Architecture of a digital economy policy: A tool to achieve efficiency in the development of the local economy

C E Sanjuán¹, M Cárdenas García¹ and J de J Cañizares Arévalo¹
¹ Grupo de investigación ROTA, Universidad Francisco de Paula Santander, Ocaña, Colombia

E-mail: cesanjuan@ufpso.edu.co, mcardenasg@ufpso.edu.co

Abstract. This paper describes the different guidelines and actions undertaken in the Institutional Development Plan of the Universidad Francisco de Paula Santander in the period 2011-2019 to design the road map that allows the implementation of a digital economy policy that strengthens the economic and social development of the region of Norte de Santander (Colombia). This process includes the connection of the university to a national project with an impact on the region, as well as the formulation of academic-administrative strategies that are expressed through lines of action and institutional purposes that guide the road map of the digital economy.

1. Introduction
It is completely doubtless the importance of the knowledge generation and its applicability to the economic and social environment in the regions, so the Universidad Francisco de Paula Santander as a higher education institution committed to developing the department of Norte de Santander, which is actively involved in the generation and transformation of knowledge for the construction of new economic scenarios, particularly the Information Technologies sector which present a significant growth in recent years as it is evidenced by the figures presented by global and national organizations such as the Economic Commission for Latin America and the Caribbean (ECLAC) [1], Organization for Economic Cooperation and Development (OECD) [2] and the Communications Regulation Commission (CRC) [3], as well as by studies and theories developed by authors like Tapscott, Drucker, Carley, among others, about the importance of knowledge production in the development of the digital economy.

2. Data description
The term Digital Economy has been used for several years. Professor Don Tapscott [4] in his book The Digital Economy: Promise and Peril in the Age of Networked Intelligence, noted how in the new economy would be more important intellectual production "knowledge" than physical force in generating value, thus referring to a paradigm shift through the term. Tapscott presented eleven features in the digital economy and three components for innovation (economy, organization and technology).

On the other hand, Peter Drucker [5] stated the following situation: "If it exists or not a new economy and what it could become into, it is something that we won’t get to know until a couple of years. But what is already certain is that this economy and the society to which it belongs will be organized according to management, since the key resource of this economy will be in fact, and it
already is - knowledge. It can be said that knowledge has become a key economic resource, replacing traditional labor, land and capital of economists”. Taking into account the authors Tapscott and Drucker, it is evident to note that one of the main key elements of the Digital Economy is knowledge.

Now, how do you define the Digital Economy? According to Tapscott [6] this is defined as: "a new socio-political and economic system characterized by an intelligent space consisting of information, tool access, information processing and communications capabilities”.

Moreover, Rob Kling and Roberta Lamb in IT and Organizational Change in Digital Economies: A Socio-Technical Approach, defines it this way: "the digital economy focuses on goods or services whose development, production, sale, or provision is critically dependent upon digital technologies" [7].

OCDE defines the Digital Economy as the result of a transformation process triggered by the Information and Communications Technologies (ICT). Its revolution has cheapened, boosted and widely standardized technologies, improving in that way business processes and driving innovation in all sectors of the economy [2].

The authors Del Aguila, Padilla, Serarols and Veciana have defined that four subsectors can be identified in the Digital Economy: Digital goods and services; Mixed digital goods and services; Production of ICT-intensive goods and services: Market research, computer-assisted design and production of tangible goods with controls based on ICT. The ICT industry that supports the above three segments [6].

In the document entitled Digital Economy for structural change and equality issued by ECLAC [1] and the European Union, it is mentioned that the digital economy consists of three main components: Broadband infrastructure, ICT applications Industry, and end users. However, taking into account the aforementioned components and being accurate in that broadband is the foundation and first component of the digital economy, which according to other authors, can be framed in the fourth subsector (ICT industry) of the digital economy defined by Del Águila et al, it should be noted that the second component (ICT applications industry) is essential for generating services and applications for different users (companies, government and individuals), that is in accordance with Tapscott's statement that takes knowledge as the first characteristic and driving force of the digital economy.

Raul Katz [8], in his work the digital ecosystem and economy in Latin America, highlights the importance of analyzing and understanding the digital ecosystem, both globally and regionally, to provide an empirical basis to help define public policies consistent with the objective of maximizing value creation in the region, contributing to the economic development.

Meanwhile in Colombia, the CRC issued the document Regulatory road map for the Digital Economy in Colombia [3] that, taking into account that ICT are transversal to the entire economy, five fundamental parts that interact in the Digital economy are identified:

- Users: The customer is at the center of the ecosystem as the main engine.
- Facilitators: communications, hardware and software companies, that provides abilities to the digital economy for its development, so they are an essential part of the value chain.
- Disruptors market: purely digital companies, which are at the forefront of innovation and development processes (Google, Amazon, Apple, Facebook).
- Traditional companies in the digital conversion process.
- Support areas: Nourish the digital economy through the provision of financial and human resources (Investors and financial market, labor market and academia), regulatory stability and promotion policies (government and regulators).

3. Methodology
After analyzing all the information obtained from the emergence of the term Digital Economy and its sub-components and key parts, it is suitable for the Universidad Francisco de Paula Santander to analyze and establish regulations and policies that are targeted to reinforce the economic and social development of the region through the Digital Economy, so that they can maximize the benefits obtained from the use of new technologies, integrating best practices within the institution, which
allow in turn to face the challenges and opportunities of the Digital Economy under the existing institutional framework in a time horizon of 5 years, tracing the route to the digital economy in the region.

4. Results

According to Cohen and Zysman DeLong [9] in his paper The Next Industrial Revolution, the strong advance of ICT has brought about profound economic, social and cultural changes in recent decades. These changes are reflected in the figures shown in studies by different organizations worldwide. The CAF Observatory of the Digital Ecosystem of Latin America and the Caribbean [10], based on figures from the International Telecommunication Union, Owloo, Euromonitor, ECLAC and UNCTAD, present the data on the evolution of connectivity, and home and production digitization. Below, Table 1 shows the information on the advances in connectivity and development of applications and services corresponding to the years 2004-2015 for Latin America and the OECD.

Table 1. Evolution of connectivity, home digitization and production: Penetration of technologies and services.

| Technology and services       | Latin America and the Caribbean | OECD\(^a\) |
|------------------------------|---------------------------------|-----------|
|                              | 2004 | 2015 | 2004 | 2015 |
| Connectivity                 |      |      |      |      |
| Computers (% homes)           | 15.63| 46.93| 57.87| 80.29|
| Smart phones\(^b\)            | 0.28 | 46.36| 2.40 | 67.15|
| Fixed broadband (% homes)     | 4.37 | 40.57| 27.51| 80.07|
| Mobile broadband\(^b\)        | 0.91 | 57.41| 17.13| 87.09|
| Internet\(^b\)                | 14.36| 54.42| 50.63| 77.22|
| Home digitization             |      |      |      |      |
| Social networks\(^b\)         | 0.00 | 47.77| 0.00 | 48.05|
| e-Commerce\(^c\)              | 0.57 | 2.66 | 1.55 | 6.86 |
| Electronic banking            | 9.36 | 10.88| 23.41| 95.51|
| Internet\(^d\)                | 64.57| 87.94| 71.88| 94.86|
| Digitization of manufacturing |      |      |      |      |
| Electronic banking\(^d\)      | 65.62| 77.18| 62.04| 77.34|
| Supply chain\(^d\)            | 30.82| 41.41| 21.13| 35.06|
| Digital channels\(^d\)        | 10.22| 16.39| 11.96| 17.90|

\(^a\) Average values from OECD including Chile and Mexico as member states.

\(^b\) Percentage of population.

\(^c\) Percentage of retail.

\(^d\) Percentage of establishments.

Katz R and Callorda F [11] in the document Business initiatives and public policies to accelerate the development of the Latin American digital ecosystem, present as a result that an increase of 10% in the digitization index generates an increase of 0.75% in GDP per capita for a sample of 150 countries, and 2.42% in the GDP of countries that belong to the OECD. Thus, in the CAF Observatory of the digital ecosystem, it is concluded as the coefficients indicate, the increasing digitization reflects on a scale a return to where the impact on economic growth accelerates the growth of the digital ecosystem. In the same report, digital ecosystem is defined as "New socio-economic and industrial context resulting from the massive adoption of digital information and communication technologies". The report of the CAF observatory places Colombia in the group of countries with the "Advanced" feature, ranking third in the development of the digital ecosystem and being on par with countries that have joined forces regarding the positioning of the digital economy, such as Trinidad and Tobago, Puerto Rico, Chile, Costa Rica, Brazil, Uruguay and Argentina. Colombia ranks in third place after Puerto Rico in the development rate of the Digital Ecosystem in 2015; this position is the result of the efforts of the national government made with the implementation of policies, plans and widespread-growth strategies of new technologies such as Vive Digital Plan 2010 - 2018, which led to the creation of the Colombian Vice Ministry of Digital Economy in 2017.
However, it should be noted that the Observatory of the Digital Ecosystem, in the SWOT analysis (Strengths, Weaknesses, Opportunities and Threats), considers the following as threats for the country in the digital transformation:

- Colombia needs to increase its production capacity of digital industries, since its levels do not currently show a trend towards international competitiveness.
- The country needs to strive in order to universally integrate the formation of IT abilities in the educational system opposed to isolated and low-demanding programs [10].

The Universidad Francisco de Paula Santander sees the need to generate actions aimed at the construction and development of a policy of Digital Economy, which allows the study, analysis and incorporation of innovative disciplines in new digital models, which have evolved and established with great prospects for present and future, for the preparation of professionals today and tomorrow in digital strategies. Aware of the importance for economic and social development of the region, the University has been one of the institutions that have joined the task of contributing to the digital transformation of the country from its zone of influence by joining different strategies, programs and projects which from the national level have been executed by the University, generating a huge impact in the ICT areas within the region.

- Ocaña Digital, ILO Convention No.000, 217 (ICT Ministry - UFPSO) worth COP $2.090 million, Impacting: 1 municipality, 20 educational institutions, connectivity, Wi-Fi, Interactive Centers, Training and content generation.
- Norte de Santander Vive Digital, Convention No. 762 (Ministries of TIC and Interior - UFPSO), with a value of COP $4.721.059.480, impacting: 5 municipalities (Ocaña, Abrego, La Playa, Hacari, Cucuta), 80 Educational institutions, connectivity, Wi-Fi, content generation (OVA - web Applications).
- Norte de Santander Vive Digital - Phase 2, Convention No. 0491 (Ministries of TIC and Interior - UFPSO), with a value of COP $5.973 million, impacting 7 municipalities (Los Patíos, Villa del Rosario, Pamplona, Chinacota, Zulia, Tibu, Cucuta), 300 teachers in comprehensive assistance for the promotion and prevention of school health; 40 teachers and 2.000 students in teaching promotion and prevention of tropical diseases through video game tools; 4.300 parents, 1.500 teachers and 4.300 students trained in the use of systems and the construction of a control and monitoring model for the work in basic and secondary education.

5. Discussion
According to the fourth objective of the Digital Agenda for Latin America and the Caribbean (eLAC2018) [12], where the importance of promoting policies aimed at strengthening the ecosystem of Regional Digital Entrepreneurship, encouraging the adoption, development and transfer of new technology trends and generating capabilities and options to access to them; the Universidad Francisco de Paula Santander wishes to assume an active role to this reality and proposes the alignment of the academic and administrative environment of the institution with the Digital Economy, through the relevant regulations with a missionary approach.

To achieve this purpose, it is necessary to design academic and administrative strategies for the development of the Digital Economy Policy, which hypothetically may result in new academic programs, the inclusion of teaching of digital economy, the creation of new departments and the strengthening of groups in applied research.

The road map of the University towards the digital economy through the implementation of a policy intended to cover two strategic axes of the Institutional Development Plan 2011-2019 of the Universidad Francisco de Paula Santander [13]; in this document, the strategic lines pursued with the proposed initiative are identified for each strategic axis (see Table 2).

It is important to align the digital economy route with the institutional purposes derived from its strategic management. It is also highlighted that the Institutional Educational Project [14] of the
Universidad Francisco de Paula Santander, aligns its purposes to the digital economy roadmap, as it is observed in Table 3.

**Table 2. Strategic lines.**

| Strategic axis              | Strategic line                  | Sub-strategic objective                                                                 |
|-----------------------------|---------------------------------|-----------------------------------------------------------------------------------------|
| Academic and Administrative Management | Resources: Physical, laboratories, ICT. | Consolidate technological and telecommunications infrastructure. Implement ICT systems to facilitate teaching, research, community outreach and administrative management with criteria of innovation, anticipation, planning, efficiency, and continuous improvement. |
| University, Society and State | Social Responsibility: Extension and Projection | Maintaining a permanent activity of presence in the country. Contribute to the development of the region. |

**Table 3. Institutional purposes of the institutional educational project.**

| Institutional purpose                                                                 |
|---------------------------------------------------------------------------------------|
| Projection, relevance and social commitment.                                           |
| Guide the institutional strengthening actions towards sustainable regional development, through active participation in the processes that contribute to social and economic advancement, regionally and nationally. |
| Propose an administrative reform at the University to facilitate the implementation of policies to be defined from a self-assessment and taking into account the flexibility of the structure to make adjustments resulting from this process. |
| Orienting technical and human resources to the pursuit of material and financial resources that enable us to fulfill the institutional mission efforts. |
| Administrative and financial policy.                                                   |

In the case of the Institutional Educational Project of the university campus in Ocaña [15], the institutional purposes are adapted to the road map from the commitment to the environment, the knowledge society, as shown in Table 4.

**Table 4. Institutional purposes of the Ocaña campus.**

| Institutional purpose                                                                 |
|---------------------------------------------------------------------------------------|
| Knowledge Society.                                                                   |
| Based on the Information Society, this approach extends the dimensions of higher education: distance learning, open and online universities, wide massification of supply, borderless classrooms. |
| As a major public university in the region, Universidad Francisco de Paula Santander Ocaña provides fundamental support for the development of the northeast of the country. In this sense, the articulation of its development plan with other regional development projects is necessary, establishing a balance between what it thinks and what it does, between reflection and action framed in national policies. |
| Compromise with the Environment.                                                      |

Taking into account the importance of knowledge in the development of the digital economy and stressing the important role of the University in generating knowledge, the following goal is set out as part of the Digital Economy Policy at the Universidad Francisco de Paula Santander: to promote in the region the development of the Digital Economy through academia, research and extension. To achieve this objective, it is necessary to add the following action lines:

- To promote from academia growth in the ICT sector. Implementation of ICT in the management and production processes through new growing tools as the market associated with the Internet of things IoT, Bigdata and the support of the development of Digital Content, developing activities such as training and inclusion of advanced and specific topics in ICT.
- To promote entrepreneurship and digital innovation in the region. Productive structural change in the country and specifically in the region depends on the strengthening and the contribution
made by the University; for that reason, it is necessary to leverage and support the Digital Entrepreneurship and Innovation thanks to the technologies, continue to strengthen the Entrepreneurship and Innovation Digital Ecosystem, and develop activities strengthening Digital Entrepreneurship through regulation.

- Transforming businesses in the region to the Digital Economy. The incorporation of technologies in a transversal way in all the productive sectors of the regional economy as the main engine to improve productivity, growth and innovation, through the creation from the University of policies, programs or guidelines that allow the massification of ICT, especially in MSMEs.

6. Conclusions
The Digital Economy brings numerous promises and opportunities for social and economic development for the regions, but in turn implies a potential danger to the regions, businesses and companies that fall behind and do not have the elements to allow them to be part of the digital processing. Among these consequences is the business transformation to a knowledge economy, where the latter will allow to make huge profits and positive changes in the regions. The Digital Economy provides an opportunity to foster innovation and inclusive growth. Therefore, the government of Colombia has promoted the development of digital content with support for over 900 enterprises with training programs.

Retaking the five parts that interact with the Digital Economy, according to the CRC in the document Regulatory roadmap for the development of the digital economy in Colombia and stressing the threats that the CAF Observatory Digital Ecosystem proposed in the SWOT (DOFA) analysis, the importance that higher education institutions have the necessary tools to increase the production of digital industries in their regions (e-learning, video games, 2D-3D animations, apps, IoT, VoD, BigData, Software) to strengthen the international competitiveness. Thus, training in IT skills will be integrated into the education system.

It is important that the roadmap to the Digital Economy at Universidad Francisco de Paula Santander be aligned with development plans (IDPs) and institutional educational projects (PEI as in Spanish), so that its objectives and activities digital strategies are included at the academic and administrative levels to the inclusion of the digital ecosystem and therefore digital transformation in the institution begins to be visualized.

On the way of the roadmap towards the digital economy of the Universidad Francisco de Paula Santander, it should be paid special attention to digital entrepreneurship in the region, it should draw the necessary guidelines so that enterprises achieve strength in the market; this should be supported with the fact that according to the BBVA innovation center (and data from the World Economic Forum), Colombia ranks fourth with the highest number of innovative enterprises in the initial phase, only surpassed by Chile, Denmark and South Africa [16]. Meanwhile, according to the IT Observatory of the Ministry of Information and Communications Technologies (MINTIC), the Information Technology (IT) industry has had a significant growth in the number of companies, employees and sales, representing 1.19% of the GDP with sales of COP $ 9.6 billion.

The University must establish rules and criteria for the analysis of regional, national and international markets, in different sectors of the economy, which allows it to make academic offers that are at the forefront of the needs of the market, thus promoting the digital economy in the region and promoting the digital transformation in companies.

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