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Smart city projects and improvement of public service supply chains

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Abstract—The involvement in smart city initiatives is a key factor of changes in modern cities. It drives the integration of ICT, the development of collaborative behaviours, and the involvement of people in the life of the city. This paper is interested in the impact of such initiatives on the performance of public services and on the supply chains that provide these services. Based on the example of the Toulouse metropolis in France, it shows that smart city initiatives are becoming a vector for instilling continuous improvement in public services.

Keywords—Interoperability and sustainable enterprise; Internet of Services and Service Science; Smart City; ICT.

I. Introduction

The mutation of the public service through innovative methods, or methods coming from other domains remains a major issue for modern societies.

Five factors [1] are at the origin of the mutations required for public service: 1) the increasing urbanization creates new challenges for managing a city community. 2) The satisfaction of users of public services depend on the role of the concerned people (users, citizens, consumers etc.) but requires more and more personalization. 3) The governance pressure for decreasing the public budgets while maintaining service quality. 4) The interest of the citizens for a better participation in the life of the city is a potential lever for public management and economic development. 5) The direct transposition of industrial improvement approaches (BPM and Lean) to public service has encountered a massive resistance.

With the development of supply chain management and business process management, the industrial sector has demonstrated its capability to improve processes using realistic and holistic approaches. But, in France, programs such as the Planning Programming Budgeting System (PPBS) introduced in the early 1960, "Rationalization of Budgetary Choices" (RCB) in 1970's, New Public Management (NPM) in the

1990's, "Organic Law Relating to the Laws of Finance" (LOLF) in 2000's regularly reminded the requirement of public services efficiency and the improvement of underlying processes but rarely resulted in important changes [2].

Recently, the involvement of citizens, users and companies throughout ICT (Information and Communication Technologies) has benefited to quality of life in cities through various experiences [3]. The concept of "Smart City" is implemented at an international level [4] and its label allows publicizing the realised progress [5] and comparing cities performances.

Now, the "smart city" initiatives are centred on the requirement to develop added value for citizens with realistic investments. They come back to the principles of service for citizens and create an opportunity to instil change in public processes if coupled with appropriate business processes management approaches.

This paper is centred on that idea. It analyses, in the Toulouse French metropolis, the impacts of a portfolio of "smart city" initiatives on the improvement of public processes.

II. State of the Art

A. Industrial methods in Public Services

Some attempts for using industrial methods in public services have shown the interest of such approaches [6], [7] that nevertheless require to interpret and re-structure the expectations of the public service, and to create dedicated tools and methods allowing to better answer to the users' needs.

In 2007, the "Direction Générale de la Modernisation de l'État Français" (DGME) decided to spread continuous improvement principles in various public services (prefectures, hospitals, social security treasury, courts, etc.) through the General Revision of Public Politics ("Révision Générale des Politiques Publiques"; RGPP) [8]. Tools like JIDOKA and POKA YOKE were tested in prefectures, Value Stream

Mapping in courts, or 5S in operating rooms of hospitals [9]. The principle of a participative system has attracted the state agencies involved in these projects, but the integration of continuous improvement has often not survived the test phase, the performance assessment principles always associated with these methods having been badly perceived by the agents [10].

The concept of SCM appeared in the 90's. Supply chains are networks of organisations linked by upstream and downstream flows, producing value through products and services delivered to customers [11].

To our best knowledge, the hospital sector has been the first public service that studied and took in consideration approaches coming from Supply Chain Management (SCM) in its daily management [12], taking advantage of their specialisation on one type of service: health. Studies have shown the important benefit resulting from the introduction of the SCM dimension in the hospital sector (decrease up to 46% of the expenses, collaborative supplies, decrease of wastes and wasted times, improved availability of medicines, increased availability and productivity of critical resources) [13].

In 2015, South Africa published a report [14] on the integration of SCM in its public organisations. This report shows the benefits expected from the method: better planning, transparency, decreased costs and wastes, decrease of corruption. Nevertheless, it does not explain precisely the way SCM principles are integrated in public services but shows a success in their integration.

B. Specificities of the city Public Sector

A Public service can be defined as an action performed by a public authority in order to address needs of general interest [15], [16]. The concept of general interest, based on values shared by the members of a society, is a first difference with the industrial sector. In public services, the shared common values rely in the importance of a service provided for the general interest. While the industrial sector focuses on the financial aspect and market segments, public service is concerned with quality of result and equity [17]. The public service has the moral but also legal imperative to satisfy its users with justice and equity, giving a right of recourse to the users against the institutions [18]. In this context, the identification of users expectations and the definition of the services to provide are major challenges.

When considering a city or a metropolis, a broad spectrum of services has to be considered: transportation, energy, education, healthcare, buildings, physical infrastructures, food, water, public safety [19]. ISO37120 that addresses the sustainable assessment of a city identifies 16 domains of public activities: support for economy, education, environment, finance, fire and emergency response, governance, health, recreation, safety, shelter, water and solid wastes management, telecommunication, transportation, urban planning, sanitation. This diversity of public intervention creates a management complexity. Moreover, [20] underlines that these domains must not be considered as independent but "should be treated as an organic whole in a holistic way".

Present metropolises are more and more in competition and are eager to capture up-to-date tendencies with a "marketing"

objective until recently absent from public service. This may be done through the concepts of "Smart City" and sustainability making the city more attentive and attractive to individual needs [21], [22].

C. Smart City and sustainability frameworks

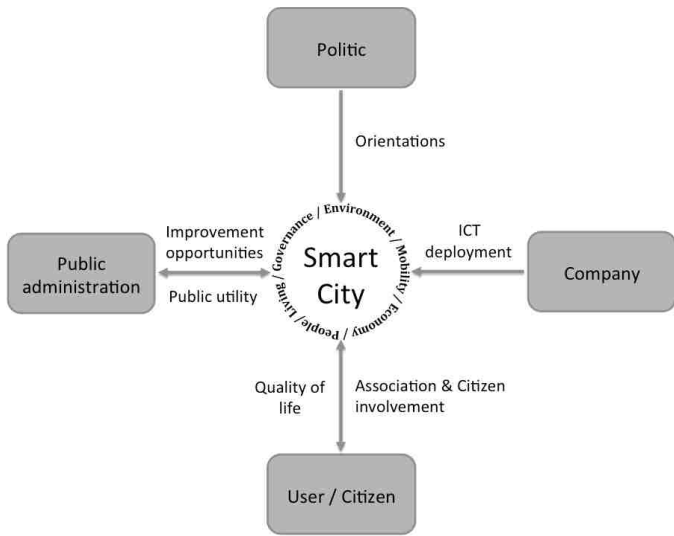
Cities face a rapid growth of their population [23] and have to fight against wastes for a better sustainability [24]. In that sense, the "lean", the sustainability and the supply chain management related concepts are consistent with the principles of "Smart Cities" and sustainability. Defining the concept of Smart City is nevertheless difficult. In an extensive review of the literature, [25] highlights the discrepancies between the definitions of Smart and Sustainable concepts, as the former is primarily focused on ICT but has evolved to integrate the latter. According to [25] a Smart City looks for a better quality of life through an enrolment of all the stakeholders thanks to ICTs.

As suggested by [26], the "Smart City" supposes also a participative model for involving the citizens in the urban life, like the continuous improvement model. In order to measure the improvements, smart indicators are set and usually grouped in six categories: (1) smart economy (e.g. Public expenditure on R&D, Unemployment rate...), (2) smart people (e.g. Foreign languages or computers skills...), (3) smart governance (e.g. Number of universities, e-Government use by individuals...), (4) smart mobility (e.g. Sustainable, innovative and safe public transportation...), (5) smart environment (e.g. efficient use of water and electricity...) and (6) smart living (e.g. Number of public libraries, Theatre and Cinema attendance...) [20]. They are different from those included in the usual norms used for quality management in industry (namely the ISO 9000 standards), and are closer to those related to corporate social responsibility (ISO 26000), environment management (ISO 14001) or energy management (ISO 50001). However, none of these smart standards covers all the needs of nowadays metropolises and a brand new set of indicators (not listed here) has been published in the ISO 37120 standard dealing with sustainable development of public communities [27]. Both smart and sustainable indicators provide a performance level but are not sufficient to define and position improvement actions within a metropolis organisation and regarding its stakeholders.

Moreover, like SCM, the "Smart City" principles promote transversality and interoperability between actors and could also play a role in industrial supply chains with the implementation of new technology, urban logistics and traffic regulation [28].

Figure 1 summarizes the state of the art of this paper. The stakeholders communicate through the Smart City located in the center. All the actors have the common ambitions to improve the six dimensions that characterizes the Smart City. The multiplicity of Smart City projects seems to have an impact on public service processes. This paper aims to confirm these impacts on the jurisdiction of the local government.

Fig. 1. Representation of Smart City impacts on public service processes



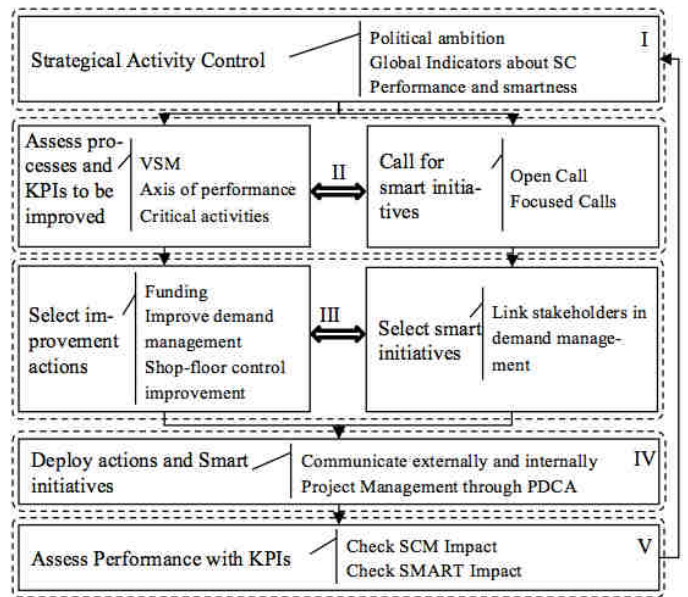
III. New management structure of public action

This section aims to develop a new methodology to control the public activities. This new method of control, depicted in Fig. 2, is based on continuous improvement tools, SCM, performance assessment and smart city initiatives. SCM improves collaboration between actors while continuous improvement tools and performance assessment drive the improvement process. Smart city initiatives consider the city as a global eco-system of which public activities are only a little part. Such initiatives first aim at improving the quality of life but they can also profit to facilitating public services supply chain.

The method is divided into five steps:

- First step, the political environment is in charge of providing the guidelines for the public services within a political program.
- Second step consists in the identification of the impacted processes thanks to a process analysis.
- In the third step, the processes are redesigned taking into account the new potential of smart initiatives acting as performance levers.
- Fourth step consists in deploying the solution with the project management tools.
- Fifth step is to evaluate the performance and compare it with the initial objectives concerning the strategic impulse given by the political vision.

Fig. 2. Main steps of the implementation method



In a previous communication, this methodology description and the examples focused on internal management of public activities (left side of Fig 2) [29]. This article will focus on the right part of Fig. 2, i.e. on the management of innovation through Smart City opportunities.

In the first paragraph, we will introduce the Smart City approach applied by the city of Toulouse. In addition, we will highlight the impacts of Smart City projects on the internal processes of the Public Service. In the following, we will present our summary table to characterize the public action in line with the Smart City approach and sustainability.

A. The impact of Smart City projects on public processes; Toulouse example

The metropolis of Toulouse has the particularity of having completely melted the precepts of Smart City and sustainability. The durability designs are also linked with green supply chain or lean to decrease non-added values.

The goal of Smart City in Toulouse is to build with citizens the smart city of tomorrow: more fluid, friendly, innovative, dynamic, attractive, responsible, sustainable. A city that takes advantage of the most efficient technologies to make life easier for citizens and make public action more effective. This approach is called "Toulouse l'Open Métropole" [30].

The "Open Métropole" is built around five ambitions: an adaptable, efficient and breathable city; Easier and smooth mobility; An international city and rooted in its roots; A city of good living, more warm and intergenerational; A more beautiful, clean and safe city.

To work on these ambitions fifteen groups of work have been implemented. From these fifteen projects, eight projects (demonstrators) were implemented in the framework of partnerships between public and private actors on a wide range of themes (energy, water, parking, autonomy of the elderly, urban congestion, autonomous and connected vehicle, etc.). There also resulted in smaller projects called "experiments".

The objective of the experiments is the emergence of new products and behaviours, with the help of local startups.

In this paper, we will focus on experiments. Since the launch of Smart City, eighteen experiments have been carried out on the territory. They all aimed at promoting or extending services to users in the Smart City's frame of mind. We noted that some have impacts on public processes that produce public services (see Tables I and II). For example, the following three experiments will support our purpose.

MyFeelBack: It is a mobile application enabling users to declare road incidents, incivility or cleanliness problems. This experimentation has the consequence of integrating the citizen in the process of continuous improvement of the public action (generation of alert), evaluation the rate of satisfaction (success or not of the answer to the alert) of the citizens. But also, the service is generated on demand and driven by the need: instead of organizing turns for surveying infrastructures, citizens alert.

Qui Dit Miam is a mobile application to increase communication around School meals of the City of Toulouse (menu composition, allergens, origin, push alert for menu changes). This new service has resulted in an improvement in Customer Relationship Management by the utilities, a change of supplier following the putting forward of a non quality by the consumers as well as the re-definition of the processes of delivery of goods (evaluation of organic bread by consumers has changed the supply circuit).

Nacelles: It is connecting urban furniture allowing to create exchanges between the different actor of a city. This urban furniture has quickly demonstrated impacts on citizen consultation. The implementation of this new tool allowed to increase the customer and citizen relationship management process. Moreover, the emergence of this tool brings continuous improvement in the civil service process by placing the citizen as an actor.

Of the eighteen experiments that were launched on the Toulouse metropolitan territory, twelve experiments demonstrated to have an impact on the processes of the public service [31]. We have concatenated all these experiments in two Tables (Table I & II). The first table informs about the different experiments with their impacts on the dimensions of Smart City for the city.

TABLE I. The impact of Smart city projects on the city

Projects	Smart city dimensions	Smart city impact
Spotminder	Smart People	Propose a digital social wall at 4 cultural events in order to involve those who are not present.
MyFeelBack	Smart Environment	Citizens declare problems on wastes and infrastructure and assess the quality of the answer. Improve the quality of the services rendered by the public service by analysing the level of user satisfaction.
Qui Dit Miam	Smart Environment & Smart Living	A mobile application to increase communication around School meals of the City of Toulouse (menu composition, allergens, origin, push alert for menu changes).

Helpiness	Smart Living & Smart Environment	Propose a mobile application to facilitate the exchanges and environment of the person assisted (friends, professional helpers, invoice, etc.)
Coovia	Smart Mobility	Propose an innovative digital carpooling solution for everyday trips and multimodal solutions in metropolitan France, with secure carpool points.
Parkisseo	Smart Mobility	Deploy parking sensors and develop a tool to optimize parking in Toulouse.
CityMéo	Smart Economy	Develop interactive digital communication to disseminate useful information to citizens via information screens: information about the city, traffic, weather, etc.
Ze Watt	Smart Mobility	Provide a global charging service for electric vehicles to companies, visitors, administrations and other users who wish to.
Nacelles	Smart Governance	Propose a connected urban furniture to favor the interaction with the citizens and the increase the collective consciousness of the territory
Oabike	Smart Living	Propose a mobile application specializing transport and safety in bicycle.
ThirtyOne	Smart Mobility	Test an experimental system of hybrid motorization for electrically assisted bicycles.

Then a second table, we position the experiments in adequacy with their impacts on the processes of the public administration of Toulouse.

TABLE II. The impact of Smart city projects on public process

Projects	Public process impacted	Nature of impact
Spotminder	Cultural affairs department	Customer relationship management (statistics on the citizen touched by an event, publicity of the event)
MyFeelBack	Direction tranquillity and public safety	Integrate citizen in the continuous improvement, Statistical evaluation
Qui Dit Miam	Direction for Solidarity, Education and Sport	Customer relationship management Evaluation of the quality of service Fighting waste
Helpiness	Direction for Solidarity, Education and Sport	Improving the cooperation in the supply chain of the public partners Integrating the consumers into the supply chain
Coovia	Direction mobility and network	Improving the interoperability of mobility services, design of secure car pool points.
Parkisseo	Direction mobility and network	Instrumentation of production (sensor), make control turns on sensors alerts, change the pay process
CityMéo	Direction local Democratic	Enrichment of Customer relationship, reduce setup for communication change
Ze Watt	Direction mobility and network	Change city employees movements to electric vehicles
Adveez	Direction for Solidarity, Education and	Instrumentation of production (sensor) Customer relationship management

	Sport	
Nacelles	Direction local Democratic	Citizen Relationship Management Customer relationship management, Integrate citizen in the continuous improvement
Oabike	Direction mobility and network	Incident reporting on bicycle paths, Evaluation of the cycling transport plan, Employee relationship management
ThirtyOne	Direction mobility and network	A lever to increase the internal development of electric transport

From Table II, it can be noted that these projects have the following major impacts on the public activities:

- Enriching the bilateral relationship with customers and citizens (CRM & CiRM effect): Spotminder, Qui Dit Miam, CityMéo, Adviez and Nacelles.
- User goes back directly to the recording of the problems and the evaluation of the response (citizen in the loop of continuous improvement): MyFeelBack, Qui Dit Miam, Nacelles and Oabike.
- Service driven by need instead of pushing, customers at the heart of supply chain services requirements: MyFeelBack, Qui Dit Miam, Nacelles and Oabike.
- Adaptation of physical infrastructures: Coovia and Ze Watt.
- Better sustainability of public processes: Qui Dit Miam, Helpiness, Coovia, Parkisseo, CityMéo, Ze Watt, Nacelles and ThirtyOne.
- Sensors equipping the system managed by the public process: Parkisseo and Adviez.

Now that we have demonstrated the impact of Smart City projects on the internal processes of the public service, we must succeed in managing all Smart City projects in parallel with the daily actions of the public service. The impacts of Smart City projects on internal processes can be divided into two main categories: Supply Chain Management and Continuous Improvement. Indeed, the concept of Smart City is based on ICT and multi-actor collaboration, it makes sense to find strong impacts on the management of the information system (CRM, sensors). The integration of citizens and the digitization of the logistic chain naturally bring continuous improvement to the public administration. But it also offers the capability to move to pulled management of the service.

B. Assessment of the public action and the impact on the smart city and sustainable approach

For the evaluation of public action, the paper is based on the internal practices of the Toulouse administration. The survey of various practices in different directions from the Toulouse administration results in a distribution of evaluation of public action into four categories and sixteen dimensions. The dimensions associated with the categories are shown in Table III.

TABLE III. The dimensions of public service management in Toulouse

Category	Fields
Outcome	Innovation
	Effectiveness / Satisfaction
	Personnalization
	Environment
	Societal
	Adaptability
Project management	Relevance
	Transversality / Collaboration
	Action plan
	Quality
Efficiency	Economy, cost of service
	Resource performance
Constraint	Ethics
	Traceability
	Law / Justice / Equity
	Formalization

Table III summarizes the internal practices and emphasizes their consistency with the standards of the Smart City and sustainability. In the state of the art, we have identified dimensions that define Smart City and sustainability. In these dimensions we find the Smart Governance, Economy, Environment, etc. which are also present in the synthesis of our internal practices. Smart City approaches and sustainability incorporates dimensions such as mobility, health, education, etc. Which are competencies of the public service. The improvement of public performance thanks to our new public management method will have a direct impact on the performance of the Smart City approach and of sustainability within Toulouse.

The evaluation of projects on the impact of public service processes through our synthesis of internal practices will enrich Smart City's models and sustainability. Until now Smart City projects have been conducted as opportunities without identifying input to the public service. In the future the evaluation of our actions with our synthesis of practices will promote Smart City projects to improve the performance of the public.

IV. Conclusion

This insight and analysis demonstrates the impact of Smart City projects on the processes of public administrations. The analysis of the twelve experiments revealed several types of impacts on public service processes. These impacts can be categorized into three industrial methods: Customer Relationship Management, Supply Chain Management and Continuous Improvement.

This paper validates the model (Figure 2) of our suggested method for managing public service. The work on the identification of internal evaluation practices must be consolidated and then shared by all the public actors and fully integrated into our approach.

The future perspectives of our research will be to apply the method to new projects of different sizes, to check the adaptability of the method with respect to the projects. Using this method, we hope to successfully implement and adapt

industrial methods (SCM and continuous improvement) within the Public Service.

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