



**International Journal of Electronic Governance**

ISSN online: 1742-7517 - ISSN print: 1742-7509

<https://www.inderscience.com/ijeg>

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**DOI:** [10.1504/IJEG.2023.10050660](https://doi.org/10.1504/IJEG.2023.10050660)

**Article History:**

Received:	12 October 2021
Accepted:	13 July 2022
Published online:	05 April 2023

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## **Governance mechanisms in vulnerable communities using a technology platform: a study case in 13 de noviembre, Colombia**

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**Abstract:** In developing countries, the lack of means, infrastructure, and technologies have increased basic needs, reduced citizen participation, and delayed social, economic, and political transformation processes. This is especially noticeable in the governance limitations caused by the digital gap in the case examined here, i.e., the 13 de Noviembre neighbourhood in the 8th district in Medellín, Colombia. The objective of this study was to design and implement a technology platform that provided services through a web portal to this vulnerable population as a governance improvement strategy. A wireless network infrastructure in the ISM band was designed and implemented, and services were enabled through a captive portal with authentication. The appropriation of ICTs enables the implementation of strategies to improve

governance because citizens can conduct multiple activities online: access services and procedures, participate in e-government, take informal education courses, generate citizen participation mechanisms, boost new ventures, and promote local businesses.

**Keywords:** governance; technology platform; captive portal; wireless network; ICT.

**Reference** to this paper should be made as follows: Zuluaga, S.M.Y., Lozano, J.M., Álvarez, F.L.S., Sánchez, J.A.B. and Corrales, M.M. (2023) 'Governance mechanisms in vulnerable communities using a technology platform: a study case in 13 de noviembre, Colombia', *Int. J. Electronic Governance*, Vol. 15, No. 1, pp.87–104.

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## 1 Introduction

In recent decades, governance has become a global concept and drawn the interest of disciplines such as political science, sociology, economics, and geography. It has also been applied in different fields on a local, national, and international scale (Glückler et al., 2019). The concept of governance refers to multiple ways, mechanisms, and processes by which individuals, companies, organisations, societies, and governments interact, coordinate, and make decisions. In addition, governance in this usage describes patterns of rules and mechanisms of social coordination and decision making in which a group of actors regulates collective issues and interests (Hollstein et al., 2017). Therefore, the meaning of this term varies according to the abstraction level and the context where it is used. Currently, this concept has acquired other meanings such as urban governance or

digital government because of the relevance of information and communication technologies (ICTs).

E-governance aims to address citizen needs in a centralised collaboration and participation environment by using adequate innovation tools that are consistent with the objectives in the strategic plans that communities prioritise (Vaidya, 2020). Information exchange platforms with key characteristics such as modularity, compatibility, and standardisation (Tiwana et al., 2010) have become innovative ways of social governance. They resolve common and collaboration needs of stakeholders and promote interaction and coordination mechanisms to empower governments and citizens in decision making, state control, and citizen participation.

As the world becomes increasingly interconnected, vulnerable communities demand more transparency – by means of strategies and tools based on emerging technologies – to counter discrimination, inequality and marginality. These problems have been accentuated/increased during the COVID-19 pandemic in low-income Latin American populations (Ortega and Béhague, 2022), where it has hit particularly hard in terms of infections and deaths, as well as economic impact (Blofield, 2021). ICTs are considered tools with great potential and social impact on communities, allowing them to access multiple digital resources in order to have a say in decisions related to smart city planning (Hernández-Moreno, 2020). Therefore, some local initiatives have been recently created, such as those reflected in the functions of the Secretaría de Innovación Digital in Medellín, Colombia, i.e., defining a master plan of smart city and the management of processes, administrative procedures, requests, complaints, claims, and suggestions at the service of citizens (Alcaldía de medellín, 2021). These initiatives are also aligned with the regional agenda of innovation and territories regarding organisations and competitive territories (G8 Universidades, 2021).

### *1.1 Research problem*

One of the realities of vulnerable communities is their little participation in the design and implementation of actions that facilitate decision making and state control in a timely manner using ICT-based strategies. As a result, they exhibit limited access to and appropriation of ICTs for electronic payments, online processes and services, e-commerce, online courses and training, and entrepreneurial initiatives that help to improve citizens' quality of life. This problem has been investigated in other studies. According to Jain (2020), people who live in developing countries are not aware of the benefits of activities associated with e-governance, which require access to and use of ICTs, due to their condition of vulnerability (low literacy levels and poverty threshold).

Therefore, this study aims to answer the following question: What is the influence, on vulnerable communities, of the access to and appropriation of ICTs through a platform of collaborative web services that helps to improve governance processes?

Compared with the available literature, this study makes two contributions: First, it evaluates the level of user satisfaction with a technology platform and the improvement of services provided to a community. These elements had not been considered in other studies in the literature. Second, it applies a replicable methodology that is different from others proposed in the literature.

## 2 Literature review

A review of the literature about this topic can offer clear definitions of the concepts of *governance*, *digital cities*, *urban* and *smart governance*, *digital governance*, and *citizen participation*, thus avoiding ambiguity. In order to construct the theoretical framework of this study, a literature review was carried out using different sources, as shown in Table 1, including reports, papers, and books that address aspects such as governance, ICTs as generators of governance, and the centralisation of city services.

**Table 1** Literature review

<i>Document title</i>	<i>Authors</i>	<i>Scope</i>	<i>Method</i>	<i>Result</i>
Barriers to the Development of Smart Cities in Indian Context	Rana et al. (2019)	To identify the key barriers of smart cities from a review of existing literature and views of experts in this area	To identify the key barriers of smart cities from a review of existing literature and views of experts in this area	“Governance” is documented as the most significant category of barriers for smart city development followed by “Economic”; “Technology”; “Social”; “Environmental” and “Legal and Ethical”
Smart destinations and the evolution of ICTs: a new scenario for destination management?	Ivars-Baidal et al. (2019)	To propose a systemic model for the emerging smart tourism destination (STD) management	Application of the Delphi technique to determine the impact of ICTs on the management and marketing of tourism	The efficiency of the STD will not depend exclusively on technology but also on an appropriate governance of the destination that incorporates strategic–relational, instrumental and applied levels
Platforms and infrastructures in the digital age	Constantinides et al. (2018)	To bring forward leading-edge research from the information systems, platforms, infrastructure, and economics literatures in the digital age	Research on platforms and infrastructures based on multiple disciplines	Themes emerging from the architecture and governance of infrastructures and platforms are presented, and then opportunities for further research are discussed

**Table 1** Literature review (continued)

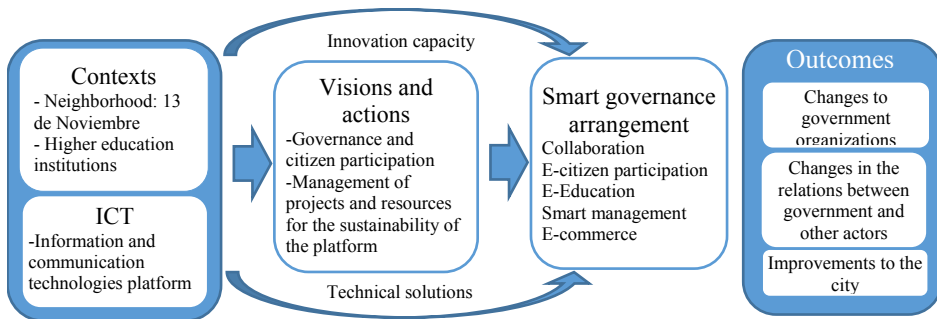
Document title	Authors	Scope	Method	Result
Understanding ‘smart cities’: Intertwining development drivers with desired outcomes in a multidimension a framework	Yigitcanlar et al. (2018)	To develop a clearer understanding on the new city model by identifying and linking the key drivers to desired outcomes, and then intertwining them in a multidimensional framework	A systematic review of the literature on smart cities, focusing on those aimed at conceptual development and provide empirical evidence base	This paper helps in expanding the understanding beyond a monocentric technology focus of the current common smart city practice

Source: Created by the authors

### 2.1 Governance

The term *governance* is essential to understand the concept of digital governance. Governance is the process of interaction and decision-making between the actors involved in a collective matter (Hufty, 2011). This process can take place on a local or international level and affect different political fields and multiple time scales (Lange et al., 2013). In governance, the government is an enabler that provides legal and regulatory frameworks and the political order under which the market and civil society can plan and act. Yanliu (2018) presents a framework of governance in different contexts with four main building blocks: contexts and ICT; visions and actions; smart governance arrangement; and outcomes. Figure 1 presents an adaptation of that framework to this study. The context analysed here is a neighbourhood in Medellín, Colombia (i.e., 13 de Noviembre) and two Higher Education Institutions. The aim of this study is to make improvements and necessary changes for a better citizen governance through a technology platform that offers tools and services such as social networks, chat, VoIP, and instant messaging.

**Figure 1** A framework for understanding smart governance in different contexts (see online version for colours)



Source: Created by the authors

## 2.2 Digital cities

Currently, cities must take measures to satisfy the needs of their citizens and improve the quality of the services they provide. ICTs can serve as catalysts of change by promoting the automation of multiple processes in the city and digitising them, thus turning cities into *digital cities*. Social initiatives based on ICTs are designed and implemented in these cities to inspire radical changes in their dynamics of operation. This helps cities to improve the quality of life of their citizens, the efficiency of operation of urban services, and competitiveness (Raj and Raman, 2015).

## 2.3 Urban and smart governance

Urban governance is mainly concerned with the processes whereby government is organised and run in towns and cities and the relationships between state agencies and *civil society*, a term that includes citizens, communities, private actors, and volunteer organisations (Raco, 2020).

Based on the concept of urban governance, communities in their territories started to use these technologies, and the stakeholders initiated deliberate collaboration. Therefore, mechanisms and services based on available information systems have been generated to empower communities. This has resulted in *smart governance*, which aims not only to adopt technologies but also have effective governance processes that produce innovative impacts on communities (Jiang, 2021).

Citizen participation mechanisms and smart governance gave birth to the concept of *smart cities*, which are urban innovation ecosystems where knowledge flows easily thanks to the deliberate interaction and collaboration of different stakeholders. Thus, wealth is created by means of a flexible and integrated institutional structure supported by an infrastructure of networks and services to serve communities (Camboim et al., 2019).

After the lockdowns in different cities caused by the COVID-19 pandemic, communities started to appropriate more strongly the concept of smart city, which involves five key dimensions (Bosh et al., 2017): people, planet, prosperity, governance, and propagation. This appropriation helped to improve prevention mechanisms in public health management.

## 2.4 The role of ICTs as governance mechanisms

ICTs have become facilitators of change, efficiency, and organisational effectiveness in all types of communities, as well as public, private, and non-profit organisations for three reasons (Suleiman et al., 2017). First, storing and monitoring data can be used to produce big citizen-centred databases, which support the decision-making process of urban governance (Ju et al., 2018). Second, ICTs allow cities to empower and educate their citizens so that they can become members of society capable or engaging in a debate about their own environment (Allwinkle and Cruickshank, 2011). This is because social networks, the internet, and open data are broadly used for citizen participation in urban governance, but they should be based on values and are data-intensive (Lee et al., 2013). Third, as pointed out by Batty et al. (2012), new technologies provide new ways for citizens, governments, companies, and multiple agencies to interact and collaborate in order to increase their understanding of the city.

Therefore, ICTs as governance mechanisms have promoted e-administration, smart government, and smart services that help to establish a balanced relationship between the government, the market, and civil society based on equity, principles, and values.

## 2.5 *Digital governance and citizen participation*

Digital governance, sometimes referred to as e-governance or online government, can be defined as the public sector's use of ICTs (e.g., internet, mobile devices, and digital content) to improve the efficiency and effectiveness of the way knowledge and services are provided to citizens, companies, and organisations. E-government is, in essence, a useful tool for the government and communities to reduce costs, increase profits, and improve the provision of public services and citizen participation (Saeed, 2012). This leads to good governance, which is considered a new type of approach to the provision of high-quality services to citizens. Promoted by the use of the internet and wireless technologies, digital governance adapted to current conditions and contexts helps to mitigate social gaps and increase the level of commitment between citizens and governments (Vij and Gil-Garcia, 2017).

One way to promote citizen participation is by means of social capital, defined by (Putnam, 1996) as features of social life – networks, norms, and trust – that enable participants to act together more effectively to pursue shared objectives.

## 3 **Objectives of the study**

The main objective of this study is to construct mechanisms of social governance and citizen participation based on the implementation of a technology platform that facilitates and provides access to information and services to vulnerable populations.

## 4 **Research methodology**

The methodology adopted in this study is an adapted version of the Software/System Development Life Cycle (SDLC), which is shown in Figure 2. The SDLC methodology was used to facilitate the design and implementation of this technological tool for a low cost in the shortest possible time. This methodology includes well-structured stages to quickly produce high-quality, well-tested systems that communities can use easily. The following is a description of its five stages.

### 4.1 *Stage 1: analysis of the population's requirements*

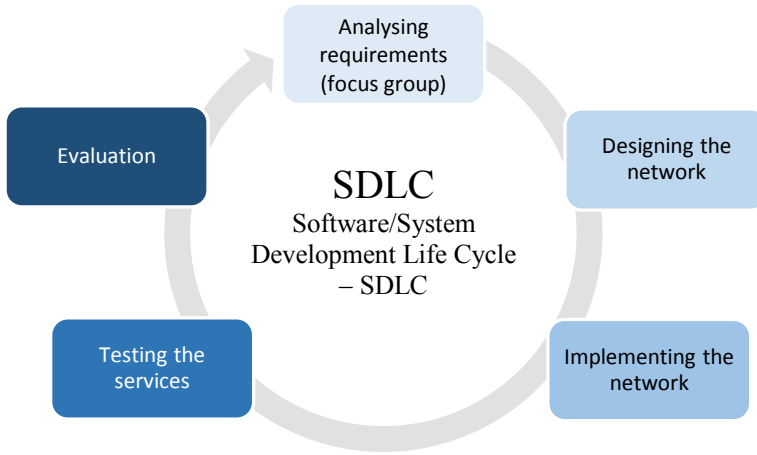
To analyse the population's requirements, the following stages were implemented:

#### 4.1.1 *Sample selection*

This study was conducted with a group of 40 families who live in the 13 de Noviembre neighbourhood (La primavera sector), 8th district in Medellín, Colombia. They were characterised using information from the latest census (in 2015), considering the following aspects: gender, occupation, and educational attainment (shown in Figure 3).

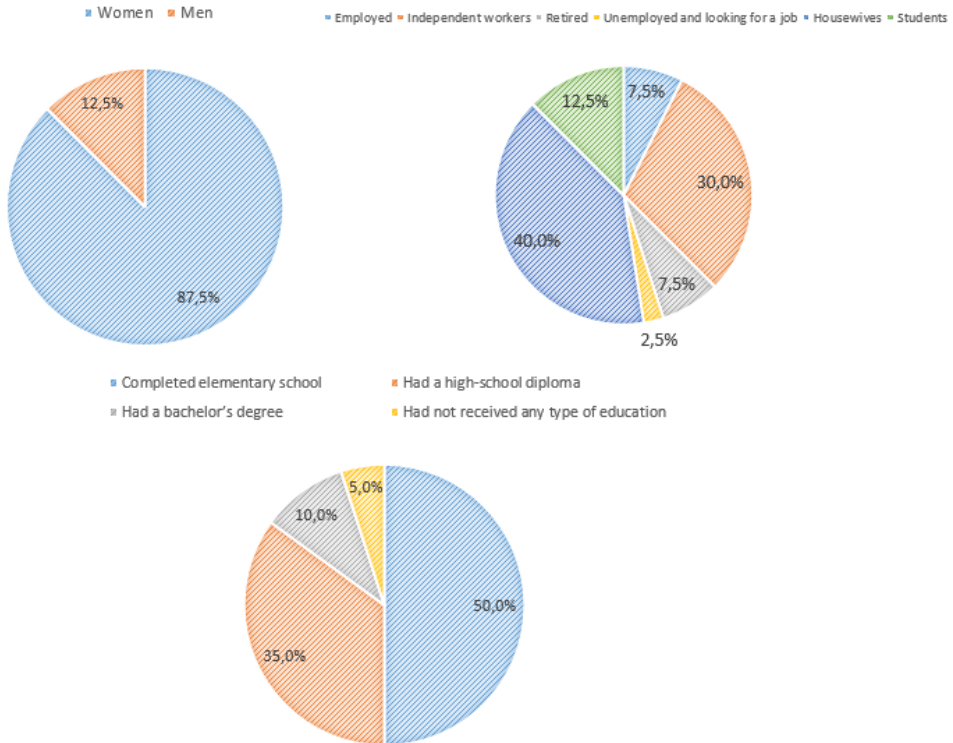


**Figure 2** Life cycle of the software model (see online version for colours)



Source: Created by the authors

**Figure 3** Population characteristics (see online version for colours)



Source: Created by the authors

#### *4.1.2 Data collection instrument*

Focus groups were conducted to collect information about this populational sample. They were run with 40 participants at the building of the community action council. Participants were asked a series of open-ended questions about their priorities in terms of content and access to the information that should be included in a technology platform at the service of the community in order to promote their appropriation of governance, citizen participation, online processes, electronic services, and entrepreneurship. In addition, a survey was administered to small business owners in the community to establish their priorities regarding the information the technology platform should have in order to boost their businesses and ventures.

#### *4.1.3 Data analysis*

To analyse the collected data, the triangulation method was implemented with the responses of participants in the group interviews, those of small business owners in the area of interest, and the information found in different studies about governance mechanisms using ICTs. The data were entered into an Excel spreadsheet to classify the ideas expressed by each participant (recording their occupation) into subcategories. A total of 28 subcategories were created based on similarities in the answers. From this group, 20 subcategories obtained most answers. They were grouped into five categories based on their similarity. Finally, after the categories and subcategories were defined, the authors were asked about possible services that could be offered to benefit the population studied here.

### *4.2 Stages 2 and 3: Designing and implementing the network infrastructure and the technology service platform*

To complete the life cycle of the technology platform, the following design and implementation stages were carried out:

#### *4.2.1 Communication network infrastructure*

The design and implementation of the communication network infrastructure in this study was divided into two stages. In the first stage, a point-to-point radio link with a WiFi-WLAN network topology was designed and implemented to share the internet connection from the main backbone, located in the Fraternidad Campus of the Instituto Tecnológico Metropolitano (ITM), with the signal reception points, located in the 13 de Noviembre neighbourhood (La primavera sector), as shown in Figure 4. This design included network nodes, which were located in three areas of the neighbourhood: the community action council (CAC), an evangelical church, and the Solidaridad por Colombia foundation. Each node was linked to the ITM's data centre in the Fraternidad Campus, which provided internet access and had virtual servers to support the services offered to the community, e.g., captive portal, FTP, VoIP, Web, WordPress, cloud services, DHCP, database, and MediaWiki.

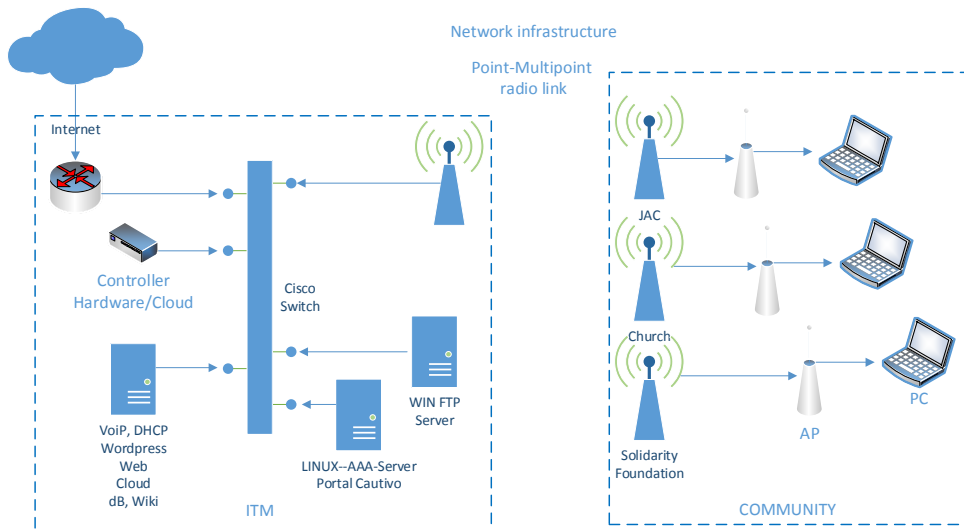
**Figure 4** Point-to-point link from the ITM to la primavera sector (see online version for colours)



Source: Created by the authors

In the second stage, a Wi-Fi network was designed and implemented in the Fraternidad Campus of the ITM, where the backbone of the project was located. Said network enabled a WLAN connection between the application server and the internet access link. The topology proposed by CISCO (2014) was used as a framework for this purpose, as seen in Figure 5.

**Figure 5** Network topology used in this study (see online version for colours)



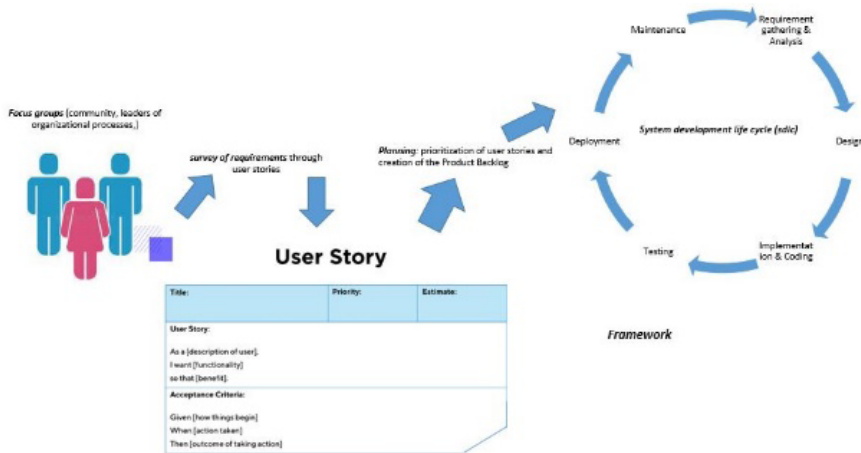
Source: Created by the authors

#### 4.2.2 Services and applications in the technology platform

The services and applications in this technology platform were defined based on the Scrum method (Figure 6) because it is a reference point in the agile culture that aims to have small work teams produce results in short times (Schwaber and Sutherland, 2020).

As per the Scrum process, user stories based on the requirements of the participants were documented to conduct this study. Afterward, a Product Backlog was created based on a prioritisation of participants' interests. Sprints were also created for each prioritised requirement; each of them was completed in one week. Regarding the ceremonies in this project, a daily Scrum was implemented to plan and develop each Sprint using JIRA Software, and 15-minute sprint retrospectives were conducted immediately after the end of each sprint. These retrospectives were carried out with a group of users according to their role in the use and management of the platform, correcting mistakes and making improvements in real time.

**Figure 6** Scrum framework used here to design the web portal (see online version for colours)



Source: Created by the authors

Approximately 12 stories were created in work sessions with the stakeholders. Six of those user stories were prioritised in the backlog:

- 1 multi-user capability
- 2 designing content management systems (CMS)
- 3 integrating social networks and multimedia contents
- 4 open-source software orientation
- 5 easy administration and service security
- 6 integrating external websites related to government, educational, entrepreneurship, social, and cultural processes and services with information that promotes the development of digital skills to safely face the risks associated with the use of the internet and ICTs.

#### 4.3 Stage 4: testing, optimising, and documenting the network design

After the network was implemented, several activities were carried out: a network prototype was built, and the network design was tested; tests of VoIP transmission over

the infrastructure were carried out; the network’s design was optimised; and the design process was documented.

#### 4.4 Stage 5: evaluation

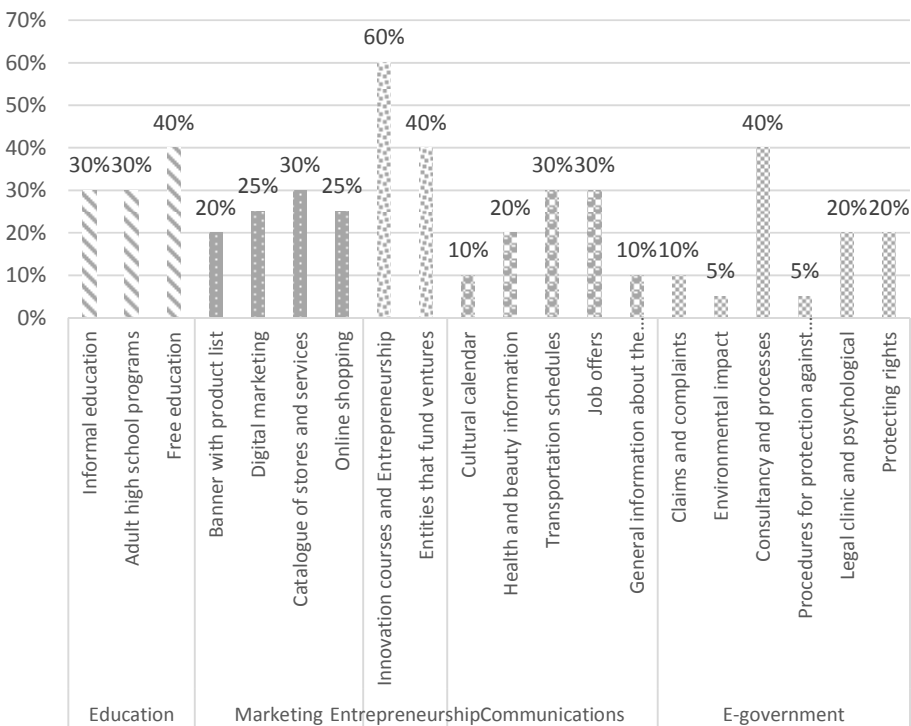
Based on the test results, the network design was optimised, and the process was finally documented. Smooth data transmission between the ITM and the community node was achieved.

### 5 Results

#### 5.1 Information and contents required for the technology platform

The results of the first stage are the services and information that the community wanted to find in the web portal. Table 2 shows the five categories (Education, Marketing, Entrepreneurship, Communications, and E-government) and subcategories that encompass all the ideas expressed by the participants, as well as the percentage of occurrence of each idea.

**Table 2** Requirements for the platform



Source: Created by the authors

The first category refers to this population’s need for informal education; in order to fulfil it, the proposed platform offers short, free, easy-to-access courses. The *Marketing* section

features advertisement strategies implemented by businesspeople in the community who wish to promote their products using digital banners, product catalogues, and online stores. Under *Entrepreneurship*, the platform offers sort courses on innovation and entrepreneurship. It also contains information about entities that fund ventures, so that many women who are household heads can start their venues from home and thus earn additional income. *Communications* is aimed at strengthening the existing relationship between inhabitants of the community. A *Cultural calendar* was designed to post activities organised by the community, such as bazaars and parties where homemade products are sold. In addition, the portal includes health and beauty information, transportation schedules, job offers and general information about the schools in the neighbourhood. Under *E-government*, users have access to consultancy and processes, procedures for protection against mistreatment and abuse, legal clinic, psychological services, and rights protection because this population is vulnerable to violence and mistreatment. This is complemented with a form to submit claims and complaints.

Regarding governance and citizen participation processes, 80% of the participants consider that the project and resources to facilitate the sustainability of the platform. They also think that the mayor's and governor's offices could contribute to the implementation of the project. Additionally, according to 20% of the participants, a monthly fee should be charged to beneficiary families. Participants also identified, in their neighbourhood, a non-profit civic, community-based organisation in the solidarity economy, with legal status and its own assets, composed of residents in the area, who combine their efforts and resources to promote a comprehensive development of the community. In addition, five private foundations in the area contribute to the work of the national government thanks to the intervention of all the actors involved to solve social problems with programs that facilitate better life opportunities.

## 5.2 Design and implementation of the infrastructure and service platform

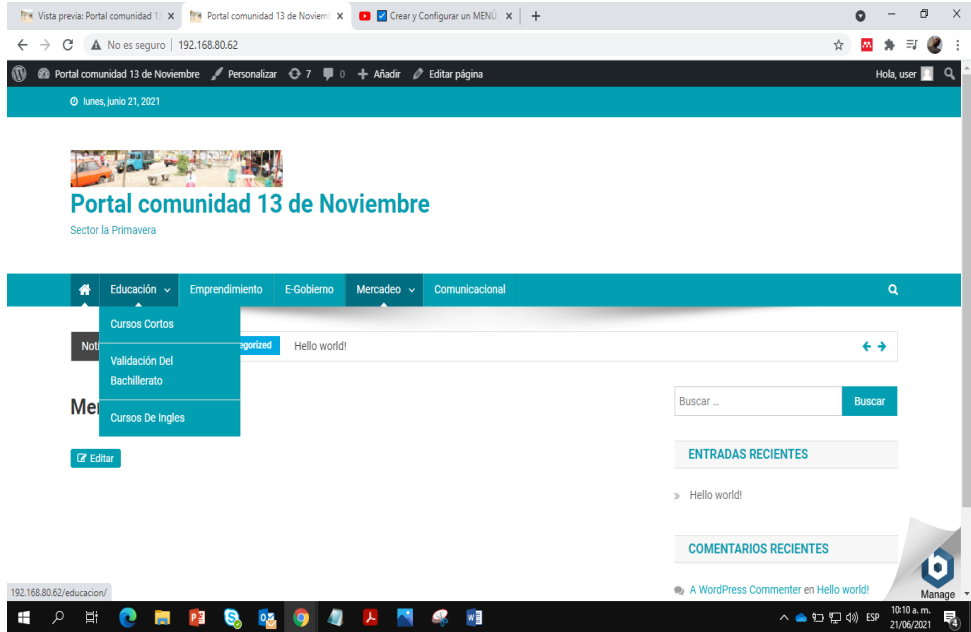
As a result of the implementation of the network infrastructure described in this paper, three free 16-Mbps broadband internet access points were provided to 40 families in the 13 de Noviembre neighbourhood (La primavera sector). Thanks to this, the community had access to the web portal with the contents and services that they had requested. The three access points were connected to the internet through a VPN that was responsible for guaranteeing the security and access to the services.

In the design and implementation of the web portal, the Scrum framework facilitated collaborative working, the retrospective to make changes in a timely manner, and flexibility throughout the implementation cycle of every sprint. In addition, user stories were prioritised based on client expectations, concrete results, and desired times, as shown in Figure 7.

This paper aimed to answer the following research question: What is the influence, on vulnerable communities, of the access and appropriation of ICTs through a platform of collaborative web services that helps to improve governance processes? The results show that such access and appropriation improved the efficiency and times of common processes and services available to citizens (e.g., paying bills and taxes, refilling transportation cards, and checking criminal records) because the information was centralised in the web portal so people would not need to go to offices or booths. The platform also facilitated decision-making to solve conflicts and problems that occur in the 13 de Noviembre neighbourhood (La primavera sector) because there was better

interaction with judicial control organisations by means of completely anonymous channels to report and inquire about crimes such as robbery, sexual abuse, mistreatment, and workplace harassment. Regarding informal education, innovative experiences were created through online courses in which people could learn about different topics in accordance with the labour needs of the community. Finally, the communication channels between different actors present in the community were improved thanks to the use and appropriation of the tools and services available in the platform, such as social networks, chat, VoIP, and instant messaging.

**Figure 7** Design of the web portal (see online version for colours)



*Source:* Created by the authors

## 6 Conclusions and discussion

This study contributes to the body of empirical research about the mechanisms of appropriation of governance based on the use of ICTs. It established a framework to understand urban and smart governance, the role of ICTs as a governance mechanism, and digital governance and citizen participation. It showed that the concept of governance, from the perspective of ICTs, varies depending on the interests of each discipline, government, and the local, national, or international level. For instance, according to Rahman (2010), governance is a new model where the value of community empowerment is not only due to having access to, and utilisation of, information, rather it is directly and indirectly related with ICT. In turn, according to Lin (2018), governance, from an ICT approach, is a participatory and collaborative response of different stakeholders (governments, research institutions, companies, and citizens), supported by the internet and social networks, that aims to solve different social, economic, and

environmental problems and address challenges related to sustainability, social inclusion, and economic transformation.

In the local context, governments encourage citizen collaboration and participation through ICTs in order to solve problems and improve the quality of life in vulnerable communities. However, these programs are not continued over time due to a lack of leadership, governability, community empowerment, and completion of strategic plans for the following government.

This study evidenced a change and a new way of thinking in a collaborative, participatory manner supported by public policy, smart economy (competitiveness), smart governance (citizen participation), smart people (social and human capital), smart environment (natural resources), smart life (quality of life), and smart mobility (transportation and ICTs). This had a positive impact and generated the appropriation of the technological tools by the population who benefited from them. Eighty percent of the participants were satisfied with the proposed platform.

### *6.1 Limitations*

All the information and content requirements for the technology platform were defined by focus group meetings with a sample of just 40 families, which is not highly representative considering the number of inhabitants and stakeholders in the neighbourhood. Additionally, the internet access provided by the ITM was very limited because there was only one connection point for the entire community. The number of devices (computers, tablets, smartphones, and laptops) in the community was not enough to meet the demand of the users. Likewise, the lockdowns due to the COVID-19 pandemic delayed the delivery times of the execution, operation, expansion, and maintenance of the point-to-point communication network infrastructure between the nodes in the Fraternidad Campus of the ITM and the access points located in the building of the community action council. Finally, as this was a pilot study, the literature did not offer relevant information reported by other authors to enrich the discussion on governance based on ICT platforms in the context of appropriation in vulnerable communities in urban territories.

### *6.2 Future research directions*

Considering the limitations of this study, three future research directions can be proposed:

- 1 analysing and applying other frameworks different from Scrum to design and implement a collaborative web platform
- 2 expanding the coverage of the network infrastructure and community services in order to also analyse their impact and governance from the perspective of ICT appropriation in vulnerable urban communities
- 3 conducting a qualitative study adopting a phenomenological approach that includes all the methodological stages to compare the results obtained in this study.



## Acknowledgements

We would like to thank the Instituto Tecnológico Metropolitano (ITM) and the Corporación Universitaria Minuto de Dios (UNIMINUTO) for funding the project entitled *Plataforma tecnológica para una red comunitaria como instrumento de construcción de gobernanza social*, which is registered at ITM's Office of Research under code PE19203.

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