Urban Diagnosis for the Design of Smart City Projects

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Abstract — **This paper presents a diagnosis methodology for the design of the smart city projects. This diagnosis is crucial to understand and rank the city challenges and difficulties, to explore the impact of the smart city transformation on the city and to develop a collective vision of how the smart city transformation will help to cope with the city challenges and to meet the city stakeholders' expectations. The par presents successively a synthesis of the literature review, the smart city concept and finally the urban diagnosis for the design of smart city projects. The latter includes three parts: the expectations from the urban diagnosis, a methodology for the urban diagnosis and its output. The papers show the importance of the urban diagnosis for the success of any smart city project and how to conduct an effective and smart urban diagnosis.**

Keywords : Urban Intelligence, Smart City, diagnosis, participatory, digital, pilot project

I. INTRODUCTION

Literature review shows an increasing concern about smart [1]. This academic activity leads to multiple definitions and concept of the smart city including different concerns such as the use digital technology, the participatory governance, the improvement of urban services and quality of life, sustainability, resilience and the economic activity [2-5].

Initially, the development of the smart city concept focused on environmental concerns. Then it was extended to include the use of digital technology as a major tool for urban development [7-8]. The risk is to see smart cities as hubs of technological innovation more than centers of sustainable and social developments [9-11]. Some researchers explain this by the fact that cities are rushing to become leaders in technological innovation and knowledge generation [12-15]. Some authors qualified smart city initiatives as empirical without solid scientific basis [16-18]. Recent papers focused on how the design and implementation of smart city strategy could be a relevant subject foe research [19]–[22].

Some authors highlighted that the fact that smart city initiatives were not integrated into the city's urban planning mechanisms [7, 24-25]. They attributed this shortcoming to gap between frameworks related to the smart city concept and with urban planning and development. [13] pointed that the design of the smart city is still confused and that several ambiguities remain about how to achieve the objectives of the smart city. Analysis of some smart city initiatives shows that they are ill-suited to meet local needs and do not take into account privacy and security issues [13]. Some authors highlighted that the implementation of smart city initiative faces major barriers, such as significant investment, integration of social, environmental and economic concerns [5], [6], [26], the complexity of urban issues and the multitude of urban stakeholders [27]–[29].

A successful smart city initiative should be based on (i) a comprehensive diagnosis of the city to understand and rank the major city challenges and figure out how the smart city transformation could cope with these challenges in considering the city expectations of the city stakeholders and the available resources (ii) the selection and implementation of pilot projects to check the smart city project feasibility and to measure its impact on the city [32]. Both the urban diagnosis and pilot projects will help to design an effective and relevant smart city project. The following sections will present the smart city concept and urban intelligence, the urban diagnosis for smart city projects and finally the identification and selection of pilot projects.

II. SMART CITY CONCEPT

The Smart city concept refers to urban innovation with the objective to improve the quality of life in cities. The Smart city is not only about the use of technology in the city, it is a comprehensive approach that associates technology and social innovation to build an inclusive city [30]. The cooperative and creative aspect are major features of the smart city. It creates synergies between the different components of the city and takes care of the various components of the city, with emphasis on the residential, political, economic, cultural and social functions as well as on the urban services related to the administration, transport, water and energy supply and municipal waste collection and treatment. The intelligence of the smart cities lies on:

1. The ability to create synergies and target the possibilities of pooling (means and resources).
2. The integration of local specificities and requirements.
3. Participatory democracy; build the project with the citizens.
4. Sustainable development
5. Urban resilience, increasing the capacity to overcome and to cope with hazards.
6. Technological advances; integrate technological advancements to improve services and performance.

The decisive element, keystone of everything that we have stated before, is the interest given to people and citizens

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in the process of urban development and in any SC approach. Indeed, the central element of a city is people. Therefore, it is his right to be put at the center of attention and all reflection.

From a societal perspective, a smart city must be seen as caring, inclusive, accessible, affordable, sociable, engaging and participatory. The figure 1 shows the Pillars of urban intelligence. Figure 1 illustrates the major pillars of the smart city, which include human-centered participatory governance, sustainability, resilience, technology, adaptation to the local context and synergy.
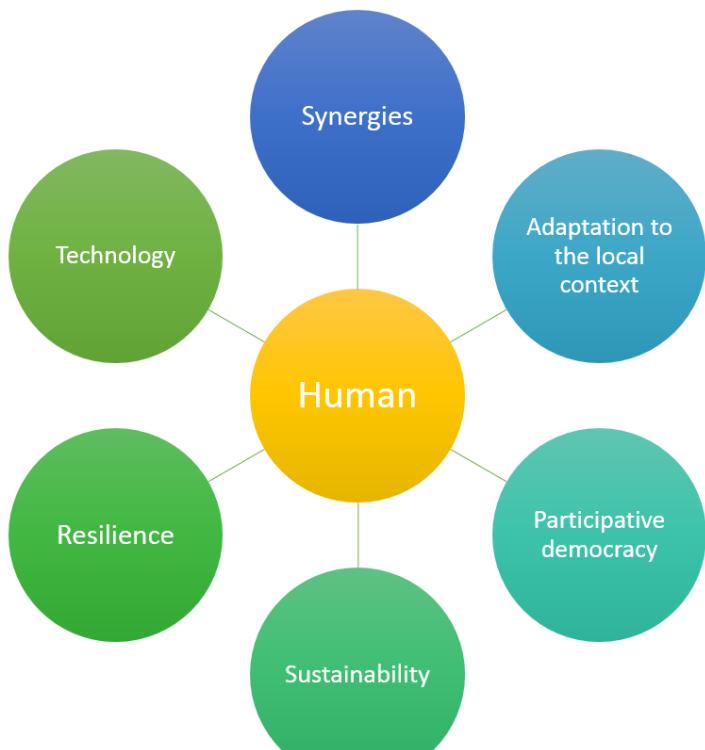
Figure 1: Pillars of urban intelligence

III. URBAN DIAGNOSIS FOR SMART CITY PROJECTS

A. Expectations from the urban diagnosis

The smart city should focus on meeting citizens' needs and expectations and on local requirements and specificities. A smart city must have a clear overview of the current situation of the city. This is why we consider that a smart city approach must start with a comprehensive diagnosis of the different features and functions of the city. Some authors reported the need to establish a rigorous, holistic and explorative urban diagnosis process for smart city projects [31].

The urban diagnosis for smart city projects aims to:

- Conduct a general inventory of the existing situation.
- Identify available resources.
- Identify the city stakeholders

- Listen and figure out the city stakeholders' expectations.
- Explore the impact of the smart city transformation on addressing the city challenges and the stakeholders' expectations
- Define the priorities of the smart city transformation
- Propose recommendations for establishing an effective smart city roadmap

B. Methodology for the urban diagnosis

The urban diagnosis should start by setting out the objective, perimeter, expectations and agenda of this diagnosis. It should also include the configuration of the project governance, which constitutes a key element of the smart city project. The project governance should include in a governance committee representative of the city stakeholders including policy-makers as well as representatives of the city departments and services, urban services providers, economic sector and civil society. The city should appoint a referent for the smart city project, who ensures the coordination between the team in charge of the urban diagnosis and the members of the governance committee.

Figure 2 summarizes these preliminary actions for the realization of an effective urban diagnosis.

The diagnosis procedure includes three phases: preparatory, discussion phase and audit phases. Figure 3 summarizes these phases.

The preparatory phase consists in starting the study and preparing for the exchange phase. It starts by the identification of the list and agenda of meetings. It is necessary to include all the actors of the city with emphasis on citizens' representatives. Participatory democracy must occupy a central role. for the citizens' engagement in the smart city transformation. A questionnaire is established for the meetings and send before the meeting. This preparatory phase includes also collection of documents from the city, institutional reports, newspapers and social media. Open data sources data constitute also an interesting source for the diagnosis.

The second phase includes meetings and discussions phase with the city stakeholders representatives previously identified. This phase allows a good understanding of the city challenges from different perspectives, to collect and cross the information and data about the city difficulties, resources, capacity buildings and to explore with the representative of the city stakeholders the expectations from the smart city initiative could help in addressing the city challenges.

The third phase focuses on the analysis of collected data. This phase starts by the construction of an information system from data collected before the meetings as well as during and after the meetings. The city challenges are identified and ranked according to scores attributed by the city stakeholders. The expectation from the smart city transformation are also identified and ranked. Finally, the impact of the smart city transformation on the economic, social and environmental developments are also identified.
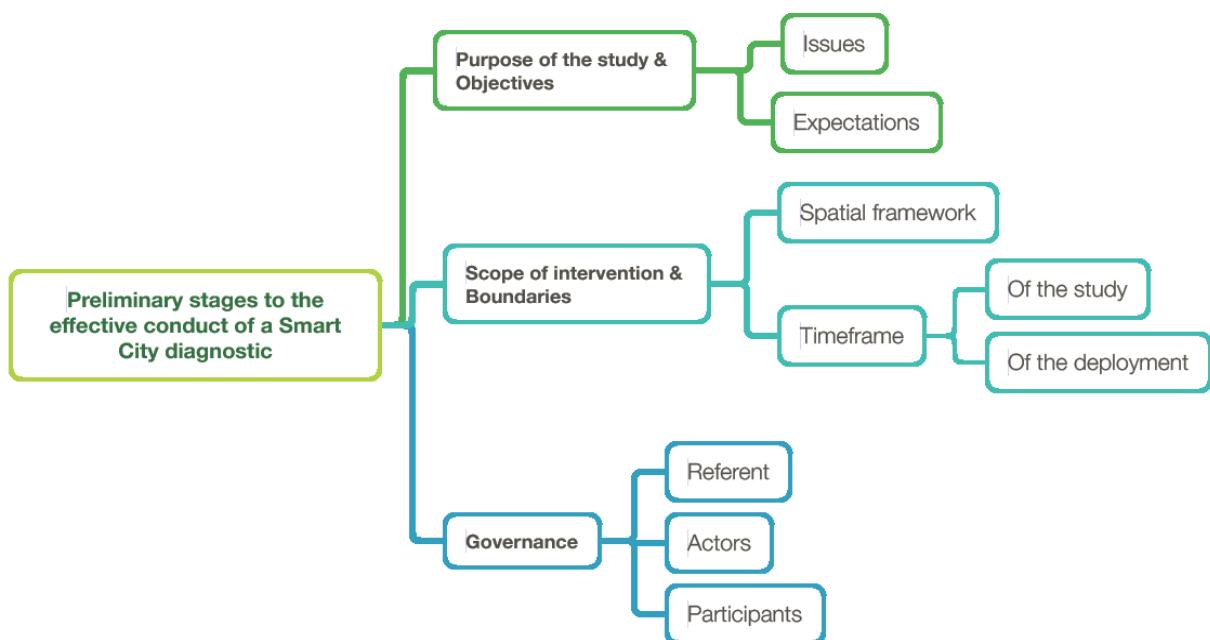
Figure 2: Preliminary stages to the effective conduct of a Smart City diagnosis
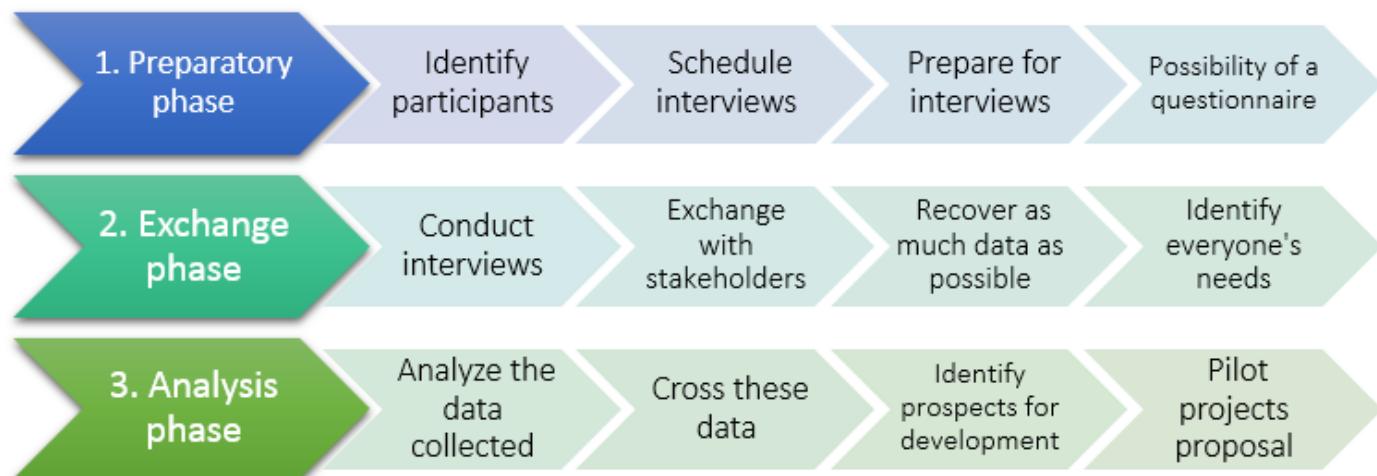
Figure 3: Progress of an urban diagnosis

C. Output of the urban diagnosis

Data analysis results in the identification of a set of core projects for the smart city initiative. These projects could be classified in 7 categories according to their main concern (Figure 4).
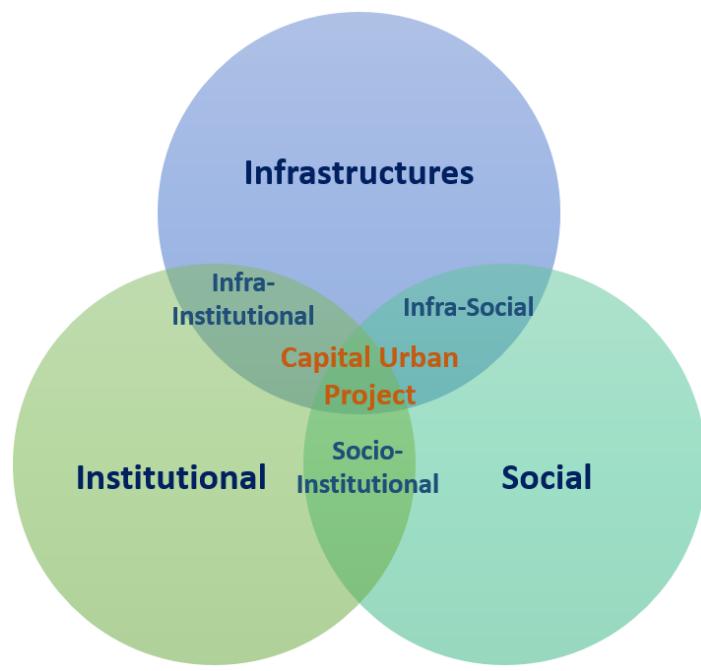
Figure 4: Classification of projects according to their main concern

These projects could be ranked according to indicators identified by the representatives of the stakeholders to significant criteria such as:

- ❖ Required investment,
- ❖ Social, economic and environmental impacts,
- ❖ Implementation barriers,
- ❖ Required time for implementation
- ❖ Interoperability,
- ❖ Capacity building
- ❖ Social acceptance.

A set of scores was identified for these indicators. Table 1 provides details about the scoring system for the selected indicators. The score of each indicator is determined as the average of scores attributed by the representatives of the city stakeholders. Then the global score (SG) of the project is determined by the indicator is the sum of the scores attributed for the different indicators:

$$GS = \sum_{k=1}^{k=N} S_k$$

N stands for the number of criteria, while S_k denotes the average score of the kth criterion.
The global score (GS) could be also determined by the use of a system of weights (Wk) for the set of criteria, which allows to consider preferences for some criteria:

$$GS = \sum_{k=1}^{k=N} Wk S_k$$

The weights of the criteria should be determined by a consulting the representatives of the city stakeholders.

Table 1: Scoring system for the indicators of the smart city core projects

Indicator	Scoring system
Investment (S1)	5: Very low, 4: Low, 3: Medium, 2: Important and 1: Very important.
Social Impacts (S2)	5: Very important, 4: Important, 3: Medium, 2: Weak and 1: Very weak.
Economic Impact (S3)	5: Very important, 4: Important, 3: Medium, 2: Weak and 1: Very weak.
Environmental Impacts (S4)	5: Very important, 4: Important, 3: Medium, 2: Weak and 1: Very weak.
Required time for implementation (S5)	5: Very short, 4: Short, 3: Medium, 2: Slow and 1: Very slow.
Implementation Barriers (S6)	5: Very low, 4: Weak, 3: Medium, 2: Important and 1: Very important.
Degree of Interoperability (S7)	5: Very strong, 4: Strong, 3: Medium, 2: Weak and 1: Very weak.
Building capacity (8)	5: Very strong, 4: Strong, 3: Medium, 2: Weak and 1: Very weak.
Social Acceptance (S9)	5: Very important, 4: Important, 3: Medium, 2: Weak, 1: Very weak.

Based on the smart city projects ranking, the city priorities and the availability of resources, a roadmap is established for the smart city initiative. This roadmap includes the following:

- ➤ A description of the governance of the smart city initiative
- ➤ A ranked list of the core projects of the smart city initiative with the implementation agenda.

For each project, it provides:

- • the current state,
- • the transformation target,
- • the impact of the project on the city,
- • the resources to be mobilized,
- • the agenda of the realization
- • the evaluation process
- • description of the pilot projects

IV. CONCLUSION

The design of smart city projects constitutes a crucial step in the smart city projects. This design should be based on a collective and comprehensive understanding of the current challenges of the cities, the priorities of the city transformation and the expectation from this transformation for the improvement of the quality of life in the city, the efficiency and quality of urban services and the participation of citizens in the city decisions. To achieve this objective, the city should conduct with the city stakeholders a deep urban diagnosis, which allows to establish a roadmap for the smart city initiative. The paper showed the importance of the preparation of this phase as well as the collection of data and the discussion with the representatives of the city stakeholders. It showed also how the use of indicators and scores attributed by the representatives of the city

stakeholders could be used to select and rank the core projects of the smart city initiative.

The smart city roadmap should provide the organization of the governance of the smart city as well as a ranked list of the core projects the implementation agenda. It should also provide for each project the current state, the transformation target, the impact of the project on the city, the resources to be mobilized, the agenda of the realization the evaluation process and a description of the pilot projects.

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