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## Developing smart city services by mobile application

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**Abstract:** The smart city concept brings together technology, government and different layers of society to utilize technological enablers such as the internet of things (IoT) and artificial intelligence (AI). These enablers, in turn, facilitate the development of various aspects of the smart city including, e.g., transportation, governance, education, safety, and communication. However, the transition toward smarter cities involves not only technological development but also the changing and evolving roles of citizens, service providers, and city authorities. In this transition, the key issue is the growing and evolving roles of collaboration, participation, and co-ordination.

The purpose of this paper is to present a practical example of a smartphone application that provides citizens with the most essential everyday city services in an easy and accessible manner. The application also acts as a platform for communication between the citizens and city authorities, facilitating collaborative processes and digital participation within the smart city.

**Keywords:** Smart city, mobile application, digital participation.

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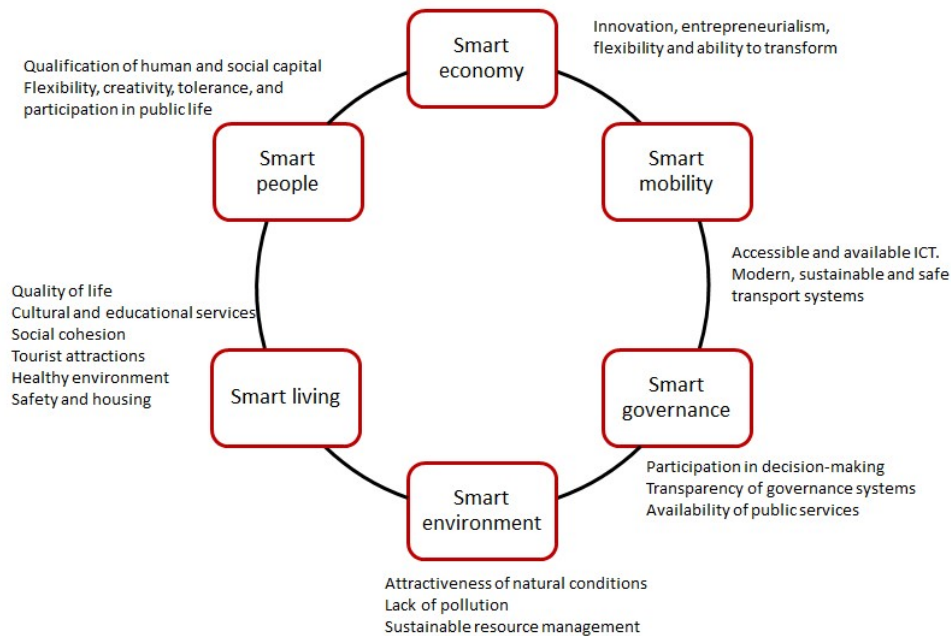
### 1 Introduction

The concept of smart city derives from the intersection of studies in urbanism and the development of information and communication technology (ICT), combined with the dimensions of creativity and humanity (Nam and Pardo, 2011; Pereira *et al.*, 2017). The smart city concept represents new ways of organizing city functions and urban life for environmental purposes, based on digitalization (Öberg, Graham and Hennelly, 2017). In the field of ICT, rapid development of software, hardware, and networks has made it technologically possible to connect people and the facilities serving their everyday needs in the cities (Pereira *et al.*, 2017). Thus, the smart city concept brings together technology, government, and different layers of society to utilize technological enablers such as the internet of things (IoT) and artificial intelligence (AI). These enablers, in turn,

facilitate the development of various aspects of the smart city including, e.g., transportation, governance, education, safety, and communication. Thus, different and often complementary aspects of the smart city encompass an efficient, technologically advanced, sustainable, and socially inclusive city (Vanolo, 2014). General trends in this development include the transition from global to local production and consumption, a change from competitive to collaborative manufacturing and service provision, and a move from shareholder-based business to multiple stakeholder viewpoints (Herrschel, 2013; Öberg, Graham and Hennelly, 2017).

The smart city development requires not only technological enablers, but also a new way of thinking among cities, businesses, citizens, and academia, who include the key stakeholders of this development. The transition toward smarter cities involves the changing and evolving roles of these stakeholders (Lom, Pribyl and Svitek, 2016). Citizens should no longer be considered merely as users, but *stakeholders* having an active role as participants, collaborators, and developers in the city's activities. In the same manner, technology should no longer be considered as an asset, but as a *dynamic enabler* in smart city development. Moreover, business is no longer viewed as provider, but instead as collaborative *partner*. These new roles, together with the ecosystems formed by smart cities, form a framework for a new kind of development of urban areas. In this framework, it is important to understand that smart city development does not mean merely providing new digital services for the citizens; it includes a transformation process involving city structures, governance, and functions, as well as interaction and collaboration between the city stakeholders (Vanolo, 2014; Pereira *et al.*, 2017).

The purpose of this paper is to make a practical contribution to the rather wide literature of smart city development by presenting a mobile tool for citizens containing a set of digital services needed in the everyday life of the city. This smartphone application provides the user with a platform for communication with the city authorities on the most common everyday issues, including questions, suggestions, general feedback, and reporting on the wide variety of city services including education, public transportation, and health care. The application also provides the users with an information channel for events and activities taking place in the city, and enables electronic use of public libraries. In the same manner, the application provides the city authorities with a channel for effectively distributing information, news, and messages to the citizens. The rest of the paper is organized as follows. Section 2 describes the framework of smart cities based on a concise review of the previous literature on this field, with an emphasis on digital participation and collaborative processes enabled by digitalization. In Section 3, the smartphone application for digital city services is introduced and described. Section 4 discusses the results and gives guidelines for further research in this field.



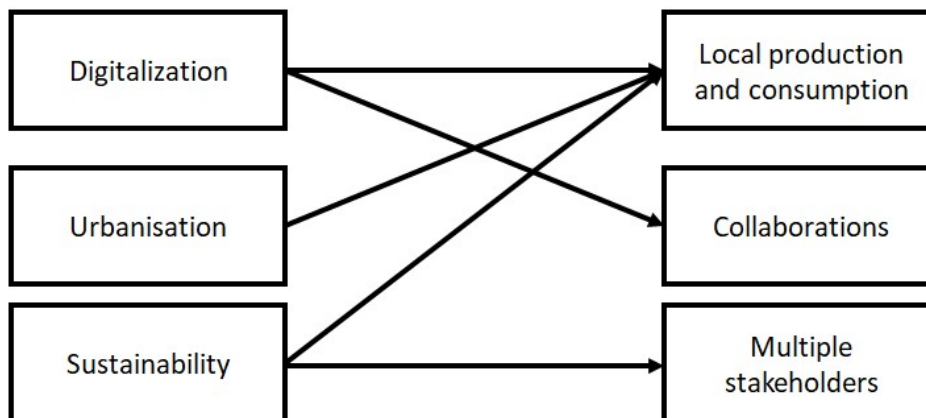
**Figure 1. Dimensions of the smart city concept, adapted from (Giffinger and Suitner, 2015).**

## 2 Smart city concept

Smart city initiatives have recently been merged into a model to make cities better places to live in. The smart city can thus be considered as an ideal of sustainable urban living. The smart city is a rather vague concept, defined in various ways, depending on the context of smartness (Öberg, Graham and Hennelly, 2017). According to Giffinger and Suitner (2015), the concept of a smart city should incorporate at least one of the following dimensions (Figure 1): 1) *smart economy* related to, e.g., innovation, entrepreneurship, flexibility, or productivity; 2) *smart mobility* in the context of sustainable resource management and transport systems; 3) *smart governance* with implications for participation, decision-making, and transparent governance structures; 4) *smart environment* that is understood as attractive natural conditions and lack of pollution as well as sustainable management of resources and energy; 5) *smart living* and quality of life; and 6) *smart people* in terms of qualifications, creativity, education, and flexibility (Vanolo, 2014). In this manner, smartness in the smart city context can be associated with very different phenomena. One factor these phenomena have in common is sustainability, which is included in one form or another in almost all of the above mentioned dimensions (Öberg, Graham and Hennelly, 2017). Moreover, Herrschel (2013) suggests that the smartness of smart cities has come to include “innovativeness, participation, collaboration, and co-ordination”. This highlights the role of smart processes, collaborative practices and ways of working as opposed to pure ICT-based technological development. The latter is seen as an enabler rather than a key element of the smart city

concept. Despite this rather broadly defined framework, previous literature in the smart city field is relatively coherent in suggesting that the digitalization and urbanization behind smart city development are moving production and consumption from global to local, manufacturing from competitive to collaborative, and business from shareholder to multiple-stakeholder (Öberg, Graham and Hennelly, 2017), as illustrated in Figure 2.

The concept of smartness of a city can be understood on three conceptual levels (Lom, Pribyl and Svitek, 2016). First, in the *context of marketing*, smartness involves user perspective and the smart services related to smart cities are linked to user-friendliness, which means that the concept of smart cities is required to adapt itself to user needs and interfaces with end-users, represented by city inhabitants (Marsá-maestre *et al.*, 2006). Second, in the *context of strategic management and development*, the smart city concept is directly related to the strategic and ideological directions taken by urban planning. This is because public actors such as governments and cities, at all levels, are utilizing the concept of smartness to distinguish their new strategies, development programs, and policies as guidelines for the development of urban areas in terms of economic growth, sustainable development, and better quality of life. Smart governance (or e-governance) means that various key stakeholders are engaged in the decision-making and public services through, e.g., social media, open data, or internet-based participation platforms (Pereira *et al.*, 2017). A key issue in facilitating these kinds of participatory tools and services is collaboration across departments and communities; so is the real user-centeredness of these services. Third, in the *context of technological development*, the enablers of the smart city concept involve the commercial utilization of the methods of artificial intelligence (AI), internet of things (IoT), and machine learning, all relying on sophisticated data collection and analysis. These technological enablers facilitate the development and deployment of the ICT-related aspects of smart cities related to, e.g., smart transportation, smart energy, smart education, smart safety, and smart communication (Lom, Pribyl and Svitek, 2016). Together these three levels of smart city concept form a smart city ecosystem that represents an extended of smart space, from personal surroundings to the larger community and entire city. Table 1 illustrates the basic characteristics of the smart city ecosystem.



**Figure 2. Key indicators of smart cities, adapted from Öberg, Graham and Hennelly (2017).**

**Table 1. Characteristics of a smart city ecosystem.**

<i>Context</i>	<i>General direction</i>	<i>User point of view</i>	<i>Governance point of view</i>
<i>Marketing</i>	The meaning of user perspective is emphasized	Usable, accessible, and user-friendly digital services	The service process needs to be adapted to user needs and interfaces
<i>Strategic management and governance</i>	Governments and cities at all levels are utilizing the concept of smartness to engage various stakeholders in decision-making	Citizens are considered as key stakeholders in participating in decision-making and the city development through participation tools	The cities facilitate participatory planning and decision-making by providing the citizens with access to digital participation
<i>Technology</i>	Utilization of the methods of AI, IoT, and machine learning together with data analysis to provide smart services	Improving the quality of life through smart services	Providing the citizens with relevant digital services facilitating sustainable living in the cities

### **3 Smartphone application as a platform for city services and participation**

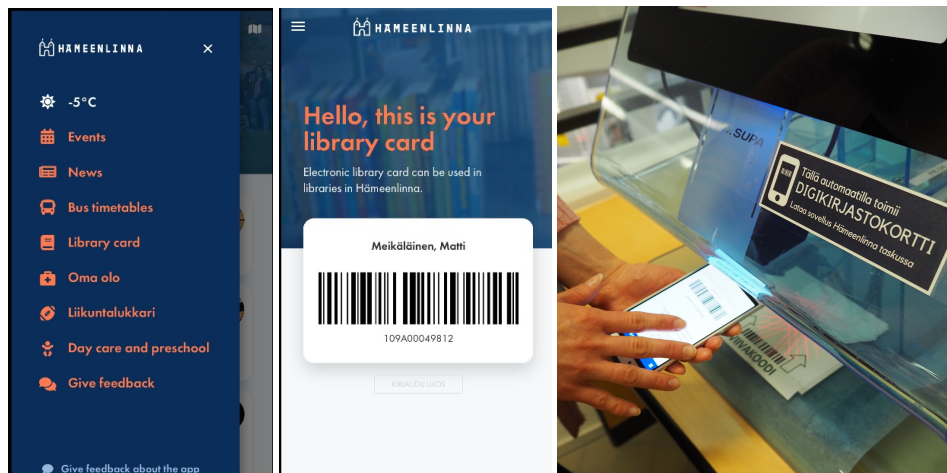
#### *3.1. Hämeenlinna in pocket - smartphone application*

The practical contribution of this paper is related to the development of a smartphone application for digital municipal services in city of Hämeenlinna, Finland. Hämeenlinna is located in southern Finland about 100 km from the capital Helsinki. About 68,000 people live there. In 2017, the city made a strategic decision to provide all the municipal services for citizens in digital form by 2020, which requires rapid development in practically all areas of smart city development. As part of this strategic goal, the city decided to design and create a smartphone application that provides citizens with the most used digital services, and is also a platform for digital participation. A development project was set up and named “Hämeenlinna in pocket”, and carried out jointly by the city and Häme University of Applied Sciences (HAMK).

### *3.2. Features of the smartphone application*

Development of the smartphone application was based on the use of the Open City Application platform. The platform provided a framework for software development in the application. In the first version of the application, launched in March 2019, the following features were included:

- **Events:** The application provides the user with a list of general and public events taking place in Hämeenlinna, including all cultural, educational, and sports-related events. The events can be viewed as a chronological list or located on a city map. The mobile application retrieves the event information from an open data-based interface that collects all the event information in the area of the city of Hämeenlinna (Kukkamäki, Jussila and Mäntyneva, 2019)
- **Actual information and news:** The application includes a news channel giving the news, announcements and information provided by the city. Users have an option to select the information they prefer to receive (e.g., leisure activities, sports, education, or culture). The mobile platform can also provide targeted information for citizens based on their own neighborhood. This, in turn, enables collaborative activities and participation at the individual level on matters related to decision-making and planning in the citizens' own neighborhood.
- **Public transportation information:** The application contains a route planning tool for public transportation. The user submits the target address and receives a suggested easiest route to the target with bus times. The system also reports possible delays or changes in the public transportation system.
- **Digital library card:** The application enables the user to take out a digital library card. It replaces the traditional loan card used in public libraries. The user can install the digital card in the application by logging into the library system through an interface; the application then creates the digital library card with associated barcode and embeds it for further use. The user can then use the digital card by showing the barcode from the screen of the mobile phone to the library's user interface (see Figure 3).
- **My health platform (Oma olo):** Through the application interface, the user has access to the digital health portal provided by the city. The portal provides a variety of instructions for self-diagnosis and care, and also access to a consultation with a nurse.
- **Schedules for free-time sports activities (Liikuntalukkari):** The application provides weekly schedules of the free-time sports activities for school-age children organized by the city.
- **Care-time allocations for nurseries:** Through the application interface, parents of small children can book their weekly care-times in the nurseries.
- **Feedback channel:** The user can send feedback, questions, or comments to the city authorities through the application. The system classifies the feedback and sends it to an appropriate city authority for further analysis and actions. The user can link the feedback to location information. This is particularly helpful when users report, e.g., faults or problems in their living environment.
- **Digital participation tool:** The application includes a digital participation tool that allows users to participate in decision-making and planning, as part of municipal governance.



**Figure 3.** From left, main menu of the mobile application, a snapshot of the digital library card available in the mobile application, and the library card being used on the self-service user interface in the library.

#### 4 Discussion and conclusions

The smartphone application used as a mobile platform for city services presented in this paper represents a practical example of user-centered smart city development. As it contains a variety of features commonly used in smart city services, it provides the user with a set of digital services that facilitate everyday communication with the city, and enable flexible utilization of the most common city services. Within the framework of the smart city presented in Figure 2, the smartphone application directly contributes to the areas of smart living, smart people, smart mobility, and smart governance.

As the smartphone application was launched in March 2019, it is not yet possible to analyze the user data and user feedback concerning it. However, the development team is making continuous efforts to collect user feedback, and further develop the application based on user views, comments and suggestions. It is equally important to utilize the great potential of the smartphone application as a platform for digital participation. For this reason, the aspects of participation will be the most important areas of further development and research on this topic.

#### Acknowledgment

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