

# **The Colombian Observatory of Science and Technology**

## **Between Relevant Context and Internationally Comparable Indicators**

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## **Abstract\***

Policymakers need statistics and indicators to diagnose the situation of the sector or issue at stake and then propose policies and programs based on evidence, and to monitor and evaluate public administration based on results. This is also the case in science, technology, and innovation (STI). In contrast to economic and social statistics, STI indicators are not always a priority for national statistical offices (NSOs), thus different types of organizations take on that responsibility. There are very few countries around the world with observatories for the design and production of STI indicators; typically government organizations in charge of STI policymaking and funding or NSO handle these activities. The purposes of this study are to assess the evolution and the results of the Colombian Observatory of Science and Technology (OCyT for its name in Spanish)—a specific chosen model for the production of STI indicators—and to highlight key institutional factors that should be taken into consideration if the model is intended to be replicated in other contexts. The research question was to assess credibility as the key dimension in the development of statistical capacity; therefore, the questionnaire given to OCyT's stakeholders was oriented to determine the technical capacity (various functions performed) and autonomy (determined by the organizational model) gained throughout the Observatory's existence. This is of special relevance because observatories such as OCyT are purposely created and usually are not governmental institutions, and as a result they must build statistical capacity and gain credibility among stakeholders.

JEL codes: O10, O30, O31, C80, C83

Keywords: Colombia, data collection, indicators, Latin American countries, science and technology, statistics and data analysis

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## **1. Introduction**

There are very few countries around the world with observatories for the design and production of science, technology, and innovation (STI) indicators; typically government organizations in charge of STI policymaking and funding or national statistical offices (NSOs) are in charge of these activities. The purpose of this study is to assess the evolution and the results of the Colombian Observatory of Science and Technology (OCyT for its name in Spanish), and to analyze the risks it faces in the future. The main objectives are to explore whether the Colombian model for the production of STI indicators has been successful and if it is sustainable, and what key institutional factors should be taken into consideration before replicating this experience in other contexts.

This research is based on the personal experience of one of this document's authors, who for almost seven years was the director of the OCyT and critically recalls its history since its inception and up to the present day (Salazar, 2009, 2010), complemented by a short survey of OCyT's main stakeholders (associates, users, scientific councilors, and former directors).

The document is organized as follows. To start, a brief conceptual framework is presented around the state's capacity to produce statistics, followed by the models producing STI indicators that were considered when the OCyT was designed, a decision that determined the development of the institution and the paths followed to produce indicators in the country. The third section presents a brief description of the Observatory's main functions. In the fourth section, the research methods are presented followed by the results of the survey applied. Finally, an analysis of the results is made pointing to the challenges, opportunities, and risks that the OCyT faces, and some conclusions are drawn.

## **2. Conceptual Framework**

The importance of National Statistical Systems (NSSs) is well established for both developed and developing countries. NSSs are composed by NSOs as well as other agencies that provide official statistics for specific sectors, as is the case of STI. Taylor (2016) proposes that the output of NSOs should have a certain number of qualities including timeliness, efficiency, modernity, professionalism, and independence. He further states that "to meet these objectives, NSOs need to comply with international standards, guarantee that production and performance standards are high, ascertain that users are satisfied by the data and the methodologies used to aggregate it, and most importantly, ensure that the credibility of its procedures is unquestioned" (Taylor, 2016: 11–12). In addition, the NSO will need to rely on a series of partners who help provide source

data in order to produce good indicators. In that sense, in the indicator production process, “credibility is both an instrumental end and a good” (Taylor, 2016: 12).

Taylor (2016) makes a theoretical analysis on the political economy factors that affect the building of statistical capacity by governments, placing emphasis on the importance of reliable data as central to public policy formulation, monitoring, and evaluation. There is no unique definition of *capacity*; therefore it is a controversial concept. Certainly, we can associate it with autonomy, impartiality, and discretion, and when looking at desired outcomes, with quality, efficiency, and effectiveness (Taylor, 2016). State capacity can be associated with a professional bureaucracy with autonomy from political power. Autonomy is never total, as all bureaucracies respond to mandates from the political regime, but bureaucracies based on meritocracy and long-term careers are in a better position regarding political pressures and leaders. More specifically, as Alessandro (2016: 4) states, “statistical capacity is defined as the existence of attributes or resources necessary to generate in a sustained manner relevant and quality statistical data, and to disseminate them adequately and timely. This definition arises from the general notion of ‘State capacity’, specifically applied to the NSS of a country. It implies both having enough human and budgetary resources, and an institutional framework that ensures the autonomy of the NSO and its NSS coordinator role.”

Taylor (2016) notes that the production of statistical data faces two political economy tensions. On the one hand, since there is no market incentive to collect and produce data, production of statistics is considered a public good. On the other hand, statistical data provide elements of accountability for the evaluation of policies, which may have positive and negative effects, if they reflect good or poor government performance. Given the central political economy tension between political pressures and policy gains, two dimensions of the statistical capacity are key to develop: technical capacity and autonomy. Regarding the first dimension, Taylor (2016: 14), citing Dargent (2014), says that “agencies are more likely to develop capacity when (i) their functions respond to the demands placed on States by international actors, (ii) they may cause potential political costs to incumbents if they perform poorly, (iii) they regulate the interests of powerful stakeholders, or (iv) they oversee complex policymaking processes.” A similar proposal is presented by Alessandro (2016) that classifies into four categories the factors that affect the development of statistical capacity: (i) factors of the economic and social context, (ii) internal political economy factors, (iii) factors within the public administration, and (iv) international factors.

With respect to the second dimension of statistical capacity, considering that an autonomous agency is free to act within legal bounds, its autonomy is determined politically and is thereby dynamic. Additionally, the autonomy of an agency is not only the result of formal

institutional protections, such as budgetary independence, appointment procedures, or policy review mechanisms. It also depends on de jure and de facto protections. The creation of the agency and the establishment of its structure, appointments, staffing, tenure, and mandate by law ensure de jure protection, as well as the agency budget as one of the most effective ways of ensuring continued agency performance, complemented by self-funding mechanisms. The autonomy of the agency leans on its expertise in terms of the qualifications for holding leadership positions such as academic credentials, years of experience in the profession, and the personal reputation of its personnel, all of which are de facto protection. De facto protections also include the diverse support structures elsewhere in government, in the private sector, in civil society, and in international institutions. The tensions that face NSOs and the qualities needed to achieve their outputs are also valid for other organizations that produce statistics, as we will see is the case of the OCyT.

### ***2.1 Institutional Models to Produce STI Data***

In the context of the creation of the OCyT, three institutional models were analyzed to produce STI statistics and indicators (Barré, 1997). These models account for the five functions to be implemented: (i) analysis of user needs and conception of indicators, (ii) development of methodologies and techniques, (iii) data collection and indicator production, (iv) storage and maintenance of indicators, and (v) interpretation and use. The models also take into consideration whether these functions are concentrated in one organization or distributed across several. We describe these three institutional models for which functions are either integrated within the organization, externalized via contracting (i.e., outsourcing), or externalized via institutionalization.

The first model proposes that the ministry or funding agency of science and technology (S&T) is also responsible for indicator production. This model was adopted for instance by the National Science Foundation in the United States; the Ministry of Education and Science of Portugal; Conacyt in Mexico; the Ministry of Science, Technology, and Innovation in Argentina; and the National Agency for Research and Innovation in Uruguay. In this case, demand, production, integration, use, and diffusion are centralized in one agency; in other words, functions are vertically integrated. Some of the advantages of this model are the possible exploitation of complementarities between the different tasks, the accumulation of know-how, and the permanent balance between supply and demand. However, some of the disadvantages are lesser technical independence, which is a reputational asset, and problematic coordination between the various functions.

The institutional arrangement of the second model consists of the S&T ministry/agency contracting the production of indicators. This is the case in Belgium, the Netherlands, Switzerland, and Germany, where externalization relies on universities or research institutes (such as the Netherlands Observatory of Science and Technology and the Center for European Economic Research). The main advantages of this model are that indicators are produced independently and that the contract regulates the needs and demands of the contractor and the supply of the producer. Some of the disadvantages are that there is a risk of discontinuity and inconsistency if the contract is not maintained over time. Usually in these cases the contract is only for certain indicators, either innovation or Frascati indicators.<sup>1</sup>

There is a variation between the first and second model and not defined by Barré, which is when the NSO is responsible for STI indicator production, such as Stat Canada, the National Institute of Statistics of Spain, and most European countries. Sometimes the NSO takes up this responsibility under request from the S&T ministry that contracts the production of indicators. The main advantages of this model are that the statistical office has experience with methodologies and techniques, data collection, indicator production, and storage and maintenance of indicators, and can guarantee confidentiality, usually backed by national legislation.

The third model proposes the creation of an independent organization in charge of producing the indicators that is nevertheless close to the S&T public agency and funded by government, such as the Observatory of Sciences and Techniques in France, today part of the High Council for the Evaluation of Research and Higher Education (HCERES); the Spanish Foundation for Science and Technology (FECYT); and the Institute for Studies in Research and Education (NIFU) in Norway. In this case, the functions of conception, development of methodologies, production, and diffusion are concentrated in the new organization. This model implies that data collection is done by a third party, therefore a new function arises: the integration of information from various sources. Some of the advantages are that an independent organization can respond to various actors and stakeholders (not only the S&T agency), guarantee continuity and quality, and generate credibility because of technical independence.

Besides the organizational and functional approach, Lepori, Barré, and Filliatreau (2008) have proposed three different models to produce S&T indicators, mainly associated with the type of indicators being produced: (i) the vertically integrated model oriented to the production of Frascati indicators, performing all five functions (same as in Barré, 1997); (ii) the data-driven

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<sup>1</sup> In Frascati indicators we include research and development (R&D) input indicators such as R&D expenditures and education in S&T (see OECD, 2015).



model, mainly related to bibliometrics and patents indicators and highly dependent on data sources; and (iii) the customer-driven model that produces human resource and web indicators (in this case the process is based on experimental design). For the purposes of this paper we use the Barré (1997) categorization.

Complementing the above, Lepori, Reale, and Tijssen (2011: 3–4) describe four trends regarding the design and production of STI indicators. First, there is a growing need for performance indicators for evaluation processes, and for a collaboration with policymakers in the design of indicators. Second, in recent years, there has been a shift from the development of general purpose indicators towards customized indicators closely related to the specificities of their usage context; this shift raises the issue of comparability between indicators. Third, there has been a conceptual shift from a “linear” process where indicators proceed from design towards (standardized) production and interpretation and a more interactive process. This trend brings into question the stability of methodologies in the design of indicators and their comparability over time. Finally, there is a clear trend in the broadening of data sources (for instance big data or social networks data). This trend also leads to a problem of comparability in the data and reproducibility of indicators produced; it requires an increased methodological effort in the design of indicators to account for multiple sources and contexts. Some of these issues will be addressed in the last section.

Lepori, Barré, and Filliatreau (2008) and Lepori, Reale, and Tijssen (2011) make the case for a multiple and diverse system of producers and users of indicators, allowing various actors and models to intervene who have different interests, each model with pros and cons. For instance, the vertically integrated model has proven to be efficient in producing Frascati indicators, but “to have difficulty in renewing indicators” (Lepori, Barré, and Filliatreau, 2008: 40). Following international standards is key for credibility and comparability in this case, and therefore change takes more time than in other situations because it usually involves the revision of manuals and guidelines. In the data-driven model, even if now there are more bibliometric sources of data (ISI-Thomson Reuters, Scopus, Google Scholar, Open Archive System, etc.), still the dependence on the data sources limits the indicators that can be produced, and as Lepori, Barré, and Filliatreau (2008: 40) say, “it displays a typical case of technological irreversibility.” Finally, the customer-driven model is attractive because it responds directly—with agility and flexibility—to users’ needs and can combine different data sources; however, if competences are not accumulated and systematization of results and methodologies is not achieved, they can become a unique measurement with limited applicability over time. Finally, Lepori, Barré, and Filliatreau (2008: 39) conclude that “research is fundamental to the development of new indicators because of its

innovative character, the link with conceptual development and theory, and finally the possibility of performing experiments.”

Lepori, Barré, and Filliatreau (2008) say that modern systems of STI indicator production should “promote the separation between the data producers, the indicator producers, and the indicator users, since there is evidence that innovation will better emerge if these actors are independent and cooperate, because they require different competencies, while there is competition at the interfaces. This does not exclude alliances and forms of integration, but one should avoid the creation of closed vertically integrated systems” (p. 42). As a result, the emergence of communities of practice in this field is very common, such as the OECD Working Party of National Experts on Science and Technology (NESTI) or the Ibero-American/Inter-American Network of Science and Technology Indicators (RICYT), where producers (statisticians), users (policymakers and practitioners), and others converge.

### **3. The Colombian Case: The Observatory of Science and Technology (OCyT)**

The Colombian Observatory of Science and Technology was created in 1999 as a not-for-profit organization promoted and lead by Colciencias, the national governmental agency in charge of policymaking and funding of STI activities in the country. Since its origin, the OCyT was conceived as a public-private partnership. In 1999, 25 organizations joined Colciencias in creating the OCyT, including universities, other public institutions (the National Department of Planning and a regional government), research and development (R&D) centers, scientific associations, and industry associations, among others. In 2018, the OCyT had 37 associates or members;<sup>2</sup> some have left and others have joined over the years. The associates contribute to the financial sustainability of the organization (core funding) and act as a counterbalance to any eventual attempt by Colciencias to control the Observatory. That way, the OCyT can remain both administratively autonomous and technically independent.

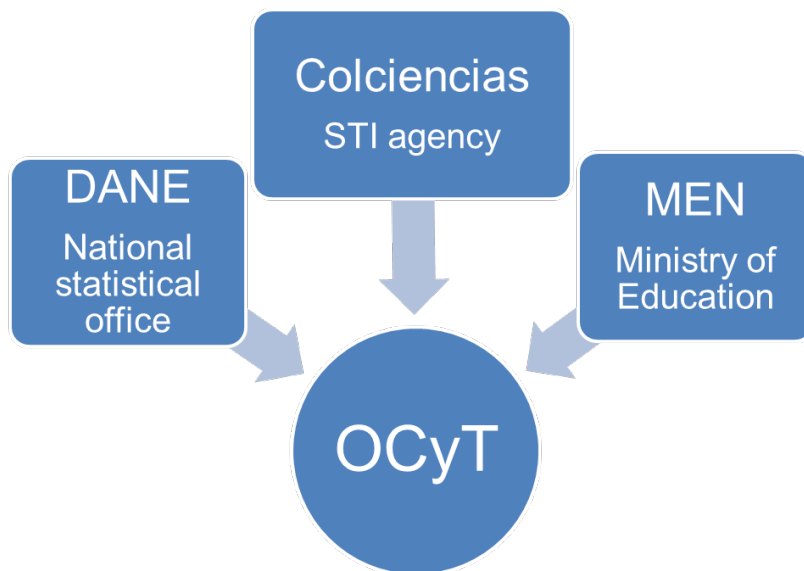
The OCyT was created because there was a clear need, mainly among Colciencias’ policymakers and managers, to have regular and reliable indicators supporting the design and evaluation of STI policies (Colciencias, 1996; Jaramillo, 1996a, 1996b; Ordoñez, 2002). Even though Colciencias had (and still has) this responsibility, it chose to create an independent institution (the third model) and innovated regarding the organizational arrangement by establishing a public-private partnership instead of a subsidiary agency.

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<sup>2</sup> See <http://ocyt.org.co/es-es/organosyequipo>.

Despite the OCyT not being a public organization, the annual report it publishes is considered the official source of national STI indicators, based on the “delegation” of that responsibility by Colciencias. Therefore, the Observatory performs a public function, and its annual report is a public good. Based on the above, the subset of the NSS related to STI indicators in Colombia is depicted in Figure 1, focusing on the public agencies that produce most the data compiled by the OCyT (administrative data provided by the Ministry of Education and Colciencias, and surveys conducted by the national statistical agency—DANE for its name in Spanish). More specifically, Figure 2 shows the different sources of information that the Observatory uses (in the top left quadrangle are included these three governmental agencies). Without this data the OCyT could not produce the annual report. Of these mentioned agencies, only Colciencias is part of the governing bodies of the Observatory. However, DANE considers the OCyT part of the Colombian NSS. Meanwhile, with the Ministry of Education there is a longstanding collaboration relationship but no formal agreement.

**Figure 1: Colombian System for Production of STI Indicators**



Source: OCyT.

Given that the Observatory generally does not collect primary data—except for S&T expenditures and for public perception of S&T—access to third-party information is crucial, and the opportunity for data access must be assured to systematically produce the indicators (Salazar and Colorado, 2010). To that end, the OCyT has established formal and informal agreements with the most important STI-related database owners or administrators such as DANE, responsible for

conducting the demographic, economic, and innovation surveys;<sup>3</sup> the Ministry of Education (MEN), in charge of higher education data;<sup>4</sup> and of course Colciencias, responsible for collecting research data,<sup>5</sup> especially regarding researchers, projects, research groups, and publications. In addition, the Observatory relies on access to international databases to collect bibliometric data—from Web of Science (WoS), Scopus, and the Redalyc project—and patent data—from the United States Patent and Trademark Office (USPTO), the European Patent Office (EPO), and the Japanese Patent Office (JPO). As stated above, data on R&D expenditures and public perception of S&T are collected through the Observatory's own surveys applied to different institutions such as governmental organizations, universities, R&D centers, NGOs, and citizens. As could be appreciated, the sources of information are of different natures: surveys, administrative registries, proprietary databases, and public and open information systems. The capacities needed to use this data for the production of indicators is also different. As we presented above, in many European countries these capacities are housed in various institutions. In the case of Colombia, these capacities have been developed by the OCyT.

The integration and treatment of the data is not mechanical work, and while these activities are usually not seen nor duly appreciated (data carpentry is known as a gray labor<sup>6</sup>), they are key to obtaining reliable results and require deep knowledge on how the data is collected and registered, definitions and attributes of the variables, and design and structure of the databases. Taking into consideration the different types of data compiled, they need to be treated differently, especially that from administrative registries where data is not purposely collected for the production of statistics and indicators. Surveys and specialized datasets are easier to deal with because from the outset they are thought of as sources of statistical information. Because of this, the OCyT has become one of the more qualified users of the aforementioned datasets. In several cases, the producers of the data contact or hire the Observatory to provide expert advice when reforms or updates to the information systems are to be undertaken.

As Taylor (2016) states, if data is the blood, the NSS is the circulatory system: a key aspect of the agencies in the NSS is to make the blood circulate, and to have access to it when needed. One could say that the Observatory plays a major role in the NSS and the national system of STI in making the blood circulate, by integrating STI-related data and making it available to everyone.

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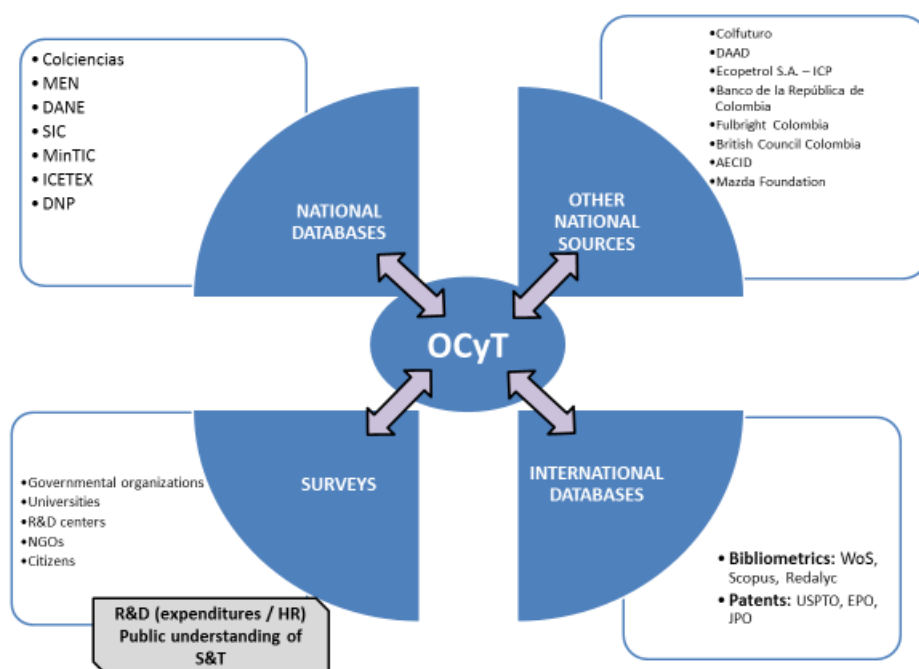
<sup>3</sup> <https://www.dane.gov.co/index.php/en/statistics-by-topic-1/technology-and-innovation/survey-of-technological-development-and-innovation-edit>

<sup>4</sup> <http://www.mineducacion.gov.co/sistemasdeinformacion/1735/w3-propertyname-2672.html>

<sup>5</sup> <http://www.colciencias.gov.co/scienti>

<sup>6</sup> See for instance: <http://blogs.lse.ac.uk/impactofsocialsciences/2014/09/01/data-carpentry-skilled-craft-data-science/>

**Figure 2: Sources of Information Used by the OCyT**



Source: Salazar and Colorado (2010).

Complementing the above, certainly not all sources are equally important for the production of the annual report of indicators. Table 1 attempts to qualify that contribution.

**Table 1: Contribution of Different Sources of Information to the Production of Indicators (According to Topic)**

Topic or indicators/ organization	Expenditures in STI	Education in S&T (includes scholarships)	Research capacities	Scientific production (publications and patents)	Innovation	ICT	Public understanding of science
Colciencias	Low	Medium-low	High	Medium-low			
MEN		High					
DANE	Medium				High		
OCyT (own surveys)	High						High
MinTIC						High	
SIC							
ICETEX		Low					
International databases				High			
Other sources		Low				Low	

Source: Authors' elaboration.

Notes: MinTIC: Ministerio de Tecnologías de la Información y las Comunicaciones (Ministry of Information and Communication Technologies); SIC: Superintendencia de Industria y Comercio (Industry and Commerce Office); ICETEX: Instituto Colombiano de Crédito Educativo y Estudios Técnicos en el Exterior (Colombian Institute for International Studies and Technical Training)

Even if the main purpose of the Observatory is the regular production of STI indicators, along with this it has built other expertise. Of relevance is the research and know-how developed in the elaboration of methodologies, not only for data collection but also for evaluation and characterization of organizations, programs, and policy instruments, activities that are very context specific and customized to the needs of the contractor.

#### **4. Research Questions and Methods**

The research question was to assess OCyT's credibility as the key dimension in the production of indicators or the development of statistical capacity. Therefore, questions were posed regarding technical capacity (i.e., functions performed) and autonomy (organizational model).

To answer these questions, we conducted an online survey directed at OCyT's main stakeholders: the OCyT's associates (represented by university vice-rectors of research, deputy directors of governmental agencies, etc.), indicator users both at the national and international

levels (policymakers, researchers, journalists, politicians, and international organizations), OCyT's scientific councilors (past and current), and OCyT's former executive directors.

The questionnaire was divided into three main topics. The first focused on the organizational arrangement following Barré's model and the functions performed to produce indicators and also looking at different options for the future of the OCyT. A second section was oriented toward assessing credibility (building trust), on how the Observatory has become a producer of high-quality and reliable S&T indicators, and the achievements during its lifetime. Finally, open questions were included regarding risks, challenges, and opportunities that the OCyT faces at present and will encounter in the future (5 and 10 years ahead). The main results of the survey are presented in the next section.

## **5. Survey Results**

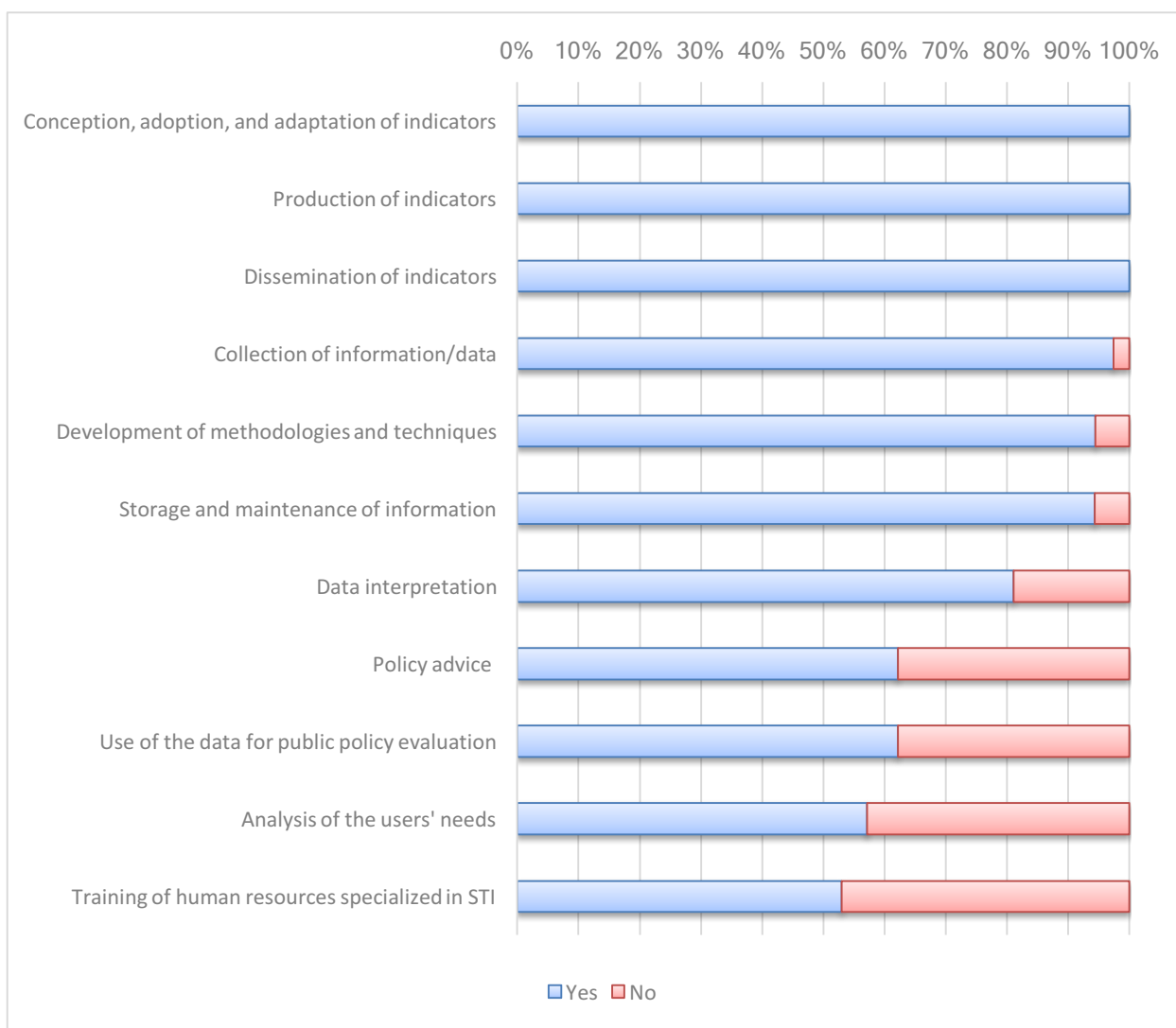
The online questionnaire (see Annex 1) was sent to 88 people; 38 answered, which means a 43 percent response rate. More than three-quarters of the respondents affirm knowing the reasons the Colombian Observatory was created as an independent entity of Colciencias. However, when looking at the explanations or comments to this inquiry, responses were not as clear cut.

According to most respondents, the main reason for the creation of this entity is the collection of information about the state of STI in the country. Around half of them considered that information collection should be used for policy advice and evaluation. Many of the respondents consider that OCyT should be independent but do not provide information as to why this should be the case. From the few respondents that elaborated on this, several reasons were presented, most of them related to objectivity, transparency, stability, and continuity in the statistics. According to one of the respondents, OCyT should be created independently of Colciencias to avoid the drawbacks of the latter, such as its lack of competencies and legitimacy to produce statistics.

Then they were asked about the functions developed by the OCyT. All respondents say that OCyT is fulfilling the core elements around the production of STI statistics, that is, those related to the conception of indicators, the development of methodologies and techniques, data collection, and indicators production, along with the storage and maintenance of data (see Figure 3). In addition, about half of the respondents consider that the Observatory devotes part of its activities upstream (analysis of users' needs) and downstream (use of data for policy evaluation and advice) of the indicators' production process. Finally, training activities to promote specialization of human resources in STI also constitutes a function of the organization for around

half of the respondents. Therefore, according to the results of this survey, the Observatory is considered to concentrate its activities in the core STI indicator production process, which are the functions it was originally designed to fulfil. Yet, there seems to be a tendency to move towards a more vertical integration as in Model 1.

**Figure 3: Which of the following functions is OCyT developing?**

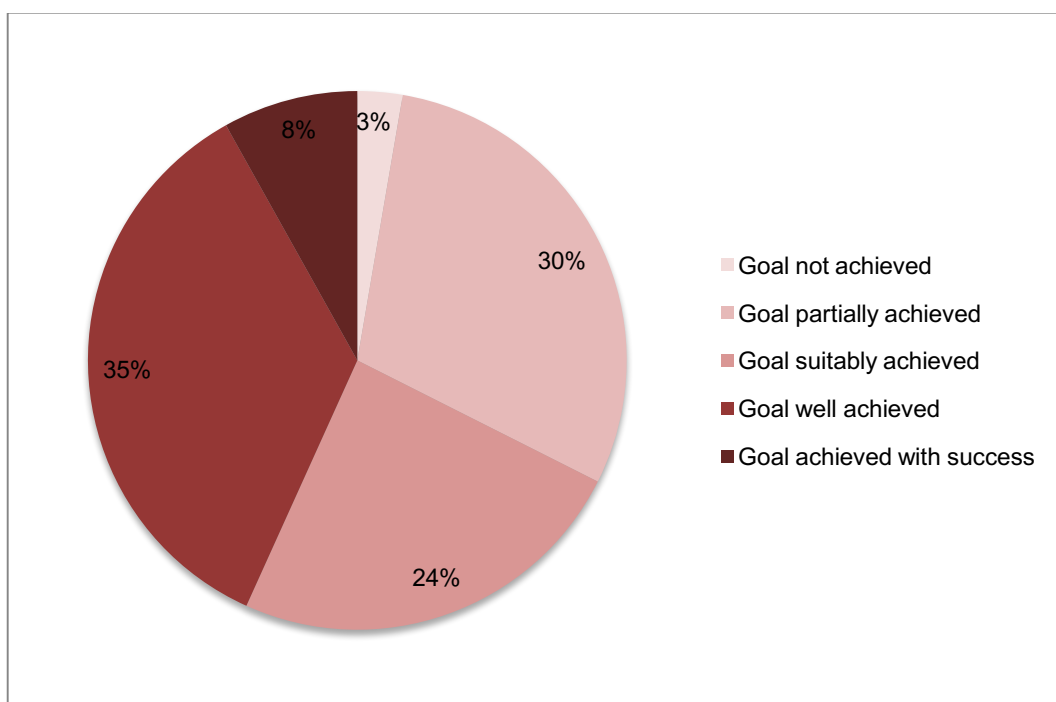


Source: OCyT's stakeholders survey.



As mentioned earlier, the main goal of the OCyT is to produce reliable indicators to use them for the design and evaluation of STI-related policies. According to more than 97 percent of OCyT's main stakeholders that responded to the survey, this goal has been achieved (see Figure 4). As depicted in Figure 4, the degree of achievement differs across respondents. More than half of them (67 percent) considers that the objective has been well achieved, while less than one-third sees it as a partial achievement. A minority (3 percent) think the OCyT has not fulfilled its goal with success.

**Figure 4: Do you think that the ultimate goal or the goal pursued with the creation of the Colombian Observatory of Science and Technology (i.e., having reliable indicators for the formulation and evaluation of STI public policy) has been achieved?**



Source: OCyT's stakeholders survey.

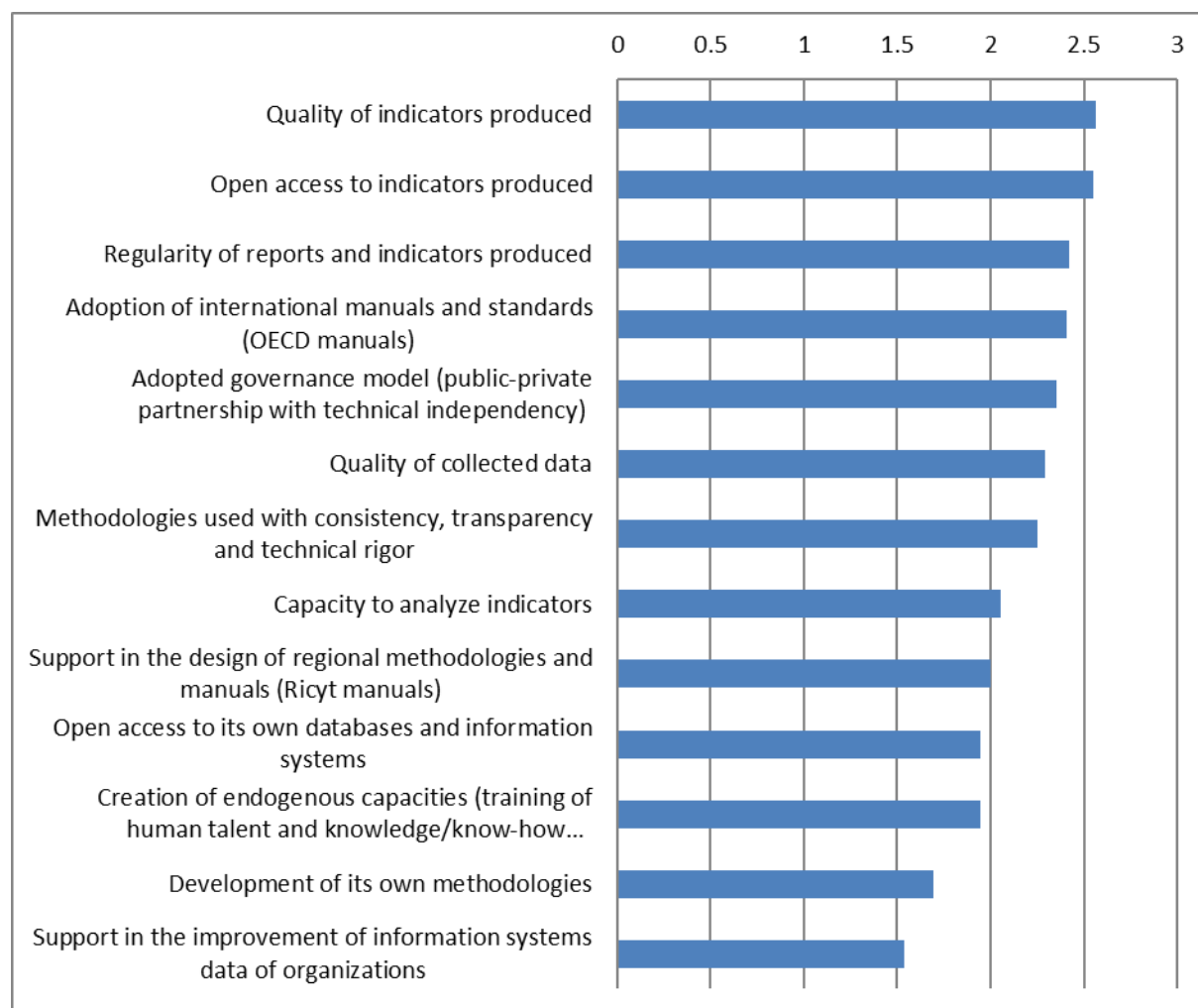
As an open question, stakeholders were asked about the main achievements of the OCyT since its creation; what stands out in the responses is related to the quality, reliability, objectivity, and regularity of the indicators and reports it produces. Some respondents attribute this to its independence from the government. The OCyT has gained great legitimacy in the production of indicators related to the state of STI and its policies. Some respondents also mentioned the recognition of the entity at the national and international level.

These achievements are supported by the ways in which the OCyT has built trust among its clients, users, and stakeholders. According to Figure 5, the factors that contributed the most to build trust are the quality and open access of the indicators produced, the regularity of the reports, and the adoption of international manuals and standards (with a weighted average of 2.57, 2.55, 2.42, and 2.41 respectively<sup>7</sup>). This result is not surprising as these are the core functions around the production of indicators, which represent the main activity of the Observatory. The governance model and the quality of the data collected along with the consistent, transparent, and technical rigor of the methodologies used have had a fairly high contribution as well to build credibility among the stakeholders of the Observatory. However, trust comes less from more advanced activities such as the analysis of indicators, the support in the design of methodologies and manuals, and the creation of endogenous capacities. Although open access to indicators contributes strongly to building trust, open access to the OCyT's own databases and information systems does not. Finally, trust cannot be attributed to the development of methodologies or the support in the improvement of data systems. Apart from these factors, the objectivity of the indicators due to the independence of the OCyT from the government along with the adaptation to the users' needs have also been mentioned as important contributors to boost trust among the Observatory's stakeholders.

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<sup>7</sup> The weighted average is calculated based on the following weights: 0 is attributed to no importance, 1 to low importance, 2 to medium importance, and 3 to high importance.

**Figure 5: How has the OCyT built trust among its stakeholders over time?**



Source: OCyT's stakeholders survey.

According to the survey, the funding structure of the OCyT is clearly seen as the major weakness for its existence and sustainability. In addition, according to a large share of respondents the Observatory also runs the risk of losing its independence from Colciencias and its clients<sup>8</sup> given its fragile financial structure.

The relationship between Colciencias and OCyT is complex when looking at the various responses regarding opportunities and challenges. Some perceive that Colciencias may

<sup>8</sup> The idea behind this statement is that clients decide what to fund (what type of projects according to their own interest). An organization like OCyT requires core funding to develop public goods and deepen its analytical capacities, which has to be complemented by doing contract research or consultancy to maintain a reasonable qualified and expert human talent.

represent competition for the OCyT either by directly producing the indicators themselves or indirectly (via sub-contracting another organization, such as a university). Others see that Colciencias constitutes a threat with respect to the visibility of the OCyT, as many people still mistake the Observatory as part of this governmental agency.

When it comes to opportunities, two important ones emerged from this survey. The first is related to the involvement of the Observatory in the evaluation and design of STI policies. The second opportunity is to respond to the increasing demand for more and better information from national and international actors in the area of STI. Respondents recommend that, beyond its main function of indicator production, the OCyT can take advantage of its qualified personnel to undertake more advanced analysis of its data through elaborate techniques such as data mining and network analysis. In addition, respondents advocate that the OCyT improve its core function as information producer through better methodological approaches, including more disaggregated data at the geographical level (e.g., regions, cities) and improved frequency or regularity of annual reports.

The main challenge in the near future according to the responses is to become a key player in the provision of information about STI in the country and its regions (at the subnational level). Many respondents argued that this should be done through the creation of partnerships with other actors at the regional or local, national, and international levels. Some consider that the OCyT should have a stronger network with international counterparts to gain legitimacy and visibility. Furthermore, for a large share of respondents there is a need to evolve towards analysis, in particular to build a capacity to analyze big data and to construct new metrics. In addition, the OCyT should be more involved in STI policymaking and policy advice and training of policy and decision makers. While achieving this, it is important to many of the stakeholders that the OCyT keeps improving the provision of STI indicators through better coverage, transparency, continuity, and technical independence. According to the responses, in undertaking these functions the OCyT can benefit from partnership with universities and research centers and with DANE. However, these prospects are greatly affected by the financial sustainability issue that was noted as a challenge. Beyond the production of indicators, facilitating the access to information on STI to a larger range of actors is key to many respondents in order to gain visibility and improve the contribution of STI to economic, social, environmental, and political issues. According to respondents, information on STI should be diffused not only to policymakers but also to other sectors such as the private sector and universities. Finally, the access to information should also be enhanced prior to the production of indicators by improving the reliance on secondary sources

of information. Finally, some respondents pointed to the competition that can also emerge from other service providers with similar technical capabilities.

Several questions were related to the future of the OCyT, looking at the institutional arrangements, the strategy to produce indicators, and more generally, what its main function should be in five years. Stakeholders were asked about the future institutional arrangement best suited for the production of STI indicators in Colombia in the short term (five years) and long term (10 years).<sup>9</sup> The results are presented in Figure 6. Independently of the time frame, respondents stated that the best-suited institutional arrangement for the future is the existing one: outsourcing relying on the Observatory. In the short term, more than 70 percent of respondents are in favor of this option, and in the long term almost 40 percent. Independently of the time frame, the three other strategies are equally favored by the stakeholders of the Observatory, with each option being selected by around 20 percent of them. However, the preference among these strategies depends on whether we are referring to the short or long term. While integrating the OCyT's function into Colciencias and outsourcing via the contracting of institutions such as universities/research centers or statistical agencies are preferred as short-term strategies, integrating the functions of the Observatory into the DANE is popular as a long-term strategy.

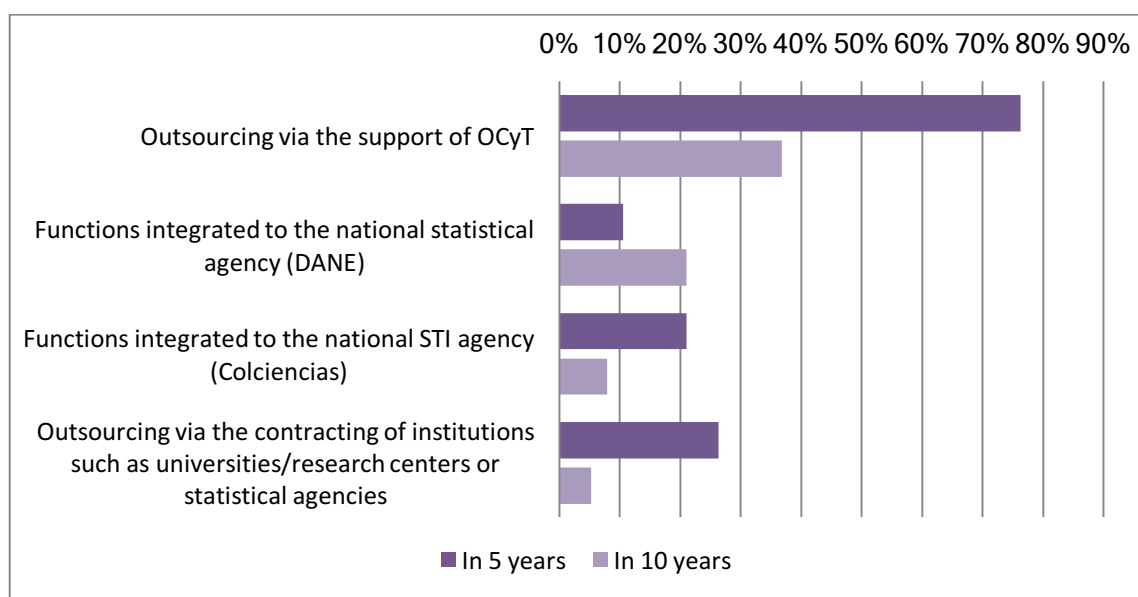
The respondents were additionally asked about the best strategy to produce STI indicators in the short term (five years) and long term (10 years); see Figure 7.<sup>10</sup> In the short term the data-driven model is the most popular strategy, followed by the customer-driven model. The strategy based on the primary collection of data is the least popular strategy of all, regardless of time period. In the long run, the customer-driven model is by far the best strategy according to the survey. Interestingly, the strategy that is most used by the OCyT—secondary collection of information—was usually the respondents' third choice.

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<sup>9</sup> The respondents could select more than one institutional arrangement for each time period.

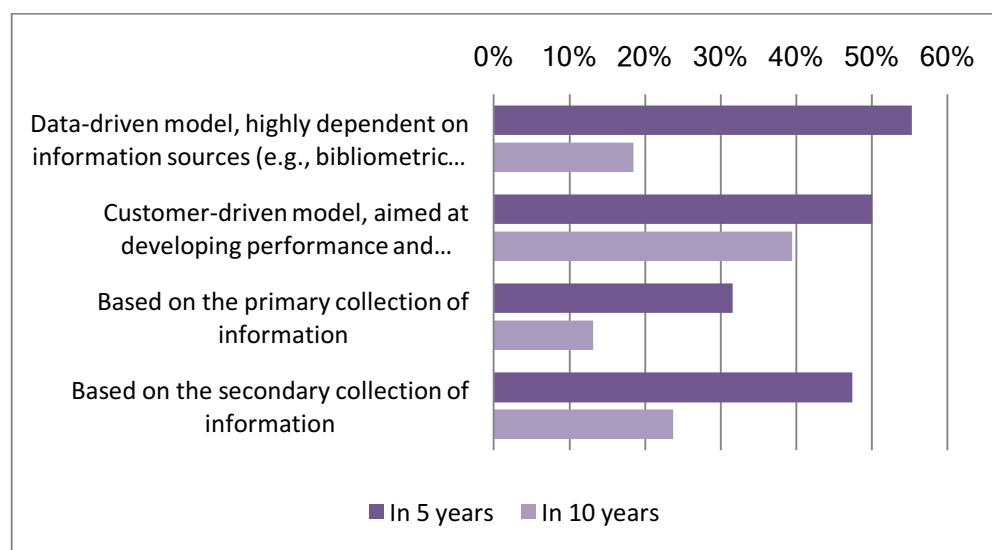
<sup>10</sup> The respondents could select more than one strategy for each time period.

**Figure 6: Which of the following institutional arrangements do you consider the most suitable for the production of STI indicators in Colombia in the future?**



Source: OCyT's stakeholders survey.

**Figure 7: Which of the following options should be OCyT's strategy in the future for the production of indicators?**

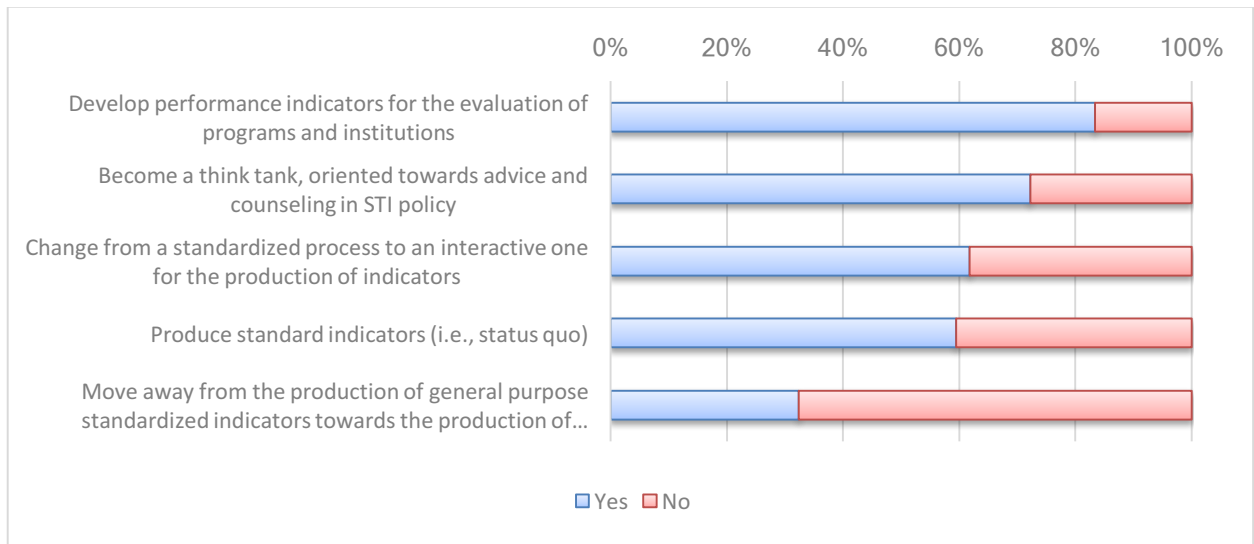


Source: OCyT's stakeholders survey.

According to most of the OCyT stakeholders surveyed, the Observatory should increase its activities in the development of indicators related to the evaluation and design (advice and counseling) of STI policies (Figure 8). Slightly more than half of the respondents consider that production of standard indicators should remain within the activities of the OCyT with a more interactive production process. Less than one-third of the respondents are favorable to the production of personalized indicators (to the customer and the context) instead of general purpose ones.

It may appear that there is a contradiction in the answers. On the one hand, respondents say that the OCyT should orient its production indicators strategy to a customer-driven model, but on the other hand, they do not want it to move away from the production of general purpose standardized indicators. This means that production of standard indicators should remain as the core function of the OCyT, as it is its main mission, but the Observatory should also be attending to customers' demands.

**Figure 8: What do you think OCyT should be doing five years from now?**



Source: OCyT's stakeholders survey.

## 6. Wrapping Up

Based on Questions 8 and 9 of the questionnaire related to risk, challenges, and opportunities, we organized the responses as a SWOT analysis, looking at the internal and external and the positive and negative factors that may affect OCyT's development. The challenges and risks posed by respondents could be classified either as a weakness or a threat, with the understanding that they are also highly related. Table 2 sums up the results of this analysis.



**Table 2: SWOT Analysis of the OCyT**

<p style="text-align: center;"><b>Strengths</b></p> <ul style="list-style-type: none"> <li>- Qualified and experienced personnel</li> <li>- Production of indicators: <ul style="list-style-type: none"> <li>o Objectivity: technical independence</li> <li>o Regularity</li> <li>o Quality</li> <li>o Reliability</li> <li>o Legitimacy: recognition of the OCyT at the national and international level</li> </ul> </li> <li>- Flexibility of the services provided</li> </ul>	<p style="text-align: center;"><b>Weaknesses</b></p> <ul style="list-style-type: none"> <li>- Fragile financial structure (dependence on contracts for the provision of services)</li> <li>- Lack of analysis of the data produced</li> <li>- Lack of coverage, regularity, and continuity in the production of indicators</li> <li>- Reliance on secondary sources of information</li> </ul>
<p style="text-align: center;"><b>Opportunities</b></p> <p>At present:</p> <ul style="list-style-type: none"> <li>- Complementarity with Colciencias</li> <li>- More influence on STI policies (evaluation and design)</li> <li>- Increased demand of information (quantity and quality) on STI from national and international actors</li> <li>- Use of its technical capacities to improve information production (better methodological techniques, more disaggregated data at the geographical level, more regularity) and the analysis of the STI system (e.g., using data mining and bibliometric analysis)</li> <li>- Widen the groups of interest outside of the domain of STI</li> </ul> <p>In five years:</p> <p>Need for a change in the system → Become a central actor in the provision of information about STI in Colombia and Latin America</p> <ul style="list-style-type: none"> <li>- Facilitate the access of information to other national actors apart from the policy makers (e.g. through open data): improve visibility.</li> <li>- Build capacity of analysis (e.g. through partnerships with universities).</li> <li>- Increase credibility: Improve the coverage, transparency, continuity and technical independence in the generation of STI information.</li> <li>- Network with international counterparts to gain legitimacy.</li> </ul>	<p style="text-align: center;"><b>Threats</b></p> <p>At present:</p> <ul style="list-style-type: none"> <li>- Competition with Colciencias and other service providers with similar capabilities</li> <li>- Being mistaken for Colciencias: visibility</li> <li>- External pressure from policymakers</li> <li>- Independence, sustainability, and continuity (due to the financial structure)</li> </ul> <p>In five years:</p> <ul style="list-style-type: none"> <li>- Independence, sustainability, and continuity (due to the funding structure)</li> <li>- Low investment in STI in Colombia</li> <li>- Delays (due to the reliance on secondary information)</li> </ul>

Source: Author's elaboration based on OCyT's stakeholders survey.

According to survey results, we could observe that there is not a unified perception of what the Observatory has achieved, what it lacks, and what should be developed based on opportunities and challenges. For instance, regarding information regularity, it seems that some respondents would like more frequent reports (not only on an annual basis). In addition, a wider coverage (topics and regions) is also demanded. Generally, we could affirm that most of the demands are related to improving the capacities of the Observatory to produce indicators and analyze them, rather than to reduce its role within the Colombian STI system.

With respect to the organizational model, most respondents agree that the current model of STI indicator production via the existence of the OCyT is adequate and recommend a mixed strategy that uses primary and secondary information, as well as a data-driven model, but also provides customized indicators, without neglecting or moving away from the production of general purpose standardized indicators. Partnerships with national actors (especially universities and R&D centers) and international actors seem to be an adequate path to follow that will strengthen the Observatory's research capacities and provide higher visibility.

The relationship between the OCyT and Colciencias is and will be complex; these two organizations are closely linked, and they need each other. Without Colciencias' support, funding, and data provision, the OCyT could not perform its role adequately, and Colciencias needs the indicators produced by the OCyT to legitimate its role.

## **7. Conclusions**

Because the OCyT is a not-for-profit organization and a public-private partnership, certainly its sustainability relies on the support provided by its associates (mainly Colciencias) on the one hand, and on the other hand, on project funding. The issue at stake is if the OCyT should remain mainly as an indicator producer (its main goal and what it is paid for) or evolve into a research organization (knowledge producer), a consultant (service provider), or a combination of these. Based on the survey results, the OCyT has been able to build statistical (technical) capacity with the necessary qualities of timeliness, professionalism, and independence. Its institutional autonomy is challenged by the financial structure, which is highly dependent on project funding and Colciencias, limiting its capacity to strengthen its research capabilities. Its credibility has been built over time, based on the quality of indicators, open access to data, regularity of indicators and reports, adoption of international standards, and transparency of the methodologies used. In sum, OCyT's main assets are objectivity (technical independence), regularity, quality, and reliability.

As a short-term strategy, the Observatory should maintain access to secondary information and databases (and not become a producer of primary data), and continue production

of standard indicators. In the long run, the strategy is to move to a customer-driven model, developing performance indicators and having greater influence in policymaking and policy advice. Looking at the institutional arrangements, the current approach is the most preferred; however, in 5–10 years there is an option (according to 20 percent of respondents) to consider a new institutional arrangement: integration with Colciencias or DANE, preferably the latter.

If one follows Lepori, Barré, and Filliatreau (2008), who propose three different models (vertically integrated, data-driven, and customer-driven), the challenges that the Colombian Observatory faces are major in maintaining the production of standardized indicators for international benchmarking but also advancing to a more interactive process, customized to users' needs and contextualized. There is no dichotomy, however, between the production of standard indicators or customized and context-relevant indicators. On the one hand, indicators are used to make international comparisons, therefore it is necessary to adopt international standards and guidelines. On the other, indicators should help policymakers design, monitor, and evaluate policies, programs, and instruments, and in that sense, indicators should be customized to their needs and be context relevant. To do so, the OCyT will need to deepen its research capabilities, which rely on highly qualified personnel and accumulation of know-how.

## References

- Alessandro, M. 2016. La economía política de la capacidad estadística: Una revisión de literatura. IDB Working Paper Series No. IDB-DP-472. Washington, D.C.: Inter-American Development Bank.
- Barré, R. 1997. La producción de indicadores para la política de investigación e innovación: Organización y contexto institucional. In H. Jaramillo and M. Albornoz (eds.), *El universo de la medición: La perspectiva de la ciencia y la tecnología*. Bogotá: Colciencias, RICYT, Tercer Mundo Editores.
- Colciencias (ed.). 1996. Hacia la construcción de un observatorio de ciencia y tecnología. Bogotá: Colciencias.
- Dargent, E. H. 2014. Determinantes internacionales de la capacidad de las agencias estatales: lecciones a partir de Colombia y el Perú. *Revista Apuntes XLI* (74): 9–40.
- Jaramillo, H. 1996a. Hacia la construcción de un observatorio de ciencia y tecnología en Colombia. In Colciencias (ed.), *Hacia la construcción de un observatorio de ciencia y tecnología*. Bogotá: Colciencias.
- Jaramillo, H. 1996b. Towards a new observatory for science and technology in Colombia. *Research Evaluation* 6(3): 201–204.
- Lepori, B., R. Barré, and G. Filliatreau. 2008. New perspectives and challenges for the design and production of S&T indicators. *Research Evaluation* 17(1): 33–44.
- Lepori, B., E. Reale, and R. Tijssen. 2011. Designing indicators for policy decisions: Challenges, tensions and good practices. Introduction to a special issue. *Research Evaluation* 20(1): 3–5.
- OECD (Organisation for Economic Co-operation and Development). 2015. *Frascati Manual 2015: Guidelines for collecting and reporting data on research and experimental development*. 6<sup>th</sup> edition. Paris: OECD.
- Ordoñez, G. 2002. La experiencia colombiana en la puesta en marcha del observatorio de ciencia y tecnología, OCyT. *Cuadernos del Cendes* 19(51): 83–108.
- Salazar, M. 2009. El OCyT en el SNCTI: 10 años poniendo a prueba un modelo. Paper presented at Seminario Taller Tendencias en la Medición de la Investigación y la Innovación, Bogotá.
- Salazar, M. 2010. Challenges to the Colombian S&T indicators production system. Poster presented at 3rd European Network of Indicators Designers (ENID) Conference, Paris.
- Salazar, M. and L. A. Colorado. 2010. La importancia de la información en la construcción de indicadores: Una verdad de Perogrullo. In M. Salazar et al., *Indicadores de Ciencia y Tecnología: Colombia 2010*. Bogotá: OCyT.
- Taylor, M. 2016. The Political Economy of Statistical Capacity: A Theoretical Approach. Discussion Paper No. IDB-DP-471. Washington, D.C.: Inter-American Development Bank.

## Annex 1: Survey Questionnaire

**1. Do you know why an STI observatory independent of Colciencias was created in Colombia?**

Yes / No (comments)

**2. Which of the following functions is OCyT developing?**

Analysis of the users' needs	Yes / No
Conception, adoption, and adaptation of indicators	Yes / No
Development of methodologies and techniques	Yes / No
Collection of information/data	Yes / No
Production of indicators	Yes / No
Dissemination of indicators	Yes / No
Storage and maintenance of information	Yes / No
Data interpretation	Yes / No
Use of the data for public policy evaluation	Yes / No
Training (in the workplace) of human resources specialized in STI	Yes / No
Policy advice	Yes / No

**3. Do you think that the ultimate goal or the goal pursued with the creation of the Colombian Observatory of Science and Technology (i.e., having reliable indicators for the formulation and evaluation of STI public policy) has been achieved?**

Goal not achieved /  
Goal partially achieved /  
Goal suitably achieved /  
Goal well achieved /  
Goal achieved with success

**4. Which of the following institutional arrangements do you consider the most suitable for the production of STI indicators in Colombia in the future?**

Outsourcing via the support of OCyT	In 5 years and/or in 10 years
Functions integrated to the national statistical agency (DANE)	In 5 years and/or in 10 years
Functions integrated to the national STI organization (Colciencias)	In 5 years and/or in 10 years
Outsourcing via the contracting of institutions such as universities/research centers or statistical agencies	In 5 years and/or in 10 years

**5. Which of the following options should be OCyT's strategy in the future for the production of indicators?**

Data-driven model, highly dependent on information sources (e.g., bibliometric and patent data)	In 5 years and/or in 10 years
Customer-driven model, aimed at developing performance and evaluation indicators	In 5 years and/or in 10 years

Based on the primary collection of information	In 5 years and/or in 10 years
Based on the secondary collection of information	In 5 years and/or in 10 years

**6. How has the OCyT built trust among its stakeholders (not only associates, but all users of the indicators) over the years?**

Quality of collected data	High contribution / medium contribution / low contribution / no contribution / does not know
Quality of indicators produced	High contribution / medium contribution / low contribution / no contribution / does not know
Regularity of reports and indicators produced	High contribution / medium contribution / low contribution / no contribution / does not know
Support in the improvement of information systems data of organizations	High contribution / medium contribution / low contribution / no contribution / does not know
Methodologies used with consistency, transparency, and technical rigor	High contribution / medium contribution / low contribution / no contribution / does not know
Development of its own methodologies	High contribution / medium contribution / low contribution / no contribution / does not know
Support in the design of regional methodologies and manuals (e.g., Ricyt manual)	High contribution / medium contribution / low contribution / no contribution / does not know
Adoption of international manuals and standards (OCDE manuals)	High contribution / medium contribution / low contribution / no contribution / does not know
Creation of endogenous capacities (training of human talent and knowledge/know-how accumulation)	High contribution / medium contribution / low contribution / no contribution / does not know

Capacity to analyze indicators	High contribution / medium contribution / low contribution / no contribution / does not know
Adopted governance model (public-private partnership with technical independency)	High contribution / medium contribution / low contribution / no contribution / does not know
Open access to indicators produced	High contribution / medium contribution / low contribution / no contribution / does not know
Open access to its own databases and information systems	High contribution / medium contribution / low contribution / no contribution / does not know

Others?

**7. From your perspective, what are the main achievements of OST in its 16 years of existence?**

Open question

**8. What are the risks and opportunities facing the OCyT today?**

Open question

**9. What challenges and opportunities may OCyT face in five years?**

Open question

**10. What do you think OCyT should be doing five years from now?**

Produce standard indicators (i.e., status quo)	Yes / No
Develop performance indicators for the evaluation of programs and institutions	Yes / No
Move away from the production of general purpose standardized indicators towards the production of personalized indicators according to the customer and the context	Yes / No
Change from a standardized process to an interactive one for the production of indicators	Yes / No
Become a think tank, oriented towards advice and counseling in STI policy	Yes / No