Chapter 1

Future Smart Cities Research: Identifying the Next Generation Challenges

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Abstract

The recent debate on smart cities research is challenged by the arrival of brand-new technologies and new ideas on their social impact. Beyond the hype and the expectations, the next generation smart cities research has to be grounded on the lessons learnt and the experience of the current extensive implementations of smart cities projects worldwide. Additionally, it is required to revisit the basic assumptions for the added value of smart cities research to the strategic blueprints around the world. This chapter is aiming to communicate a new agenda for future smart cities research including social, economic, technological, and community factors. The main contribution is organized around a framework that intends to integrate the technology sophistication, the human and social dynamics, and the strategy orientation of smart cities.

Keywords: Future smart cities research; next generation smart cities; artificial intelligence; metaverse; internet of everything; cloud computing; community engagement; participation; civic engagement; sustainable development goal

1. Introduction

The evolution of smart cities overtime proves a continuous intersection of Social Sciences, Computer Sciences, and Urban Design domains (Lytras, Visivizi, Chopdar, Sarirete, & Alhalabi 2020; Lytras, Visivizi, Torres-Ruiz, Damiani, & Jin, 2020; Visvizi, Jussila, Lytras, & Ijäs, 2020). The scientific and industrial contributions from each domain are in a continuous interaction and integration with the value proposition of smart cities (Lytras & Visvizi, 2019; Lytras, Visvizi, & Sarirete,

2019; Visvizi & Lytras, 2019). Within the sophisticated socio-technical context of the smart cities the debate on future smart cities has to be updated and to respond effectively to three different challenges namely: The dynamics of future smart cities; the human and social dimension; the strategic footprint (see Fig. 1.1).

The dynamics of future smart cities is an amalgamation of diverse factors aiming to promote the unique value proposition of smart cities and to address the emerging new era challenges (Lytras & Visvizi, 2018; Visvizi & Lytras, 2018a, 2018b, 2018c). These factors include but are not limited to the following core value components

- Technology sophistication.
- Human connectivity.
- Hub of everything.
- Enhanced well-being.

The human and the social dimension of future smart cities is related to the core human and social challenges for the future urban and rural space where social interaction will address current limitations and problems including social inclusivity, promote of democracy as a core component of smart cities, human connectivity and technology enhanced digital transformation of human and social experience. Significant considerations for the human and the social dimension include the following factors.

- Social coherence.
- Social dynamics.
- Democratic forum and co-design of policies.
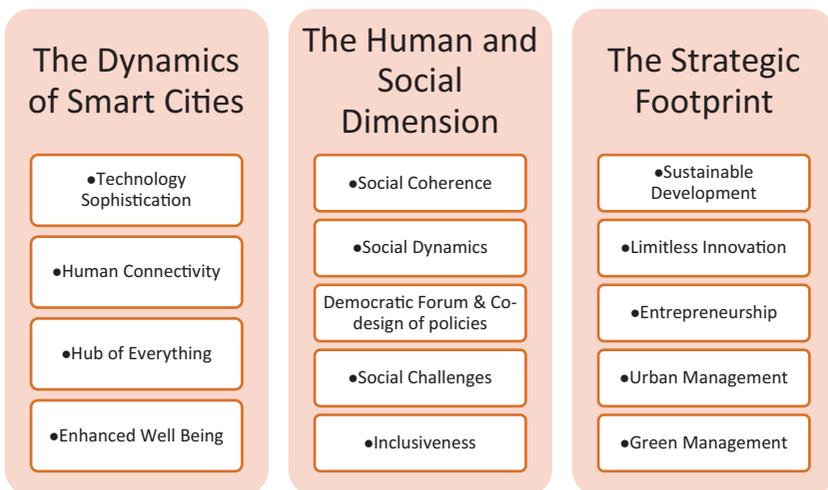- Social challenges.
- Inclusiveness.

Fig. 1.1.   The Dynamics of the Future Smart Cities.

The strategic footprint is related to the high-level strategic objectives that are serving as the overarching pillars for the implementation of smart cities projects. The future smart cities have to be grounded on objectives that among others promote the following significant goals:

- Sustainable development.
- Limitless innovation.
- Entrepreneurship.
- Urban management.
- Green management

The purpose of this chapter is to provide an introductory discussion on the three-tier approach to future smart cities. In Section 2, we elaborate on the dynamics pillar, in Section 3, we are providing key insights for the human and the social dimension while in Section 4, we are elaborating with the determinants and the impact of the strategic footprint of future smart cities. In Section 5, we are summarizing the discussion around indicative initiatives toward the implementation of the three-tier approach to smart cities.

2. The Dynamics of Future Smart Cities

The fast evolution of technologies in the last years and the promising new technological arrivals, provide unforeseen opportunities for the design, implementation, and integration of smart cities services and applications. A huge, interconnected backbone of networks, data streams, and applications requires governance, standardization, and efficient co-existence.

Artificial Intelligence, Cloud Computing, 6G Networks, Blockchain Networks, Fog Computing, Virtual and Augmented Reality, Metaverse, Recommendation Systems, Location Aware Services, Crowdsourcing and Crowdfunding Platforms, Free and Open Source, sophisticated image processing tools, and other fully customizable technologies compose a very powerful technological capability that can be customized and synthesized for innovative smart cities services (Alkmanash, Jussila, Lytras, & Visvizi 2019; Chui, Lytras, & Visvizi, 2018; Lytras, Aljohani, Visvizi, Ordonez De Pablos, & Gasevic, 2018; Lytras, Damiani, & Mathkour, 2016; Lytras & Mathkour, 2017; Lytras, Raghavan, & Damiani, 2017; Lytras & Visvizi, 2020; Lytras, Visvizi, Damiani, & Mthkour, 2018; Lytras, Visvizi, Daniela, Sarirete, & Ordonez De Pablos, 2018; Visvizi & Lytras, 2020; Zhang Jiang Ordonez de Pablos Lytras & Sun, 2017; Zhang, Zhang, Sun, Lytras, Ordonez de Pablos, & He, 2017). The quality of smart cities services is directly linked to the quality of the enabling technologies and the human talent that can conceptualize, design, and implement new applications. Furthermore, enormous effort will be required on the redesign of workflows and the systematic business process management that will lead to a new era of digital transformation of future smart cities. The technology sophistication of future smart cities also stresses the need for a well-defined and integrated data governance strategy. The complex data, services, and application ecosystem of future smart cities has to be seen as

a strategic resource that must generate added value for all the stakeholders and mostly for the citizens.

The human connectivity is another critical determinant for the dynamics of the future smart cities. The quest of new forms of social connectivity promotes the context-aware character of smart cities of the future. The modes for collaboration, the enhanced collaborative content filtering of content authored and consumed in the smart cities context, the utilization of recommendation systems, the social ratings, and the dynamic composition of human-sensitive services on demand, are only few of the aspects of a new era of human wisdom and capability. Services related to human and social development must be also considered as bold responses to the new requirement of social evolution. Learning services, systems that promote the collaborative capability and the social responsibility against critical social problems and challenges are included in the dynamics. The evolution of emerging technologies such as the Metaverse and the Augmented and Enriched Reality define new creative spaces for new forms of connectivity that currently are perceived from the majority of smart cities users as futuristic. There is an ongoing developmental process that defines new spheres of exploitation of new services under metaverse that in the near future will replace traditional or standards modes of connectivity and social interaction. A lot has to be done also on the psychological and ethical aspects of these new developments.

This path to the future forms of human and social connectivity enabled by a next generation technology sophistication brings also forward another dimension of the dynamics of the smart cities. The evolution of technologies like internet of things or the internet of qnything, potentially promote the role of future smart cities as hubs of everything. A global umbrella of numerous, diverse, complementary services has to be facilitated from humans, business users, and professionals with different social, educational, political, psychological, and other backgrounds. Thus, the future smart cities, can be seen as extended value networks. The discussion for the more detailed aspects of this dimension goes beyond the purposes of this chapter, but to our opinion this metaphor of the future smart cities will have an impact on the perceived value of the smart cities.

Last but not least, the enhanced auality of life and well-being is the absolute determinant for the value-based impact of the smart cities research and implementation. There is a critical need for the adoption of the UN Sustainable Development Goals (https://sdgs.un.org/goals) and the interpretation toward the composition of updated quality of life and well-being indexes. The 17 sustainable development goals (SDGs) to transform our world:

Goal 1: No poverty.
Goal 2: Zero hunger.
Goal 3: Good health and well-being.
Goal 4: Quality education.
Goal 5: Gender equality.
Goal 6: Clean water and sanitation.

Goal 7: Affordable and clean energy.
Goal 8: Decent work and economic growth.
Goal 9: Industry, innovation, and infrastructure.
Goal 10: Reduced inequality.
Goal 11: Sustainable cities and communities.
Goal 12: Responsible consumption and production.
Goal 13: Climate action.
Goal 14: Life below water.
Goal 15: Life on land.
Goal 16: Peace and justice strong institutions.
Goal 17: Partnerships to achieve the goal.

Toward this direction, future smart cities as living organization should have the capacity to maintain and to exploit analytical reporting for enhanced decision-making including dashboards and visual analytics aiming to document over-time the measurement and the evolution of metrics that reflect citizens' well-being and quality of life (Table 1.1).

Table 1.1.   Key Determinants of the Dynamics of the Future Smart Cities.

Dynamics of Future Smart Cities Services	Challenges
Technology Sophistication	• Data governance • Standardization • Technologies management • Digital transformation • Workflow management • Business process management
Human and social connectivity	• Context-awareness (social ratings, new collaboration modes, recommendation systems, social ratings, etc.) • Social inclusiveness • New forms of connectivity • Growth and development
Hub of everything	• A hub of diverse, complementary services • Users with different social, educational, political, psychological and other backgrounds • An extended value networks of shared perceptions
Enhanced quality of life and well-being	• Quality of life index (KPIs, analytics) • Systematic standardization based on SDGs priorities and strategies • Collaborative response to well defined challenges • Policy-making and regulation

3. The Human and Social Dimension of Smart Cities Revisited

The social agenda in the future smart cities research has to deal with diverse social challenges of our times. Addressing bold social issues like social coherence, social inclusion and social responsibility must be a pivotal strategic priority for future smart cities. The utilization of smart cities services related to opinion sharing for the cultivation of a democratic sphere of exchanging of ideas and creative initiatives should be seen as a collaborative co-design process of social policies and bottom-up social inclusive regulations. Top personal privacy and security should be also considered as overarching principles within execution of regulations for the self-organization of measurement that will secure the sustainable and unforced utilization of democratic principles.

Inclusiveness and social challenges must be also realized in the future smart cities as key components of a dual context for the social-centric and the human-centric response to bold social problems. Diversity has to be exploited in the direction of social inclusive policies that will utilize human capital with respect (Table 1.2).

4. The Strategic Footprint of Smart Cities Revisited

The ongoing discussion on the impact of smart cities projects and initiatives worldwide brings forward the necessity to design effective, long-term, integrated strategies for the integration of smart cities research within broader governmental or other strategic frameworks. On the quest of the core components of the strategic footprint of the future smart cities, the discussion is accumulated around bold

Table 1.2.   Social Dimension of Future Smart Cities Revisited.

Social Dimension of Smart Cities Revisited	Challenges
Social coherence and inclusion	• Social responsibility • Social justice
Democratic forum & co-design of policies	• Opinion sharing • Democratic sphere for exchanging ideas • Bottom-up policy-making • Privacy and Security
Social challenges	• Poverty • Access to education • Access to high quality health • Access
Inclusiveness	• Social inclusive policies • Human-centric participatory decision-making • SDG's based inclusive strategies for all aspects of social activity

strategic objectives of our times. Future smart cities can serve as the vehicles and the enablers for the implementation of bold strategic objectives that mobilize a variety of resources. The following list is not exclusive but summarizes complementary core pillars for the future strategic footprint of smart cities.

4.1. Sustainable Development

The sustainable development is not a high-level abstract vision. The sustainable development is not a high-level abstract vision. It refers to a set of well-defined objectives, strategies and initiatives with a positive social impact. The key determinants of sustainable development in the context of future smart cities should focus on educated citizens, justified use of all the kind of resources within a long-term strategy for the social value of programs and activities.

4.2. Limitless Innovation

Limitless innovation, is a bold response of the future smart cities' ecosystem toward the exploitation of the human talent, and the people's skills and competencies, toward novel solutions to given problems. The integration of innovation capability in future smart cities must be seen not only in the context of urban spaces available for the gathering and co-working of talented people, but also as a transparent, ubiquitous backbone of services, and technological capabilities for shortening the time from idea generation to innovation launching. Know-how transfer, best practices adoption and a continuous developmental effort for empowering human capital are bold actions to this direction.

4.3. Entrepreneurship

Future smart cities should enhance any form 0 entrepreneurship including social entrepreneurship as well as entrepreneurship enhanced by all forms of technology including metaverse, artificial intelligence, robotics, automation, 5.0 Industry etc. The internet of everything and the expansion of a technology-driven business ecosystem can set future smart cities as mature entrepreneurship hubs.

4.4. Urban Management

The management of the urban space in future smart cities will be challenged by a new era of augmented and enhanced reality. Metaverse will enrich physical urban space and enhanced reality will provide numerous reference and value layers for the exploitation of all the components of the physical space including humans, environment, buildings, smart devices, networks, vehicles, processes, digital twins of everything, and many other traditional or futuristic objects of the physical environment.

4.5. Green Management

The protection of the environment and a full agenda with green footprint is another strategic footprint for the future smart cities research. Actions related to

clean energy management, investments on recycling and strategies to resist to climate change, large scale actions for enhancing the environmental consciousness.

5. Indicative Initiatives and Use Cases for Future Smart Cities

In the previous section we elaborated from a philosophical point of view on the dynamics and the core determinants of future smart cities. We adopted a high-level abstract approach trying to summarize a broad agenda for the domain.

In this section, we provide a complementary approach. We summarize a very selective quite focused overview of high impact initiatives for future smart cities. We deploy the dimensions we discussed and for the shake of the discussion, we integrate only three use cases for the various dimensions while the options are unlimited. The following is the list of recommended or indicative use cases and initiatives:

Use Case 1.   A contextual data governance strategy for future smart cities (per case).
Use Case 2.   A roadmap for digital transformation and maturity assessment.
Use Case 3.   An artificial intelligence and machine learning workflow for optimization of core areas of smart cities, for example, healthcare.
Use Case 4.   A collaborative space for co-design of social inclusive policies and strategies.
Use Case 5.   Metaverse innovation space.
Use Case 6.   A machine learning enabled recommendation platform for team-based development and skills building.
Use Case 7.   An internet of vehicles smart transportation system.
Use Case 8.   Shared economy e-marketplaces.
Use Case 9.   Climate change observatory.
Use Case 10.   Happiness and well-being indexes and KPIs
Use Case 11.   Citizen's visual analytics and dashboards.
Use Case 12.   Artificial intelligence services for managing requests of citizens.

Each use case has three bold components as discussed in the previous section. It utilizes a data and technology infrastructure that has multiple layers of sophistication and reflects a holistic data governance strategy. Several implementations of smart cities projects unfortunately are built without a bold data governance framework and this will cause critical issues related to integration and interoperability in a greater future smart cities' infrastructure. The second core component is related to human and social dynamics. The use cases serve as unique value carriers for the utilization of human capital and asset through a progressive knowledge management approach. This dimension and several times underestimated in current smart cities implementations. Different types of smart cities users require different considerations and also the different personality features should be taken into consideration. Last but not least each use case is aligned to an overarching strategy promoting goals and objective with social and developmental footprint (Table 1.3).

Table 1.3.   Use Cases for Future smart Cities.

Dynamics of Future Smart Cities Services	Challenges	Use cases
Technology sophistication	• Data governance • Standardization • Technologies Management • Digital transformation • Workflow management • Business process management	• A contextual data governance strategy for future smart cities (per case) • A roadmap for digital transformation and maturity assessment • An artificial intelligence and machine learning workflow for optimization of core areas of smart cities, for example, healthcare
Human and social connectivity	• Context-awareness (social ratings, new collaboration modes, recommendation systems, social ratings, etc.) • Social inclusiveness • New forms of connectivity • growth and development	• A collaborative space for co-design of social inclusive policies and strategies • Metaverse innovation space • A machine learning enabled recommendation platform for team-based development and skills building
Hub of everything	• A hub of diverse, complementary services • Users with different social, educational, political, psychological and other backgrounds • An extended value network of shared perceptions	• An internet of vehicles smart transportation system • Shared economy e-marketplaces • Climate change observatory
Enhanced quality of life and well-being	• Quality of life index (KPIs, Analytics) • Systematic standardization based on SDGs priorities and strategies • Collaborative response to well defined challenges • Policy-making and regulation	• Happiness and well-being indexes and KPIs • Citizen's visual analytics and dashboards • Artificial intelligence services for managing requests of citizens

6. Discussion and Conclusions

Smart cities seem to be another buzz word of our times. The ongoing development of smart cities projects worldwide contribute to a sophisticated agenda for the technology sophistication, the social dynamics and the strategic orientation of future smart cities. In our approach, we are analyzing the phenomenon through the lenses of the human and social dynamics and the quest of a new generation of digital transformation that will lead, the exploitation of the human talent. Bold responses to social problems and challenges must be integrated in the context of smart cities research and implementation not as wishful thinking but as bold strategies with great social impact.

This edition is a bold effort on bringing forward diverse aspects of the integrated strategy for future smart cities.

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