

Smart Cities: An opportunity for libraries to be part of future urban management

English translation of the original paper: “*Smart cities: una oportunidad para las bibliotecas públicas de formar parte de la gestión urbana*”

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Abstract:

The concept of Smart City arises from the need to apply technology in urban processes, both for sustainability and for mobility.

Although initially the term was born in IT private companies, from the academic field and public management professional (architects, urban planners and commands) are using it increasingly just to have an integral vision of the territory where the decision making is based on the use of Big Data to achieve the ultimate goal of efficiency.

It is an integral vision of the territory that consists of six dimensions: smart economy (intelligent and sustainable), smart mobility, smart environment (natural resources), smart governance (participation), smart people (social and human capital) and smart living (quality of life).

Libraries have the opportunity to be leading nodes in this vision because, according to their trajectory and their mission, they respond to strengthening the quality of life of communities, participation as well as improving the capacities of individuals in the digital transformation of society.

Keywords: Smart cities, public libraries, urban planning, sustainability, strategic policies

Introduction

From the very first urban concentrations 8,000 years ago in Mesopotamia, cities have always concentrated the economic and human capital. They have been hubs of innovation and technological evolution because they have had the capacity to attract human capital and resources for the purpose of exchanging goods and services. The change of economic model from the *industrial city* to the *digital city* has been a difficult transition since cities must cope with complex problems, not only technical, but also social and environmental as well.

There are different economic development models of cities and territories (digital city, creative city, learning city, etc.). The smart city archetype is one of them and it is being consolidated increasingly because it is a global comprehension of current cities and their multiple approach, that is, information technologies, infrastructures, human and social capital and the governance of institutions with a ultimate goal: to improve the future of citizenship by means of respect to our planet.

The objective of this paper is to present the *smart city* conceptual framework and how libraries can be very relevant in this city model. The structure is the following: Firstly, there is a brief description of the *smart city* paradigm. The second section introduces the global development axes of libraries and the *smart library* prototype as well. The third chapter outlines some of the affinities between *smart city* and *smart library* in order to articulate a few challenges that strategically integrate the library debate in the construction of 21st century *urbs*.

1. The urban model *Smart City*

1.1 Urban challenges

Lewis Mumford in *The City in History* conceptualizes [14] the city as a living organism that can only be understood from an integral vision by mixing History, Philosophy, Politics, Legislation and Urbanism. From a techno-productive point of view, social evolution in urban environments has experienced three eras:

-The first urban concentrations in the awakening of the agrarian revolution (from the Neolithic to the XVIIIth century). Soil and energy are sources of wealth production. It is the age of matter and people hoard and exchanges goods in these hubs.

-The industrial revolutions (XVIIIth-XXth century). The sources of energy are coal and oil, economic growth is concentrated in cities. Besides industry grows and gets specialized. Cities begins to be planned and some architects theorizes about the quality of life. Great architectural and urbanistic innovations are introduced, for instance, sewage systems, distribution of drinking water, air quality studies, public transports, first skyscrapers, and the first telecommunications break out.

In spite of these advances, can this *Fordian city* be considered an intelligent city while its urban center is sprawling population disorderly? Urban growth, based on cheap access to transport, begins to falter on the occasion of the first energy crises along with industrial relocation and globalization.

To put it in a nutshell, the urban economic growth, based on machines and factories, is fading away.

-The information revolution of the 21st century. Information is the source of wealth and the good of consumption. Although it does not break away with the "machine", it is a new concept of "thinking machine" that helps humans to describe and predict changes. Digital content and media, entertainment, tourism and cultural services create economic opportunities, for example, the "Bilbao effect"¹.

¹ <https://www.theguardian.com/artanddesign/2017/oct/01/bilbao-effect-frank-gehry-guggenheim-global-craze>

Despite their resources, cities face increasing sustainability² troubles as well as technical and social problems. In this context, thus, Mumford's (almost prophetic) thought is absolutely valid: urban congestion, suburb expansion or social disintegration must not be accepted as a unique fate of the city, but there should be an order that integrates technical facilities with biological needs and social norms.

1.2 Urban economic models. *Smart City* definitions

Cities have been innovation hubs and economic growth focuses which, with the emergence of ICT, have had different approaches and development models: *digital city*, *intelligent city*, *creative city*, *learning city*, *human city*, *efficient city* or *smart city*.

The urban *smart city* paradigm was born at the beginning of the 2000s and, although there is no definition of consensus because the academic contributions and practices are still converging, it is clear that managing future cities requires an integral approach to sustainability, mobility and housing, digital infrastructures, human capital, governance and participation as well as public services to have a better future.

Gil-Garcia [et al.] ^[6] make a magnificent effort in the conceptualization of the term based on a bibliographical search of interdisciplinary literature. Some of the definitions they select are:

² <https://www.lavanguardia.com/natural/20190605/462680840185/cruceros-transporte-and-environment.html>

Table 1
Smart City definitions

Reference	Year	Definition
Hall, R. [7]	2000	“A city that monitors and integrates conditions of all of its critical infrastructures, including roads, bridges, tunnels, rails, subways, airports, seaports, communications, water, power, even major buildings, can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizens”
Komninos, Nicos [10]	2002	“Territories with high capacity for learning and innovation, which is built-in the creativity of their population, their institutions of knowledge creation, and their digital infrastructure for communication and knowledge management”
Giffinger, R. [et al.] [4]	2007	“A city well performing in a forward-looking way in economy, people, governance, mobility, environment, and living, built on the smart combination of endowments and activities of self-decisive, independent and aware citizens”
Toppeta, D. [18]	2010	[A city] “combining ICT and Web2.0 technology with other organizational, design and planning efforts to de-materialize and speed- up bureaucratic processes and help to identify new, innovative solutions to city management complexity, in order to improve sustainability and livability”
Kourtit, K. and Nijkamp, P. [11]	2012	“A promising mix of human capital (e.g. skilled labor force), infrastructural capital (e.g. high-tech communication facilities), social capital (e.g. intense and open network linkages) and entrepreneurial capital (e.g. creative and risk-taking business activities)” “The result of knowledge-intensive and creative strategies aiming at enhancing the socio-economic, ecological, logistic and competitive performance of cities”
Woods and Goldstein [19]	2014	“The integration of technology into a strategic approach to sustainability, citizen well-being, and economic development”

Between 2000 and 2014 the definition *smart* evolves. If in the beginning there is a special focus on the sustainability and management of infrastructures through the application of technology, the importance of the concept is shifting towards the value of human capital and the quality of life of communities. All in all, it is an integral vision of the city from the double perspective (both technological and human) that aims to: improve the efficiency of urban operations, improve the quality of life of citizens and promote local economy while maintaining environmental sustainability. Any *smart city project* is based on an information system consisting of:

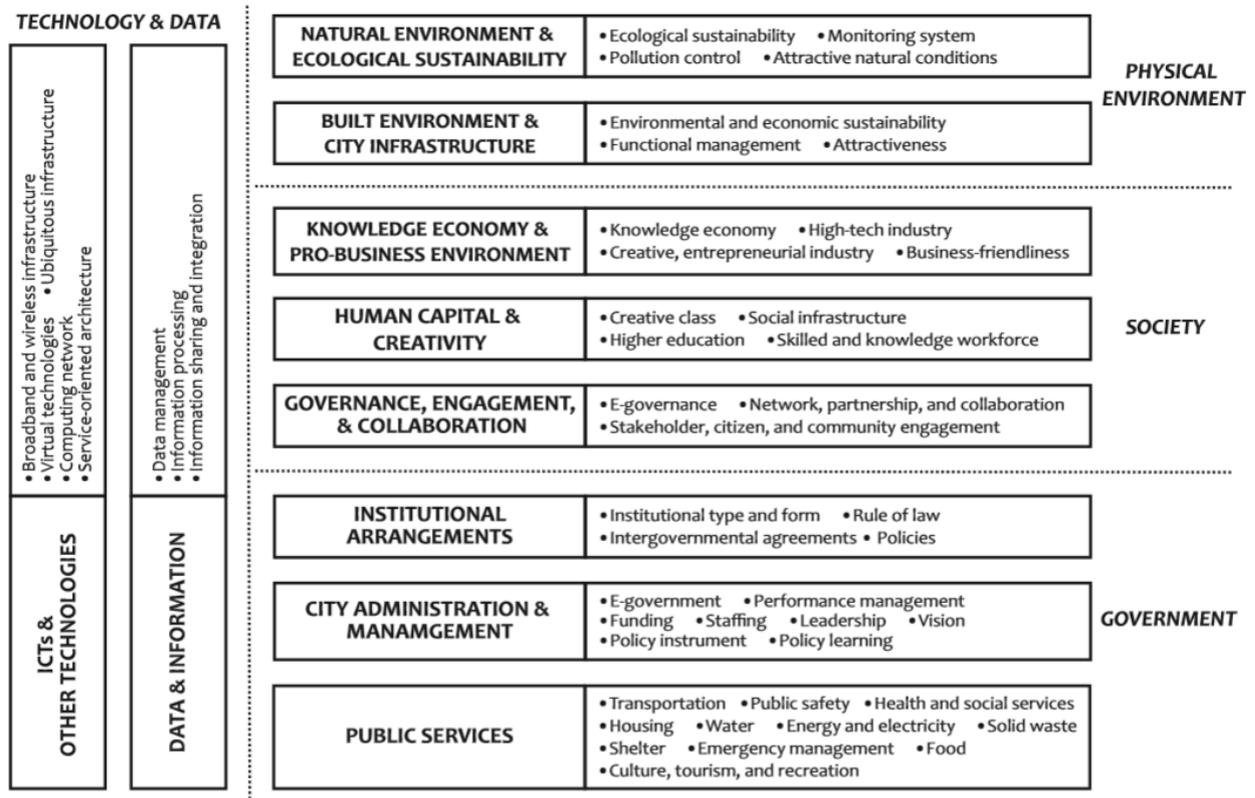
- i) Infrastructures, that is, those electronic devices and sensors that capture magnitudes of phenomena (beacons, light sensors, motion sensors, step counters, parking sensors, litter bins with weight sensors, etc.).
- ii) Data process. The world of *big data*, huge amounts of data produced by sensors and usually uploaded to servers or cloud services. It is needed to mention open data gateways as an example of good practices³.

³ <https://opendata-ajuntament.barcelona.cat/>

- iii) Management platforms. Software that provides analytics or dashboards⁴ which describe urban phenomena, prescribe possible solutions and, thanks to the use of machine learning and artificial intelligence, predict events.

Finally, Gil-Garcia [et al.] [6] proposes a scheme on the characteristics, components and elements to understand the *smart city model* that, from any perspective, turns out to be a complex system⁵.

Figure 1. Gil-Garcia [et al.]^[6] scheme of smart city components and elements



1.3 Is our city an *smart city*? Smart city assessment

El término Smart city es un continuo, es decir, no se trata de que una ciudad “*sea smart*” o “*no sea smart*”, sino que cada ciudad puede evaluar sus políticas y su gestión para continuar trabajando y lograr ser sostenible, dinámica económicamente, humana, inteligente, en definitiva, “vivable”. A tal efecto, existen algunas herramientas que evalúan el posicionamiento y los resultados de las decisiones *smart*.

The term *Smart city* is a continuum, that means, it is not about a city of "being smart" or "not being smart", but each city can assess its policies and its management to keep on working and achieving sustainability, economically growth and IT trained people. For this purpose, there are some tools that assess the positioning and results of *smart* decisions.

⁴ <https://www.ibm.com/us-en/marketplace/city-insights>

⁵ https://es.wikipedia.org/wiki/Sistema_complejo

In the aforementioned article by Gil-Garcia [et al.] [6], up to six assessment tools are identified with the smart city commitment. We will highlight, however, those of a more global scope, or those supported by academic, state or international agencies. All of them assess through indicators: innovation, economic productivity, energy efficiency, the impact of urban waste, connectivity, equality among citizens, quality of life of communities and even resilience in case of disasters.

These tools can be, on the one hand, **rankings**, that is, magnitudes based methodologically on the comparison between different cities. On the other hand, they can be **assessment frameworks**, that means, magnitudes based methodologically on the diachrony, that is, on the evolution over time.

Table 2
Assessment tools

Goal	Tool	Year	Source	Scope
Ranking	Smart Cities - European Medium-sized cities 3.0 ⁶	2014	TU Wien	Europe (population 100.000-500.000 inhabitants)
Ranking	Smart Cities – Larger European cities 4.0 ⁷	2015	TU Wien	Europe (population 300.000-1.000.000 inhabitants)
Ranking	Digital Cities Survey ⁸	2011	Center for Digital Government	United States
Assessment	Global City Indicators Facility. ISO/TC 268 ⁹	2008	International Organization for Standardization	Global
Assessment	UN-Habitat Agenda Urban Indicators (HUI) ¹⁰	2009	UN Habitat for a better urban future	Global

1.4 Critical approaches

Although the *smart city* development model has a growing support (globally, governmental, business and academic), there are also some criticisms. Here the are some of them:

- ✓ There is the paradox of the economic and environmental unsustainability of infrastructures and technological equipment. Investment costs often skyrocket and equipment is quickly get obsolete. And then? What's up with equipments and devices?
- ✓ It seems to be a neo-conservative economic development model that, focused on economic growth and the knowledge economy, ignores the inclusiveness of citizens who are "not productive" such as children, retired people or those who are not in the labor market.
- ✓ The misuse of citizen data by governments, and even, the transfer of these data to technology companies for private benefit.
- ✓ The lack of transparency in decision making. Decisions are technocratic or based on the conclusions of a thinking machine and not on models of citizen participation.

⁶ <http://www.smart-cities.eu/?cid=01&ver=3>

⁷ <http://www.smart-cities.eu/?cid=01&ver=4>

⁸ <https://www.govtech.com/dc/digital-cities/>

⁹ <https://www.iso.org/committee/656906.html>

¹⁰ <https://unhabitat.org/urban-indicators-guidelines-monitoring-the-habitat-agenda-and-the-millennium-development-goals/>

2. New library models: SMART LIBRARY

2.1 “Anchor” institutions

Gasco-Hernandez, M. [et al.] ^[3] defines libraries as "anchor" institutions of communities: organizations profoundly rooted in the territory because of their mission, their invested capital or their relationships with users, customers and purveyors. The concept includes libraries, schools, universities, museums, community health organizations as well as other non-profit institutions that serve their community. Their mere presence clearly contributes to the development and economic well-being of the community.

“Anchor” institutions have a crucial role in civic engagement because they reinforce the social bonds of the individuals, understand the needs of the collectives and weave complicities. In this sense, the discourse of Ray Oldenburg [15] about the third good spaces -that is, those social spaces that are not the first space (private sphere, home) or the second space (public sphere, work or school)- takes on an special meaning. The third good spaces of sociability are community keystones for development, lifelong learning, social inclusion, digital training and common identity.

2.2 Libraries development

The digital transformation has deeply modified the library business core (dematerialization of media and total accessibility of content) by shifting the focus from content to other assets such as users or spaces. Even so, the big problem in the background is the poor corporate projection of our mission. How do we tell society that we are strategic and fundamental pieces of its development?

Both professional literature and library institutions converge in some broad consensus when rethinking their services and their mission.

a. The GLOBAL LIBRARY¹¹

The mission of all kind of libraries has been transfigured due to the digital transformation of contents and services. Although there is strong rootedness in the knowledge ecosystem, libraries have a growing active role in the communities they serve. Libraries are aware that their action and their commitment to development must be projected corporately not only at a local level but also at national and international levels. It is about advocacy and strategy.

b. The value of the COMMON

The main foundation of any library is the value of the COMMON, that is, the value of shared information and resources by all members of its community for their own improvement. This construct has several approaches: access, rules of use, non-discrimination in terms of access, non-profit value, collective memory mechanisms, preservation and transmission to forthcoming generations. etc.

c. The essential role of BUILDINGS ^{12 13}

Library buildings are no longer mere containers of information, but must take over "THE COMMON" and ease the exchange of knowledge among the individuals of the community. Any library should be

¹¹ <https://www.ifla.org/files/assets/hq/topics/libraries-development/documents/access-and-opportunity-for-all-es.pdf>

¹² <https://2019.ifla.org/ifla-green-library-award-2019/>

¹³ <https://www.ifla.org/node/29023>

an amenity which occupies attractive buildings, useful, comfortable, flexible, accessible to their community and respectful with the environment.

d. The socialization of TECHNOLOGY

In addition to the digitalization of contents, libraries are points of socialization of technology since they have tools to access such content. Users become familiar with databases, read electronic books, are trained in the use of IT or are entertained by videogames. Libraries in many cases are technological agoras of the community.

e. Life long LEARNING

Education is the main mean of development and prosperity. Besides education system and formal education, libraries play an active role in promoting learning and training of diverse skills to face the multiple chapters of life. Overcoming the digital divide, getting updated in information and media literacy or economic literacy, and even, getting emotional support are the main assets in the programs of activities aiming at promotion of a living, useful and empathetic library.

2.3 SMART LIBRARY

2.3.1 Types of technology in libraries

As we mentioned in the previous chapter, media has been dematerialized and contents has been digitized. Libraries, in this hectic race to assume digital content and its access, invest huge amounts of money in the digital transformation of their activity, which has different specific goals:

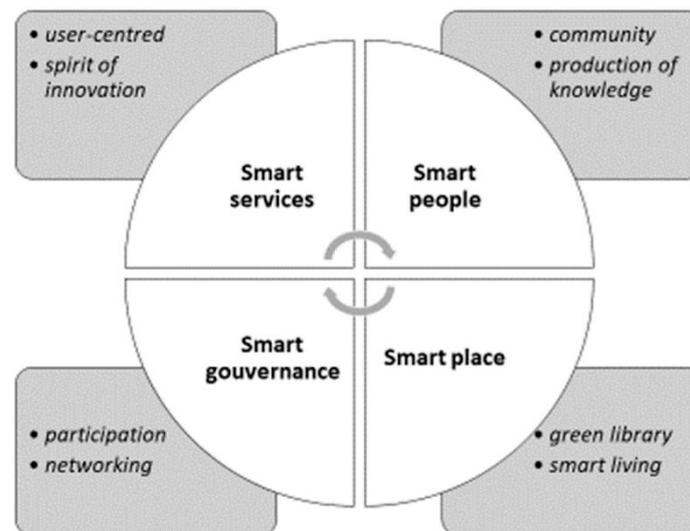
- To ease access and creation of information: databases, digitization equipment, digital libraries, and readers, personal computers, laptops, tablets, mobile phones, educational robotics equipment, 3D printers, etc.
- To manage buildings efficiently and sustainably manage buildings: BIM software (building information management), intelligent lighting systems, etc.
- To improve logistics and operations: RFID, step counters, robotics in the distribution of bibliographic materials, library software, etc.
- To get in contact with users: social media, automation of omnichannel marketing, experience evaluation screens.
- To offer UX that positions libraries as an attractive and innovative facility to their users: videogames, immersive technologies (VR or AR), etc.

In many cases costs are displaced, investments are not entirely profitable, technologies get obsolete or users do not change their consumption habits...nevertheless, we have a clear vision that we can not drop IT investments because we have to provide a good service to our patrons.

2.3.2 A multidimensional model

As noted by Leorke and Wyatt ^[12], these technological advances facilitate library processes, or, make libraries more alluring since we offer new experiences. Even though, it is plausible to assume that users continue to value the (third good) space of their community to which they can go for leisure, for exchange, for intellectual work or for introspection. Perhaps this situation leads us to the paradox of asking ourselves if the continuous investment in technology is worthwhile. Therefore, we need a strategic model that integrates technology, people and infrastructure to direct all our efforts. Schöpel, J. ^[17] presents four dimensions in this interesting *smart library*.

Figure 2. Schöpel's multidimensional model for the smart library



- i) **Smart services.** RFID, mobile and wireless access, semantic web, machine learning, IOT, natural language processing, AR or VR are emerging technologies in this model. Nonetheless, they are empty values if they neither assume interconnection nor user is in the center of activity.
- ii) **Smart users.** Users are placed in the center of service but not as if they were mere passive individuals but they play an active role by (co)producing knowledge as a community.
- iii) **Smart building** as an asset to link services-users-environment to improve the smartness of a city.
- iv) **Smart governance.** By means of management and networking, library should be appreciated by its community as a responsible institution which bases its decisions on participation and transparency.

3. Affinities between the development of libraries and the SMART CITY concept

The first affinity between the *smart city* and *libraries* is that they share the **focus on information for the development of their core activity**. While libraries are valid and recognized by the community as gateways to reliable, contrasted and plural information, the *smart city* prototype uses data generated in the city as raw material for decision-making.

Continuing with information management, **the same data architecture** can be used to manage urban space or to manage the library facilities. In fact, this is particularly relevant when library facilities are considered an open urban space due to its proximity with users¹⁴.

¹⁴ <http://www.ub.edu/blokdebid/es/content/el-diseno-del-espacio-de-la-biblioteca-publica-un-lugar-comun-de-aprendizaje-inspiracion>

Let's remember, then, how in section 1.2 we talked about:

- Infrastructure: devices and sensors that capture magnitudes of people, of movements, building performance, access to networks or wifi, etc.
- Data processing. Data captured by these sensors should be uploaded to servers or cloud. An interesting example of this would be uploading open data about libraries to platforms for urban management and operation¹⁵.
- Management platforms. Software that provides dashboards describing what happens in a library beyond the outdated indicators of loans or collection.

A third confluence field is **the multidimensional approach** to their business activity. Both in the smart city model and in libraries, the potential lies not in the mere application of technology but in what human capital can do with it. That's why strategic models are utterly needed to direct efforts and investments as well as to prevent anecdotal application of technology or displacing costs. A multidimensional approach that in libraries takes special relevance given its functions of access to information, cultural promotion, life-long learning, overcoming of the digital gap or fostering creativity and social cohesion.

Finally, the fourth aspect in common is evaluation and outcome measuring. Libraries constantly work with indicators to assess the provided service in order to justify their mission and investments received. Quite alike to urban managers in the smart city paradigm (see 1.3). (see 1.3).

For example, having Smart city index by Giffinger, R. ^[5], as framework, we see that libraries can add value (and indicators!) in the 6 areas and in 18 of the 33 categories that smart city is described:

- Smart economy* (competitiveness) → entrepreneurship, international embeddedness, ability to transform
- Smart environment* (natural resource) → sustainable resource management
- Smart people* (social and human capital) → level of qualification, affinity to life long learning, social and ethnic plurality, creativity, participation in public life
- Smart governance* (participation) → participation in decision-making, public services, transparent governance
- Smart living* (quality of life) → cultural facilities, education facilities, touristic attractiveness¹⁶ and social cohesion
- Smart mobility* (transport and ICT) → availability of ICT-infrastructure and local accessibility

¹⁵ <https://opendata-ajuntament.barcelona.cat/data/ca/dataset/dades-xarxa-biblioteques-catalunya>

¹⁶ https://viajes.nationalgeographic.com.es/lifestyle/bibliotecas-que-cambiaran-mundo_13995/4

Figure 3. Indicators for the smart city index building by Giffinger, R.[et al.]

<p>SMART ECONOMY (Competitiveness)</p> <ul style="list-style-type: none"> ▪ Innovative spirit ▪ Entrepreneurship ▪ Economic image & trademarks ▪ Productivity ▪ Flexibility of labour market ▪ International embeddedness ▪ <i>Ability to transform</i> 	<p>SMART ENVIRONMENT (Natural resources)</p> <ul style="list-style-type: none"> ▪ Attractivity of natural conditions ▪ Pollution ▪ Environmental protection ▪ Sustainable resource management 	<p>SMART PEOPLE (Social and Human Capital)</p> <ul style="list-style-type: none"> ▪ Level of qualification ▪ Affinity to life long learning ▪ Social and ethnic plurality ▪ Flexibility ▪ Creativity ▪ Cosmopolitanism/Open-mindedness ▪ Participation in public life
Indicator weight – last one : 17 %	Weight of each indicator: 25 %	Weight of each indicator: 14 %
<p>SMART GOVERNANCE (Participation)</p> <ul style="list-style-type: none"> ▪ Participation in decision-making ▪ Public and social services ▪ Transparent governance ▪ <i>Political strategies & perspectives</i> 	<p>SMART LIVING (Quality of life)</p> <ul style="list-style-type: none"> ▪ Cultural facilities ▪ Health conditions ▪ Individual safety ▪ Housing quality ▪ Education facilities ▪ Touristic attractivity ▪ Social cohesion 	<p>SMART MOBILITY (Transport and ICT)</p> <ul style="list-style-type: none"> ▪ Local accessibility ▪ (Inter-)national accessibility ▪ Availability of ICT-infrastructure ▪ Sustainable, innovative and safe transport systems
Indicator weight – last one : 33 %	Weight of each indicator: 14 %	Weight of each indicator: 25 %

4. Challenges to solve to integrate libraries in the smart city discussion

Once exposed the very first affinities between libraries and smart cities, we can get a coherent discourse of integration. Even so, it is a good exercise to think about fields of action to ease this process:

-How to calibrate what happens in the library? How to reflect its impact? Beyond the decreasing of loan index or visits, how can it be explained the impact of a library in a community? How to assess digital training or reading promotion programs in correlation with school success (or failure)? In short, how to measure the impact of inclusiveness?

These are essential issues that we urgently need to address in order to harmonize our data with the quantitative data required by the smart city concept.

-If investment is only concentrated in the smart libraries, those which attract all the media and political attention, the library systems (in their whole) could be poorer and poorer because of **uneven budget distribution**. By extension, if there is inequality between libraries, there users are endangered in not having same opportunities within the same territory.

-Historically, library institutions and librarians are aware of the sensitivity of their users' data and their information needs. Users confer the use of their data because there is a relationship of trust. However, this can be broken if library institutions **misuse data**, for example, if these are transferred to thirds or to those technological companies basing their business model on collecting data.

5. Conclusion

Integrate libraries in the discussion of the *smart city*¹⁷ is an economic and advocacy opportunity as it means being present in the local political agenda and thus:

- Receive specific funds¹⁸, specially, when a city is engaged with digital transformation and economic growth.
- Position libraries in the information ecosystem of the city and gives us the opportunity to collaborate with other technology partners.
- Become the main agents and ICT providers for minding the digital divide of population^[16].
- In short, begin to improve our corporate projection and mission in order to break stereotypes that weigh down our image.

Finally, and concluding this paper, governments, universities and technological agents are opening up strategic ways of development and research on the cities of the future, which should be not only sustainable and economically viable and but also happier^[13]. From urbanism, architecture, computer science, economics and social sciences are issuing reports and professional literature. Let us trust, then, that also from the librarianship and from our facilities we can contribute to this human dimension of technology and the city.

¹⁷ A good example shall be the library system of Singapore^[12] or Geelong (VI, Australia)

¹⁸ <https://eu-smartcities.eu/>

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