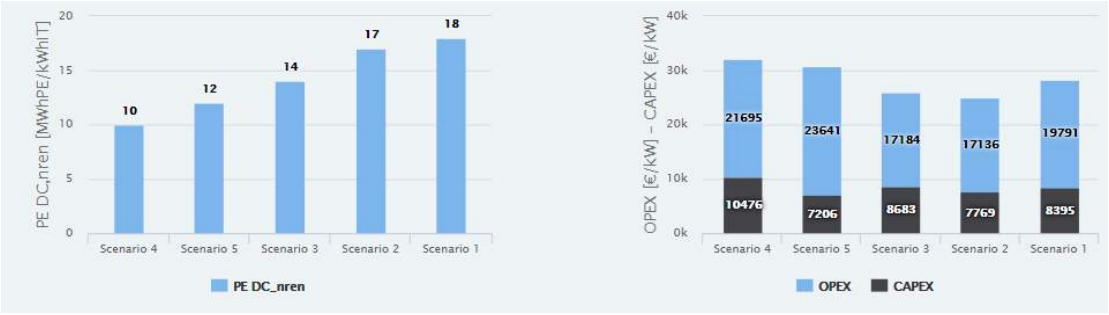

Figure 12. Non-renewable primary energy consumption and TCO for the different scenarios.

Figure 13. RER results for the different scenarios.

CONCLUSIONS

The growth of data centre demand in the last years has led to an increase in their size and power and thus in their energy consumption. The impact of these unique infrastructures on the worldwide energy map is not worthless anymore. Data centre industry and researchers have put a lot of effort to investigate new energy efficiency measures to decrease the energy demand. This is not the unique strategy and more recently, new efforts to implement renewable energy systems in these unique infrastructures have been detected. In this context, this paper presents the development of a friendly-user tool to evaluate the effect in terms of energy reduction, total cost of ownership and CO_2 emissions of many energy efficiency strategies as well as different technical solutions to provide green electricity and power to data centres. The computational engine of the tool is based on metamodels in order to process the calculations as fast as possible without compromising the reliability of the results. The tool will be available online after the end of July 2016 in www.renewit-project.eu.

Acknowledgment

The research leading to these results has received funding from the European Union's Seventh Framework Programme FP7/2007- 2013 under Grant Agreement no.608679—RenewIT.

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SISTEMA DE GESTIÓN ENERGÉTICO-AMBIENTAL INTELIGENTE PARA LA CONSECUCIÓN DE ÁREAS OPTIMIZADAS ENERGÉTICAMENTE EN LAS SMART CITIES

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PALABRAS CLAVE: Monitorización y telegestión energética, balance energético, Ciudad Energéticamente Inteligente.

RESUMEN:

El proyecto 'Sistema de Gestión Energético-Ambiental Inteligente' tiene como objetivo mejorar el estado energético y ambiental de las áreas habitadas de las ciudades a través de la correcta gestión de las infraestructuras y recursos que disponen las mismas. Por tanto, el beneficio principal es reducir el consumo energético a nivel de la ciudad y por tanto la disminución de gases de efecto invernadero. Se trata de crear una ciudad energéticamente inteligente y sostenible orientada al ciudadano, que ofrezca una serie de servicios y prestaciones que eleven la calidad de vida de sus habitantes y al mismo tiempo permitan a la ciudad incrementar su capacidad para crecer económicamente. El sistema en desarrollo cuenta con un Módulo de Energía el cual realiza la monitorización y control energético para conseguir el óptimo estado del uso de la energía, consumo y generación, en cada uno de los nodos integrados en las ciudades (casas, edificios, infraestructuras y red), incluyendo estrategias de balanceo energético que tienden al balance cero y la gestión activa de la demanda. Este módulo será empleado por los gestores energéticos para potenciar las herramientas de mejora del estado energético de las ciudades. Así mismo, cuenta con Módulo de Mantenimiento cuyo objetivo es la detección temprana de anomalías en los diversos nodos y posterior gestión de las mismas. Además, integra servicios e infraestructuras TIC que ponen a disposición del ciudadano la información energética que pueda serle de utilidad y promueve un comportamiento proactivo respecto a las decisiones de mejorar su entorno energético y ambiental.

1 INTRODUCCIÓN / ANTECEDENTES

El problema que se presenta y al cual se pretende dar solución es disminuir los consumos energéticos, así como la contaminación medioambiental existente en las ciudades actuales. Por tanto, el principal objetivo es mejorar el estado energético y ambiental de áreas habitadas en las ciudades gestionando correctamente los recursos de las mismas, convirtiéndolas así en Smart Cities.

El primer paso hacia la gestión energética inteligente de los edificios e infraestructuras urbanas en las ciudades es la implementación de una monitorización energética adecuada. Conocer el uso y estado energético de edificios e infraestructuras es, por tanto, la tarea inicial y, para ello, se dispone ya de herramientas y tecnologías como analizadores, contadores de metering, sistemas de adquisición de datos, etc. que realizan dicha función. Así pues, la monitorización energética permite, además de conocer el uso y el estado energético, identificar acciones de mejora. Junto a la monitorización cabe destacar la telegestión que añade a la monitorización la posibilidad de llevar a cabo actuaciones activas para la mejora energética, además de habilitar la interacción con el usuario.

En la actualidad pueden encontrarse diversas iniciativas, tanto a nivel Nacional como Europeo, que desarrollan parte de los objetivos y áreas de los servicios planteados por el concepto de "ciudad inteligente". La plataforma europea de Smart Cities (www.smart-cities.eu) dispone de un ranking de ciudades europeas participantes en el programa para la valoración de los aspectos: Smart Mobility, Smart Environment, Smart People, Smart Living, Smart Governance y Smart Economy, mediante la definición y el cómputo de una serie de factores e indicadores en cada uno de ellos.

Del mismo modo, existen muchos proyectos en el marco de Smart City a nivel Nacional e Internacional. Algunos ejemplos relacionados con la temática del presente proyecto, principalmente con la gestión energética inteligente, son: *Smart City Málaga* (http://www.smartcitymalaga.es/), *Smart City San Cugat del Vallés* (http://smartcity.santcugat.cat/), *Amsterdam Smart City* (http://www.amsterdamsmartcity.com/), *Masdar City* (Abu Dhabi, Emiratos Árabes Unidos).

El proyecto presentado pretende demostrar que la implantación y uso de herramientas de gestión energética permiten identificar medidas de ahorro energético que de otra manera permanecerían ocultas al gestor de la instalación. El hecho de incorporar esta herramienta en un ayuntamiento, por ejemplo, supone numerosas ventajas por los siguientes motivos:

- Supone una confianza adicional de cara a los usuarios. No inspira el mismo nivel de confianza a un usuario permitir que un ayuntamiento implante un Controlador Energético en su edificio, a que lo haga una empresa cualquiera.
- Como administración pública, es responsable de la elaboración de políticas públicas de eficiencia energética.

Los beneficios para el ayuntamiento serían 1) *sociales*, pues constituiría un modelo a seguir (papel ejemplar de la Administración), 2) *tecnológicos*, por el hecho de disponer de una nueva herramienta tecnológica basada en Tecnologías de la Información y la Comunicación, 3) energéticos - ambientales obteniendo una mejora en eficiencia respecto a líneas bases iniciales y 4) *económicos*, si adquiere el derecho de imponer penalizaciones a las áreas de la ciudad que no cumplan con las directrices establecidas en cuanto a consumo energético. Le permitiría, además, concretando el ámbito de actuación de mejora energética:

- Caracterizar, en base a los patrones de consumo, las diversas zonas de la ciudad y detectar anomalías energéticas en los edificios. Localizando los principales focos de actuación y permitiendo actuar sobre ellos.
- Realizar recomendaciones, dotar de incentivos a las áreas que disminuyan su consumo y reduzcan las emisiones e incluso aplicar penalizaciones a las áreas que superen un cierto umbral de consumo y emisión de gases de efecto invernadero.
- Actuar de manera inmediata cuando aparezcan problemas en las instalaciones, edificios. Y zonas.

Toda la información quedaría centralizada permitiendo hacer responsable a cada área o micro-red de su consumo energético y trasladándole la posibilidad de alcanzar reducciones. Cabe decir que, aunque la implantación sea realizada en un ayuntamiento, diversas empresas del sector de la energía pueden integrarse y participar, disponiendo así de un adecuado ámbito de negocio: empresas privadas del sector energético como Empresas de Servicios Energéticos, ingenierías de implantación de mejoras energéticas, gestores TIC de la herramienta, empresas para la gestión del mantenimiento en base a los resultados proporcionados por la herramienta.

2 DESCRIPCIÓN / SOLUCIÓN DEL PROYECTO

El proyecto propone, para la resolución del escenario arriba descrito, diseñar y desarrollar un sistema global de gestión inteligente que comprenda la **Gestión Energética del edificio / micro-red / ciudad** desde el nivel de campo hasta el nivel de usuario. A continuación se describe la solución:

Ámbito de Instalaciones de Edificio En este nivel de campo se encuentran los *Controladores Locales*, los cuales tienen la misión de monitorizar y controlar las variables energéticas de cada nodo[i]. Éstos comunicarán aguas abajo con los sensores y dispositivos de medida existentes, así como con diversos actuadores energéticos. Toda la información adquirida y capacidad de actuación en campo podrá ser empleada aguas arriba por el *Controlador Energético de Edificio*.

Ámbito Edificio En una capa superior se encuentra el *Controlador Energético de Edificio*, cuyas funciones principales son las de monitorización y control del entorno con el objetivo de disminuir el consumo y realizar un uso adecuado de los recursos, incluyendo generación y almacenamiento. Dado que este dispositivo puede integrar varios tipos diferentes de controladores locales de instalaciones se hace necesario un *Modelo de datos energético unificado* que englobe las siguientes entidades: de consumo (climatización, iluminación y carga inteligente), Entidad recurso generación (eólica, fotovoltaica), Entidad recurso almacenamiento (BMS), Entidad de Monitorización (energética, meteorológica), Entidad otros (vehículo eléctrico).
El Controlador Energético gestionará cada una de las entidades de las que disponga el edificio: entre sus funciones cabe citar las de monitorización, control y obtención de la predicción de consumo y de generación de las mismas. Dispone, así mismo, de una función específica de balance energético a través de indicadores. Por tanto, este dispositivo de control será capaz de obtener un estado energético global del edificio, así como proporcionar una predicción del consumo y la generación del mismo en las 24 horas siguientes. Así mismo se dispondrá de una relación de alarmas ocurridas con objeto de poder actuar en caso de fallo o avería en coordinación con el módulo de Mantenimiento que será descrito en apartados siguientes. Aguas arriba del mismo se encontrará el Centro de Control Energético-Ambiental.

Ámbito de área o micro-red El *Centro de Control Energético Ambiental Inteligente* será el encargado de mantener el balance energético a nivel de área/micro-red y de mejorar la estabilidad de red. Éste sistema de información a modo de SCADA tiene como funcionalidades principales: 1) acceder a la información de los Controladores Energéticos, 2) agrupar los nodos o edificios por criterios globales energéticos para su operación conjunta, es decir operar sobre un agrupamiento de nodos con posibilidades de mejora conjunta, 3) implementar funcionalidades avanzadas de:

- *Algoritmo de predicción de la demanda*, implementado mediante el uso de un modelo de predicción basado en redes neuronales (ANNs) se utilizará para predecir la demanda de cada una de las horas del día, de forma que la predicción de la demanda de una hora se convertirá en entrada para la red que predice la demanda de la siguiente hora.

- *Algoritmo de predicción de la generación*, utilizará la predicción de las variables climatológicas en base a modelos numéricos de predicción climática (NWP), condiciones locales que afecten directamente a la producción eléctrica de cada instalación y un modelo de predicción basado en ANNs que utiliza como entradas tanto los valores históricos de generación de energía producida por el generador como las variables climatológicas locales la zona.

- *Algoritmo de gestión de la demanda* (GAD), consistirá en la modificación del perfil de la curva de demanda de un nodo con el fin de mejorar la eficiencia del mismo. La aplicación de medidas GAD dependerá en gran medida del nodo donde se vayan a aplicar y de la naturaleza de los procesos que en él se desarrollen. Las diferentes estrategias GAD que en principio serán consideradas en relación a la modificación del perfil de la curva de carga de cada nodo son las siguientes: Reducción de los picos de consumo e incremento de consumo en las horas valle, desplazamiento de consumos desde horas pico a horas valle y reducción del coste global de la energía.

Ámbito de ciudad A través del *sistema TIC* desarrollado los usuarios dispondrán de una serie de interfaces web desde los cuales se podrá visualizar la principal información inferida a partir de los datos recogidos, los resultados tras los análisis y las alertas generadas, a nivel de instalación, edificio o área de la ciudad (según sea el usuario). Estos Servicios cubren las siguientes funcionalidades: 1) capturar los datos provenientes de las micro-redes o de fuentes públicas abiertas (mediante paradigmas de comunicación escalables: publish/subscribe, REST); 2) almacenar la información capturada en una infraestructura big data (dado el volumen de datos que se recogerá, así como su variabilidad y velocidad, se propone distribuir el almacenamiento y cómputo en una infraestructura escalable basada en Cloudera); 3) implementar funcionalidades avanzadas de generación de alertas a nivel de ciudad (mediante técnicas estadísticas basadas en Deep Learning); 4) visualización de los datos y resultados de los análisis.

A continuación se muestra una figura de la arquitectura del Sistema de Gestión descrito.

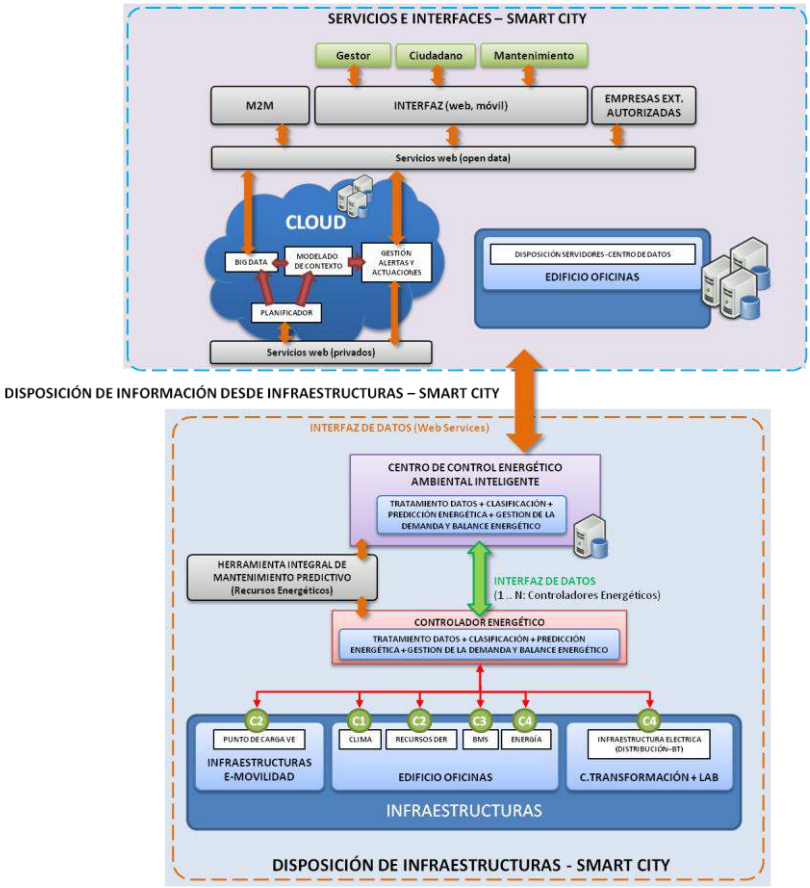

Figura 1: Sistema de Gestión Energético-Ambiental Inteligente. Source: ITE.

Mantenimiento orientado a activos energéticos Además de las funciones puramente energéticas, y puesto que la conservación y el mantenimiento de los servicios de una Smart City constituyen un aspecto fundamental de la misma, por ejemplo para lograr una alta eficiencia en el funcionamiento de los servicios y facilitar la habitabilidad y el confort de la ciudad, ganando la confianza de los ciudadanos y mejorando su calidad de vida, se definen y desarrollan dos módulos de mantenimiento:

- El módulo de Mantenimiento de recursos energéticos, integrado en el Centro de Control Energético-Ambiental Inteligente se centra en instalaciones de importancia actuales (como la climatización) y otros que los edificios a medio plazo dispondrán (generación y almacenamiento). De cada una de ellas han sido definidos varios indicadores clave de rendimiento con el objetivo de disponer de un indicativo que facilite el trabajo de mantenimiento y ayude al técnico encargado en los trabajos de diagnóstico y detección de fallos en algún punto de estas instalaciones.

- El módulo de Mantenimiento de personal irá integrado en el último nivel del sistema de gestión, estando dirigido a la planificación y optimización de rutas de mantenimiento de la infraestructura. Éste hará uso de tres algoritmos:

- *Algoritmo de asignación de tareas a días*, búsqueda de un patrón que realice las tareas respetando las frecuencias de visitas a un punto, agrupando tareas según su localización, y equilibrando la carga de tareas a lo largo de un período de tiempo. Se plantea la resolución del problema de Mixed Integer Linear Programming mediante un sistema de clustering (Naderi & Ruiz, 2010).

- *Algoritmo de optimización de rutas*, como segundo paso, se pueden optimizar las rutas, teniendo en cuenta el tiempo de ejecución estimado de cada tarea y las restricciones de la jornada laboral, minimizando el desplazamiento entre tareas. Se plantea la resolución del problema Capacitated Vehicle Routing Problem mediante una fase constructiva basada en el método de Clarke and Wright y una fase de búsqueda local basada en Variable Neighborhood Descend (De Jaegere et Al., 2014).

- *Algoritmo de inserción en punto óptimo*, finalmente, se asignarán las tareas de mantenimiento que no estaban programadas, de manera que se sigan cumpliendo las restricciones anteriormente impuestas. Se plantea resolver este problema mediante una búsqueda exhaustiva de la mejor solución.

3 METODOLOGÍA

La plataforma o sistema de gestión energética para ciudades inteligentes se ha dividido según la funcionalidad que debe cubrir en distintas capas desde el nivel de campo, más cercano a las instalaciones y edificios, a los niveles de información superiores, más cercanos a las áreas y sistemas de telegestión remotos. Todos los módulos de la plataforma propuesta se han desarrollado por medio del desarrollo de tecnologías de automatización y comunicaciones industriales a nivel de campo. A niveles de información se han desarrollado los interfaces de comunicaciones, visualización y gestión con múltiples herramientas combinadas de desarrollo de software. Los algoritmos desarrollados hacen uso de metodologías y técnicas de control inteligente y aprendizaje de máquina como redes neuronales, así como de técnicas y métodos avanzados de optimización metaheurística.
El proyecto que engloba este trabajo y resultados es el proyecto Ciudades Energéticamente Inteligentes (CEI). El trabajo ha sido realizado por los institutos tecnológicos ITE (Instituto Tecnológico de la Energía) e ITI (Instituto Tecnológico de Informática) de la Comunidad Valenciana. Actualmente se inicia el tercero y último año de proyecto.

4 RESULTADOS Y DATOS OBTENIDOS

Los resultados obtenidos son los siguientes:

- Análisis del concepto de Ciudad Inteligente y sus condicionantes de mejora energética ambiental que deben asimilar. De esta manera se ha centrado la tecnología a desarrollar en una definición de Ciudad Energéticamente Inteligente y sus necesidades en este ámbito, teniendo en cuenta barreras tecnológicas, institucionales, económicas, sociales y normativas.

- Definición y desarrollo de sistema de gestión energética para edificios y áreas de ciudades que permita optimizar los recursos de consumo, generación y almacenamiento que habitualmente emplean o que, por la evolución de las Smart Grids, utilizarán. Además se ha definido la arquitectura global y en detalle de la plataforma y de cada subsistema integrante, que combina tecnologías de automatización, comunicaciones y computación.

- Integración en la plataforma de elementos avanzados de gestión energética-ambiental como son los algoritmos de predicción de demanda y generación, así como el de balance y gestión de la demanda. Del mismo modo integración en la plataforma de elementos avanzados de gestión de mantenimiento de los activos energéticos integrados en los edificios que se monitorizan y del personal que realiza estas acciones.

Una vez puesto en marcha en piloto podrán obtenerse resultados numéricos de los ahorros de consumo y coste, así como la consecuente reducción de emisiones. El hecho de implantar un sistema inteligente energético en el edificio y aplicar TICs implica una serie de ahorros los cuales se citan a continuación:

- A través de la monitorización mediante contadores inteligentes de energía, TICs y la concienciación del usuario se podrá obtener una reducción del 10% del coste total de la energía (Leygue et.al, 2014), (Bariss et. Al, 2014), (Vassileva et. Al, 2013).

- Mediante sistemas centralizados de control energético, sistemas de domótica y sistemas de gestión de edificios, es decir, a través de la automatización y el control del edificio será posible obtener ahorros del 20% correspondientes a una reducción del consumo total del 12% (Siemens Switzerland Ltd., 2012).

- Referente al distrito o ciudad, la automatización y el empleo de TICs, permitirá obtener los ahorros siguientes: Nodos activos, consumidores y productores. El uso óptimo de los recursos permitirá ahorros del 30% en las pérdidas de transmisión de energía en la red y hasta un 40% de ahorro de energía a través del control (Peter & Dietmar, 2011).

5 CONCLUSIONES

En este artículo se ha presentado el diseño y de la plataforma para la gestión inteligente para la consecución de áreas en entornos urbanos optimizadas en su vertiente energética y ambiental siguiendo el paradigma de las Smart Cities. Así pues, la plataforma hace uso de técnicas de automatización, computación y métodos derivados del aprendizaje automático supervisado y la optimización metaheurística para resolver los problemas que se plantean en el diseño de la plataforma.

Por una parte el centro de control de la plataforma precisa de unas capacidades de predicción tanto de la demanda como de la producción de generación que se resuelven aplicando modelos de predicción basados en redes neuronales. El centro de control de la plataforma requiere realizar una planificación óptima de los recursos energéticos, tanto a nivel de demanda como de recursos de generación para satisfacer de forma óptima la estrategia de balance energético definida a nivel central. La planificación en determinados casos puede requerir de distintos algoritmos de optimización avanzada, tanto deterministas como metaheurísticos, para su resolución.

El proyecto, aparte de las tecnologías existentes, propone el establecimiento de nuevas tecnologías de control basadas en algoritmos (predicción de la generación, predicción de la demanda, balance energético, gestión de la demanda, indicadores de mantenimiento) en el marco de la eficiencia energética para la implantación en el marco de las ciudades inteligentes, contribuyendo a la mejora

en la huella de carbono total de la ciudad y de la información que a este respecto está disponible en cada momento para ciudadanos y los propios gestores de infraestructuras.

En cuanto a los sistemas TIC que deben dar soporte a la plataforma en este proyecto, dada la cantidad y complejidad de los datos generados, es necesaria la adopción de una arquitectura cloud "Big Data", incorporando información procedente de fuentes abiertas. Dichos datos se analizarán mediante técnicas de aprendizaje automático en dicha infraestructura Big Data.

Referente al sistema de monitorización y control, el sistema aquí propuesto dispone de las funciones base, de mantenimiento y avanzadas, incorporando los algoritmos anteriormente descritos.

De este modo, como características diferenciadoras, respecto a otros Sistemas de Monitorización y Control, se destacan las siguientes:

- Proporciona información, no sólo de un edificio o instalación, sino a nivel de micro red y ciudad.
- Permite configurar el número de entidades que se disponga en cada una de las instalaciones o edificios que conformen la micro red o la ciudad.
- Integra algoritmos de predicción de la generación y del consumo (conjuntamente, a diferencia de otros sistemas), los cuales aplican no sólo a nivel de edificio o instalación, sino también a nivel de micro red y ciudad.
- Integra algoritmos de balance energético y gestión de la demanda a nivel de micro red.
- Dispone de un módulo de mantenimiento que cuenta con más de 25 indicadores para las entidades de climatización, almacenamiento y energía solar fotovoltaica.

El grado innovador o característica distintiva reside principalmente en que el sistema CEI es aplicable a distritos o ciudades, mientras que estos sistemas de monitorización se aplican únicamente a nivel de edificio.

6 AGRADECIMIENTOS

Cabe aquí dar agradecimientos al Instituto Valenciano de Competitividad Empresarial (IVACE), así como al Fondo Europeo de Desarrollo Regional, al haber cofinanciado el proyecto al 50% por el programa operativo FEDER de la Comunitat Valenciana 2014-2020.

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8 NOTAS

[i] Estos pueden ser de diversa índole: Nodos de consumo, nodos de generación y almacenamiento, nodos activos (nodos de consumo que dispongan de recursos de generación y almacenamiento), nodos observables y controlables de la red de distribución de energía.