DATA AND GOVERNANCE IN SMART SUSTAINABLE CITIES

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Abstract *– Smart cities use information and communication technologies to improve quality of life, efficiency of urban operation and services, and competitiveness. Several challenges result from the large use of data in smart cities; we focus here on three that we consider most urgent to address in terms of governance. The first relates to the data heterogeneity that results from the diversity of stakeholders, applications, processes and tools involved, requiring operational data governance to ensure ecosystem sustainability. The second relates to the uncertainty generated by new business models and new technologies, requiring a risk management approach that continuously takes into account new risks and threats. The third challenge is the need to adapt people's skills so that they can cope with rapidly evolving technologies.*

Keywords – Data governance, data heterogeneity, data skills, risk management, smart city

1. INTRODUCTION

In October 2015, ITU-T Study Group 5 agreed on the following definition of a "smart sustainable city" [1]:

"A smart sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects".

Hence, smart sustainable cities pursue multi-dimensional objectives, each requiring the use of large amounts of data. This specific situation results in several challenges in terms of governance. After a description of the specific context of data processing and management in smart cities, we will focus on three challenges that we consider most urgent to address: operational data governance, new risks and threats, and people's skills.

2. CONTEXT

Innovative cities use large amounts of data. Data is produced, analyzed and stored for many applications; this includes street lighting, air quality, energy monitoring, traffic regulation and smart buildings. Applications that require the use of sensors and data collection are everywhere.

The few applications we have just listed already reflect one of the main governance challenges generated by smart cities: the data heterogeneity that results from the plurality of stakeholders, applications, processes and tools involved. The SynchroniCity IoT Large-Scale Pilot for Smart Cities [2] is a concrete example of an integrated project that illustrates the multidimensional nature of smart city requirements.

In addition, reliance on the implementation of new business models, innovative solutions and advanced technologies creates uncertainty and requires adapted skills and capabilities. Ensuring a successful transition to smart sustainable cities therefore requires managing data complexity and uncertainty through operational data governance (**3**), a risk management approach that takes into account new risks and threats (**4**), and the development of people's skills to help them cope with rapid change (**5**).

3. OPERATIONAL DATA GOVERNANCE

Massive amounts of data pass through smart cities. One could say that smart cities rely on data, while smart sustainable cities rely on data governance.

The major challenge smart cities face is data heterogeneity, which stems from the plurality of stakeholders, applications, processes and tools involved. Data heterogeneity, in terms of granularity, quality,

depth or language, makes analytics and aggregation difficult and more generally prevents the data from being used effectively. This challenge is accentuated by data ubiquity, which makes data governance very different from the governance of other resources to which they are often compared (oil, financial resources, etc.).

Operational data governance is therefore essential, to control, monitor and protect the ecosystem. This necessarily involves a cartographic understanding of circulating and stored data: which data, who produces the data and why, where does the data come from and where is it stored and secured? Building information modeling (BIM) and city information modeling (CIM) are examples of large-scale initiatives whose objective is to foster governance and harmonize building and city data [3]. By extension, operational data governance relies on the ability to capture the "big picture" of the ecosystem's data through data aggregation capabilities and end-to-end visibility of data processing [4].

Smart cities are data-driven, but massive data collection is not a panacea unless proper governance is in place [5]. In fact, in the long run, improving the efficiency of data use may well involve minimizing data volumes.

4. NEW RISKS AND THREATS

The resilience and stability of smart sustainable cities requires active management of uncertainty. The emergence of new technologies and new business models calls for faster implementation of an adapted risk management approach, as safe growth may be hampered by the many unknown unknowns generated by data management and processing. Existing standards and methodologies [6] could be adapted to the specific needs, contexts and complexities of cities, communities and projects. But whatever the chosen approach, the most important component is the ability to anticipate new risks and threats. Data-related threats evolve as smart cities develop, so anticipating risks, cyber risks and threats is an ongoing process [7]. Below, we propose three specific risks that should be taken into account.

4.1 Systemic risk

The smart cities paradigm in which systems and data are interconnected raises questions about virality issues such as bad data contagion, the dissemination of erroneous information resulting in panic, and the dissemination of fake news [8]. Furthermore, the potential data dependencies generated by data flows between systems raise the question of the impact of a massive blackout (electricity, transportation, banking, etc.) [9] or bankruptcy of a major service provider. As described in the IRGC Guidelines for the Governance of Systemic Risks [10], "systems prone to systemic risks are highly interconnected and intertwined with one another."

4.2 Business resilience, future value and rising costs

Smart cities rely on IoT and on the implementation of innovative solutions and technologies such as machine learning and blockchain, whose large-scale use is still in the testing phase. The current economic pressure on innovation could generate unexpected future costs. As stated by Sculley, Holt, Golovin, et al., "it is dangerous to think of these quick wins as coming for free" [11]. This encourages us to consider technological debt as a risk. Moreover, just like traditional businesses, players in the data economy still have to prove their strength and resilience in this new era of technology, where a growing share of the value chain is based on intangible capital [12].

4.3 Decision risk

Smart cities entail a growing number of data-based decisions related to a wide range of topics (energy, traffic, tax, safety, insurance, etc.) and stakeholders (citizens, cities, companies, etc.) hoping for effective, fair and unbiased decisions that will result in operational efficiency, sustainable economic growth and social justice. The efficiency of the decision-making process depends on technical and non-technical parameters such as algorithms, data quality and governance, each of which could be a source of bias or error. What, then, are the economic, social or environmental consequences of wrong decisions, bias or errors due to poor quality data, misinterpretation or an inability to use the data effectively?

Projects under construction should be challenged in the light of these risks and threats. But risk identification is only the first step in implementing a risk management approach. Other issues must also be addressed by stakeholders, including the need to improve risk assessment (likelihood and magnitude) through the collection and analysis of loss

data. This has already been done in some industries that have implemented a risk management approach [13]. Another critical issue is the question of risk appetite and, more pragmatically, who bears the risks and will have to bear the costs of uncertainty: companies, governments, cities or citizens?

5. PEOPLE'S SKILLS

Smart sustainable cities are cities where people are equipped to face the challenges that arise from their economic and social environment. Adapting individuals' skills to meet the current and future needs brought about by digitization and technical progress is therefore a priority for each and every stakeholder – cities, companies, states and citizens. As noted in the Geneva Initiative on Capacity Development in Digital Policy, digital development involves many unknown unknowns and needs to remain flexible and ready to adapt to change [14].

At the "Shape Your Digital Future!" Internet Governance Forum held in Geneva in December 2017 [15], a strong consensus emerged on two points:

Skills gap analysis: The need to bridge gaps and train individuals through continuous, flexible training plans. As the Council of Europe points out, digital training is a process, not a state that individuals reach after completing a training course [16].

Soft skills: The need to raise awareness about the importance of soft skills and encourage curiosity and creativity to understand the digital world and the changes it brings.

Each organization should, without delay, take stock of the above and implement the necessary measures locally to draw up the inventory of skills and needs, train individuals and prepare training plans. Creating smart sustainable cities means recruiting digital skills in line with current and future needs, emphasizing the development of soft skills, and nurturing people's ability to change and evolve.

6. CONCLUSION

The digital development of cities and large use of data raises many governance challenges, starting with the need for operational data governance to manage the heterogeneous data produced.

Given the uncertainty generated by new technologies and business models, to ensure the sustainable development of smart cities, it is essential to embrace a risk management approach that takes into account new risks and threats on an ongoing basis. And this simply is not possible without the awareness and improvement of people's digital skills.

The stakeholders involved in or impacted by the implementation of smart city applications – cities, citizens, companies, public and private organizations – must remain flexible and ready to adapt to the digital future. Otherwise, we run the risk of generating huge costs due to a lack of preparation, which the ecosystem as a whole will have to pay.

REFERENCES

[1] https://www.itu.int (FG-SSC)

[2] https://synchronicity-iot.eu/

[3] Dr. F. Sielker & Prof. P. Allmendinger's report provides an overview of six countries' BIM strategies: *International experiences: Future Cities and BIM*, University of Cambridge (2018). As the adoption of BIM is not yet generalized, some initiatives aim to promote its development. The Smart Buildings Alliance for Smart Cities principles are one example: http://www.smartbuildingsalliance.org/

[4] The *Principles for effective risk data aggregation and risk reporting* published by the Basel Committee on Banking Supervision are a concrete example of a data governance initiative at industry level, which emphasizes the importance of having reliable, available, and complete data to ensure a comprehensive understanding of the analyzed environment: https://www.bis.org/publ/bcbs239.pdf

[5] This document, in French, analyses data management as a challenge for the future of communities : *Collecte et gestion des données numériques pour le pilotage des politiques publiques - Vers un big data territorial*. http://www.fnccr.asso.fr/article/big-data-territorial-publication-de-letude-de-la-fnccr/

[6] Here are some examples of risk management standards, methodologies and applications: (i) The International Organization for Standardization (ISO) publishes ISO31000 standard on Risk management, (ii) Enterprise Risk

Management by the Committee of Sponsoring Organizations of the Treadway Commission (COSO, www.coso.org), (iii) an industry-level example – Operational Risk Framework, Basel Committee on Banking Supervision https://www.bis.org/publ/bcbs195.pdf, (iv) a country-level example from Switzerland, based on the NIST Cybersecurity Framework Core – *Minimum standard for improving ICT resilience*, Bern 2018, Federal Department of Economic Affairs, Education and Research (EAER), Federal Office for National Economic Supply (FONES).

[7] For example, in the banking industry, the Basel Committee has proposed an initial list of risks that stakeholders are continually expanding. The Committee of Sponsoring Organizations of the Treadway Commission (COSO, www.coso.org) also recommends improving the risk assessment process to align it with evolving technologies and markets.

[8] The GIP Digital Watch observatory for Internet governance and digital policy, Top digital policy developments in 2017. https://dig.watch/

[9] This document, in French, discusses the cyber risks associated with the emergence of smart cities: *Les « Smart Cities » sous l'angle du risque cyber. Perspectives et challenges de demain*. Thierry PERTUS https://www.club-ebios.org/site/presentations/ClubEBIOS-2015-09-08-PERTUS.pdf

[10] https://www.irgc.org/wp-content/uploads/2018/09/IRGC-2018.-IRGC-Guidelines-for-the-governance-of-systemic-risks.pdf

[11] Sculley, D., Holt, G., Golovin, D., et al. Hidden technical debt in machine learning systems. In: Advances in neural information processing systems. 2015. p. 2503-2511.

[12] WIPO study shows that, today, almost a third of the value chain is based on intangible capital. This includes databases, digital skills, tool flexibility, data management process, ability to extract value from data and, more generally, anything that represents know-how or an advance in the field of data processing and management. *Intangible Capital in Global Value Chains*, World Intellectual Property Report 2017. WIPO Publication No. 944E/17.

[13] For example, aviation accident and incident statistics such as the Bureau of Aircraft Accidents Archives (B3A), established in Geneva in 1990 for the purpose of handling all information related to aviation accidentology: http://www.baaa-acro.com/. See also the financial sector's initiatives on loss data collection: https://www.bis.org/bcbs/publ/d355.pdf or this older Loss Data Collection Exercise https://www.ffiec.gov/ldce/

[14] The Geneva Initiative on Capacity Development in Digital Policy. https://digitalswitzerland.com/2017/12/27/geneva-initiative-capacity-development-digital-policy/

[15] https://igf2017.sched.com/info

[16] The European project DigComp offers a useful framework: Digital Citizenship Education Volume 1: Overview and new perspectives, October 2017 (p.23).