



USER NEEDS SYNTHESIS REPORT

Open Algorithms (OPAL) Project

Draft for review

March 15, 2017

This User Needs Synthesis Report was elaborated as part of a User Needs Assessment undertaken by the OPAL team. It was developed by Viviana Cañon, User Needs Consultant for OPAL, as Lead Author, with guidance and inputs from Emmanuel Letouzé, Natalie Shoup, Anta Diena, Babacar Birane and Ana Lucia Martinez Arias. This Report and Study benefitted from valuable contributions by the OPAL Executive Committee, core partners Orange-Sonatel, Teléfonica-Movistar, the *Agence Nationale de la Statistique et de la Démographie de Sénégal* (ANSD) and the *Departamento Administrativo Nacional de Estadísitica de Colombia* (DANE).

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About Open Algorithms (OPAL) Project

The Open Algorithms (OPAL) project is a socio-technological innovation to leverage private sector data for public good purposes by "sending the code to the data" in a privacy preserving, participatory, commercially sensible, scalable and sustainable manner.

OPAL's core element will consist of an open platform and algorithms that can be run on servers of partner companies behind their firewalls to extract key development indicators of relevance for a wide range of users and results will be made available via an interface. OPAL will start with pilots in Senegal and Colombia, in partnership with their National Statistical Offices—ANSD and DANE—and leading local telecom operators—Orange-Sonatel and Telefónica Colombia. Local engagement and empowerment are central to the development of OPAL: needs, feedback and priorities will be collected and identified through local workshops and discussions, and their results feed into the design of future algorithms. These algorithms will be open, therefore subject to public scrutiny and redress. A local advisory board will provide guidance and oversight to the project, to ensure it abides by key ethical principles. In addition, training will be delivered around the project to foster its use and diffusion as well as capacities and connections more broadly. For more information about OPAL please see here: http://www.opalproject.org/about-us/

Implementing the OPAL project is a process that involves three stages: (1) set up including consultations, partnerships and project team development (2) pilots and prototyping in Senegal and Colombia (3) operationalization and expansion

This User Needs Analysis spans the first and second stage of this process.

EXECUTIVE SUMMARY

This reports aims to identify key priorities for use cases and indicators that are feasible to produce with Telco data in Colombia and Senegal. The Needs assessment will guide OPAL strategic decisions, reflecting choices guided by the needs and desires of society, the beneficiaries of the project's efforts.

Consultations and design sessions were undertaken with diverse groups of stakeholders in Colombia and Senegal, such as government agencies, universities, think tanks, civil society organizations, small businesses and other potential users of the project.

In Senegal, 46 ideas for use cases and indicators were identified, most in areas of i) health; ii) employment and economy; iii) education; and iv) agriculture, food security and nutrition.

For Colombia, 40 ideas for use cases and indicators were defined. The most prominent were: i) infrastructure, mobility and transport; ii) social and demographics; iii) agriculture; and iv) peace and post-conflict. An opportunity was also identified for OPAL to close information gaps for indicators for the Sustainable Development Goals (SDGs)[1], where Colombia does not have accurate or enough data, information or methodology.

Although the need for a project like OPAL was broadly confirmed in both countries, some limitations for the use of big data and for the project were discussed, namely, the lack of a culture of data sharing, institutional and regulatory obstacles, privacy, and data literacy.

[1] As a part of the Agenda 2030, On September 25th 2015, countries adopted a set of goals (the Sustainable Development Goals) to end poverty, protect the planet, and ensure prosperity for all as part of a new sustainable development agenda (Agenda 2030). Each goal has specific targets to be achieved over the next 15 years

INTRODUCTION

The User Needs Analysis is based on the nine *Principles for Digital Development*[2], particularly Principle One OR principe one: "Design with the User providing recommendations to avoid international development technology tools creation or tech-enabled projects without sufficient input from stakeholders whose engagement and ownership are critical to long-term success."

This principle comprises among others the following insights: (1) develop contex-appropiate solutions informed by user needs, (2) include all user groups in planning, development, implementation and assessment, (c) develop projects in an incremental and iterative manner, (3) design solutions that learn from and enhance existing workflows and plan for organizational adaptation, AND (4) ensure solutions are sensitive to and useful for the most marginalized populations.

It also corresponds to the aim of OPAL to be "user-centered" by keeping user needs, environment, and preferences at the center of the project and product design.

ABOUT THIS REPORT

This reports aims at identifying key priorities for use case indicators that are feasible to produce with Telco data in Colombia and Senegal. The user needs analysis will guide OPAL strategic decisions by highlighting the needs of society that could be the beneficiaries of the project's efforts.

The report gives an overview of the main objectives of the user needs analysis, which are summarized in four research questions:

- What are the most urgent priorities of development to be tackled in the countries?
- What are the indicators that are not available that countries would like to have?
- What are the indicators that exist but are costly or difficult to produce?
- What are the main limitations for the use of Big Data for Development in the countries that OPAL needs to take into consideration?

This study has used a variety of qualitative data collection tools (documentation and data review, interviews, online discussions, and a workshop in Senegal) to capture these needs, experiences and expectations. Information and data from United Nations and Organizations for Economic Cooperation and Development, National Development Plans in Colombia and Senegal and the Agenda 2030 were taken into consideration.

[2] The Principles for Digital Development are "living" guidelines that can help development practitioners integrate established best practices into technology-enabled programs. They are written by and for international development donors, multilateral organizations, and implementing partners, and they are freely available for use by all. For more information: http://digitalprinciples.org/about/

This Report is simply a tool for the OPAL team and the countries' users to make better decisions about the prioritization of use cases and indicators to be produce by the Project. It can be also used to guide tactical and operational decisions to be made by the Project's Executive Committee.

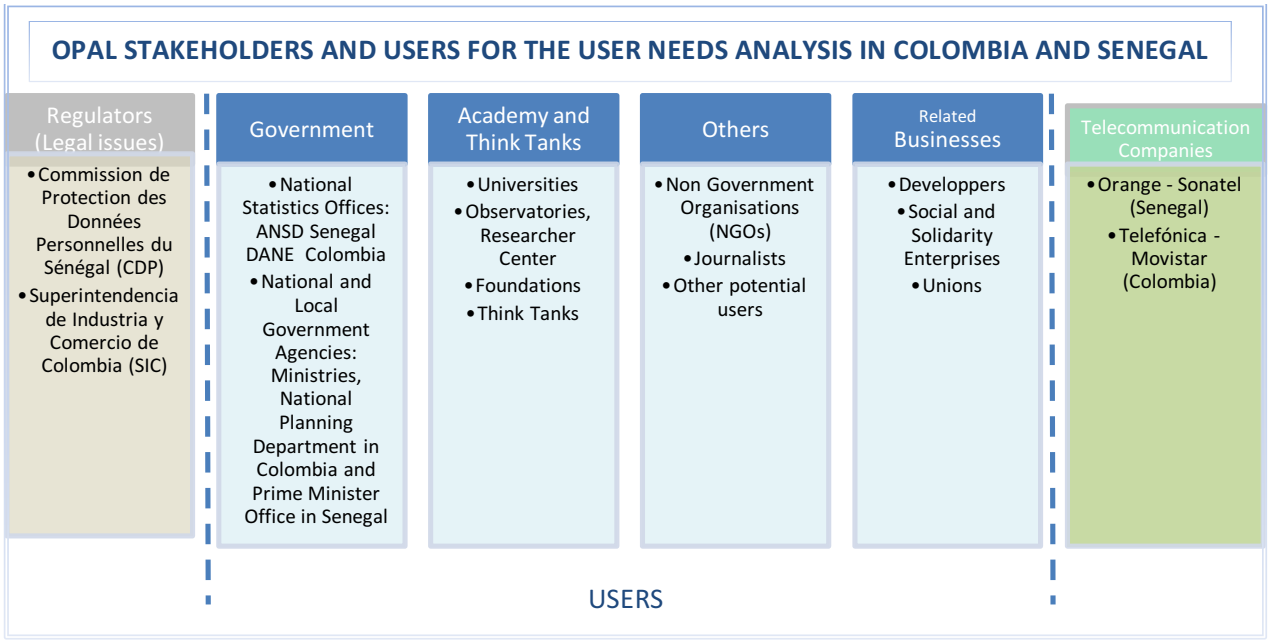
The user needs analysis is meant to collect the priorities on information needs identified in interviews and discussion sessions with a diverse group of stakeholders in Colombia and Senegal, such as government agencies, universities, think tanks, civil society organizations, small businesses and other potential users of the Project.

METHODOLOGY

Three basic steps were followed to prepare the user needs analysis: (1) Scoping and Mapping, (2) Performing interviews and discussion sessions, and (3) Writing up the report. During the three stages the following information sources were used:

- User Assessment Sessions with diverse users and Telecommunication Companies in Senegal and Colombia.
- Workshop on user needs in Senegal with key stakeholders, January 24 2017.
- Discussion sessions with the OPAL team.
- Document and data review on Big Data for Development and on the countries outlook.

Since the scoping and mapping stage, the project's stakeholders and users were defined as followed:



The length of time to perform the three stages of the User Needs Analysis was eight weeks, from January 1st to February 24, 2017. During this period, the following key deliverables were presented to the OPAL team:

- A questionnaire to perform the user needs analysis. (Annex 1)
- A list of key stakeholders to be interviewed in each country (Annex 2)
- A document guide to send to the interviewees in each country (Annex 3: English, French and Spanish versions)
- The instructions and materials for a mini-workshop session with stakeholders in Senegal (Annex 4 and Annex 5)
- A list of 46 ideas for use cases and indicators for Senegal
- A list of 40 ideas for use cases and indicators for Colombia

OBJECTIVES

The User Needs Analysis was carried out to identify key priorities (needs) for use case indicators that are feasible to produce with Telco data in Colombia and Senegal.

Two additional objectives were attained through the analysis: validation of the need for OPAL by potential users in both countries and the collection of inputs on opportunities and challenges to take into consideration in the project's implementation.

I. DEVELOPMENT PRIORITIES AND NEEDS

This section summarizes the development priorities and information needs identified through the user needs analysis in Colombia and Senegal. For each country analysis four aspects will be described here:

- Country Overview
- Most urgent development priorities
- Ideas for uses cases and indicators priorities
- Uses Cases for indicators that are costly or difficult to produce

A. COLOMBIA

1. Country Overview

Colombia has an estimated population of 48.593.405, with 76% of the population living in urban areas. Despite the country's high middle income level and its political and economic stability, Colombia faces significant development challenges as shown in *Exhibit A: Colombia country profile*, with high levels of inequality (53.5% Gini Coefficient), 27.8% of the population living below the poverty line, and an unemployment rate estimated at 8.7%. Colombia is currently in the accession process to the OECD.

Exhibit A: Colombia country profile

Country Profile: COLOMBIA		
FACTS		**Information Source**
Population	48,593,405	http://www.dane.gov.co/
Area	1,138,910 sq km	
Urban Population	76.4% of total population	
Government type	Presidential Republic	www.cia.gov/library/publications/the-world-factbook/
Adminstrative divisions	32 departments	
GDP	$690.4 billion (2016 est.)	http://databank.worldbank.org
GDP Real Growth Rate	3.1% (2015 est.)	
GDP Per Capita	$14,207 (2016 est.)	
GDP Composition by sector	Agriculture (6.9%), Industry (34%), Services (59.1%). 2006 est.	www.cia.gov/library/publications/the-world-factbook/
Income Level	High middle	http://databank.worldbank.org
Unemployment	8.7% (2016)	http://www.dane.gov.co/
Inflation rate	7% (2016 est)	http://www.dane.gov.co/
Population in Multidimensional Poverty	7.6%	https://unstats.un.org
Population below poverty line	27.8% (2015 est.)	
Ginni Coefficient	53.5%	
Human Development Index	0.720 (High H Development, No.97)	
Access to Electricity (% of population)	97%	www.cia.gov/library/publications/the-world-factbook/
Internet usage	55.9%	http://databank.worldbank.org
Total mobile phones	58.523 million	http://www.mintic.gov.co/
Mobile Penetration	120.1% (2016)	
Main Mobile operators (% participation)	Claro (48.68%), Movistar/Telefónica (23.29%) and Tigo (18.74%)	

Despite decades of internal conflict and narcotics-related security challenges, Colombia has maintained relatively strong democratic institutions. In November 2016, Colombia's Congress approved the revised peace accord with the Revolutionary Armed Forces of Colombia-FARC (the country's largest rebel group) putting an end to an internal conflict that has lasted more than five decades and has caused more than "220.000 deaths, 7 million internally displaced

people (IDPs) and 11.000 killed or injured people by land mines"[3]. In this new post-conflict era Colombia faces new challenges and opportunities.

2. Most urgent development priorities in Colombia

The Colombian Government priorities are established in the National Development Plan 2014-2018 called "Todos por un Nuevo País" (All for a New Country). The Plan is based on three pillars:

1. Peace
2. Social Equity
3. Education

The Plan establishes five transversal strategies to implement these three pillars:

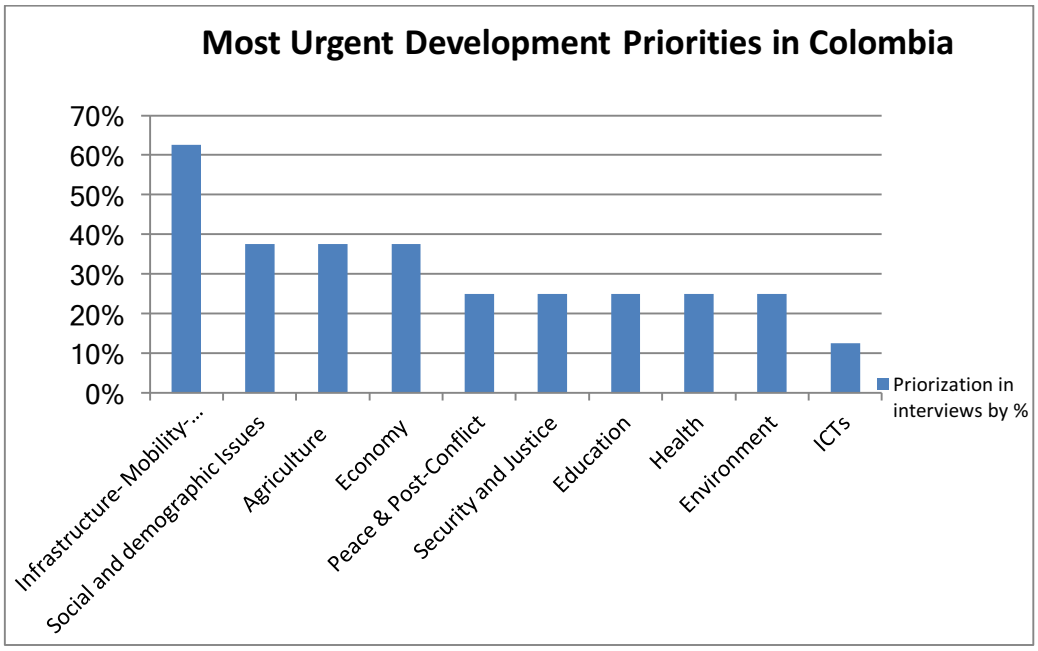
- Strategic infrastructure and competitiveness to boost economic growth.
- Social mobility, through increased quality and coverage of the educational and health systems.
- Transformation of the countryside and green growth, trying to reduce the gap between rural and urban environments.
- Consolidation of the welfare state.
- Good governance.

In some interviews when people were asked about the most urgent development priorities in the country, they referred to the National Development Plan's pillars.

Most interviewees (63%) identified infrastructure, mobility and transport as the most urgent development priority which corresponds to the Plan's first transversal strategy. In 38% of the total interviews three areas of development were identified: social and demographic issues, agriculture, and economy. In 25% of the cases, people mentioned peace and post-conflict, security and justice, education, health, and environment as the country's priorities.

Exhibit B: Development Priorities in Colombia

[3] MIROFF, Nick. The Washington Post. The staggering toll of Colombia's war with FARC rebels, explained in numbers. August 24, 2016.



One clarification needs to be made on the development priority "Peace and Post-Conflict." Although we can consider that all development priorities mentioned in the interviews need to be adjusted to the new peace and post-conflict condition in which Colombia is now, in the classification of ideas for use cases it was decided to analyze it separately due the interviewees' categorization as an independent area of development to be considered.

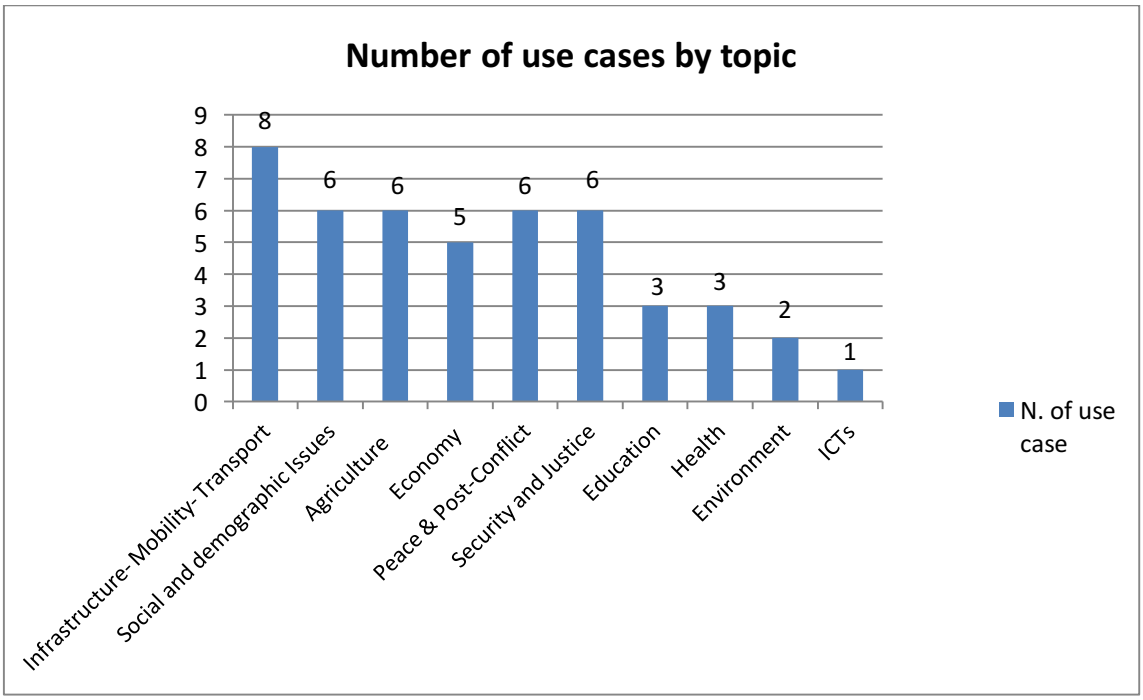
3. Ideas for use cases and indicators priorities for Colombia

Forty use cases and indicators priorities were identified in the interviews with stakeholders in Colombia. However, two key organizations for the project (DANE and DNP) mentioned during the interviews the importance of exploring the usefulness of OPAL to reach or improve the country's Sustainable Development Goals (SDGs) Indicators. The two options are briefly described below.

3.1. Use cases and ideas for indicators identified in the interviews

Infrastructure, mobility and transport received 20% of the total suggestions for use cases (8/40) as shown in Exhibit B: Number of Cases by topic-Colombia. Six uses (15%) of the total ideas) were defined by interviewees in each of the following topics: social and demographic issues, agriculture, peace and post-conflict, and security and justice. Economy got 13% of the total ideas (5 cases) and education and health only got 8% ~~of the total cases~~. Only two cases were found for environment (5%) and one for Information and Communication Technologies-ICTs (3%).

Exhibit C: Number of Cases by Topic- Colombia



The forty use cases and indicators priorities in ten different topics identified in the interviews with stakeholders in Colombia are described below.

It is important to highlight that if the user needs analysis would have been performed with a broader number of stakeholders in a longer period of time, the number of ideas would be higher. Nevertheless, the ideas presented here will certainly provide the necessary inputs to continue with the next steps of the project.

Infrastructure- Mobility- Transport

1. Understanding mobility patterns. Measuring and reducing journey/travel times for cargo transportation. (Telefónica)
2. Estimating the proportion of the rural population who live within 2 km of an all-season road (SDG No.9, Indicator 9.1.1.). DANE is already working on this by trying to integrate road information (from the Geographic Institute Agustín Codazzi, National Agency of Infrastructure-ANI and the Ministry of Transport) with information from the National Agricultural Census-CAN and the use of nocturnal remote sensing imagery. The use of mobile data can be also explored. (DANE)
3. Identify and geo-localize where convenience stores are. It would allow the improvement of distribution channels with providers. In Colombia there are countless convenience stores and until now it has been very difficult to identify where they are located. Recently, nine big companies agreed to reveal their convenience stores databases, although how this information will be shared and consolidated is still in discussion.. (Logyca)

4. Determining origin-destination patterns for travelers in urban areas to better plan mass transport systems for cities like Bogotá. (Logyca- Bogotá Transport Secretariat).
5. Timing people's movements by all means of transport in cities (the time to go to school/to work, etc). The Economic Commission for Latin America and the Caribbean (CEPAL) wants to work on this with DANE. (DANE)
6. Timing people's movements by all the means of transport in the rural areas (CEPEI)
7. Finding ways to replace cash payments by electronic payments to reduce security issues. Freight transportation involves significant amounts of cash payment, which means cargo trucks in Colombia are moving throughout the country with cash money on hand at all times. (Logyca)
8. In order to determine infrastructure priorities in the country, mapping where the rural population is located and what are their current access roads. (FIP)

Peace and Post-Conflict

9. Monitoring internally displaced persons' movements and routes and identifying causes of displacement. With 2 to 3 million displaced persons, Colombia presents the highest number of internally displaced people in the western hemisphere, and the second largest displaced population in the world after Sudan. Today data about origin and destination (receptor and ejector municipalities) in Colombia is available, but information about the displaced persons' routes is very poor. In a post-conflict situation, it is relevant to monitor if people are still being displaced by armed groups arriving on the territory. FIP and Telefonica worked on some ideas to use mobile data to monitor this. (FIP)
10. Take inventory of civil society organizations in the country (location, regions, municipalities of operation and activity, field, target population, etc). There is a need to monitor the peace agreements, and CSOs are key players to do this. One problem is the lack of information about these organizations. (FIP)
11. Measuring citizens' level of trust in the government/institutions. (FIP)
12. Studying population's social cohesion in the former armed conflict areas through the analysis of calls and SMS. One of the axes of the post-conflict era is the need to build and sustain a cohesive social fabric where the level of cooperation between individuals in the community is high. (FIP). Note: Cautions about privacy issues.
13. Analyzing the correlation between the use of mobile telecommunication in the country and zones of illegal economy. To what extent are illegal businesses operating through mobile communication? Could the mobile coverage expansion be correlated to the expansion of the illegal economy? (FIP)
14. Monitoring ex-combatants social and economic integration into society (the process by which ex-combatants acquire civilian status and gain sustainable employment and income). Comparing socio economic conditions in current concentration zones (established in the peace agreement) versus former armed conflict areas (before the peace agreement). Today, approximately 8.000 people are in this process of reintegration. (CEPEI)

Security and Justice

15. Understanding the modes of operation of illegal businesses in cities. It can be useful for cities like Bogotá where for example, one year ago, the police evicted the most popular hotspot illegal drugs trade (known as "el Bronx"). With mobile data, we would be able to know the impact of that eviction and the new business configurations after the police's intervention. (FIP)
16. Public perception of security. How people perceive threats to their physical safety and security, and what measures they perceive to be effective in mitigating these threats. Some surveys are now available but their geographical scope is limited. (FIP)
17. Using GPS data to provide information to citizens about the closest point of contact for reporting crimes/complaints/denunciations (such as, common assaults, street robbery, etc.) (U. Andes- Quantil).
18. Tracking policemen during working hours to monitor whether or not they are performing the tasks assigned by their superiors (U Andes- Quantil)
19. Understanding the factors that limit access to justice. (FIP)
20. Linking existing data on justice matters, such as tutela actions[4]and the Attorney General's Office investigations, with data mobile could contribute to improving the justice system's efficiency. However, it can be a colossal task as the justice data is not yet well systematized. (U Andes- Quantil). For solving any case, a judge needs to investigate the facts. Judicial authorities have complex mechanisms to share information amongst them, and with a weak current judicial information system, the judges' work can be complex. Impunity is one of the biggest problems in the country. (U Andes- Quantil)

Social and demographics issues

21. Estimating population densities through CDR and VRL to complement the National Population and Housing Census (Censo Nacional de Población y de Vivienda- CNPV) to be carried out in 2017. The CNPV is the biggest and most important statistic operation in the country. (DANE)
22. Registering vital statistics (births and deaths) of isolated communities (Afro-Colombian or indigenous peoples) using mobiles. Today these communities have a very low level of vital stats registration. (CEPEI)
23. Measuring social capital and citizen's participation. Currently the way to measure this is through the "BARCAS' survey" (The Barometer of Social Capital). The BARCAS has been conducted three times, but the information is not homogeneous in the three surveys, therefore comparisons are difficult to make. (FIP)
24. Measuring how civil society is organized, how they mobilize individuals through social networks, and how messages are spread through social networks. The messages' impact from certain individuals in the network (FIP is now studying Twitter's trends and impacts, but it would like to extend this analysis to other social networks).

[4] In Colombia, tutela actions are legal action usually taken by human rights defenders, labor leaders, to demand protection of their constitutional rights.

25. Measuring subjective poverty correlation with people's contact networks and social media friendships to complement the Poverty Multidimensional Index. (FIP)

Education

26. Mapping the number of people in schools with smart phones and mobiles by municipality. DANE is working on this through a project called SICOLE (Sistema Interactivo de Consulta de Colegios). (DANE)
27. Assessing the relevance of public education investment in the country. Measuring the return to society of investment in public education by municipality. Monitor what happens with students when they finish school. Are they adding value to the country's social and economic development? (DNP)
28. Identifying where the most urgent needs are on education in the country. How can we better distribute public resources towards education throughout the territory? (DNP)

Agriculture

29. Identifying where the farmers are, to connect them with global clients. (Logyca)
30. Determining farmers' needs in the production and distribution channels (as seed providers, for roads, transport and communication channels) to provide them with viable conditions to substitute illicit drug cultivation to legal crops alternatives. (FIP).
31. Identifying communication channels to inform farmers and providers about agricultural inputs and prices. (DANE)

Health

32. Improve response times to the spread of epidemics like Zika or Chikungunya. Measure the rate and speed of spread. (Telefonica)
33. Knowing the current epidemiology status in the country and monitoring the spread of emerging epidemics. (U Andes)
34. Tracking the economy of health (malfunctions, frauds, anomalies, levels of expenditures, etc). (U Andes- Quantil)

Economy

35. Geo-referencing the enterprises and their dynamics. Getting to know the enterprises' socio economic impact in cities (number of jobs, sector, number of women, etc) – CEPEI

36. Identifying the existing workforce's skills in the country. Having this information available would allow the country to fill gaps between current skill levels and those needed to tackle future challenges. Colombia is moving forward to develop new economic activities but may not necessarily be training its workforce with new skills. In the near future, the country will face a gap between demand and offer of skills. (DNP)

37. Analyzing capital flows of non-banking correspondents (for example from money transfers through companies like Efecty or Giros)- (FIP)

Environment

38. Monitoring the population's behavior in National Protected Areas to prevent environmental damage to ecosystems (including illegal hunting of endangered species). The use of mobile data and the Colombian National Parks System information could be considered. (CEPEI)

39. Measuring environmental and socioeconomic impacts of illegal mining by using satellite images, the army's photographs and other sources of data. (U Andes – Quantil)

Information and Communication Technologies (ICTs)

40. The Population's access to ICTs and internet connectivity. Today the information available comes from household surveys. The use of CDR could contribute to have more accurate information about different aspects like speed of internet access, closest internet access points, and daily/monthly internet connection time. (DANE).

Note: Technical feasibility to develop the 40 use cases through the OPAL project needs to be analyzed with the project's partners.

3.2. Sustainable Development Goals Indicators

The National Administrative Department of Statistics (DANE) and The National Planning Department (DNP) suggested evaluating how the OPAL Project could contribute to close information gaps for the SDG indicators where Colombia doesn't have accurate or enough information, data or methodology.

Yet, for ease of evaluating the OPAL usefulness on reporting SDG indicators, a matrix sent by DANE with the disaggregation of all the 169 indicators in three different categories can be analyzed. (See Annex 6: "Indicadores Globales ODS-DANE"). According to DANE analysis, the information availability status to report on the SDG indicators in the country is as follows:

Information available in Colombia to report on the 169 SDGs (%)	
54%	Total Available Information: 54%
30%	Only partial information or with improvement needs: 30%
16%	No information or methodology available: 16%

Based on 30% of the 169 indicators (highlighted in yellow in the table above), we can infer from the DANE matrix that information needs in this category are more representative on goals 2, 6, 7, 11 and 16 as follows:

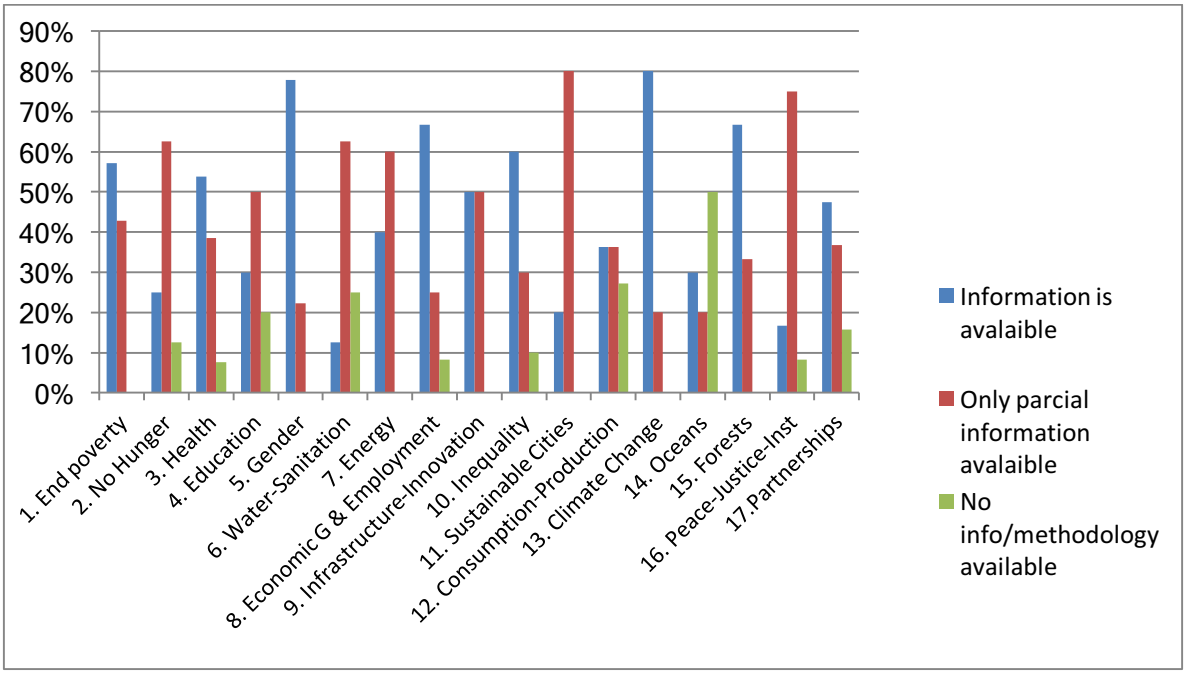
	X				X	X				X					X	

As for the 16% of the indicators where no information or methodology is available, goals n. 4, 6, 12 and 14 are the most prominent.

			X		X						X		X		

The chart below (Exhibit D) shows the availability status of information by each of the 17 SDGs in three different categories. This figure was elaborated based on the matrix presented by DANE:

Exhibit D: Information available by each SDG in Colombia



3.3. Uses Cases for indicators that are costly or difficult to produce

The information described in this section corresponds to the DANE and DNP response to the question: What are the indicators that exist but are costly or difficult to produce?

1. 1. Demographic information through the National Population and Housing Census (Censo Nacional de Población y de Vivienda- CNPV). The CNPV is the biggest and most important statistic operation in the country. Using digital tools could improve the Census data collection.
2. SDG Indicators: there are some indicators for which there is no information and methodology, particularly at the local level.

3. Global Innovation Index: Colombia is producing this indicator at a local level but it is expensive as human resources and technical capacity are required to collect the data.
4. Social Development Index: DNP is producing it. Modern Cities Index: most governorships do not have this information available and when they do, its quality is poor.
5. Measuring GDP: DANE needs between two to three months to publish the results. It means that when the information is published, it is already out-of-date. Today DNP is using Google Trends to predict the GDP outlook two months ahead.
6. Household income and expenditures. DANE produces related information but this is not sufficiently detailed.
7. Information regarding Information and Communication Technology at the local level, such as market shares or customer preferences.

B. SENEGAL

1. Country Overview

Senegal has a population estimated at 14 million, with almost 46% of the population living in urban areas. Despite the country's political and economic stability, Senegal faces significant development challenges as shown in *Exhibit E: Senegal country profile*, with a low ranking on the Human Development Index, an unemployment rate estimated at 13%, and 51.9% of the population living in Multidimensional poverty.

Exhibit E: Senegal country profile

Country Profile: SENEGAL		
FACTS		Information Source
Population	14,320,055	http://www.ansd.sn/
Area	196,712 sq km	
Urban Population	45.96%	
Government type	Presidential Republic	www.cia.gov/library/publications/the-world-factbook/
Adminstrative divisions	14 Regions	
GDP	$39.72 billion (2016 est.)	http://databank.worldbank.org
GDP Real Growth Rate	6.5% (2015 est)	
GDP Per Capita	$2,600 (2015 est.)	
GDP Composition by sector	agriculture (15.6%), industry (24.1%), services (60.3%)	www.cia.gov/library/publications/the-world-factbook/
Income Level	Low	http://databank.worldbank.org
Unemployment	13%	http://www.ansd.sn/
Inflation rate	0.1%	
Population in Multidimensional Poverty	51.9%	https://unstats.un.org
Population below poverty line	34.1%	
Ginni Coefficient	40.3%	
Human Development Index	0.466 (Low H Development, No. 170)	
Access to Electricity (% of population)	56.5%	www.cia.gov/library/publications/the-world-factbook/
Internet usage	21.7%	http://databank.worldbank.org
Total mobile phones	14.959 million	
Mobile Penetration	110.74% (2015)	www.artpsenegal.net/
Main Mobile operators (% participation)	Orange-Sonatel (53%), Tigo (24%) and Expresso (22%)	

Only 51.9% of the population has access to electricity and internet usage is 21.7%, but the number of mobile phones 14.959 million exceeds the population (14.320.055). From the latest report on mobile communication elaborated by the *Autorité de Régulation des Télécommunications au Sénégal* –ARTP, the country mobile penetration is 110.74% and the main three mobile operators share almost 100% of the market: Orange-Sonatel (53%), Tigo (24%) and Expresso (22%).

2. Most urgent development priorities in Senegal

In interviews with government agencies, when asked about the most urgent development priorities in the country, most referred to the "Plan Sénégal Emergent 2014" as a fundamental reference document.

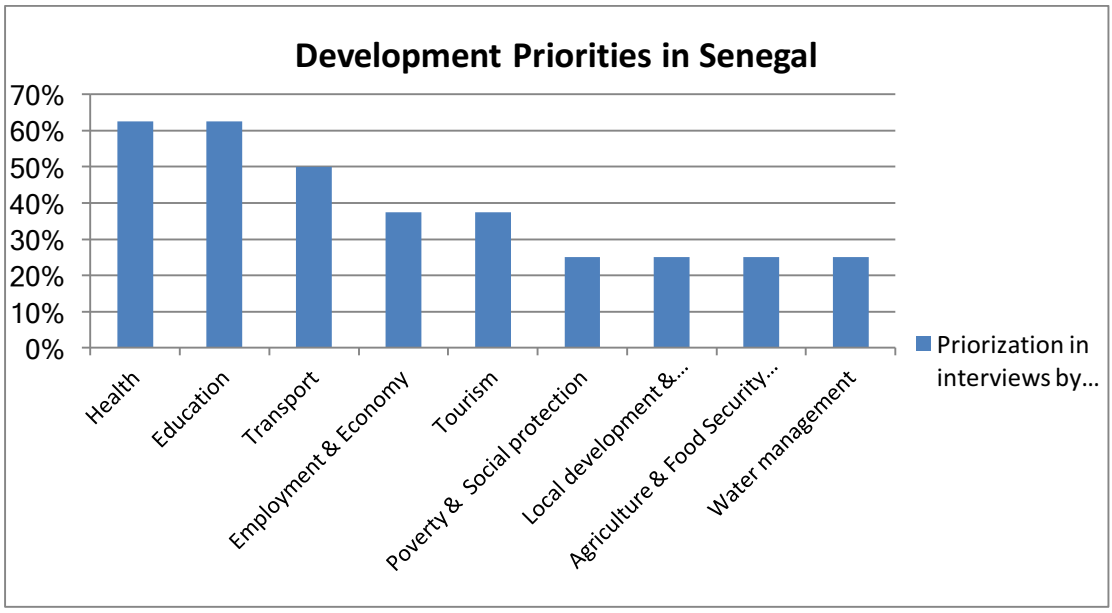
The plan is the government's road map, which aims at easing structural bottlenecks to growth and achieving development goals: "an emerging Senegal in 2035 with social solidarity and the rule of law." The plan is based on three pillars:

(1) A structural transformation of the economy through the consolidation of current engines of growth and the development of new sectors to create wealth, jobs, and social inclusion, with a strong capacity to export and attract investment.
(2) A significant improvement in the well-being of the population, a more sustained struggle against social inequality.
(3) The reinforcement of security, stability, governance, the protection of rights and liberties, and the consolidation of the rule of law.

Likewise, some of the specific aspects of the plan were identified as priorities for the interviewees, mostly related to the first two pillars.

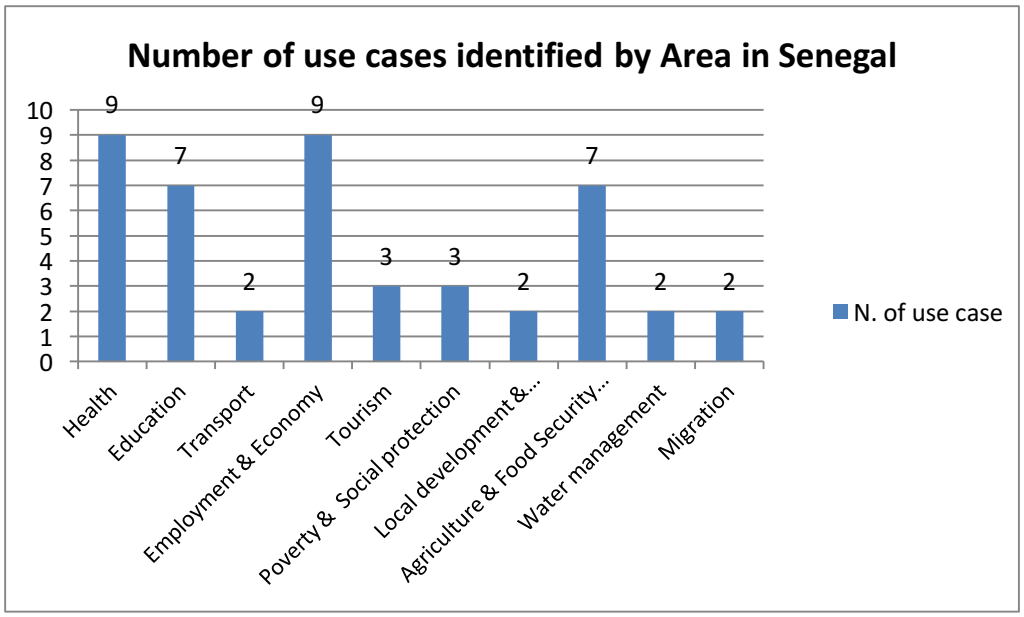
According to the organizations interviewed, nine areas of development were identified as the most urgent to be addressed in Senegal. The chart below (Exhibit F) shows health and education as the most prioritized areas (63% of the interviews), followed by transport (50%), and employment and tourism (with 38% each one). In 25% of the interviews, the following four topics were identified: poverty and social protection, local development and decentralization, agriculture, food security and nutrition, and water management.

Exhibit F: Development Priorities in Senegal



Moreover, from the interviews and the mini-workshop on user needs, 46 ideas of use case and indicator priorities were identified. The areas with more use cases are: health (9), employment and economy (9), education (7), and agriculture and food security (7). Three ideas for use cases were pointed out on tourism and poverty (3 each), and only a small number of use cases for areas of transport (2), local development and decentralization (2), migration (2) and water management (2). The chart below shows the number of use cases identified by area of development.

Exhibit G: Number of ideas for use cases in Senegal



However, the validity or technical feasibility to develop the 46 use cases through the OPAL project needs to be analyzed with the project's partners.

By analyzing both graphs we can conclude that the best areas to focus on for use case definition in Senegal are health and education, considering that they were prioritized in most of the interviews (63%) and they received a good number of ideas for use cases (9 and 7 cases for each topic). In the third and fourth place, priorities are employment and economy (being prioritized in 38% of the total interviews with 9 use cases identified), and agriculture (prioritized in 25% of the interviews with 7 ideas of use cases).

From these priorities, the topic of employment and economy is the one that has the greatest importance in the country development plan "Plan Sénégal Emergent (2014)" (First pillar: la Transformation structurelle de l'économie et la croissance).

3. Ideas for uses Cases and Indicator Priorities

This section presents the use case and indicator priorities defined by the interviewees and the participants who attended the mini-workshop on user needs *in Dakar on January 24th 2017.*

It is important to highlight that if the user needs analysis would have been performed with a broader number of stakeholders in a longer period of time, the number of ideas would be higher. Nevertheless, the ideas presented here will certainly provide the necessary inputs to continue with the next steps of the project.

Health

1. Accurate information about health centers in Senegal: supply, demand, quality, facilities, equipment, workforce, medical specialty areas (ANSD)
2. Giving open access to patient medical records to public and private health centers in Senegal in order to streamline the healthcare process and the handover between various settings, such as when a patient checks into a hospital. DHIS2 is an organization working on it (https://www.dhis2.org/)- (Baamtu)
3. Level of occupancy in hospitals/health centers in real time (mobile data).- (Baamtu)
4. Getting to know more about the socio-economic conditions of poor populations attending health centers (such as patient income level). Identify poor and vulnerable populations to provide better targeted health services. Bank transfers and calls around health centers could provide more information about that, such as when a poor person goes to the hospital and must call their family to send money. (Baamtu)
5. Monitor patient behavior to analyze correlations between lifestyle and the appearance of diseases. It can be useful for research purposes working for example with the Centre de Recherche Genetique – Université de Dakar. (Baamtu).
6. Analyzing the correlation between health and nutrition indicators. (Workshop)
7. Monitoring the spread of epidemics (prevent, control and stop the propagation). – (Workshop)
8. Health status of women of reproductive age (UNFPA).
9. Study of factors affecting fertility rates and family planning (UNFPA).

Economy and employment

10. Cartography of enterprises in Senegal (geographic location, sector, size, industry, employees) to complement and improve the RNEA database (Senegal National Survey for enterprises).- (Deloitte)
11. Labor supply and demand in the country (more granularities, especially on the labor supply side). – (ANSD)
12. Proportion of population working in the informal sector (by sector, activities, geographical location, education level, number of jobs by economic unit, social conditions, etc) – (ANSD)
13. Characterize economic units in the informal sector (volume of telephone communication, use of internet, consumption of electricity and water, etc.)- (ANSD)
14. Aspects/factors affecting enterprise performance (les événements affectant la vie des entreprises). – (ANSD, Deloitte)
15. Economic performance "des enterprises du secteur modern » (They referred to digital business and new enterprises focused on services which are very difficult to monitor). Information about sales, production, consumption, Ebitda, investments). – (ANSD, Deloitte)
16. Identify poles of economic development in the country for the government to develop new projects. Identify key geographical areas for the government to invest. – (ANSD)
17. Measure the impact of the government's strategy to increase employment. – (ANSD)

18. Number of jobs by sector/activity and by region. (The ANSD is currently producing this information, but it is costly and difficult to produce). – (ANSD)

Education

19. Proportion of students who are moving from their place of residence to cities for education purposes. Today in Senegal there are only 5 public universities and one virtual. All universities have at least one office in Dakar. "Senegal's big problem is Macro-Cefalia. That is, 90% of economic activity is taking place in Dakar. This is the reason why the rural areas remain largely poor and wealth goes only to the capital. When a university is built, policy makers should consider key issues, such as students' origin or educational demand by region. By having reliable information about education needs by region and the current displacement of students, we can change how the education system works in the country."[5] (Ministry of Education)
20. Evaluate the impact of government subsidies on the academic performance of students. (Ministry of Education)
21. Use and compare poverty and education data. (Ministry of Education)
22. Daily school attendance by school. (Workshop)
23. Student means of transport and travel time to school. (Workshop)
24. Detailed information about infrastructure, dotation and services for students (by school and municipality/commune). (Workshop)
25. Level of education of couples of reproductive age. (UNFPA)

Agriculture

26. Climate change impacts on agriculture. To compare daily weather information from official government stats with information provided by farmers in real time. (IPAR)
27. Monitor soil and water quality. (Workshop)
28. Crop conditions and detailed information about cereal production. "Anticiper la production". For some commodities, the most recent official stats are from 2011. (IPAR)
29. Economic study on specific cereals like rice. (Workshop)
30. Price variability of agricultural commodities. Fishery and agricultural production, and availability by zone or region. (Indicator of food price anomalies). – (IPAR)
31. Mapping people's access to land. (Workshop)
32. Measuring people movements to rural areas in high agricultural production periods (or to urban areas when climate conditions are not good for farming, such as in rainy seasons). (IPAR)

Tourism

33. Detailed and updated information about the tourism infrastructure, hotel occupancy (in real time), and available workforce by region. (ANSD)

[5] Olvier Sagna from the Ministère de l'Enseignement Supérior et de la Recherche(MESR) mentioned in his interview on user needs in Senegal. Dakar, January 26 2017.

34. Modeling tourist movements and expenditures (by country of residence). At the moment, the International Airport at Dakar is managed by a private company which shares only specific data about tourists with the National Police. By using data from mobile telecom and banks (transactions), we will be able to have more accurate information about tourism. (ANSD, Baamtu)
35. Measure the impact of unpredicted events on the tourism sector (events like natural disasters, epidemics or diseases, and food crises). For example the Ebola impact on tourism performance in Station Balnéaire Saly. (Baamtu).

Poverty and Social Protection

36. Mapping poverty in the country (this information is costly to produce and update). – (ANSD)
37. Helping the government to better identify beneficiaries for social subsidies, such as the "bourse familiale". (For example with Orange Money)- (La Primature)
38. Expanding social protection programs to the population in the informal sector. Information and characteristics about social and economic conditions of the informal sector (la mise en place d'une **Couverture Maladie universelle** (CMU) pour le secteur informel et des groupes vulnérables). «Nous proposons d'examiner les durées moyennes d'appel d'une unité économique et de la comparer à celles d'individu selon plusieurs profils. L'exercice peut mobiliser aussi les données sur la consommation d'électricité et d'eau. » – (ANSD)

Management of Water

39. Water-use efficiency. Review and improve the water tariff system in urban areas. Estimate water average consumptions per household and zone and compare the outcomes with the ANSD data (RGPHAE, 2013). – (ANSD)
40. Measuring rainfall. (workshop)

Transport

41. Public transportation occupancy rate in real time (buses). "In Senegal people can wait hours to take public transport, and routes and timetables change all the time. By following people's movements on buses, we can better determine timetables and occupancy." (Baamtu)
42. Monitoring massive population movements. One example is the religious event "la fête á Touba" when more than 2 million people from all regions in Senegal attend (Touba, la Mecque des mourides). This information can help to prevent communication, accommodation, transport and logistic problems. (Ministry of Education)

Local development

43. Measuring communication flows between municipalities (communes), regions and Dakar to better understand population dynamics and define new poles of development. Data about energy and water access/consumption can provide valuable information for the government to better define new infrastructure investments (like roads) and pivotal areas to be developed in the country. – (ANSD)

44. "L'exode rural". Monitor the movements and trends from rural to urban areas. Money transfers between families. (IPAR)

Migration

45. Tracing population movements. (Workshop)
46. Understanding the socio-economic impacts of the diaspora. Tracing international money transfers from the diaspora (using for example Orange Money Data) and analyzing the characteristics of international calls to do a social capital analysis. This information can be useful for migration public policy. (Workshop).

4. Use Cases for indicators that are costly or difficult to produce

The information described in this section corresponds to the ANSD answer to the question: What are the indicators that exist but are costly or difficult to produce?

1. Mapping poverty in the country
2. Employment by activity and region (including number of jobs by activity and by region)
3. The National Population Census
4. The National Census for enterprises.
5. Number of closed enterprises by region, department, activity and legal regime.
6. Modern sector enterprises shareholding (as digital business and new enterprises focused on services which are very difficult to monitor).

LIMITATIONS FOR THE PROJECT IMPLEMENTATION AND THE USE OF BIG DATA FOR DEVELOPMENT

This section brings together useful information and resources collected through interviews in Colombia and Senegal about the main limitations for the use of Big Data for Development and therefore, the potential limitations for the the OPAL Project's implementation.

A. COLOMBIA

Limitations could be divided into the seven categories: (a) lack of a culture of data sharing, (b) fragmented data approaches, (c) lack of technical capacities (the need for data literacy), (d) Institutional and Regulatory Obstacles, (e) Inappropriate formats and methodologies, (f) privacy and security issues, and (g) others. These limitations are briefly reviewed below:

(a) Lack of a culture of data sharing

In most of the interviews people state the lack of culture for data sharing as one of the most important limitations for any big data initiative in Colombia.

Most people do not understand the value of their own data, and therefore the data being produced by public and private institutions is not considered as significant as it should be. Data producers need to be aware of the importance of their data so that they would be able to improve the ways in which data is being produced, shared and analyzed.

On the other hand, when people do value data, they may not want to share it as it is perceived as power: one does not want to share or lose your power.

This is also a question of informing and communicating. As Telefónica mentioned, if people are well informed about the positive implications of sharing their data for a project like OPAL, they will agree to do it. It is a question on the way you communicate this to people.

Logyca also explained the limitations for the institutions to share their data according to the public or private nature of the stakeholders:

- Within the private sector: as information is power, sharing it is not in the enterprise culture and in fact, data is for many companies perceived as a competitive advantage.
- Between the public and the private sector: there is a natural disincentive for companies to share their data with public institutions. For example, enterprises may think that the government will use their data to tax them at higher rates or to impose fines.
- Within the public sector: "institutional jealousy" poses as an obstacle to data sharing between public organizations. In some cases, institutions develop very complex procedures to provide any information or to release their data.

As Logyca and FIP highlighted, people share their data based on the incentives they have or would receive. A good way to promote information sharing for the private sector is to give them something valuable in return, such as data analysis or strategic information regarding the market.

(b) Fragmented Data Approaches

Data challenges are addressed by most institutions in a fragmented manner (in public and private sectors). Organizations are used to working independently and focus only on solving the specific information problems of the moment. CEPEI and Logyca shared the idea that holistic approaches need to be considered to tackle data challenges.

(c) *Lack of technical capacities- the need for data literacy*

In 62% of the total interviews in Colombia, interviewees indicated that there is need for data literacy in the country.

There is need for people training on data mining and analysis. More particularly, as DNP stated, "the need is to expand data analytics to all sectors and areas of knowledge in the society. Although it is still needed to have engineers well qualified on data mining, education and training needs to be part of all areas of knowledge. This is the way towards the creation of a data culture in the country."

Adding to the challenge, financial and human resources are limited in public and private organizations. Telefónica says that although the Ministries of Education and ICTs are working on developing programs to address these challenges, big efforts need to be made on increasing young people's interest in choosing a career in data sciences, ensuring the resources needed to develop an ecosystem of useful initiatives on Big Data can grow.

(d) Institutional and Regulatory Obstacles

The way national budget is established does not allow implementing innovation processes. There is a kind of "budget inertia" that only allows the institutions to keep doing the same thing all the time. When an institution asks for a new project, the way to go forward is highly complex.

Likewise, according to DNP, only 30% of state authorities use open data. If we do a detailed review on this, the real figures can be even smaller.

Alongside the institutional obstacles, regulation is referred by the interviewees as one of the problems. Although the country has a good regulatory and legal framework for Big Data, difficulties come from the implementation and interpretation of laws by all authorities. Sometimes between agencies it is not clear whether the information is allowed by law to be shared and under this scenario, each institution interprets the law according to its own interests. Again, the problem is not the law, but rather the way it is applied.

(e) Inappropriate formats and methodologies

This is a data quality problem. As some interviews said "Extracting micro data can be impossible as the formats and methodologies to publish information are inappropriate."

There is low production of digital data in the country (public and private sectors), which makes its analysis and use very difficult. As CAOBA pointed out: "data producers don't easily open access to their information and when they do, the data is incomplete or presented in an inadequate format (usually appears on paper), which prevents a full application of any data initiative." This idea is shared by DNP and FIP.

There is also a need for innovation in data mining. A need to find and use alternative ways to extract information and then to link different data sources to have better information on development issues. Innovation could also help to reduce the costs related to on-site surveys.

(f) Privacy and Security issues

Some interviewees agreed on the importance of considering anonymization and data privacy protection as key aspects to be reviewed during the project implementation.

Although people may not be aware of violated privacy issues on social networks, it works in a different way with mobile companies and telephone providers. "People have contradictory views about the way they manage their data. We need to make sure people are aware of their data sharing implications. People undress on social networks, and when you ask them to share any specific information about them, they refuse: you cannot undress someone who is already naked."[6] This view is also shared by FIP, which mentioned that there is evidence showing how extortions and other criminal activities are now operating using social networks.

(g) Others

- Big data—Bias. Although there has been some progress on this, it is still an issue that should be taken into consideration in each of the stages of any Big Data for Development project.

- Linking information from diverse sources. DNP is working on it but there is still much to be done. We need to be able to link mobile data with the available data from public and private sources. Sometimes the most valuable information comes from aggregation of data: video cameras, cellphones, official data, etc. Aggregating information from public and private organizations. For example, having bank and mobile data together can certainly give us a high added value.

[6] Álvaro Rámirez Suárez from Telefónica- Colombia mentioned in his interview on user needs in Colombia.. February 7 2017.

B. SENEGAL

Limitations can be summarized in the following six points: (a) institutional and regulation obstacles, (b) lack of financial and human resources, (c) lack of coordination between stakeholders for data sharing, (d) privacy, (e) data access, (f) the project's neutrality, and (g) others.

(a) Institutional and regulation obstacles

Although a regulator authority for personal data protection (CDP) was created in 2013 as a good sign for the country's Big Data ecosystem, some people think the CDP's power is debatable as it does not have the necessary tools to exercise its role. Moreover, most people in Senegal are not aware of the importance of their data and its confidentiality. Despite this context, to take the OPAL Project forward and ensure its success, the used data must be anonymized.

(b) Lack of financial and human resources

Financial and human resources are limiting factors in the public sector. For instance, the ANSD is not funded sufficiently to be able to produce statistics on some development aspects or to do it in an ongoing basis. Demand is always greater than supply, and hence prioritization is not always an easy task. This is true for the ANSD and for other government institutions.

(c) Lack of coordination between stakeholders for data sharing

Coordination with public and private stakeholders is a challenge. The lack of coordination of data collection and lack of information sharing between partners are some of the factors hindering ANSD's work. In fact, OPAL is perceived as a project that can contribute to better connecting with institutions and to the broader ANSD institutional network. For example, a joint initiative between ANSD and SONATEL could be difficult to imagine for both institutions without OPAL.

For project coordination, it is also important to connect OPAL with the other initiatives or projects that are taking place in Senegal and Africa as the IT Forum Africa and le Salon International des Professionnels de l'Economie Numerique- SIPEN.

Coordination between stakeholders is essential. As Baamtu mentioned "OPAL could contribute to it by improving communication channels between the ones who have data needs (to make decisions or do a scientific research) and the ones who have the technical capacity to model or to develop algorithms (such as start-ups)."

(d) Privacy

As UNFPA stated: "regarding privacy issues in Senegal, people could be grouped into two: a large group of people who share all their personal data and a very small group of people who

take privacy issues very seriously". For either of these groups, as the Ministry of Education pointed out, confidentiality is not a minor issue. Anonymization is a key aspect of the OPAL project. It should not be possible to identify social groups or make profiles of people. Although in Senegal there aren't ethnic problems, we should be very careful in not drawing wrong conclusions about people (as their religion, gender, economic conditions, among other aspects)."[7]

SONATEL also highlighted the importance of working with the CDP by saying: "we need to be sure about how we manage the geo-location rights of people. We also need to analyze if we take or not a participatory approach with the people."[8]

When there is a survey from the ANSD or any government agency, there is a low propensity of respondents to give data. Conversely, when people buy a phone or open a bank account, they easily give their data. The real problem is that people do not understand the importance of giving their personal data. There was a famous incident in Senegal in the elections of 2000, when a government agency published on its website a list of all the citizens who could vote with their personal data. Today the law doesn't allow the public institutions to publish this information anymore. However, this is only an example that shows how in Senegal there is not a data culture within and without public institutions.

There is no education about personal data privacy in Senegal, as Deloitte mentioned "the notion of "private life" or even "the invasion of privacy" in Africa is very different from Western countries. African culture is to share many things. People don't see a risk when someone asks them details about their family, their whereabouts, preferences, etc. People easily give their personal data to anyone. However sometimes people are concerned about giving their personal data, because they think companies will use that data to sell them things."[9]

(e) Data Access

Data access is a problem in Senegal. "Sometimes the information exists, but it is disorganized or inaccessible. The first step is always to identify where the data is and then, find a way to get it. This is true for Senegal and for other African countries."[10]

(f) The Project's neutrality

Some people highlighted the importance of maintaining the neutrality of the project as it was perceived that OPAL was an Orange project. Telecom companies are perceived for some

[7] Olvier Sagna from the Ministère de l'Enseignement Supérior et de la Recherche (MESR) mentioned in his interview on user needs in Senegal. Dakar, January 26 2017.
[8] Mame Gor Guindo from Sonatel mentioned in his interview with OPAL. January 26 2017.
[9] Yves Christian Kpakpo from Deloitte- Sénégal mentioned in his interview on user needs in Senegal February 3rd 2017.
[10] Idem

people as "start-ups killers" or as "a business looking only for profits." If OPAL's neutrality is not maintained, the project's image might deteriorate.

(g) Others: Data Mobile

- Having all the Telecoms data in the country: for the future success of the project having data from all telecom operators is crucial as it will allow the country to have more accurate information about its population and regions. It would also allow researchers to work with representative samples. For example, for a research institution like IPAR, updated and granular data is very valuable. "IPAR is always analyzing agricultural production trends, and in some cases, the most recent data available about socio-economic issues or climate change is only from 2011. This scarcity of updated indicators makes the researchers' work very difficult."[11]

- Mobile Data Bias: "with data mobile (from SENELEC, SONATEL, SDE, etc.) it is not always possible to identify the person or the economic unit (les unites économiques) from the informal sector. It can be a limitation for the project."[12]

- OPAL needs to have a strategy to attract private companies. For instance, for companies like Deloitte cartography, of enterprises in Senegal (geographical location, sector, size, industry, employees, etc) with the RNEA database (Senegal National Survey for enterprises) would add value.

[11] The IPAR team (Souadou Sakho-Jimbira, Lamine Samake and Isswu Dieye, among others) mentioned in the interview session on user needs in Senegal. Dakar, January 26th 2017.
[12] The ANSD team mentioned in the interview session on user needs in Senegal. Dakar, January 26 2017.

RECOMMENDATIONS

In order to provide additional insight about OPAL and its future implementation, ten key recommendations are presented here based on the user needs analyses in Senegal and Colombia. These recommendations can inform future analyses in other countries prioritized by the project.

(1) Building from what exists

No matter the level of development of a country, most of the times, there is no need for a "building from scratch" situation. Ongoing initiatives in countries need to always be taken into consideration. In Colombia, www.datosabiertos.org or www.datarepublica.org were mentioned as important references for the project, and in Senegal, www.geosenegal.gouv.sn and www.dhis2.org. However, if the project focuses on specific sectors or cities in the pilot phase a broader list of national and local initiatives need to be identified and analyze with respective stakeholders.

(2) Linking data from diverse sources

Valuable indicator and use cases can be developed from linking mobile data with other sources of information. Using official indicators prepared by National Statistics Offices or even the police, and aggregating this to mobile and bank data can certainly give OPAL users a high added value.

(3) Working together with countries on their data challenges

Sustainable Development Goals (SDGs) and National Population Census are mentioned by National Statistics Offices as key priorities. OPAL needs to explore its usefulness to obtain or improve the country's indicators where there are no other options available, particularly for the SDGs.

(4) Country Context

Although Colombia and Senegal share some socio economic realities, they are very different and a one-size-fits-all approach to OPAL's implementation, during the pilot phase or later upon expansion, could negatively affect the project's success in each the country.

Making sure OPAL is always adapting to the country context in all its stages of implementation. The project is taking already this approach as it's conducting this user needs analysis, but it is important to keep this view during the project's implementation and later on.

(5) NSOs empowerment

Continuing to empower NSOs in the process of the project's implementation is key to ensuring the project's sustainability and legitimacy. Although some institutions sometimes sense that

NSOs do not work more efficiently or are not recognized, coordination between stakeholders should be taken into consideration in the project's implementation.

(6) Culture of data sharing

This is a big challenge in most developing countries, and OPAL has the potential to contribute to tackle this issue by promoting data literacy and demonstrating big data usefulness for social good.

(7) Keeping OPAL users at the center of the project

OPAL users should be always welcome to share with OPAL their data needs. The user needs analysis should be an open and continuous process that will allow the project to succeed.

In the same way, open communication channels should be considered. Although it was a request made by some people in Senegal, it can be extended to other countries. In order to engage stakeholders, it is good practice to continuously and consistently inform them about the project's progress.

(8) City Approach

Based on ideas for use cases, some of the stakeholders identified information needs for cities, mainly for capital cities (Dakar and Bogotá). Although the user needs analysis did not take a local or urban approach, the project does certainly have great potential for being applied in cities.

(9) Keeping neutrality

One of the key features about OPAL is its neutrality as this condition allows organizations and partners to confirm genuine interest to work for the benefit of society. The project needs to be careful about the content and the way it communicates with people, to ensure there are no miscommunications or misunderstandings.

(10) Knowledge sharing

Sharing best practices and failures between the countries that are part of the project must be considered in the future. It can also take the form of a South-South Cooperation process.

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