

Document of
The World Bank

Report No: ICR00002635

IMPLEMENTATION COMPLETION AND RESULTS REPORT
(IBRD-79440)

ON A

LOAN

IN THE AMOUNT OF US\$25 MILLION

TO THE

REPUBLIC OF COLOMBIA

FOR THE

STRENGTHENING THE NATIONAL SYSTEM OF SCIENCE,

TECHNOLOGY AND INNOVATION PROJECT

IN SUPPORT OF

THE FIRST PHASE OF THE

SCIENCE, TECHNOLOGY AND INNOVATION PROGRAM (APL-1)

August 24, 2016

Education Global Practice
Latin America and the Caribbean Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective December 31, 2015)

Currency Unit = Colombian Peso

COP\$1.00 = US\$0.00032

US\$1.00 = COP\$3174.5 CO

FISCAL YEAR

January 1 – December 31

ABBREVIATIONS AND ACRONYMS

AD	Afro-descendants
BSC	Balanced Score Card
CNCyT	National Council for Science and Technology
COLCIENCIAS	Administrative Department of Science, Technology and Innovation (<i>Departamento Administrativo de Ciencia, Tecnología e Innovación</i>)
CONPES	National Council of Economic and Social Policy (<i>Consejo Nacional de Política Económica y Social</i>)
CPS	Country Partnership Strategy
DNP	National Planning Department (<i>Departamento Nacional de Planeación</i>)
FDI	Foreign Direct Investment
FJC	<i>Francisco José de Caldas</i> Fund
GDP	Gross Domestic Product
ICR	Implementation Completion and Results Report
ICT	Information and Communication Technologies
IP	Indigenous People
IPPF	Indigenous Peoples Planning Framework
IDB	Inter-American Development Bank
M&E	Monitoring and Evaluation
R&D	Research and Development
RICYT	Science and Technology Indicators Network (<i>Red de Indicadores de Ciencia y Tecnología</i>)
SNCTeI	National Science, Technology and Innovation System (<i>Sistema Nacional de Ciencia Tecnología e Innovación</i>)
STI	Science Technology and Innovation
TFP	Total Factor Productivity
WB	World Bank

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COLOMBIA
Strengthening the National System of Science, Technology and Innovation

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A. Basic Information			
Country:	Colombia	Project Name:	Science, Technology and Innovation
Project ID:	P117590	L/C/TF Number(s):	IBRD-79440
ICR Date:	08/05/2016	ICR Type:	Core ICR
Lending Instrument:	APL	Borrower:	REPUBLIC OF COLOMBIA
Original Total Commitment:	USD 25.00M	Disbursed Amount:	USD 21.32M
Revised Amount:	USD 25.00M		
Environmental Category: B			
Implementing Agencies: Administrative Department of Science, Technology and Innovation - <i>Departamento Administrativo de Ciencia, Tecnología e Innovación (COLCIENCIAS)</i>			
Cofinanciers and Other External Partners: N/A			

B. Key Dates				
Process	Date	Process	Original Date	Revised / Actual Date(s)
Concept Review:	12/04/2009	Effectiveness:		10/20/2010
Appraisal:	04/23/2010	Restructuring(s):		09/05/2013 06/03/2015 12/07/2015
Approval:	07/15/2010	Mid-term Review:	07/30/2012	
		Closing:	12/31/2013	08/31/2015 12/31/2015

C. Ratings Summary	
C.1 Performance Rating by ICR	
Outcomes:	Moderately Satisfactory
Risk to Development Outcome:	Moderate
Bank Performance:	Moderately Satisfactory
Borrower Performance:	Moderately Satisfactory

C.2 Detailed Ratings of Bank and Borrower Performance (by ICR)			
Bank	Ratings	Borrower	Ratings
Quality at Entry:	Moderately Satisfactory	Government:	Moderately Satisfactory
Quality of Supervision:	Moderately Satisfactory	Implementing Agency/Agencies:	Moderately Satisfactory
Overall Bank Performance:	Moderately Satisfactory	Overall Borrower Performance:	Moderately Satisfactory

C.3 Quality at Entry and Implementation Performance Indicators			
Implementation Performance	Indicators	QAG Assessments (if any)	Rating
Potential Problem Project at any time (Yes/No):	No	Quality at Entry (QEA):	None
Problem Project at any time (Yes/No):	No	Quality of Supervision (QSA):	None
DO rating before Closing/Inactive status:	Moderately Satisfactory		

D. Sector and Theme Codes		
	Original	Actual
Sector Code (as % of total Bank financing)		
General industry and trade sector	40	31
Public administration- Industry and trade	50	30
Tertiary education	10	23
Basic education	0	16
Theme Code (as % of total Bank financing)		
Education for the knowledge economy	100	100

E. Bank Staff		
Positions	At ICR	At Approval
Vice President:	Jorge Familiar	Pamela Cox
Country Director:	Gerardo Corrochano	Gloria M. Grandolini
Practice Manager/Manager:	Reema Nayar	Chingboon Lee
Project Team Leader:	Robert J. Hawkins	Alejandro Caballero
ICR Team Leader:	Robert J. Hawkins	
ICR Primary Author:	Sara Troiano	

F. Results Framework Analysis

Project Development Objectives (from Project Appraisal Document)

The Project Development Objective (PDO) is to: (i) strengthen COLCIENCIAS' capacity to promote human capital for the knowledge economy, research and development (R&D) and innovation; and (ii) raise awareness of science, technology and innovation in the Colombian society.

Revised Project Development Objectives (as approved by original approving authority)

The PDO was not revised.

(a) PDO Indicator(s)

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
Indicator 1	Percentage of COLCIENCIAS annual investment budget committed by the end of the second quarter of the calendar year			
Value	4.8%	60%		70%
Date	2009			12/31/2015
Comments	Surpassed (117% achieved). This indicator measures progress towards strengthening COLCIENCIAS' capacity to promote human capital for the knowledge economy, R&D and innovation through activities under Component 1.			
Indicator 2	Number of instruments designed or redesigned and approved by COLCIENCIAS' Board of Directors (cumulative)			
Value	0	3		4
Date	2009			12/31/2015
Comments	Surpassed (133% achieved). This indicator was dropped in the 2013 restructuring, as the design of these instruments was assessed not to be a Project outcome. Results from these instruments are now captured under PDO indicator 4. The 4 instruments that meet this indicator are: i) Labor Insertion; ii) Diaspora; iii) Innovation Management; iv) Social Appropriation (see Annex 2 for more details on these activities).			
Indicator 3	Lessons learned summary completed based on the results of the evaluations.			
Value	No	Yes		Yes
Date	2009			12/31/2015

Comments	100% achieved. This indicator was dropped in the 2013 restructuring in favor of indicator 4, which is more outcome-oriented. The evaluations conducted focused on the instruments: i) Labor Insertion; ii) Diaspora; iii) Ondas; iv) Social Appropriation; v) Innovation Management. A lessons learned summary has been produced in 2015.			
Indicator 4	Number of new ideas or innovations developed by Labor Market Insertion, Diaspora, Innovation Management, Open Innovation and Priority Area program activities reflected in Components 2 and 3.			
Value	0	30	n.a.	168
Date	2013			12/31/2015
Comments	Surpassed (560% achieved). Indicator was introduced by the 2013 restructuring in substitution of the original PDO indicators 2 and 3. The new design of the indicator captures more directly the innovative outcomes developed by investment under components 2 and 3. It considers product, process and organizational innovation. Examples include the creation of a new magnetic fiber (in process of patenting), the design of a telescopic tripod to measure noise pollution, new systems of compressed air to improve energy efficiency, a new voice therapy instrument to rehabilitate people with disabilities, new processes for consultation of indigenous communities, a new low-cost system for water purification. See Annex 2 for more examples.			
Indicator 5	Total grant applications for R&D and innovation subprojects (<i>anteproyectos para recuperación contingente</i>) received yearly by COLCIENCIAS			
Value	2009	2674		n.a.
Date	2009			
Comments	Not available. This indicator was dropped in the 2013 restructuring to reflect a change in COLCIENCIAS' activities and selection of the subprojects. COLCIENCIAS no longer supports innovation subprojects which were originally pre-project concept notes (<i>anteproyectos para recuperación contingente</i>). All sub-projects are now financed as final subprojects through the <i>convocatoria</i> (call-for-proposal) process, in which the budget for funding is pre-determined. (More information on the evolution of demand for subprojects financed through <i>convocatorias</i> is presented in Section 2.3).			
Indicator 6	Percent of population that agrees that Colombia creates Science and Technology.			
Value	75% Science; 72% Technology	76% Science; 73% Technology		53% Science; 52% Technology
Date	2012			12/31/2015
Comments	Not achieved. This indicator was introduced in the 2013 restructuring. It is measured by a perception survey of public awareness on STI that asks the national population whether it agrees with the statement that Colombia			

creates Science and Technology. The survey was conducted in 2012 and in 2015. Although both editions were representative at a national level, due to budget constraints the sample size was reduced significantly in 2015 (from 6113 in 2012 to 1612 in 2015), resulting in higher variation/error in the 2015 survey.

(b) Intermediate Outcome Indicator(s)

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
<i>Overall project</i>				
Indicator 1	Direct project beneficiaries			
Value	n.a.	1,230,126		1,539,019
Date	2013			12/31/2015
Comments	Surpassed (125% achieved). This is the sum of beneficiaries from <i>Ondas</i> , <i>Social Appropriation</i> , and <i>Labor Market Insertion</i> programs. This is approximately 3.2 percent of the Colombian population in 2015.			
Indicator 2	Female beneficiaries (% of total)			
Value	n.a.	10%		52%
Date	2013			12/31/2015
Comments	Surpassed (520% achieved).			
<i>Component 1. Strengthening COLCIENCIAS' operational and policy making capacity; institutional strengthening of the STI National System</i>				
Indicator 3	Number of staff trained according to a revised competencies model			
Value	0	80%	80	94
Date	2009		2013	12/31/2015
Comments	Surpassed (117% achieved). In its original design, this indicator was intended to measure the percentage (versus the number) of staff trained according to the revised competencies model. It was revised in the 2013 restructuring because of an expected influx of new staff members to COLCIENCIAS in 2013-2014. The Bank team and the Borrower considered it difficult to have this influx of new staff trained within the timeline of the first phase of the Project. Hence, the goal of 80% of staff trained was changed to a total of 80 staff members trained, based on the			

	number of COLCIENCIAS staff employed at the time of the restructuring (104). The figure achieved corresponds to roughly 94 percent of the permanent staff in COLCIENCIAS at the time of appraisal, and 78 percent of the permanent staff currently employed in COLCIENCIAS.			
Indicator 4	Number of management units using the Balanced Score Card			
Value	0	10		10
Date	2009			12/31/2015
Comments	100% achieved. The Balanced Score Card consists of a set of key performance indicators. This strategic planning and management system is used extensively worldwide to align business activities with the vision and strategy of the organization, to improve internal and external communications, and to monitor organization performance against strategic goals.			
Indicator 5	Revised COLCIENCIAS' <i>convocatoria</i> processes, from call-for-proposals to subproject monitoring, developed and approved by COLCIENCIAS' Board of Directors (cumulative)			
Value	0 (No)	1 (Yes)		1 (Yes)
Date	2009			12/31/2015
Comments	100% achieved. " <i>Convocatoria</i> " is a call for proposals widely disseminated by COLCIENCIAS, inviting eligible individuals, institutions or firms, to submit subproject proposals, for the purposes of competitively selecting beneficiaries under Components 2, 3 and 4 of the Project. The new process incorporates the results from the technical assistance carried out by a consultancy for process revision.			
Indicator 6	Number of research papers, short policy papers, or technical papers completed by the internal policy unit (Cumulative)			
Value	0	13	8	10
Date	2009		2013	12/31/2015
Comments	Surpassed (125% achieved). The scope of this indicator was expanded in the 2013 restructuring to include the completion of short policy and technical papers, in addition to research papers, in accordance with the more clearly defined function of the internal Policy Analysis Unit. The target for this indicator was revised from 13 completed papers to 8 as a result of delays to the establishment of this Unit (see Section 2 for more details). Examples of papers completed include the Proposal for a National Policy of Social Innovation, the Strategic Plan for STI in Energy and Mining, the Case Studies of Korea and Turkey's Experience in Establishing Science & Technology Parks.			

Indicator 7	Number of beneficiaries who have completed short course(s)			
Value	n.a.	420		683
Date	2013			12/31/2015
Comments	<p>Surpassed (163% achieved). The indicator was introduced in the 2013 restructuring to monitor progress on a new activity that supported the development of short courses for regional stakeholders in the Colombian STI system. The decision of the government to use regional royalties (<i>regalías</i>) to finance STI activities at the local level found many regional stakeholders unprepared. The short courses served as capacity building for STI project development and implementation (see Section 2 for more details).</p>			
<i>Component 2. Strengthening COLCIENCIAS' capacity to promote development of human capital for science and technology</i>				
Indicator 8	Total number of students covered yearly by <i>Ondas</i>			
Value	0	1,200,000		1,536,479
Date	2009			12/31/2014
Comments	<p>Surpassed (146% achieved). The <i>Ondas</i> program finances STI education and research activities for pupils in pre-primary, basic and secondary education. The figure presented here is <i>cumulative</i> for the period 2011-2014 (after 2014 the program was financed through regional <i>regalías</i> rather than Project funds). Note that the original design of the indicator (as per PAD) indicates 1.2 million as <i>yearly</i>, rather than <i>cumulative</i>, target. The Bank team and the implementing agency share the view that this was the result of a misunderstanding in Project preparation: the target set is unrealistic as annual achievement (yearly beneficiaries were approximately 300,000 as of 2009), and the indicator was always interpreted as cumulative during Project implementation. On average, number of students covered <i>yearly</i> by <i>Ondas</i> has been 380,000 in the period 2011-2014.</p>			
Indicator 9	Monitoring and evaluation framework for <i>Ondas</i> designed			
Value	No	Yes		Yes
Date	2009			12/31/2015
Comments	100% achieved. The framework was completed in 2013.			
Indicator 10	Number of doctoral graduates participating in the Labor Insertion programs financed by COLCIENCIAS under the Project (cumulative)			
Value	0	15	29	28
Date	2009		2013	12/31/2015

Comments	93% achieved. The target for this indicator was revised upwards in the 2013 restructuring to reflect progress to date and revised expectations.			
Indicator 11	Number of subprojects involving researchers residing abroad participating in collaborative research projects (cumulative)			
Value	0	10	37	54
Date	2009		2013	12/31/2015
Comments	Surpassed (146% achieved). These subprojects aimed at promoting collaboration between Colombian researchers and the Colombian <i>diaspora</i> . The target for this indicator was revised upwards in the 2013 restructuring to reflect progress to date and revised expectations.			
Indicator 12	Number of evaluations for the <i>convocatorias</i> corresponding to the Labor Insertion and Diaspora pilots completed.			
Value	0	2		2
Date	2009			12/31/2015
Comments	100% achieved. The two studies provide a process evaluation of the two pilots, and sum up the main results from these investments.			
<i>Component 3. Strengthening COLCIENCIAS' capacity to promote research and innovation; investment for research and innovation.</i>				
Indicator 13	Number of proposals financed for innovation-management capacity building subprojects			
Value	0	1.3	100	128
Date	2009		2013	12/31/2015
Comments	Surpassed (128% achieved). This indicator was originally formulated as "Ratio of proposals for innovation management capacity building subprojects received, to proposals financed". It was revised in the 2013 restructuring because the ratio of proposals received to those financed depends on a number of factors (for instance, quality of proposals submitted, amount of financing available, etc.) that do not reflect COLCIENCIAS' capacity. The new indicator measures the number of proposals actually financed under the Innovation Management activity. Nevertheless, the achievement of the indicator as originally formulated would be of 5.6 as of December 2015.			
Indicator 14	Number of R&D and innovation subprojects in priority areas for which Project resources have been committed (cumulative)			
Value	0	10	2	5
Date	2009		2013	12/31/2015

Comments	Surpassed (250% achieved). The target for this indicator was revised downwards in the 2013 restructuring to reflect progress to date and revised expectations. The frequent changes in COLCIENCIAS' leadership (changing 5 directors in 5 years) made it difficult to complete the identification of the areas to prioritize and the validation process of business plans for each of them. The 5 subprojects financed focused on the areas of renewable energy, biofuels, and biodiversity.			
Indicator 15	Project resources committed to finance R&D and innovation subprojects in which there is at least one firm participating (cumulative).			
Value	0	US\$4 million	n.a.	US\$6.5 million
Date	2009		2013	12/31/2015
Comments	Surpassed (140% achieved). This indicator was dropped in the 2013 restructuring given that Project resources are an input and not an outcome indicator.			
Indicator 16	Number of evaluations for the calls-for-proposals corresponding to the R&D and innovation pilots completed			
Value	0	3		3
Date	2009			12/31/2015
Comments	100% achieved. The 3 evaluations include a results evaluation of the call <i>Locomotora</i> (under the Innovation Management activity), a case-study evaluation for 2 <i>convocatorias</i> for Innovation Management, and a process evaluation for Priority Areas.			
<i>Component 4. Promoting Social Dissemination of Science, Technology and Innovation and Institutional Communication</i>				
Indicator 17	Monitoring and evaluation framework for social dissemination of STI defined			
Value	No	Yes		No
Date	2009			12/31/2015
Comments	Not yet achieved (On track for achievement by September 2016). The definition of the framework was sub-contracted to the National Observatory for STI. A first set of indicators to be used for monitoring and evaluation of social dissemination activities has been defined as of April 2016. This first proposal is currently being discussed in national and regional working groups. A final version is expected to be approved by September 2016.			
Indicator 18	Number of citizens directly <i>participating in</i> COLCIENCIAS' citizen participation activities financed by the Project (excluding <i>Ondas</i> and mass			

	media)			
Value	0	75,000	8,500	27,512
Date	2009		2013	12/31/2015
Comments	Surpassed (324% achieved). The wording of this indicator was changed in the 2013 restructuring from “benefitting” to “participating in” since the former concept is less straightforward to measure. The target was revised down to 8,500 to reflect the actual targeted number of participants for activities as planned in FY13 and FY14. The total number of participants at Project completion includes 25,000 participants from “A Ciencia Cierta”, and 2,512 participants from the Social Appropriation pilot program (see Annex 2 for more details on these activities).			
Indicator 19	Annual number of document downloads from COLCIENCIAS’ Web page (not including documents related to calls for proposals)			
Value	18,000	39,500	n.a.	87,086
Date	2009		2013	12/31/2015
Comments	Surpassed (210% achieved). This indicator was dropped in the 2013 restructuring. It was replaced by intermediate indicator 20 that better captures COLCIENCIAS’ improvement in reaching Colombian society and increasing awareness about science, technology and innovation.			
Indicator 20	Annual number of unique visits to COLCIENCIAS’ web page			
Value	n.a.	429,000		4,735,851
Date	2013			12/31/2015
Comments	Surpassed (1104% achieved). The actual number of unique visitors registered at Project completion includes visitors in the period September-December 2015, as COLCIENCIAS installed the tool to measure this indicator (Google Analytics) only by the 08/24/2015. Assuming a constant number of visitors for each 4-month period, COLCIENCIAS’ web page could have achieved as much as 18,943,404 unique visitors in the whole year.			
Indicator 21	Development of social innovation policy document			
Value	No	Yes		Yes
Date	2013			12/31/2015
Comments	100% achieved. This document served as input for the development of the CONPES (national strategy/policy document).			

G. Ratings of Project Performance in ISRs

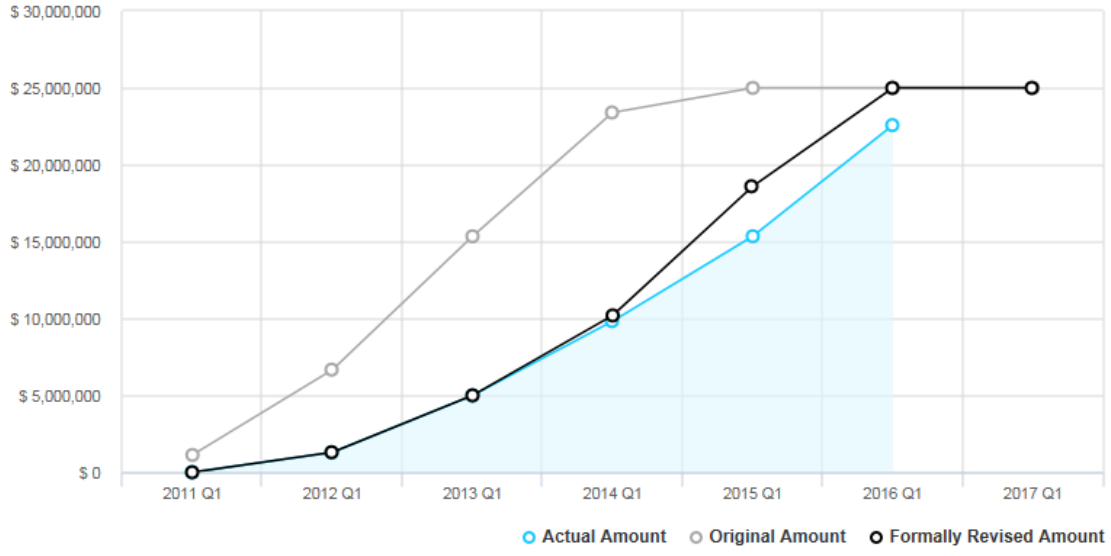
No.	Date ISR Archived	DO	IP	Actual Disbursements (USD millions)
1	10/11/2010	Satisfactory	Satisfactory	0.00
2	05/01/2011	Satisfactory	Satisfactory	0.00
3	01/29/2012	Satisfactory	Moderately Satisfactory	5.00
4	08/24/2012	Satisfactory	Moderately Satisfactory	5.00
5	05/16/2013	Moderately Satisfactory	Moderately Satisfactory	8.10
6	12/09/2013	Moderately Satisfactory	Moderately Satisfactory	11.21
7	07/06/2014	Moderately Satisfactory	Moderately Satisfactory	13.56
8	01/15/2015	Moderately Satisfactory	Moderately Satisfactory	19.11
9	08/10/2015	Moderately Satisfactory	Satisfactory	22.58
10	12/22/2015	Moderately Satisfactory	Satisfactory	22.58*

*The disbursed amount at the end of the grace period was US\$20.64 million. See Section 2.2 for explanation of this discrepancy.

H. Restructuring (if any)

Restructuring Date(s)	Board Approved PDO Change	ISR Ratings at Restructuring		Amount Disbursed at Restructuring in US\$, millions	Reason for Restructuring & Key Changes Made
		DO	IP		
05/09/2013		MS	MS	8.10	<ul style="list-style-type: none"> - Expand scope of Project's components - Revise the results framework - Modify the disbursement arrangements - Reallocate proceeds - Change Project's costs - Extend the closing date until 8/31/2015 - Amend legal documentation
06/03/2015		MS	MS	19.11	Extend closing date until 12/31/2015
07/12/2015		MS	S	22.58	Reallocation of funds

I. Disbursement Profile



1. Project Context, Development Objectives and Design

1. The Science, Technology and Innovation (STI) Project responded to the Government's objective of strengthening the National System of STI as the first necessary step to achieving a growth model based on science, technology and innovation. The operation financed the strengthening of STI institutions, as well as the design, implementation and evaluation of a series of innovative STI investment pilots. If successful, the Project would: (i) strengthen COLCIENCIAS (Colombian Administrative Department of STI) capacity to promote human capital for the knowledge economy, research and development and innovation; and (ii) raise awareness of science, technology and innovation in the Colombian society.

1.1 Context at Appraisal

2. By 2009, Colombia had experienced a decade of strong and sustained growth, in sharp contrast to its weak performance during the late 1990s. Driven by increased domestic demand, abundant liquidity, and fiscal incentives for investment, annual growth rates averaged 6 per cent over the 2000s. Improvements in the business environment, as well as in security, also contributed to an important inflow of foreign resources for investment. Nevertheless, Total Factor Productivity (TFP) and export sophistication remained relatively low. The Government recognized that to transform these short-term achievements into sustainable long-term growth, the country had to develop a new productive economic model, leveraging on technology and innovation activities.

3. In 2009¹ the Government approved the Law 1286, by which: (i) it created the National System of Science, Technology and Innovation (STI) (SNCTeI by its acronym in Spanish), promoting the integration of the Innovation pillar in the existing System of Science and Technology, and the interaction between the public sector, the private sector and academia as STI stakeholders; (ii) it assigned to COLCIENCIAS, the national agency for science and technology, the responsibility of designing, updating, coordinating and implementing the National STI Policy, and elevated the status of the institution to Administrative Department reporting directly to the Presidential Cabinet; and (iii) it set up the National Fund for STI Financing *Fondo Francisco José de Caldas* (FJC Fund), to channel resources from different actors of the SNCTeI and manage them through an independent fund.

4. These reforms aimed to improve the institutional context to more effectively face the existing challenges in the STI sector. This policy area had previously been characterized by budget fluctuations, institutional fragmentation and weak sector leadership. The development of scientific skills was limited, and the country had an inadequate stock of advanced human capital. Publicly financed research had little economic relevance and limited international linkages. Similarly, there were only weak links between key STI stakeholders, such as local

¹ Between 2006 and 2009, a series of strategic institutional documents were produced, all recognizing the key role played by STI in achieving equitable and sustainable growth: the National Development Plan 2006-2010; the long-term Government strategy "Colombia Vision to 2019," the National Competitiveness and Productivity Policy (CONPES 3527); and the National STI Policy (CONPES 3582).

researchers, the Colombian *diaspora*, the private sector, and knowledge institutions. Firms had low capacity to undertake commercially-oriented innovations leading to the introduction of new products and services. Access by society to content and information related to STI was relatively low, and there was limited awareness of public incentives for STI investment.

5. To support the implementation of the new STI policy, in June 2009 the Government requested the preparation of two projects, one financed by the Inter-American Development Bank (IDB) and another financed by the World Bank (WB). These two projects, although independent, were designed to finance complementary activities in order to maximize synergies.

6. The Science, Technology and Innovation Project responded to the Government's objective of strengthening COLCIENCIAS and the SNCTeI to develop a new, productive growth model based on science, technology and innovation. The operation was also fully aligned with two of the FY08/11 CPS pillars: (i) achieving sustained equitable growth, by increasing knowledge generation, absorption, and utilization; and (ii) improving governance, by strengthening the public entities of the national STI system (Report No. 42847-CO).

1.2 Original Project Development Objectives (PDO) and Key Indicators (as approved)

7. The Project was designed as the first phase of an expected two-phase Adaptable Program Loan (APL).² The objective of the APL was to enhance the Borrower's ability to generate, identify, disseminate, apply and integrate knowledge among its citizens to foster economic growth and diminish inequities (letter dated April 22, 2010, from the Director of COLCIENCIAS on behalf of the Borrower to the Bank).

8. The objectives of the Project were to: (i) strengthen COLCIENCIAS capacity to promote human capital for the knowledge economy, research and development and innovation; and (ii) raise awareness of science, technology and innovation in the Colombian society.³

9. These objectives were to be measured by the following key indicators and targets:

- PDO indicator #1 - 60 percent of COLCIENCIAS' annual investment budget committed by the end of the second quarter of the calendar year;

²The second phase was expected to be financed through a loan of US\$225 million (PAD, Report No: 52760-CO). Phase II would have been triggered when both conditions presented below were met. **Condition I:** The following three conditions are met: (i) design or redesign of at least three new or existing financing instruments approved by COLCIENCIAS' Board of Directors; (ii) evaluations completed for the investment pilots effectively carried out and lessons learned summary completed; and (iii) at least 75 per cent of loan proceeds have been disbursed. **Condition II:** 2 out of 4 of the following actions are met: (i) at least 50 per cent of COLCIENCIAS' staff trained according to the new competencies model; (ii) at least 80 per cent of COLCIENCIAS' management units using the Balanced Scorecard or an equivalent performance management tool; (iii) revised COLCIENCIAS' *convocatoria* processes, from call-for-proposals to subproject monitoring, developed and approved by COLCIENCIAS' Board of Directors; and (iv) at least one research paper completed by the internal policy analysis unit.

³ Loan Agreement, Loan 7944-CO, 2010. There are no discrepancies between the PAD and the Loan Agreement.

- PDO indicator #2 - 3 instruments designed or redesigned and approved by COLCIENCIAS' Board of Directors;
- PDO indicator #3 - "Lessons learned" summary completed;
- PDO indicator #4 - 2674 grant applications for R&D and innovation subprojects (*anteproyectos recuperación contingente*) received yearly by COLCIENCIAS.

1.3 Revised PDO and Key Indicators, and reasons/justification

10. The PDO was not revised. However, key indicators and targets were revised during the 2013 Project restructuring. The following key indicators were dropped and added (more details can be found in the Data Sheet):

Dropped (3)

- PDO Indicators #2, #3 and #4

Added (2)

- 168 new ideas or innovations developed by Labor Market Insertion, Diaspora, Innovation Management, Open Innovation and Priority Area program activities reflected in components 2 and 3; and
- 76 percent of the population agrees that Colombia creates Science, and 73 percent agrees that Colombia creates Technology.

1.4 Main Beneficiaries

11. The direct target group were Colombian stakeholders of the SNCTeI: public STI institutions, especially COLCIENCIAS and regional actors active in the STI sector (primarily through activities under Component 1); domestic research institutes and Colombian researchers, both residing in the country or abroad (primarily through activities under Component 2); children and youth attending the education system (primarily through activities under Component 2); the private sector (primarily through activities under Component 3); and the Colombian society as a whole (primarily through activities under Component 4 and spillovers from the other activities), including indigenous people and most vulnerable groups (see Section 3.5).

1.5 Original Components

12. Component 1 (US\$5.8 million) aimed at strengthening COLCIENCIAS' operational and policy-making capacity; and institutional strengthening of the STI National System including: (a) the enhancement of its organization, human resource capabilities and business processes; (b) the improvement of its strategic and sector planning and policy-making; (c) the improvement of its capacity to monitor, evaluate and manage the Project.

13. Component 2 (US\$14.6 million) aimed at strengthening COLCIENCIAS' capacity to promote the development of human capital for the knowledge economy through: (i) the financing of a pilot to promote the labor market insertion of doctoral graduates (*Labor Market Insertion* program); (ii) the financing of a pilot to promote linkages between Colombian and non-Colombian scientists and the Colombian diaspora (*Diaspora* program); (iii) the financing

of investments to promote the development of scientific skills in basic and secondary education (*Ondas* program).

14. Component 3 (US\$17.6 million) aimed at strengthening COLCIENCIAS' capacity to promote Research and Development (R&D) and innovation through the financing, including matching grants, of investment pilots to support: (i) the development of innovation-management capabilities in firms (*Innovation Management* program); (ii) R&D and innovation subprojects in strategic knowledge areas (*Priority Areas* program); (iii) subprojects under revisions of existing COLCIENCIAS' instruments for *recuperación contingente* and *cofinanciación*; and (iv) the provision of technical assistance to develop and implement plans and carry out evaluations.

15. Component 4 (US\$3.5 million) aimed at promoting social dissemination of STI and institutional communication by financing investments to: (i) increase awareness and disseminate knowledge of STI among the public and private sectors in Colombia (*Social Appropriation*); and (ii) increase COLCIENCIAS' visibility in the Colombian society.

1.6 Revised Components

16. The 2013 Project restructuring allowed for an expanded set of activities under Component 2 (short courses for relevant stakeholders at the regional level in the Colombian STI system; and expansion of the scope of the *Ondas* program to pre-school level); Component 3 (by introducing a new pilot program to promote *Open Innovation*⁴); and Component 4 (dissemination of successful experiences of social innovation; the development of a Social Innovation Policy). The restructuring also dropped the financing of the implementation and evaluation of *recuperación contingente* and *cofinanciación*⁵ matching grants. Finally, the sub-component to finance the acquisition and operation of vehicles for mobile classrooms (under Component 4) was dropped.

1.7 Other significant changes

17. The Closing Date was extended twice, first for 20 months until August 31, 2015 and then for another 4 months until December 31, 2015. During the 2013 restructuring, funds were reallocated from the disbursement category "Stipends under Component 2" to the category "Grants under Component 2" to finance the expansion of *Ondas*, the activity on STI education, to pre-school level. During the 2015 restructuring, funds were reallocated from the disbursement category "Consultants' services under Components 1, 2 and 3" to the categories "Grants under subprojects under Component 3" (to finance additional subprojects under Priority Areas and Innovation Management) and "Stipends under Component 2" (to compensate for currency fluctuations and allow for full payment of previous commitments).

⁴ This activity was eventually not implemented as a separate program, but the principle behind it (to let specific demand for innovation on certain topics to rise spontaneously from civil society) was maintained in the *Social Appropriation* program and *A Ciencia Cierta* under Component 4.

⁵ Two types of matching grants for research and for innovation.

2. Key Factors Affecting Implementation and Outcomes

2.1 Project Preparation, Design and Quality at Entry

18. The Project design built on lessons learned through the WB engagement in Higher Education and other relevant sectors in Colombia. The policy note "Colombia 2006-2010: A Window of Opportunity" (Report No. 50681) was critical in identifying the main sectoral challenges that needed to be addressed, and in proposing specific policy recommendations.⁶ Previous Bank operational experience in the country confirmed the suitability of COLCIENCIAS as implementing agency (Colombia Higher Education Project, Loan No. 7155-CO, P074138); and the efficacy of promoting demand-driven innovation research, and to involve local actors, in technology development (Colombia Agriculture Technology Development Project, Loan No. 3871-CO, P006880).

19. The Project design also benefitted from operational experiences from Bank-financed projects in middle income countries in Latin America (Argentina, Uruguay, Chile and Mexico) and other regions (Turkey, Croatia, Armenia). Among the lessons learned from these experiences, the Project design incorporated the following: (i) to support institutional strengthening in the STI sector before financing large-scale investment activities; (ii) to include the evaluation of pilot programs measured in the results framework, to inform design and scale of follow up activities, if proven successful.

20. Coordination with the IDB was ensured to avoid overlaps and deliver the maximum value added from collaboration. Activities financed by WB and IDB respectively were organized around the same development objectives and the same project components. Implementation guidelines for the two independent projects were collected in one unique Operations Manual of reference and the projects shared one coordination team. Overall, the Project design was adequate in its stage-by-stage articulation, choosing to support institutional strengthening and identifying pilot activities with high potential before investing in large-scale sub-projects. The pilot activities were very innovative in their design, both at country level and in the sector globally. The preparation process was highly participatory.

21. The Project design may have underestimated some of the risks for implementation. First, previous operational experiences in the STI sector all suggest that the implementation of activities to promote science and innovation entails a slow-growing learning curve. None among the operational examples mentioned in the PAD seems to suggest three years as a realistic time frame to implement both important institutional reforms and the design, implementation and evaluation of the envisaged large number of pilot investments. Indeed, the initially foreseen closing date may have been too optimistic for this Project design. Secondly, the risk of high volatility in COLCIENCIAS' budget, and the direct consequences

⁶ In particular, the Project design incorporated the policy note recommendations on increasing private sector capacity for innovation by (i) increasing awareness among CEOs to new parameters of competitiveness such as quality, technology and innovation (*Innovation Management* pilot under Component 3); (ii) increase firm absorptive capacity through ice-breaker programs that temporarily subsidizes employment of young researcher in businesses without R&D capacity (*Labor Market Insertion* pilot under Component 2); and (iii) concentrate R&D funding around topics relevant to sectors with R&D capacity (*Priority Areas* under Component 3).

in terms of high staff turnover, were not identified at appraisal. Accordingly, no related mitigation measure was discussed (as for instance including requirements in the Loan Agreement for the Borrower to financially contribute to the Project in an agreed, fixed amount, or in terms of consistency in the budget assigned to COLCIENCIAS as a percentage of GDP).

2.2 Implementation

22. Project implementation took two years longer than originally planned, and only 20.64 million (83%) of the estimated US\$ 25 million have been disbursed after completion of the grace period. This is due to delays in implementation which were mainly a result of significant political and budgeting changes in the country, and in the STI sector in particular, not envisaged at the time of appraisal. Notwithstanding these challenges, the extended implementation period did lead to significant institutional learning and the scaling up of most of the planned activities⁷.

23. In 2011, a new General System of Royalties (*Sistema General de Regalías*) was set up, to distribute revenues from mining and energy-related royalties to regional governments. The system requires local governments to invest at least 10 percent of revenues from royalties in STI activities, to be administered at local level. Despite the clear added value of this reform in empowering local STI actors, it implied a significant change in the role of COLCIENCIAS. On the one hand, these additional funds for STI, equivalent to more than twice the annual budget of COLCIENCIAS, were now directly at local governments' disposal. On the other hand, local stakeholders were lacking COLCIENCIAS institutional capacity and experience in STI investment, and required significant training and implementation support.

24. COLCIENCIAS suffered from important changes in leadership and budget allocation. The agency had 5 Directors (plus 2 Acting Directors and a number of technical Directors) in the period 2010-2015, implying continuous changes in the priorities and processes that made it difficult to maintain a consistent long-term strategy. The introduction of *regalías* as a source of public investment in STI on the one hand, and the emergence of new policy priorities for national public resources on the other, resulted in a shrinking and volatile budget for COLCIENCIAS. The agency budget was cut by 11 percent between 2011 and 2015, going from 0.061 percent of GDP in 2011 to 0.043 in 2015, with important variations in between. The high turnover in COLCIENCIAS technical staff was one of the direct consequences that severely affected Project implementation.

25. The implementation of activities under Component 1, targeting COLCIENCIAS institutional strengthening, responded to the changing political climate with a stronger focus on COLCIENCIAS' role as coordinator of the STI policy. In particular, the optimization of the *convocatoria* (call-for-proposal) process to finance sub-projects was strategic in positioning COLCIENCIAS as the technical partner for oversight and allocation of public STI investment, independently from the source of financing (*regalías*, Ministries' resources for STI, etc.).

⁷ As reflected by the number of key and intermediate targets that were surpassed at Project completion.

26. The Project was restructured three times (May 2013, June 2015, and July 2015 - Level II restructurings), to adapt to these changing circumstances and to allow for an extended implementation period (more information in the Data Sheet, Section H and Section 1 in this document).

27. The major issues raised by COLCIENCIAS at the introduction of *regalías* were i) the governance of the system; (ii) the major challenge of incorporating new stakeholders into the process of designing STI programs; and iii) the opportunity to leverage social innovation at the local level for greater support of the Peace Process⁸. The 2013 Project restructuring responded by introducing a new activity to develop capacity building courses for relevant stakeholders in the STI system at the regional level; *Open Innovation* activities to provide a system to incorporate more voices and stakeholders into the system; and the stronger focus on Social Innovation to ensure more attention on relevant regional issues.

28. A strong technical involvement of COLCIENCIAS in STI investments on the one hand, and the progressive capacity building of regional stakeholders and civil society on the other hand, strengthened the transition to the new *regalías* system to finance STI investment.

29. A focus on sustainability and recurrent cost management by COLCIENCIAS was reflected in the 2013 restructuring through the choice of eliminating the pilot investment on mobile classrooms for dissemination of STI activities, as this instrument was anticipated to involve high recurrent costs of operation that could not have been sustained by COLCIENCIAS' budget in the medium-long run. New activities introduced by the same restructuring included more strategic and relatively less costly interventions that leverage the STI network in the country (dissemination of successful experiences of social innovation, and the development of a Social Innovation Policy under Component 4), or decentralized pilot investments whose potential scale-up could eventually be financed under the *regalías* system (as in the case of the extension of *Ondas* to pre-school level under Component 2).

30. The adjustments in the set of the activities to be implemented, and the way of implementing them, are also the result of a proactive incorporation of lessons learned during the process of implementation. The recent "Functional & Governance Analysis of Public Investment in STI" (World Bank & Colombia DNP, 2016) in Colombia, highlights evidence of a learning process in implementation as one of the major strengths of COLCIENCIAS. The same study suggests that this fruitful incorporation of lessons learned is partly due to a good articulation between the different areas in COLCIENCIAS in charge of strategy, implementation and evaluation (World Bank, 2016, page 121).⁹ This articulation has been

⁸ The Colombian Government has been engaged in peace talks with the country's largest rebel group, FARC, since November 19, 2012.

⁹ The report also highlights some degree of heterogeneity among the performance of the single instruments financed by COLCIENCIAS in terms of design, implementation and evaluation. The analysis suggests that all the best performing instruments were among those financed by the Project, while none of the Project activities was among the worst performing programs. This observation suggests that the Project may have facilitated an effective and efficient implementation of activities not only through the overall institutional strengthening of COLCIENCIAS, but also directly by providing specific technical assistance on some of the instruments, and

directly supported by activities under Component 1 that analyzed and recommended the reform of COLCIENCIAS' organizational structure.

31. The APL required two conditions (for a total of five specific actions) to be met before development of Phase II.¹⁰ Both conditions were met under the Project. However, subsequent to changes in government priorities and the introduction of regional STI funds through *regalias*, the government has decided not to pursue the second phase of the APL.

2.3 Monitoring and Evaluation (M&E) Design, Implementation and Utilization

32. **Design.** With regard to monitoring of the Project, key and intermediate indicators were adequately identified and reflected the PDO and Project components, although some of them had a bias towards measuring processes rather than outcomes.¹¹ One important weakness was the choice of the only key indicator that monitors progress against achievement of one of the two parts of the PDO, namely "raise awareness of STI in the Colombian society". The indicator measures the "Percentage of people that believes that Colombia creates Science and Technology": it does not directly capture awareness, it is very sensitive to changes in perception on issues other than STI (for instance perception on the Government's performance, or on the country's economic trends), and it is relatively costly to measure (as it requires a survey representative at national level). With regard to evaluation, another weakness is the preparation for evaluation activities at Project design. Although both the PAD and the results matrix stress the importance of carrying out evaluations of the financed activities, no specific indication was given on the type, scope, and possible techniques to apply, neither in the PAD nor in the Operations Manual. Moreover, no baseline data collection was carried out for most indicators, nor control groups identified to allow for impact evaluations.

33. **Implementation.** Appropriate data on indicators was collected on a timely basis and made available to staff in COLCIENCIAS and the Bank. Collection mechanisms, however, were time consuming and not automatic, due to delays in the implementation of the COLCIENCIAS online Integrated Information System (one of the activities financed by the IDB). The evaluation of some key activities was more focused on process analysis than on results or impact (evaluations of the *Diaspora* and *Social Appropriation* programs).¹² Institutionally, the strategy of the Evaluation Policy Unit was very sensitive to changes in COLCIENCIAS leadership.

ensuring some continuity of the lines of activity, continuity that in the case of COLCIENCIAS' programs not supported by the Project was hampered by frequent changes in the agency's leadership and budget volatility.

¹⁰ See Section 1.2 for further details.

¹¹ One of the recommendations from the Decision Meeting for this Project was precisely to prefer indicators likely to capture short- and mid-term changes (Decision Note – Decision Meeting March 30, 2010). Indeed, it is particularly challenging to design an accurate results matrix to capture outcomes of STI projects. Outcome indicators (for instance, development of innovative products and services, increase in productivity, and trade in R&D services) may be difficult to materialize in the relative short life of a project.

¹² Even in this case, the IDB Project envisaged a component dedicated to evaluations that, if implemented in a timely manner, would have likely supported the quality of the evaluations conducted under the WB Project.

34. **Utilization.** Monitoring indicators were used to measure progress and to identify problems. Findings were used to modify procedures and to take actions. Many of the indicators in the results framework were included in the Balanced Score Card system adopted to monitor COLCIENCIAS management's performance. Information from M&E was shared not only with the operational units in charge of the programs, but it was also utilized in internal workshops on the Design of STI Policies and Programs. Interviews with COLCIENCIAS' personnel confirmed that one of the main added values of the Project was to sustainably strengthen the M&E culture within the agency.

2.4 Safeguard and Fiduciary Compliance

35. **Environmental safeguards.** The Project triggered OP/BP 4.01 and included an Environmental Assessment (EA). The EA procedure, integrated in the Environmental Management Framework, establishes that: (1) sub-projects to be financed by COLCIENCIAS will contain all environmental provisions to ensure a low environmental impact; (2) beneficiaries are required by contract to comply with the environmental management and, when necessary, to obtain environmental permits from the competent authorities. In 2014 the Bank Team reviewed the environmental performance of a representative sample of sub-projects, and provided recommendations to improve implementation of the EA. An Action Plan was agreed on and properly implemented by COLCIENCIAS.

36. **Social safeguards.** The Project triggered OP/BP 4.10 and included an Indigenous Peoples Planning Framework (IPPF). The IPPF called for COLCIENCIAS to: (i) eliminate potential discriminatory factors to ensure equal access for research and innovation grants; (ii) adopt special outreach and communication measures targeted to these populations to ensure that they were aware of and could compete for research grants; and (iii) provide technical support to indigenous people (IP) and Afro-descendants (AD) who were interested in the preparation of competitive proposals. The IPPF outlined several other recommendations to integrate IP and AD priority issues within the research lines supported, support the upstream participation of IP and AD groups in the regional science, technical and innovation programs, and protect the intellectual property of the beneficiaries, among others. The IPPF was satisfactorily implemented by COLCIENCIAS.

37. **Financial management (FM)** performance was assessed Moderately Satisfactory throughout project implementation, except during the supervisions carried out in June and December 2014, where the FM was rated as Moderately Unsatisfactory¹³. Subsequently COLCIENCIAS took corrective actions. As of July 2016, COLCIENCIAS has completed and submitted justification of expenditures (SOE) incurred by the beneficiaries, for all the subprojects executed by December 2015 and is to reimburse the Bank the outstanding

¹³ This temporary downgrading was due to: (a) key FM positions staying vacant for long time; (b) implementation of cumbersome internal controls for the financial follow-up of subprojects; (c) staff arrangements and procedures for the follow-up of subprojects were not adequate nor conducted in a timely manner; (d) contracts for the subprojects were entered with an implementation period that could not be met by the project closing date; (e) the process to contract a new fiduciary agent were delayed; (f) the actions to implement the recommendations from the external audits and the Bank supervisions did not adequately address the causes of the findings.

advance to the Designated Account, amounting to US\$676,629. The Bank extended the grace period by two months, to allow completion of the justification by the subproject beneficiaries, and reimbursement to the Bank the unused advance to the Designated Account. The final audit for FY 2015, including the grace period, was received on June 30, 2016. The project FM risk was assessed as Substantial.

38. From 2011 to 2014 the Project was audited by private audit firms and the audit for FY 2015 was completed by June 30, 2016. The auditors issued an unqualified (clean) opinion on the project financial statements. Nevertheless, they pointed out that although COLCIENCIAS implemented action plans to solve internal issues, in some instances the actions were ad-hoc instead of strategic measures to correct the root causes. The explanation for this deficiency, among others, was the rotation of financial and technical staff and the frequent changes in the agency's Executive Director. Acceptable interim unaudited financial reports were submitted within the contractual date.

39. **Procurement** processes were performed in conformity with WB guidelines, the provisions of the Loan agreement and the Project Operational Manual, as confirmed by the independent review conducted between December 2014 and February 2015. As with financial management, the frequent changes in COLCIENCIAS leadership resulted in changes in the team which required a familiarization process on project management. The inclusion of the Project procurement plan in the Bank's SEPA system (since 2013) allowed for an efficient management and monitoring of all contracts incurred during Project implementation.

2.5 Post-completion Operation/Next Phase

40. Based on the lessons and processes learned during Project implementation, COLCIENCIAS will further reinforce its role as coordinator of the STI system and will increasingly leverage resources external to its own budget to finance STI investments.

41. The new Government program "*Colombia Científica*," run by the Ministry of Education and in preparation to be financed by a new WB operation,¹⁴ will support scholarships for PhD students (*Pasaporte a la Ciencia*) and the formation of thematic research networks on priority areas (*Ecosistema Científico*) among national and international universities thus providing continuity on the human capital dimensions of the Project. The new program will use the *Convocatoria* process optimized during this Project and rely on COLCIENCIAS as a technical partner and implementing agency, but will shift the financial burden of these activities to the Ministry of Education (scholarships for PhDs currently represent as much as 70 percent of COLCIENCIAS's current expenditure). This will offer COLCIENCIAS financial margin to increasingly focus its activities on innovation and competitiveness, and reinforce the link with the private sector, consistent with the 2014-2018 National Development Strategy (see Section 3.1).

¹⁴ Although this new operation is expected to draw on lessons learned from this Project, it is the opinion of the Bank Team that this cannot be properly considered as a second phase of the APL. The scope of the new operation, still under discussion, is in line with the original APL's aim, but presents a much narrower focus on human capital formation.

42. The pilot investments that have proven most successful will be continued or scaled up. This is the case of *Ondas* (Component 2), which will continue to be financed through *regalías* in the future, and an evolution of *Innovation Management* (Component 3), managed by COLCIENCIAS with support from local Chambers of Commerce, and jointly financed by the Ministry of Finance (through tax credits) and the private sector (providing direct investment)¹⁵.

43. For those pilots where it will not be possible to leverage enough financial resources for continuation/scale up, COLCIENCIAS will support strategic spin-off initiatives with a narrower focus, but whose added value has been confirmed by the pilot experience. As an example, COLCIENCIAS will finance the creation of a dedicated online platform to support the matching of supply and demand of PhD graduates.¹⁶

3. Assessment of Outcomes

3.1 Relevance of Objectives, Design and Implementation

44. **Relevance of objective.** Pre-2013 restructuring rating: Substantial; Post-2013 restructuring rating: Substantial.

45. The objective was strategically aligned to the country's strategy and remained important during implementation. The current National Development Plan (NDP) 2014-2018 "*Todos por un nuevo país*" identifies competitiveness as a cross-cutting policy for the achievement of the development pillars and states that the competitiveness strategy should have its foundations in innovation – with an emphasis on the integration of the National System of Competitiveness with the National System of STI.

46. Despite this issue that the second part of the PDO could have been defined better, it is still assessed as substantially relevant. As shown in Annex 10, this part of the PDO was mainly supported by Project activities under Component 4, which aimed to increase the outreach of STI policy, getting civil society, indigenous and afro-descendants population, children and adolescents from vulnerable context, and other vulnerable groups, into STI activities. This is consistent with the Equity Pillar of the current NDP 2014-2018.

47. The Project objective is also aligned with the third strategic theme of the 2012-2016 Country Partnership Strategy, focusing on *inclusive* growth with enhanced *productivity*.

¹⁵ The design of the next phase of the Innovation Management program is another example of incorporation of the lessons learned during Project implementation. The pilot experience highlighted that demand comes from two different types of firms: (i) firms with low-innovation capacity, that require training on STI investment, and are better reached by local actors such as Chambers of Commerce; and (ii) firms with medium to high innovation capacity, which have financial means to invest in STI but require highly specialized technical support. COLCIENCIAS' services will therefore be organized so as to address these two different types of beneficiaries, and focus on capacity building and specialized training services rather than providing grants. Both type of beneficiaries will nevertheless receive tax credits to invest in STI.

¹⁶ Lessons learned from the *Labor Insertion* pilot suggested that the difficulty to find enough information to match demand and supply of high-skilled graduates may represent a more important barrier to labor insertion of PhDs than the financial constraint of the private sector to pay for the PhD's wage.

48. **Relevance of design and implementation.** Pre-2013 restructuring rating: Substantial; Post-2013 restructuring rating: Substantial.

49. The Project design was very appropriate in support of the newly created National STI System (Law 1286, 2009). It emphasized institutional strengthening in the STI sector as the essential condition to build a system. Pilot investments provided crucial information to develop the current STI strategy, identifying a few areas of action with the highest potential. The planned activities were consistent with Project objectives. The restructurings allowed the Project to adapt to changing circumstances to ensure achievement of the PDO. Implementation was characterized by a strong learning process and the continuous adjustment and incorporation of lessons learned.

3.2 Achievement of Project Development Objectives

50. To assess the Project’s achievement, this ICR considers separately the following dimensions of the PDO: (i) strengthen COLCIENCIAS’ capacity to promote human capital for the knowledge economy, research and development (R&D) and innovation; and (ii) raise awareness of science, technology and innovation in the Colombian society.¹⁷ The assessment relies on the Project’s key indicators, supplementary indicators collected at the ICR stage, and results from evaluations. Supportive evidence from intermediate indicators is also presented in Annex 2. Split ratings have been applied to reflect the changes to key indicators introduced in the 2013 restructuring.¹⁸ The causal linkages between outcomes, indicators, components and specific activities financed are detailed in Annex 10.

Strengthen COLCIENCIAS’ capacity to promote human capital for the knowledge economy, research and development (R&D) and innovation.

51. *Rating.* Pre-2013 restructuring rating: High; Post- 2013 restructuring rating: High. The objective was achieved. All the key indicators effective up to 2013 were achieved or surpassed, as well as indicators effective after the 2013 restructuring.

Table 1. Results: Strengthen COLCIENCIAS’ capacity to promote human capital for the knowledge economy, research and development (R&D) and innovation

Key indicators	Pre-2013 restructuring ^(a)	Post-2013 restructuring ^(b)
Percentage of COLCIENCIAS annual investment budget committed by the end of the second quarter of the calendar year	Target: 60% Actual: 70%	Target: 60% Actual: 70%
Number of instruments designed or redesigned and approved by COLCIENCIAS’ Board of Directors (cumulative)	Target: 3 Actual: 4	n.a. (indicator dropped)
Lessons learned summary completed based on the results of the evaluations	Target: Yes Actual: Yes	n.a. (indicator dropped)

¹⁷ The two dimensions of the PDO are equally weighted. Nonetheless, it appears that the Project design places greater weight (as evidenced in the components and activities) to the first part of the PDO rather than the second.

¹⁸ More information on changes introduced to Components are presented in Section 1.6, while changes to indicators and the rationale behind them are discussed in the Datasheet.

Key indicators	Pre-2013 restructuring ^(a)	Post-2013 restructuring ^(b)
Number of new ideas or innovations developed by Labor Market Insertion, Diaspora, Innovation Management, Open Innovation and Priority Areas program activities reflected in components 2 and 3	n.a (new indicator)	Target: 30 Actual: 168
Additional outcome indicators collected at ICR stage		
Performance of COLCIENCIAS programs financed by this Project relative to the average performance of STI programs in Colombia , as per scores obtained in the Functional Analysis (Source: World Bank, 2016)*		Target: n.a. Actual: 111%
Percentage of firms beneficiaries (Innovation Management - <i>Locomotor de la Innovación</i>) that thinks that the technical support received was useful / very useful (Source: InnovosGroup, 2016)		Target: n.a. Actual: 93%
Percentage of PhDs participating in the Labor Insertion program hired by the same firm involved in the program (Source: COLCIENCIAS)		Target: n.a. Actual: 46%
Increase in investment in STI among beneficiaries firms (<i>Locomotor de la Innovación</i> , post- vs. pre- intervention) (Source: InnovosGroup, 2016)		Target: n.a. Actual: 113%
Increase in Colombia capacity for innovation, as measured by the relative score in the Global Competitiveness Index (2010-2015) (Source: World Economic Forum, 2015)		Target: n.a. Actual: 15%
Increase in Colombia technological readiness, as measured by the relative score in the Global Competitiveness Index (2010-2015) (Source: World Economic Forum, 2015)		Target: n.a. Actual: 8%

Note: (a) Targets effective up to the 2013 restructuring. Actual values at project closing.

(b) Targets at 2015, according to the 2013 restructuring. Actual values at project closing.

* This is calculated as the ratio between the score obtained by COLCIENCIAS' programs financed by the WB, and the average score obtained by all STI programs considered in the analysis.

52. Activities financed under the Project were instrumental to strengthen COLCIENCIAS' institutional capacity to promote human capital for the knowledge economy, R&D and innovation. Ninety-four professionals among COLCIENCIAS' staff have been trained according to a revised competencies model¹⁹ which is now a permanent and ongoing practice in the agency. Ten management units (up from 0 in 2009) are now using the Balanced Scorecard system to monitor key indicators and are being accountable for progress against objectives. The COLCIENCIAS *convocatoria* process was reformed with vastly improved efficiency. The Project also financed an organizational analysis that informed the partial reorganization of COLCIENCIAS and the current division of roles and responsibilities among the teams/areas.

53. All of these activities resulted in an improved capacity of COLCIENCIAS to efficiently plan and organize activities. The percentage of COLCIENCIAS annual budget committed by the end of the second quarter of the calendar year increased from 4.8 percent in 2009 to 70 percent in 2015. The ability of COLCIENCIAS to meet both conditions required to trigger Phase II of the APL supports the argument of increased institutional capacity (see Section 1.2 for description of triggers and Datasheet for information on achievement). Programs supported by the Project have been evaluated as performing better than the average STI

¹⁹ This corresponds to roughly 94 percent of the permanent staff in COLCIENCIAS at the time of appraisal, and 78 percent of the permanent staff currently employed in COLCIENCIAS.

programs implemented in Colombia, in terms of program design, implementation, and governance²⁰ (World Bank, 2016).

54. The capacity of COLCIENCIAS to generate innovations through the pilot programs largely surpassed expectations, especially considering the relatively short time for implementation of some of these instruments. Beneficiaries developed as many as 168 innovations²¹ in only five years of project implementation. Interestingly, many of these innovations have a high social and environmental impact, and their development involved groups that rarely access to STI activities, such as indigenous communities, children and adolescents (specific examples are offered in Section 3.5 and Annex 2 in this document).

55. The development of innovations was not the only positive outcome from pilot programs. Almost half of the PhDs benefitting from the *Labor Insertion* program were Colombian citizens who had completed their studies abroad. Hence, this instrument could have had the unintended positive externality of tackling brain drain. Six months after program completion, 13 out of the 28 beneficiary PhDs were employed by the same firms where they had developed their research as part of the program.

56. Importantly, activities to promote human capital for the knowledge economy also targeted Colombians at early stages of life, from pre-school to secondary education. The Project financed the extension of the *Ondas* program to an additional 1.5 million children and adolescents throughout the whole country. *Ondas* beneficiaries participated in 10 international fairs on technology and innovation in 2014-2015, and won international prizes of up to US\$100,000 to develop their innovative ideas.²² On average, learning outcomes in mathematics and Spanish are improving faster in *Ondas* schools with respect to non-*Ondas* schools, with even higher positive differences for schools that have participated three years or more in *Ondas* (see Section 3.3 and Annex 3).

57. An econometric analysis looking at the differences pre- and post- participation in the *Innovation Management* program (*Locomotora para la Innovación*) suggests that participants registered an increase of 113 percent in the budget allocation to STI investment with respect to the pre-program levels, an increase of 44 percent in the number of employees with a PhD,

²⁰ This refers to the conclusions of the "Functional & Governance Analysis of Colombia Public Investment in STI" (2016), jointly carried out by the Government of Colombia (DNP) and the WB. The analysis considers 8 institutions of the federal government: BANCOLDEX, COLCIENCIAS, iNNpulsa, MADR, MINCIT, MINTIC, PTP and SENA.

²¹ The definition of innovation to be used has been discussed by COLCIENCIAS and the WB and reflected in the document "Typologies of projects qualifying as innovative - Criteria and conditions for identification" (2014, version 3). According to this definition, "...product innovation is the introduction of a good or service that is new or significantly improved with respect to its characteristics or previous applications. This includes significant improvements in technical specifications, components, materials, software, ease of use and other functional characteristics. Process innovation is the implementation of a method of production or delivery, new or significantly improved. This includes significant changes in processes, equipment and / or software. Organizational innovation is the implementation of a new organizational methodology for into the business practices of the company, workplace organization or external relations".

²² In the United States, Brazil, Peru, Uruguay, Chile, Ecuador, Argentina, and Mexico. Details and examples are described in Annex 2 in this document.

an increase of 68 percent in the number of employees assigned to STI activities, and an increase of 87 percent in the number of STI projects financed. The program was thus successful in mobilizing resources for STI among the private sector (InnovosGroup, 2016). The qualitative analysis suggests that this program was preferred to other types of STI subsidies offered by the public sector as grants were accompanied by technical assistance. Ninety-three percent of the beneficiary firms thinks the technical assistance received was useful (33 percent) or very useful (60 percent).

Raise awareness of science, technology and innovation in the Colombian society

58. *Rating. Pre-2013 restructuring rating: Modest; Post- 2013 restructuring rating: Substantial.* The key indicator effective up to 2013 is not measurable in its original design. The indicator effective after the 2013 restructuring was not achieved.²³

59. While the original key project indicator measuring demand for COLCIENCIAS' services was dropped due to a change in COLCIENCIAS' policy, other additional indicators confirm substantial and sustained demand during Project implementation. Further, while the revised indicator aimed to measure awareness of science and technology in Colombian society more broadly, its correlation to Project impact is not direct and is deemed a poor choice as a Project indicator (see Section 2.3). Additional indicators collected at ICR stage indicate that the Project was effective in raising awareness of science, technology and innovation in the Colombian society (see Table 2). The focus of the 2013 restructuring on activities such as open innovation (*A Ciencia Cierta*); social innovation; and regional capacity building greatly helped raise awareness in society.

Table 2. Results: Raise awareness of science, technology and innovation in the Colombian society

Key indicators	Pre-2013 restructuring^(a)	Post-2013 restructuring^(b)
Total grant applications for R&D and innovation subprojects received yearly by COLCIENCIAS	Target: 2674 (+33% from baseline) Actual: not measurable*	n.a (Indicator dropped)
Percent of population that agrees that Colombia creates Science and Technology	n.a.(New indicator)	Target: 76% (Science); 73% (Technology) Actual: 53% (Science); 52% (Technology)
Additional indicators collected at ICR stage		
Total grant applications for R&D and innovation subprojects financed by <i>convocatorias</i> received yearly by COLCIENCIAS (Source: COLCIENCIAS)	Target: n.a. Actual: 2181 (yearly average 2010-2014, +270% from the period 2005-2009)	
Number of people participating in Project's activities (Source: COLCIENCIAS)	Target: n.a. Actual: 1.5 million	
Percent of population that knows what COLCIENCIAS is (Source: OCyT, 2016)	Target: n.a. Actual: 38% as of 2015 (+16 percentage point from 2012)	
Increase in the number of citations of COLCIENCIAS	Target: n.a.	

²³ The ability of this indicator to capture progress against the PDO is discussed in Section 2.3.

Key indicators	Pre-2013 restructuring ^(a)	Post-2013 restructuring ^(b)
and/or its activities in the media (2010-2015) (Source: IADB 2016)		Actual: 50%
Number of COLCIENCIAS followers on Facebook page (since 2013) (Source: Facebook)		Target: n.a. Actual: 59,737
Number of COLCIENCIAS followers on Twitter account (Source: Twitter)		Target: n.a. Actual: 100,403
Number of unique visitors registered on Colciencias Website (Source: COLCIENCIAS)		Target: n.a. Actual: 6,314,468 from September to December 2015

Note: (a) Targets effective up to the 2013 restructuring. Actual values at project closing.

(b) Targets at 2015, according to the 2013 restructuring. Actual values at project closing.

* It is not possible to measure this indicator, as COLCIENCIAS no longer supports innovation subprojects which were originally pre-project concept notes (*anteproyectos para recuperación contingente*). All subprojects are now financed through *convocatorias*.

60. Overall, 1.5 million people, including civil society, indigenous and Afro-descendent communities and vulnerable groups (see Section 3.5) participated in the Project's activities. This represents approximately 3.2 percent of the whole Colombian population. Cumulatively, 888 grant applications were received for the new pilot programs financed under Components 2, 3 and 4. Total demand for COLCIENCIAS instruments to support R&D and innovation increased, as reflected by the evolution of grant applications received in the period 2010-2014 (10,904 applications) with respect to 2005-2009 (4,047 applications). The positive results obtained by pilot investments under Components 2 and 3 (paragraphs 49-52) also suggest that these were instrumental to increase awareness of STI among beneficiaries.

61. The Project financed the *Social Appropriation* pilot program that empowers local actors in the STI system (community leaders, small producers, etc.) and financed research proposals generated in partnership between communities and research organizations. As many as 2,512 individuals from The Project directly supported the "A Ciencia Cierta" contest, which mobilizes civil society to develop an innovative solution to a local problem with support from other actors in the national STI system (usually academia and research institutions, but also firms and the public sector). As many as 25,000 people participated in this activity. Overall, the total number of people participating in these two initiatives greatly surpassed the target set at appraisal (8,500). In general, activities under Component 4 widened the outreach of STI activities to civil society, NGOs, foundations, and other actors beyond the traditional science and innovation community.

62. The Project also financed consultancy services and online platforms to disseminate COLCIENCIAS activities. Recognition of COLCIENCIAS as the reference institution for STI policy in the country has increased, as illustrated by the 50 percent increase (2010-2015) in the number of weekly mentions of COLCIENCIAS or its activities in the media. The percentage of population that knows what COLCIENCIAS is increased from 22 percent in 2012 to 38 percent in 2015. The number of followers in the institutional social media pages is also significantly high. The Twitter account, active since 2010, reached 100,403 followers and

the Facebook page, opened in 2013, reached 59,737 followers.²⁴ The increasing use of online communications and web 2.0 tools by COLCIENCIAS provided the means to reach out a wider target population.

3.3 Efficiency

Rating: Modest

63. The Economic Analysis included in the PAD did not provide an estimate of the IRR of the Project. The Economic Analysis in this ICR (Annex 3) provides a cost-benefit analysis of one of the key activities financed by the Project: the *Innovation Management* program, involving demand of knowledge by the private sector.²⁵ A review of cost efficiency is also provided for the *Ondas* program, Diaspora activity and Labor Insertion of PhDs.²⁶

64. A difference-in-difference test shows that children in *Ondas* schools improve their performance between 5th grade and 9th grade considerably more than children in non-*Ondas* schools, with even higher positive differences for schools that have participated three years or more in *Ondas*. Differences in learning outcomes are used to estimate economic benefits from the participating children during the course of their life with respect to non-participating children. In 2011, the average cost of the program per region was approximately US\$14,500 (46 million Colombian Pesos) with a unit cost per research group of US\$115 (360,000 Colombian Pesos) and a unit cost per student of US\$1.10 (3,500 Colombian Pesos). Moreover, the low cost of *Ondas* per student as compared with the current costs of educating a student²⁷ suggests a potential cost-effective opportunity to enhance learning outcomes, increase transition to higher educational levels, and increase interest in science and technology.

65. A cost-benefit analysis of the Innovation Management pilot was carried out. The analysis takes a conservative approach by limiting the cost and benefits to ten years, and presents different scenarios with discount rates of 5, 10 and 12 percent. Estimates of benefits are based on a difference-in-difference approach, observing differences in terms of (i) higher sales; and (ii) more patents (the value of the patent was estimated at the 10% of the market value of an average international patent). Depending on the strictness of assumptions used to estimate benefits, the IRR for this activity was estimated to range between 13 percent and 29 percent.

66. The *Diaspora* and *Labor Market Insertion* programs were both efficient in their use of Project resources. *Diaspora* brought unit costs down 35 percent over the course of the Project from US\$26,000 per output to US\$17,000 per output.

²⁴ Figures as March 2015. To put these numbers into context, the average number of followers per Twitter account is approximately 208 (<http://expandedramblings.com/index.php/march-2013-by-the-numbers-a-few-amazing-twitter-stats/>), while the average number of followers per Facebook account is 350 (<http://www.statista.com/statistics/232499/americans-who-use-social-networking-sites-several-times-per-day/>).

²⁵ Constraints in evaluating the efficiency of the remaining activities are discussed in Annex 3.

²⁶ The activities below represent the “value chain” model that COLCIENCIAS is moving toward, integrating the supply and demand of knowledge in a more integral manner representing human capital development, research and innovation.

²⁷ http://www.oecd.org/edu/Colombia_EAG2014_CountryNote_ESP.pdf

67. Project Administration Costs were relatively low (4 percent of Total Project Costs).

3.4 Justification of Overall Outcome Rating

Rating: Moderately Satisfactory

68. The Project objective was relevant throughout implementation and its design was consistent with both the PDO and the new priorities of the National System of STI in Colombia. Many of the pilots financed were innovative in the region in both their design (e.g. *Innovation Management*, coupling subsidies with technical training) and objectives (e.g. *Social Appropriation*, targeting increased participation and appropriation by civil society in STI activities). The Project was effective in achieving the PDO. Two out of three key targets were achieved (see Section 2.3 and 3.2 for a discussion on the key target not achieved). Seventeen out of nineteen intermediate indicators were achieved or surpassed. Additional indicators collected at ICR stage show compelling results. Importantly, results had a direct impact on vulnerable groups, or show high social and environmental potential (see Section 3.5). Economic efficiency is rated Modest. The overall ratings for the two periods are weighted by the disbursement percentages associated with each implementation period, yielding an overall weighted rating equivalent to Moderately Satisfactory.

Table 3. Weighted Project Rating

		Pre 2013 restructuring	Post 2013 restructuring	Overall
Pre- and Post-restructuring outcome rating				
Relevance	Objectives	Substantial	Substantial	
	Design	Substantial	Substantial	
Efficacy	Overall Efficacy	Substantial	Substantial	
	Strengthen COLCIENCIAS' capacity to promote human capital for the knowledge economy, R&D and innovation	High	High	
	Raise awareness of STI in the Colombian society	Modest	Substantial	
Efficiency		Modest	Modest	
Rating		Moderately Satisfactory	Moderately Satisfactory	
Overall outcome rating				
Rating value		4	4	
Disbursement weight		40%	60%	
Weighted value		1.6	2.4	4
Final Rating				Moderately Satisfactory

3.5 Overarching Themes, Other Outcomes and Impacts

(a) Poverty Impacts, Gender Aspects, and Social Development

69. A proactive effort was made to get the most vulnerable population involved in the STI activities financed by the Project. The proportion of *Ondas* beneficiaries from the regions with the highest concentration of indigenous and afro-Caribbean population²⁸ out of total beneficiaries went up from 26 percent in 2010 to 31 percent in 2014. As of 2015, 7 percent of Project beneficiaries were children and adolescents from indigenous communities. The *Social Appropriation* program did not explicitly target the most vulnerable population by design, but de facto ended up focusing on rural communities, indigenous populations and other ethnic minorities. Similarly, the *A Ciencia Cierta* contest, open to the whole population, rewarded several proposals submitted by indigenous communities. Importantly, this program was also able to reach areas inflicted by Colombia's armed conflict.

70. Notably, these activities had the effect not only of empowering indigenous communities and increasing their awareness about the benefits from science and innovation, but they also offered a public platform to increase awareness in the Colombian society about indigenous culture and traditions, specific problems and resources. It was one of the first examples in the region to explicitly recognize local community knowledge as an equally important contributor to address STI challenges.

71. Many of the innovations developed under pilot programs had a clear focus on social development, focusing on topics such as health (the development of low-cost point-of-care diagnostic for tuberculosis; a prototype tool for evaluating motor rehabilitation of patients with neurological diseases; the use of DNA sequencing technology for the diagnosis of hereditary cardio diseases), environment protection (protection of hydro resources, agro-ecology, biodiversity), social development of marginalized groups (a new model of agricultural production combined to social support to families previously employed in cocaine plantations), and environmental sustainability (a new water purification process which generates less waste and optimizes the use of chemicals; air compression engines to improve energy efficiency in high-volume production).

(b) Institutional Change/Strengthening

72. COLCIENCIAS institutional strengthening is discussed in Section 3.2. Among the other important institutional changes to be highlighted, it is important to note an increased effort by COLCIENCIAS to reach out and coordinate with other actors of the SNCTeI that bring both different expertise and additional financial resources. This effort resulted in a more efficient and effective implementation of STI policies, more equilibrated geographical coverage of programs, improved ability to reach vulnerable and geographically marginalized population, and better prospects for financial sustainability of the activities.

(c) Other Unintended Outcomes and Impacts (positive or negative)

²⁸ Amazonas, Bolívar, Cauca, Chocó, Guainía, Guajira, Putumayo, San Andrés, Valle del Cauca, Vaupés, and Vichada, according to the last census (DANE, 2006: "*La visibilización estadística de los grupos étnicos colombianos*").

73. The innovations produced under the Project were often the result of a collaborative effort among different STI stakeholders (academia and private sector under *Priority Areas* and *Innovation Management*, PhD students and private sector under the *Labor Insertion* program, domestic and international academia or technical experts under the *Diaspora* and the *Innovation Management* programs), which promotes a progressive change of culture in the way the country does innovation. Field-interviews conducted during the ICR mission also suggest that Project activities changed the way research is conducted within the same universities, as they promoted multi-sectoral research with involvement from academics and students from different disciplines. The collaboration with the private sector also created a more relevant and market focused research through the emphasis of market studies and recognition of marketable intellectual property. This change in culture is also supported by students who highlight the multi-disciplinary and real world application of their education.

3.6 Summary of Findings of Beneficiary Survey and/or Stakeholder Workshops

N/A

4. Assessment of Risk to Development Outcome

Rating: Moderate

74. Volatility of investment in STI is a concern for the sustainability of the development outcome. Ensuring adequate and continuous financial support to STI activities has been a major challenge during Project implementation, and the risk exists for this situation to persist in the future. Although the Government has explicitly committed to increase public investment in STI from 0.7 percent of GDP in 2015 to 1.5 percent by 2025, in the first quarter of 2016 it announced a contraction in public spending, including a cut in the public budget for STI by 4 percentage points. COLCIENCIAS budget has been steadily decreasing since 2013, and in 2016 it registered a reduction of 10 percentage point with respect to the previous year. Further budget cuts are expected in 2017 and 2018. The absence of a line of external credit, which has through this Project proven to ensure continuity for some lines of action, could further increase risks for COLCIENCIAS.

75. This risk to development outcome is, however, mitigated by the observed development of a suitable national STI strategy and the increased institutional capacity of COLCIENCIAS. At the sectoral level, the draft National STI Policy 2015-2025 includes strengthening capacity to promote human capital for the knowledge economy, R&D and innovation as one of the main policy objectives. Although to raise awareness of STI in the Colombian society is not explicitly identified as a policy priority in the new STI strategy, it can be expected as an indirect effect of the activities to strengthening human capital, R&D and innovation. The new STI Policy highlights the importance of continued institutional strengthening and coordination, as it clearly defines roles and responsibilities, and confirms the pivotal role of COLCIENCIAS in the SNCTeI. Finally, COLCIENCIAS has shown an increased ability to emerge as the preferred technical partner in the implementation of STI activities in the country, and to leverage resources from other public institutions to finance STI activities. This strategy, progressively implemented by the agency in recent years, has proven effective to date to partly offset drawbacks from the cuts in the agency's budget.

5. Assessment of Bank and Borrower Performance

5.1 Bank Performance

(a) Bank Performance in Ensuring Quality at Entry

Rating: Moderately Satisfactory

76. The Project design was adequate and consistent with the early stage of implementation of the SNCTeI. The Project preparation was informed by examples of good practices and lessons learned from projects in Latin America and other regions. The Bank team included experts with international experience on STI systems. Coordination with the IDB was ensured since Project preparation. Overall, the Bank facilitated preparation of the operation such that it was most likely to achieve planned development outcomes.

77. There was, however, one moderate shortcoming. Given the choice of activities and objectives, the original date for Project closure was too ambitious based on the international experiences mentioned in the PAD and used as examples in Project preparation. In addition to that, the design of the M&E system presented some weaknesses (see Section 2.3), although activities designed as part of the complementary IDB Project could have been assumed to fill at least some of the gaps identified in the design of the WB Project. Finally, the Bank team did not identify the risk of volatility in the conditions for implementation caused by frequent changes in leadership at COLCIENCIAS.

(b) Quality of Supervision

Rating: Moderately Satisfactory

78. At least two supervision missions, with specialized experts as team members, were carried out every year. There was a high level of engagement between the Bank and the client. The Bank team was proactive in identifying key issues for restructuring the Project to adapt to changing circumstances. Technical assistance received throughout Project implementation is highly valued by COLCIENCIAS. A midterm review was carried out in 2012, and lessons learned were incorporated in the 2013 restructuring. Aide Memoires provided a thorough account of implementation progress, challenges, and agreements between the two parties and show the efforts of the team to improve processes in order to achieve the PDO and outcome indicators. Coordination with the IDB project was strong.

79. There was a moderate shortcoming in the quality of supervision. Although the M&E was generally improved during the 2013 Project restructuring, changes were insufficient and M&E remained a weakness in Project design. A minor shortcoming is identified in opportunities to increase coordination with the Bank Private Sector and Competitiveness team working in Colombia on areas related to STI, to communicate with the client with one consistent voice. Early policy dialogue and technical assistance on the structure of the STI system were not well coordinated; however, this improved over the course of the Project with both Bank teams collaborating on the public expenditure review activity. While this shortcoming did not hamper the achievement of the PDO, better coordination on STI governance between the two teams would have allowed for smoother dialogue between the Bank and the Government of Colombia.

(c) Justification of Rating for Overall Bank Performance

Rating: Moderately Satisfactory

80. Taking into account the ratings on ensuring quality at entry and supervision, the overall Bank performance is rated as Moderately Satisfactory.

5.2 Borrower Performance

(a) Government Performance

Rating: Moderately Satisfactory

81. The introduction of the *regalias* system for STI investment increased the participation of regional stakeholders in the SNCTeI, and improved the geographical capillarity of STI policy. Setting up the FJC Fund incentivized collaboration and coordination among different institutions in the National STI System.

82. There were, however, moderate shortcomings. The Government could have shown more consistent political support for the STI sector throughout Project implementation. Both the levels and continuity of public resources assigned to COLCIENCIAS were not always consistent with the Project development objectives. The frequent changes in COLCIENCIAS leadership made Project implementation difficult.

(b) Implementing Agency or Agencies Performance

Rating: Moderately Satisfactory

83. Project implementation by COLCIENCIAS was successful in achieving impressive results despite the difficult conditions (low and volatile budget capacity, frequent change of leadership, high staff turnover). COLCIENCIAS was proactive in learning from experience, and making adjustments. The agency has recently demonstrated a renewed effort in improving its M&E capacity, as well as systematizing and documenting the experience to date in order to create an institutional memory. The effort to reach out and coordinate with other actors in the SNCTeI was commendable. The agency was also successful in promoting coordination between IDB and WB.

84. Nevertheless, delays in complying with commitments to resolve financial management issues that arose during Project Implementation represent a moderate shortcoming. Additional minor shortcomings are: (i) the agency started to pay attention to evaluation of results and impact from activities at a late stage in Project implementation; (ii) efficiency of pilot investments could have benefitted from more integration between the programs financed.²⁹

(c) Justification of Rating for Overall Borrower Performance

Rating: Moderately Satisfactory

85. Based on the ratings on government and implementing agency performance, the rating is Moderately Satisfactory.

²⁹ For instance, by exploiting the areas of synergies between the *Labor Market Insertion*, *Diaspora* and *Innovation Management* programs.

6. Lessons Learned

86. **The role of COLCIENCIAS as coordinator of the STI policy in the country would benefit from a sharper definition, and increased consistency between its functions and the resources assigned.** The agency is currently in charge of the design of the STI policy, implementation of STI programs, and to some extent evaluation of both policies and programs. On the one hand, the involvement of the agency in cross-institutional STI investment ensured a certain level of consistency and technical quality in STI activities. On the other hand, the burden of tasks carried out by COLCIENCIAS has rapidly escalated, especially in program implementation. In the years to come, the efficacy and efficiency of COLCIENCIAS's work could benefit from: (i) a different distribution of the functions of designing, implementing and evaluating STI policy across different institutions (e.g. Ministries focused on policy, COLCIENCIAS focused on implementing it, and the National Observatory having a stronger evaluation role); and (ii) better consistency between the functions and the role assigned to COLCIENCIAS, and the budget allocated to the it.

87. **Selectivity and prioritization of STI programs will be important in moving forward.** Although the Project design, including several pilot programs to be tested and evaluated before scaling up, was appropriate as a first phase of APL, maintaining the same diversification with more mature programs can be counterproductive. Selectivity and prioritization in STI sector may be particularly difficult given the wide range of areas and stakeholders involved, but failure to prioritize will likely imply inefficiencies such as the introduction of programs that overlap with existing ones, the fragmentation of budget in many small interventions and increases the administrative costs.

88. **Step-by-step articulation of financing and specialized technical assistance are key for successful STI programs, particularly innovation subsidies.** The incorporation of lessons learned during the implementation of pilot investments allowed COLCIENCIAS to introduce changes in the design of innovation grants that proved to be crucial to bring positive outcomes, and deserve to be taken into account in future STI operations. First, there must be some continuity in the lines of action (programs, research priority areas to be financed), in order to allow for long-term planning. Similarly, calls-for-proposal for innovation grants must be articulated so as to cover the whole chain of value creation: from innovation design, to development of a prototype, to commercialization. Finally, subsidies must be accompanied by specialized technical coaching to support beneficiaries (academia, research institutes, private sector, etc.) in designing and implementing a research/business plan.

89. **The Project was best practice in its ability to widen the outreach of STI activities to actors beyond the traditional science and innovation community.** Among the consequences of this strategic choice, there was the empowerment of local actors and vulnerable communities, the orientation of R&D towards innovation with high social impact, the increased awareness about indigenous culture, the early exposure of children and adolescents to STI activities. Importantly, results from these activities provided an important lesson for the national STI policy, proving the potential of bottom-up initiatives versus top-down approaches. Interaction with actors other than the traditional science and innovation community improved the efficiency, capillarity and outreach of STI activities.

90. **The Bank involvement was crucial to ensure some degree of continuity in the operational lines financed by COLCIENCIAS, in providing concrete examples and guidelines for institutional strengthening, and in helping manage innovative programs.** The added value from the Bank operation can be summarized in three aspects. First, in a context of high volatility in both budget and political leadership in the STI sector, the Project's resources provided an incentive to consistently maintain open lines of action in this 5-year period, and avoid further changes in strategy. Stability of resources and strategy are particularly important in STI activities that generally require a medium to long term period of implementation before bearing fruit. Second, in addition to activities under Component 1, the Bank also contributed to institutional strengthening by introducing new processes via Project implementation itself. For instance, both the M&E system and the procurement capacity in COLCIENCIAS greatly benefitted from the Project implementation experience, allowing for a more efficient use of public funds. Finally, the continuous technical assistance provided by the Bank was crucial to develop and implement STI activities that were completely new to the country.

91. **Institutional changes during the Project's life provide some interesting examples of good incentives for institutional coordination.** The introduction of the *regalias* system to finance STI provided incentives for increased participation of regional actors and institutions in the STI sector, and more interaction between stakeholders from different sectors. The FJC Fund worked smoothly during Project implementation, and represented an instance for further coordination between actors of the SNCTeI. Still, notwithstanding the progress to date, there is still room for improved coordination among public institutions working on STI, maybe through a clearer definition of roles, responsibilities and scope of action of each institution (something that is being partly addressed by the draft STI Policy 2015-2025).

7. Comments on Issues Raised by Borrower/Implementing Agencies/Partners

(a) Borrower/implementing agencies

See Annex 7.

(b) Cofinanciers

(c) Other partners and stakeholders

Annex 1. Project Costs and Financing

(a) Project Cost by Component (in USD Million equivalent)

Components	Appraisal Estimate	Revised Estimate (2013 Restructuring)	Actual/Latest Estimate	Percentage of Appraisal
Component 1: Strengthening COLCIENCIAS' operational and policymaking capacity, project management and fees	5,800,000	5,395,000	2,526,411	44%
Component 2: Strengthening COLCIENCIAS' capacity to promote human capital	14,600,000	14,280,000	6,757,831	46%
Component 3: Strengthening COLCIENCIAS' capacity to promote research and innovation	17,600,000	18,300,000	15,684,563	89%
Component 4: Promoting social appropriation and dissemination of STI	3,500,000	4,475,000	3,029,969	87%
Total Baseline Cost	41,500,000	42,450,000	27,998,774	67%
Physical Contingencies	0		0	0
Price Contingencies	0		0	0
Total Project Costs	41,500,000	42,450,000	27,998,774	67%
Front-end fee PPF	0		0	0
Front-end fee IBRD	0		0	0
Total Financing Required	25,000,000	25,000,000	20,647,714	83%

(b) Financing

Source of Funds	Type of Cofinancing	Appraisal Estimate (USD millions)	Actual/Latest Estimate (USD millions)	Percentage of Appraisal
Borrower*		16.50	7.35	45%
International Bank for Reconstruction and Development		25.00	20.65	83%

*As per PAD (Annex 5: Project Costs), this amount includes funding for subprojects from universities, firms and other private entities. It does not include any fiscal resources.

Annex 2. Outputs by Component

Component 1: Strengthening COLCIENCIAS' operational and policy making capacity; institutional strengthening of the STI National System

1. Activities under Component 1 supported institutional strengthening of the STI National System institutional through: (a) the enhancement of its organization, human resource capabilities and business processes; (b) the improvement of its strategic and sector planning and policy-making; (c) the improvement of its capacity to monitor, evaluate and manage the Project.
2. The *convocatoria* (call-for-proposal) system to finance sub-projects was optimized thanks to a timely revision of the process, and technical and legal adjustments based on international best practices. Given the good and smooth performance of the process in recent years, the *convocatoria* system developed by COLCIENCIAS has been adopted by local governments, other governmental agencies, partner Ministries (Education, Information & Communication Technology). This resulted in more consistency between the processes used by different governmental agencies to finance STI investment, improved efficiency and coordination in the STI system, and a pivotal role of COLCIENCIAS as capacity builder or direct implementing agency of the *convocatorias* themselves.
3. The Project financed consultancies to inform a restructuring of COLCIENCIAS' organizational structure and a more efficient definition of functions and responsibilities among the staff, in the context of the newly defined role of COLCIENCIAS as Administrative Department and as the coordinator of STI policy in Colombia. Recommendations from the consultancies were followed as much as allowed by the agency's financial constraints. Among the reforms, following the re-organization there is now a clearer separation of roles between the teams defining the strategy, those in charge of evaluation and policy design, and those in charge of implementation and coordination.
4. Project activities included training courses for management, and the development of a Balanced Score Card (BSC) system to monitor and hold management accountable on progress of against implementation and results. The design of the BSC was also informed by the Project results framework and monitoring experience accumulated with Project implementation. The system is now fully implemented, accessible in the internal online platform. It is used by the technical staff and management, and the agency leadership (Director and Sub-Director), offering a common platform when all these staff levels can access and monitor progress against targets.
5. As part of activities under Component 1, COLCIENCIAS developed and approved a revised competencies model that identifies: (i) the existing weaknesses in COLCIENCIAS staff's technical capacity; (ii) the topics/areas to be included in the program of permanent courses for staff; (iii) the minimum technical requirement to be hired as staff in COLCIENCIAS. Ninety-four staff (corresponding to 78 percent of the permanent staff currently employed in COLCIENCIAS) received training according to this revised competency model. Additionally, 683 local stakeholders in the National STI system received

short courses on STI project development and implementation, to improve capacity building at the regional level in light of the recently introduced *regalias* funds for STI.

6. The Project supported the setup of a Design and Evaluation of Public Policy Unit within COLCIENCIAS, by financing consultancies to inform the design of such unit, the procurement of relevant information material such as access to bibliography and databases, and workshops to disseminate the Unit’s findings and studies. The Unit completed evaluations of COLCIENCIAS policies and programs, and it is currently organizing both internal and external workshops to make sure that the findings from evaluations are incorporated in the implementation of existing programs and the design of new ones. Importantly, courses taught by the Unit on the design on public programs include mandatory exercises for attendees on how they would design an impact evaluation for such programs, in an attempt to promote a new culture of evaluation and learning.

Table A2.1- Outputs under Component 1

Outputs	Type of indicator*
70% of COLCIENCIAS annual investment budget committed by the end of the second quarter of the calendar year	KI
1.11 as ratio of performance of COLCIENCIAS programs financed by this Project relative to the average performance of STI programs in Colombia , as per scores obtained in the Functional Analysis (World Bank, 2016)	ICR
94 staff trained according to a revised competencies model	II
Revised COLCIENCIAS’ <i>convocatoria</i> processes	II
Revised competency model	II
10 management units using the Balanced Scorecard	II
10 papers completed by the internal Evaluation Policy Unit	II
683 beneficiaries who have completed short courses	II

* KI = Key Indicator; II= Intermediate Indicator; ICR = Data collected during the ICR stage.

Component 2. Strengthening COLCIENCIAS Capacity to Promote Development of Human Capital for Science and Technology

7. Component 2 supported capacity to promote human capital for science and technology by financing three programs: *Labor Market Insertion of PhDs* (pilot); *Diaspora* (pilot); and *Ondas* (continuation of an existing program in basic education and pilot extension to pre-school level).

8. Experience from the *Labor Market Insertion* program confirmed that there is a genuine interest by the private sector to hire highly qualified professionals, but most of the time firms do not have the necessary tools/information to find the profile they are looking for. Similarly, there is interest by PhDs to work in the private sector, but they do not have experience nor contacts to find a suitable match in this sector. This *convocatoria* filled the need to match demand and supply of qualified personnel.

9. This line of activity was able to leverage significant resources from the private sector – for each COP\$1 invested by COLCIENCIAS, the private sector invested COP\$1.7 pesos (Estupinan, 2014).

10. Almost 50% of the PhDs benefitting from the program were Colombian citizens that had completed their studies abroad, and were looking for opportunities to come work again in the country. In this sense, this activity had the unintended positive externality of tackling brain drain. Six months after the end of the sub-projects, 13 out of 28 PhDs (46 percent) were hired by the beneficiary firm, mostly large enterprises.

11. In most cases, offering competitive wages to these PhDs required a change in the wage policy of the firm. Participation in the program allowed these firms to appreciate and quantify the added value of these highly skilled professionals, offering a concrete basis and justification for a change in the wage policy status quo. A positive outcome from this activity is thus the development of concrete and valuable information for firms to rethink the role of human capital in their combination of factors of production.

12. Nine innovations were developed, and most of them have a potential in terms of social impact (for instance, a prototype of a DNA sequencing methodology on genomic regions commonly affected by heart diseases - in the process of patenting; tool to measure the neurological impact of rehabilitation therapies in epileptic patients).

13. The *Diaspora* pilot included two types of interventions: (i) the financing of mobility expenses for researchers of the Colombian diaspora to collaborate with a domestic research groups (*convocatorias* 594³⁰-2012 and 650-2014); and (ii) the financing of mobility expenses, and other expenses associated to the development of a specific innovation subproject (*convocatoria* 547-2011).

14. Results from *convocatorias* 547 and 594 were evaluated in 2015. In the case of *convocatoria* 547, the 17 subprojects financed resulted in the elaboration of 14 articles co-authored by the researcher from the diaspora (6 published and 8 under review), 10 graduate thesis directly supported by the beneficiary researchers, and 3 technological models/prototypes developed (López Olarte, 2015). On the other hand, *convocatoria* 594 did not include the elaboration of scientific products as requirements to be met. This lack of incentive resulted in more modest results in terms of publication, with only 2 articles produced out of 21 beneficiaries. Nonetheless, the beneficiaries supported 13 graduate thesis, developed 3 experiments, and gave 11 workshops and seminars promoting knowledge exchange. Overall, in the two *convocatorias*, 6 new scientific networks/associations were created; in 9 additional cases the researchers from the diaspora joined already existent scientific networks/associations. In 86 percent of the cases, researchers in Colombia could access technological infrastructure that was not available in the country, thanks to the intermediation of the visiting researcher from the diaspora.

³⁰ These numbers refer to the *convocatoria*'s "name": the code used to identify the specific call-for-proposal.

15. The *Ondas*³¹ program supports the development of scientific and technological skills among children and adolescents from primary to secondary school, and their teachers. In particular, the program promotes cooperation, knowledge exchange and collective development of an innovative idea around a certain topic. The objective is to allow these children to develop social skills (teamwork, solidarity, cooperation, conflict management), cognitive skills (logical, inductive and deductive thinking, problem solving, etc.), and communication skills (oral, scriptural and argumentative, propositional and virtual, among others), as well as to familiarize them with the R&D process (formulation of questions of interest, observation, data collection, formulation of conclusions).

16. Between 2011 and 2014, 1.5 million children participated to this program. Several among the innovation subprojects developed by children and financed with this Project were presented in international STI conferences in Uruguay, Mexico, Brazil, Peru, Ecuador, Argentina, Arab United Emirates, and Switzerland. Among the innovations developed, it is particularly worth mentioning: a project for a bioclimatic school cafeteria (model of sustainable habitat and social interaction in vulnerable educational communities located in regions with high temperatures); an environmentally friendly water treatment system using solar energy and native plants, free of CO2 emissions.

Table A2.2- Outputs under Component 2

Outputs	Type of indicator*
128 innovations developed by Labor Market Insertion, Diaspora, Innovation Management, Open Innovation and Priority Area programs	KI
\$CO 1.7 pesos invested by the private sector for each CO\$ 1 invested by COLCIENCIAS under the Labor Market Insertion program	ICR
48% of PhDs hired by the same firm participating in the program	ICR
16 scientific articles produced under the Diaspora program	ICR
23 graduate thesis supported under the Diaspora program	ICR
Monitoring and evaluation framework for <i>Ondas</i> designed	II
1.5 million children participating to <i>Ondas</i> in the period 2011-2014	II
28 doctoral graduates participating in the Labor Insertion programs	II
54 subprojects involving researchers residing abroad participating in collaborative research projects	II
Evaluation of the Labor Insertion pilot completed	II
Evaluation of the Diaspora pilot completed	II

* KI = Key Indicator; II= Intermediate Indicator; ICR = Data collected during the ICR stage.

³¹ Multimedia material describing the program, its objective and interviews to beneficiaries can be found at <https://www.youtube.com/watch?v=NCfZPgHKtag> and <https://www.youtube.com/watch?v=mV-t4siJVGU>.

Component 3. Strengthening COLCIENCIAS' capacity to promote research and innovation; investment for research and innovation.

17. The objective of the *Innovation Management* pilot (*Locomotora de la Innovación*) is to implement product, process or service innovation, through capacity building on innovation management to firms.

18. An evaluation of this pilot was completed in 2016. Ninety-three percent of the beneficiary firms think the capacity building received was useful (33 percent) or very useful (60 percent). An econometric analysis looking at the differences pre- and post- participation to program suggests that participants registered an increase of 113 percent in the budget allocation to STI investment with respect to the pre-program levels, an increase of 44 percent in the number of employees with PhDs, an increase of 68 percent in the number of employees assigned to STI activities, and an increase of 87 percent in the number of STI projects financed (InnovosGroup, 2016).

19. The qualitative analysis suggests that this program was preferred to other types of STI subsidies offered by the public sector as it was accompanied by technical assistance. Interviews also highlighted that this program had the benefit of increasing awareness about COLCIENCIAS and its programs among the private sector. Although most of participants were already aware of the existence of the institution, the majority thought it was oriented to universities and were not aware of its full offer for the private sector.

20. Subprojects financed under the *Innovation Management* pilot supported product innovations (a telescopic tripod to measure noise pollution, a naturally sweetened yogurt, a nutritive granola based on *spirulina* (a native herb with high-protein content)), process innovations (a model to develop consumer-centered products, a statistical model for chemical analysis, analysis of samples of wastewater from oil extraction plants palm), and organizational innovations (the use of tablets to collect information on the spot while approaching new clients).

21. Call for subprojects under the *Priority Areas* pilot were opened only in December 2014. Since most of the selected subprojects are still ongoing³², it is difficult to evaluate results from this activity. Interestingly, interviews conducted during the ICR mission suggest that the short time allowed for implementation of subprojects incentivized beneficiaries to adopt very efficient implementation models, increased awareness of deadlines and deliverables, and improved accountability processes. It also required a closer, more frequent follow up of subprojects by the operational areas in COLCIENCIAS, in order to support beneficiaries on both administrative and technical issues. Staff in COLCIENCIAS suggested that this pilot forced the development of a new system to monitoring subprojects that the agency will adopt in future R&D and innovation subprojects.

22. The design of the *convocatoria* in three steps (two of which were financed under the Project) was extremely positively valued by beneficiaries: *convocatoria* 700 financed a proof

³² The second disbursement of grants to subproject is being financed by the IDB project.

of concept design of an innovation, and *convocatoria* 701 financed the development of a prototype or pre-commercial validation of the idea, so that the two calls could eventually cover different stages of the chain of value creation. The third step of commercial validation was financed by Innpulsa.

23. Examples of R&D financed under the *Priority Areas* program include the development of low cost point of care for diagnosis of tuberculosis, the study of the potential offered by the Colombia biodiversity to develop new anti-malarial compounds, the development of a substratum used for construction from cellulose material recycled from packaging and fruit waste.

Table A2.3- Outputs under Component 3

Outputs	Type of indicator*
128 innovations developed by Labor Market Insertion, Diaspora, Innovation Management, Open Innovation and Priority Area programs	KI
93% of the beneficiary firms thinks the capacity building received was useful/very useful (Innovation Management)	ICR
+ 113% in the participating firms' budget allocation to STI investment of firms with respect to the pre-program levels (Innovation Management)	ICR
+ 44% in the number of employees with PhD with respect to the pre-program levels (Innovation Management)	ICR
+ 68 % in the number of employees assigned to STI activities with respect to the pre-program levels (Innovation Management)	ICR
+ 87 % in the number of STI projects financed with respect to the pre-program levels (Innovation Management)	ICR
128 proposals financed for innovation-management capacity building subprojects	II
5 R&D and innovation subprojects in priority areas for which Project resources have been committed	II
Evaluation of the Innovation Management pilot completed	II

* KI = Key Indicator; II= Intermediate Indicator; ICR = Data collected during the ICR stage.

Component 4. Promoting Social Dissemination of Science, Technology and Innovation and Institutional Communication

24. The pilot *Social Appropriation* program financed the realization of research and innovation subprojects by civil society (community leaders, local cooperatives, etc.) in partnership with universities and research organizations. By mobilizing civil society, this program had the double objective of: (i) expanding the outreach of STI policy to actors usually excluded from this sector, such as non-governmental organizations, local research groups, organized groups of civilians, and centers of appropriation; and (ii) increasing the institutional capacity to design STI projects more tailored to people's needs, and that involve the participation of the civil society itself.

25. A qualitative analysis completed in 2015 evaluates the process, results and perception of beneficiaries from the *Social Appropriation* pilot program. The study highlights that this pilot is the first and only program in Colombia (and a pioneer in the region) that provides financial space for achieving the objectives described above. The program resulted in increasing institutional recognition of COLCIENCIAS among local communities. Support by COLCIENCIAS was positively valued at different stages of the process. In particular, beneficiaries valued the assistance provided to understand and apply to the call for proposals; and also evaluated the terms of reference for the subprojects as clear and consistent. A positive aspect highlighted was that the 3 *convocatorias* financed under this pilot had complementary objectives, allowing each to cover different stages of the development of an innovation. One negative aspect emerged during the interviews was the occurrence of delays in disbursements by COLCIENCIAS (Velasquez, 2015).

29. The evaluation captured very positive changes among the involved communities. There was a rapid empowerment of local actors, and the establishment of installed capacity that favors continuity of ideas and projects developed during implementation. Clear changes in daily activities were observed as a result of the learning process during the implementation of the subprojects, leading to a positive social appropriation outcome. Frequency of interaction with other types of institutions/actors, such as universities and researchers, increased during subprojects implementation. Finally, there was an increased recognition by researchers and universities of the added value of local knowledge (Velasquez, 2015).

30. Among the research developed under the *Social Appropriation* pilot: a mapping of coastal and marine ecological resources in marine protected areas, developed together with the resident communities; improved production processes of the initial seeds for potato cultivation, developed together with a local community of small farmers; development of media content on STI with a language more accessible by civil society; implantation of a photovoltaic system in a remote Afro-descendant community, used to increase energy capacity to be used in private housing, public lightening, and fishing; development of a water purification system using powdered chlorine from salt; design and implementation of a water distribution system; and design and creation of an experimental center for the care and conservation of hydro resources.

31. The Project financed the *A Ciencia Cierta* contest – a form of open innovation. Overall, approximately 25,000 people from civil society participated to the 2013 and 2015 editions of the contest, rewarding innovation proposals around two strategic themes: purification, use and conservation of hydro resources (2013) and agro-production for food security (2015).

32. Among the innovation projects financed: the development of a filter made of turf, sand and sieves to filter rainwater; a system to extract subterranean hydro resources; substitution of corn with *watsimba* (a native flower) as feed for chickens; a new model for agro-ecological cultivation of strawberries based on indigenous knowledge; and a new model of agricultural production combined to social support to families previously employed in cocaine plantations.

33. Activities under Component 4 included financing of consultancy services to: design and develop tools and content to stimulate citizen participation in STI policy; inform the design of the National Citizen Participation in STI Program; capacity building courses to local community leaders on how to promote and manage STI; and design and implementation of a new institutional communication strategy, including 2.0 platforms.

Table A2.4- Outputs under Component 4

Outputs	Type of indicator*
2,512 citizens participating to Social Appropriation	ICR
25,000 citizens participating to A Ciencia Cierta	ICR
50% increase in the number of citations of COLCIENCIAS and/or its activities in the media	ICR
59,737 followers in COLCIENCIAS Facebook page	ICR
100,403 followers in COLCIENCIAS Twitter account	ICR
27,512 citizens directly participating in COLCIENCIAS' citizen participation activities financed by the Project (excluding <i>Ondas</i> and mass media)	II
87,086 document downloads from COLCIENCIAS' Web page, per year (not including documents related to calls for proposals)	II
4,735,851 unique visits to COLCIENCIAS' web page per year	II
Development of Social Innovation policy document	II

* KI = Key Indicator; II= Intermediate Indicator; ICR = Data collected during the ICR stage.

Annex 3. Economic and Financial Analysis (including assumptions in the analysis)

1. This Economic and Financial Analysis draws on four of the seven evaluations conducted under the Project. The four evaluations reflect the key aspects of the innovation value chain from human capital development (*Ondas*), research (*Diaspora*), commercialization of research (*Inserción Laboral*), and firm innovation (*Locomotora de la Innovación*).
2. The scope of this analysis is to estimate the social returns to innovation management activities (i.e., “*Locomotora de la Innovación*”) and broadly assess cost effectiveness of activities on human capital formation (i.e. “*Programa Ondas*”)³³. A review of cost efficiency is also provided for the *Diaspora* activity and Labor Insertion of PhDs. The activities below represent the “value chain” model that COLCIENCIAS is moving toward, integrating the supply and demand of knowledge in a more integral manner representing human capital development, research and innovation.
3. The Economic Analysis conducted during Project preparation and included in the PAD did not provide an estimate of the IRR of the Project but rather provided data on the value of STI for productivity and economic growth; links between innovation and productivity at the micro level in Colombia; the rationale for public interventions in STI; and a calculation of the public and private investment necessary to reach a ratio of STI investment to GDP of 2 per cent by 2019.
4. *Ondas – Building Human Capital.* The *Ondas* program, started in 2001, aimed at building capacity and developing curiosity for Science, Technology and Innovation among youth. Since its introduction, over 3.5 million Colombian students have participated in *Ondas*. In 2011, the average cost of the program per region was approximately US\$14,500 (46 million Colombian pesos) with a unit cost per research group of US\$115 (360,000 Colombian pesos) and a unit cost per student of US\$1.10 (3,500 Colombian pesos).
5. The *Ondas* program also has shown positive results with regard to impact. An impact evaluation of the *Ondas* Program has been contracted³⁴ and, although official results of this evaluation are not yet available, a preliminary study reveals statically significant differences in national test scores between *Ondas* participating schools and non-participating schools. On average, non-*Ondas* schools outperform *Ondas* schools in mathematics and Spanish, both before and after the program. However, the difference in means between 2009 and 2013

³³ The reasons for the chosen approach and scope are as follows: (i) a lack of valid counterfactuals to estimate the effects of Project activities (i.e., those aimed at strengthening COLCIENCIAS' operational and policy making capacity under component 1); (ii) a lack of previous empirical research related to the majority of the Project activities in Colombia, limiting the options for the application of parameters to estimate the effect of such activities; (iii) cross-time analysis of cost effectiveness variation isn't possible for the majority of the Project activities as those activities were introduced during Project implementation; and (iv) the options to conduct rigorous impact evaluations of Project activities were constrained by the lack of baseline data.

³⁴ Diseño del Sistema de Información y Monitoreo para la Evaluación del Programa Ondas

indicates that, after the program, *Ondas* schools were converging to the results of non-*Ondas* schools. Importantly, a difference-in-difference test shows that children in *Ondas* schools improve their performance between 5th grade and 9th grade considerably more than children in non-*Ondas* schools, with even higher positive differences for schools that have participated three years or more in *Ondas*.

6. A naïve difference in differences empirical framework obtains consistent results. These initial results do not take into account factors that may explain the observed variation, (e.g., socio-economic factors that may be correlated with both higher academic performance and a school that participates in *Ondas*). However, the low cost of *Ondas* per student as compared with the current costs of educating a student³⁵ suggests a potential cost-effective opportunity to enhance learning outcomes, increase transition to higher educational levels, and increase interest in science and technology.

7. *Ondas* has also proven to be effective in raising awareness and interest in science and technology – supporting the second part of the Project’s development objective. One of the most significant aspects of the program is that all student projects are presented in a local science fair. Depending on the research and its outcomes, the students can enroll in municipal, provincial, regional, national and even international science fairs to present their projects³⁶. As a study in Bucaramanga demonstrated, students who have participated in the *Ondas* program have demonstrated better academic skills and social development compared to those who have never participated, also collaboration is one of the skills that students develop most while interacting in these type of scenarios³⁷. In 2012, the University of Sucre also performed an evaluation on the *Ondas* program for the Sucre region between 2007 and 2009. The results were impressive; 90 percent of the students participated in science fairs, at least at the regional level. Among these, 41.9 percent only attended at the regional level while 34.6 percent participated at a national level and 13.6 percent at an international level.³⁸

8. *Diaspora Program.* The second critical part of the innovation ecosystem as supported in the Project is research. The *Diaspora* program was designed to connect the local science and technology community in Colombia with the Colombian Diaspora abroad (there are over 60,000 Colombians in the United States alone³⁹). This program was executed through five *convocatorias*. The first *convocatoria* focused on both connecting researchers in Colombia and the Diaspora as well as financing proposed research projects between the two. The second only financed researchers’ travel and mobilization. This program represents how COLCIENCIAS evolved its activities to enhance efficiency. The total costs for the first round of *convocatorias* were US\$1.3 million and benefited 17 projects at a unit cost of

³⁵ http://www.oecd.org/edu/Colombia_EAG2014_CountryNote_ESP.pdf

³⁶ Fedesarrollo, “Informe Final de Sistema de Seguimiento ONDAS”, Junio 2015

³⁷ Diego Zarabanda and Juan Lopez Nuñez, “Evaluación de programas de fortalecimiento orientados a la investigación: el programa “ONDAS”, Journal for Educators, Teachers and Trainers Vol 6 (1), ISSN 1989-9572, 2015. [online] <http://www.ugr.es/~jett/index.php>

³⁸ Hernandez P and Martinez G, “Evaluación del Impacto del Programa Ondas en el Departamento de Sucre en el periodo de 2007 a 2009”, Universidad de Sucre, 2012.

³⁹ Medina y Poso-2009

approximately US\$76,000. The second round of *convocatorias* focused on mobilization. The total cost for the second round of *convocatorias* was approximately US\$100,000 with a unit cost of about US\$5,000 that benefitted 21 individual researchers. While through the first set of *convocatorias*, the beneficiary groups published 49 scientific articles (65 percent of these articles come from just 3 out of the 17 projects), the beneficiary groups in the second set of *convocatorias* generated 5 articles and a book chapter. This yields US\$26,000 per output in the first set of *convocatorias* and US\$17,000 per output in the second set of *convocatorias*. In both rounds of *convocatorias* the beneficiaries highlighted benefits in terms of the creation of international alliances, network strengthening, and human capital formation.

9. Labor Market Insertion of PhDs. The labor insertion program aimed to incentivize non-academic companies to hire PhDs; strengthen research capacity in the productive sector; and build linkages between private companies and academia. The program is representative of the application and commercialization of research and an important step in the innovation ecosystem. The total budget for the program was around US\$2.9 million (9,200 million Colombian pesos). The program benefitted 24 companies and 28 PhD graduates who developed projects that lasted from 12 to 36 months. One of the main objectives of the program was to stimulate firms to hire workers with PhDs in order to strengthen the research and development capacity of the firm. After the completion of the program, ex-post interviews revealed that in the majority of the companies (57 percent of total) the insertion of a worker with a PhD resulted in new products, access to knowledge networks, alliances with universities, and publications. Nevertheless, only 29 percent and 7 percent of those interviewed considered the program to have resulted in an increase in productivity and a reduction of costs. This is not a surprising result considering the fact that innovations would not be building on existing processes in the company and thus not greatly impact existing productivity. Also, it is important to note that despite the high salaries of the PhDs for the Colombian market, after the end of the program and the elimination of the subsidy, 46 percent of the firms hired their PhDs. This suggests that the benefits of the program exceeded its costs, taking into account that after 1 to 3 years the participating, companies had good information about the potential of PhDs to enhance the company's medium to long-term profitability and overall competitiveness. Furthermore, some positive externalities from greater research, innovation and changes in overall culture are probable given the role of these PhDs within the beneficiary companies.

10. "Locomotora de la Innovacion" (translates as *Engine of Innovation*). In 2013, COLCIENCIAS launched the "*Locomotora de la Innovacion*" program to improve the innovation implementation and innovation management capacities of Colombian companies. This constitutes a critical stage of the innovation ecosystem. Through "*Locomotora de la Innovacion*", COLCIENCIAS subsidized Colombian companies so that they could hire a preselected consulting firm to provide support in the implementation of innovation processes and build innovation capacities. The demand for this *convocatoria* was impressive. Out of 705 applicant companies, 228 met the requirements to participate in the *convocatoria*, and 94 were selected as beneficiaries⁴⁰ (as compared with 26 and 42 beneficiaries in the pilot

⁴⁰ Twenty-eight beneficiaries were financed with WB funds.

convocatorias of 2011 and 2012). Most of the beneficiaries were small companies (43 percent of the total), located in Bogota (48 percent of the total), and belonged to the information services industry (22 percent of total). The evaluation also illustrated that the Project was very inclusive and reached companies that previously were not able to participate in innovation projects. This higher level of inclusion was also benchmarked regionally. In Colombia, 90 percent of total project costs were financed by the *convocatoria* whereas in other similar international experiences (Uruguay and Chile) only 70 percent of the project costs were financed by the government. The additional funding made a difference on the type and size of company that could participate based on financial constraints. The case of Colombia was more “financially inclusive”, as testified by the higher proportion of SMEs over total number of beneficiaries.⁴¹

11. In 2015, COLCIENCIAS hired a consulting firm to conduct an impact evaluation to assess the early effects of the “*Locomotora de la Innovación*”. The evaluation would use 134 companies (those that met the *convocatoria*’s requirements but not selected as the control group) and an empirical framework based on the application of quasi-experimental econometric techniques – i.e., Propensity Score Matching and Difference in Difference – to attempt to address a potential bias in the non-random selection of beneficiaries. While the plan was to conduct a robust impact evaluation, a poor response rate in the control group made it difficult. For the survey response, 78 percent of the beneficiary companies and only 13 percent of the companies in the control group responded to the follow-up questionnaire. This high level of attrition resulted in a series of statistical issues, such as weak statistical power and additional selection bias arising from attrition, which made it impossible to carry out a rigorous impact evaluation with the available data.

12. Despite the above-mentioned caveats, sizeable increases in innovation input and outputs in beneficiaries after the program suggest positive effects of the “*Locomotora de la Innovación*” in enhancing firms’ innovation. During 2015, between 6 and 12 months after participating in “*Locomotora de la Innovación*”, beneficiary companies increased their budget allocation to innovation activities by 113 percent. These companies also registered 155 percent more patents, increased the number of innovation programs by 87 percent, and hired more qualified workers (26 percent and 44 percent more workers with undergraduate education and postgraduate education, respectively)⁴². Although rigorously establishing a causal link between the program and those observed improvements in innovation input and output indicators is not possible, the sizable increase in those indicators suggests that participating in “*Locomotora de la Innovación*” is linked, at least partially, with some of those improvements. Empirical research has established a formal relationship between innovation-related expenditures and firm productivity and sales per worker in Colombia⁴³. The literature highlights that outcomes of innovation are generally expected in the medium and long term⁴⁴;

⁴¹ InnovosGroup, Presentation on Impact Evaluation on “*Locomotora de la innovación*”, February 2016.

⁴² These changes were statically significant at conventional levels

⁴³ Innovation, R&D investment and productivity in Colombian firms / María Angélica Arbeláez, Mónica Parra Torrado.

⁴⁴ Análisis de Costo Beneficio ex ante del Programa Integral de Mejora de la Competitividad en las Economías Regionales/ Anabel Marín, José Castro, Fernando Graña y Lucía Mauro

however, most of the beneficiary firms of the “*Locomotora de la Innovación*” finalized their participation within one year of the results evaluation. This suggests that even if “*Locomotora de la Innovación*” had a true effect in enhancing firm productivity and sales per worker, such effects are unlikely to materialize until years later. These early positive indicators suggests positive longer term impacts.

13. As described by the evaluator (InnovosGroup), in their qualitative analysis, there are also striking results such as a higher engagement from the upper management (93 percent of the beneficiaries), better capabilities to face unexpected situations and resolve problems, and the creation of teams that were assigned to enhancing innovation (78 percent of the enterprises).

14. A cost-benefit analysis suggests that the social benefits of the program will exceed its costs. In order to complement the results evaluation of “*Locomotora de la Innovación*,” COLCIENCIAS hired an external consulting firm to conduct a cost-benefit analysis of the program. The evaluation selected a representative sample of all the beneficiaries of the program and considered the following elements.

15. *Costs:* Based on information provided from COLCIENCIAS, the following costs were estimated or assessed: (i) direct cost from financing the projects, (ii) future administration costs of innovation programs, and (iii) consulting firms’ fees.

16. *Benefits:* Through baseline and end-line data and direct interviews with companies in the sample and the control group (non-beneficiaries), future differential benefits between the beneficiaries in the sample and the 18 companies in the control group were estimated. This approach uses a naïve difference in difference framework to estimate the differential sales in beneficiary firms (based on the beneficiary companies’ attribution of the program to benefits) as compared with the differences observed in the control group. The benefits in the analysis include i) higher sales: the total differential increase in sales is fully achieved in the last year of the analysis (2015-10 percent of the total differential increase, 2016-20 percent of the total differential increase); and (ii) patent development: 10 percent of beneficiary firms develop a patent (the value of the patent was estimated using average international patent price). The vast majority of overall benefits in the analysis are due to higher sales which also suggests that the innovation intervention has increased firm competitiveness.

17. *Time span and discount rate:* Although innovation projects have been estimated to have life-long effects,⁴⁵ the cost-benefit analysis takes a conservative approach by limiting the cost and benefits to ten years. The discount rate employed is the one used for the National Planning Agency in Colombia (DNP): 12 percent.

18. *NPV and IRR.* In an optimistic scenario (sales increase up to 1.35 percent), the NPV is 31,085,929,914 COP (US\$9.79 million) with an IRR of 29 percent. In an intermediate scenario (sales increase up to 1 percent), the NPV is 14,860,344,267 COP (US\$4.68 million)

⁴⁵ Innovation, R&D investment and productivity in Colombian firms / María Angélica Arbeláez, Mónica Parra Torrado

with an IRR of 21 percent. In a pessimistic scenario, (sales increase up to 0.7 percent), the NPV is 952,699,427 COP (US\$0.30 million) with an IRR of 13 percent. As other benefits for the firm (e.g. increase in future innovation capabilities) and social benefits (such as positive externalities in overall knowledge generation derived from the innovation process), are expected to outweigh other costs for the firm and associated social costs, the NPV and the IRR of the program is estimated to be higher if these were included in the analysis.

Summary Table of Scenarios

	Optimistic Scenario	Intermediate Scenario	Pessimistic Scenario
IRR	29%	21%	13%
NPV (discount rate 12%)	31,085,929,914	14,860,344,267	952,699,427
NPV (discount rate 10%)	37,888,309,653.45	19,701,197,252.78	4,112,243,766.49
NPV (discount rate 5%)	60,451,413,072.745	35,789,005,979.224	14,649,799,899.064

19. *A significant number of innovations.* Finally, it is critical to note in this analysis that the final end result of the Project and key output from each stage of the innovation ecosystem is a significant number of innovations as captured in the PDO Indicator 4 which reflects 168 new ideas and innovations developed by Labor Market Insertion, Diaspora, Innovation Management, Open Innovation, and Priority Area Programs. These outputs focus on the various levels of the innovation ecosystem suggest that the Project has helped to foster collaboration among the public, private and academic spheres which is important for innovation. For instance, in analyzing Chile and Colombia manufacturing, World Bank researchers found out that collaboration with university and research institutions is associated with an increase in the probability of introducing a new product in Chilean and Colombian firms of 29 and 44 percent, respectively, and it can increase up to 58 percent in the case of Colombian firms interacting with research centers.⁴⁶

20. Furthermore, evidence of innovations from the “Diaspora” and “Labor Market insertion of PhDs” programs have served to enhance this synergy between enterprises and academia, at a national and international level.

21. Another important outcome of the Project is the spillover effects on the community at-large. While the innovations had a large direct impact on the organizations that participated in the *convocatorias*, they also create positive externalities and spillover effects on the community once they are implemented.

22. This impact on the broader community is most evidently illustrated in the “*Social Appropriation*” program of the Project. This pilot had an impact on ethnic minority communities and low resource communities in Colombia. For instance, the ICT

⁴⁶ World Bank, “Human Capital and University-Industry linkages - Role in fostering firm innovation: An Empirical Study of Chile and Colombia”, Latin American and the Caribbean region, written by D Marotta, M Mark, A Blom and K Thorn, 2007.

empowerment project implemented in an indigenous community by the Universidad del Cauca involved 5 different research groups. This example provided the community with both better access to information and improved communication (despite the mountainous geographic conditions).

23. In summary, each stage of the innovation ecosystem as reflected in the process, impact and cost-benefit analysis reveal adequate levels of efficiency and outcomes in the development of skills across the Colombian education systems and labor force, knowledge creation and transfer through research, improved resource allocation, enhanced collaboration between industries and researchers, broader outreach to disadvantaged populations of the country and, an increased innovation capacity among firms.

Annex 4. Bank Lending and Implementation Support/Supervision Processes

(a) Task Team members

Names	Title	Unit	Responsibility/ Specialty
Lending			
Alejandro Caballero	Education Specialist	LCSHE	Task Team Leader
Thomas Haven	Private Sector Development Specialist	LCSPF	
John Gabriel Goddard	Economist	ECSF1	
Maria Retana de la Peza	Junior Professional Associate	LCSHE	
Juan Carlos Serrano-Machorro	Financial Management Specialist	LCSFM	
Gabriel Penalosa	Procurement Specialist	LCSPT	
Tatiana Proskuryajova	Senior Operations Officer	LCSHE	
Reynaldo Pastor	Country Lawyer	LEGLA	
Carlos Escudero	Country Lawyer	LEGLA	
Teresa Genta-Fonz	Country Lawyer	LEGLA	
Jose C. Janeiro	Senior Finance Officer	CTRFC	
Kristine Ivarsdotter	Senior Social Specialist	LCSSO	
Carlos Vargas	Environmental Specialist	LCSHEN	
Monica L. Parra	Consultant	LCSHE	
Rachel Sorey	Consultant	LCSHE	
Juan Julio Gutierrez	Consultant	LCSHE	
Marcela Cardenas	Consultant	LCSHE	
Maria Colchao	Senior Program Assistant	LCSHE	
Antonella Novali	Program Assistant	LCSHE	
Elsa Coy	Program Assistant	LCCCO	
Supervision/ICR			
Alejandro Caballero	Education Specialist	LCSHE	Task Team Leader
Robert J. Hawkins	Senior Education Specialist	GED04	Task Team Leader
Tatiana Proskuryajova	Senior Operations Officer	LCSHE	
Janet K. Entwistle	Senior Operations Officer	LCSHE	
Thomas Haven	Private Sector Development Specialist	LCSPF	
John Gabriel Goddard	Economist	ECSF1	
Maria Retana de la Peza	Economist	LCSHE	
Juan Carlos Serrano-Machorro	Financial Management Specialist	LCSFM	
Luz A. Zeron	Financial Management Specialist	GGO22	
Gabriel Penalosa	Procurement Specialist	LCSPT	
Santiago Rene Torres	Procurement Specialist	GGO04	
Antonio Cristian D'Amelj	Senior Counsel	LEGLE	
Kristine Ivarsdotter	Senior Social Specialist	LCSSO	
Ignacio del Busto Mellado	Junior Professional Associate	LCSHE	
Juan C. Belausteguioitia	Safeguards Specialist	OPSPF	

Dianna M. Pizarro	Senior Social Development Specialist	GSU04	
Glenn S. Morgan	Safeguards Specialist	OPSPF	
Juan Carlos Vasquez Arancibia	Environmental Specialist	GFM04	
Nicole Lucilia Amaral	Junior Professional Associate	LCSHE	
Judith Marcano Williams	Consultant	LCSHH	
Sara Troiano	Consultant	GED04	ICR Consultant
Antonella Novali	Program Assistant	GED04	
Beverly Dixon	Program Assistant	LCSHH	
Elsa Coy	Program Assistant	LCCCO	
Jagannath Griffiths Palma	E T Temporary	GED04	

(b) Staff Time and Cost

Stage of Project Cycle	Staff Time and Cost (Bank Budget Only)	
	No. of staff weeks	USD Thousands (including travel and consultant costs)
Lending		
FY10	81	383
Total:	81	383
Supervision/ICR		
FY11	70	210
FY12	45	138
FY13	39	157
FY14	35	143
FY15	20	129
FY16	15	102
Total:	224	879

Annex 5. Beneficiary Survey Results

N/A

Annex 6. Stakeholder Workshop Report and Results

N/A

Annex 7. Summary of Borrower's ICR and/or Comments on Draft ICR

The Project to “Strengthen the National System of Science, Technology and Innovation” has been completed. This report presents the results obtained for each of the components of the project.

PROJECT OBJECTIVES

The project had two objectives:

- I. Strengthen the capacity of COLCIENCIAS to promote human capital for research, development and innovation and the knowledge economy; and
- II. Raise awareness of science, technology and innovation in Colombian society.

The project had the following four components:

Component 1: Strengthening of COLCIENCIAS’ operating and policy design capacity

A review of the technical operations and legal adjustments of COLCIENCIAS’ *convocatorias* was conducted in line with international standards as well as in accordance with the maturity of Colombia’s National System of Science, Technology and Innovation.

The following results were achieved:

- A new organizational structure for COLCIENCIAS was designed and is in the process of implementation.
- An institutional training plan was designed for the development of COLCIENCIAS’ employees’ job-specific competencies. The training was conducted through group learning projects, according to the priorities defined in the proposal for the entity’s new organizational structure.
- The project also resulted in the design and implementation of the "Program for capacity building in the formulation and project management of STI”, with emphasis on the use of the General Adjusted Methodology — MGA, which falls under the “General System of Royalties and Law on Science, Technology and Innovation”.
- A Balanced Scorecard model was designed and implemented for COLCIENCIAS.

Component 2: Strengthening of COLCIENCIAS’ capacity to promote the development of human capital for science and technology.

A *convocatoria* was designed and implemented to motivate companies to hire PhDs, with the end goal of strengthening the Colombian private sector’s competitiveness and its capacity to conduct research and innovation. The *convocatoria* was also designed to create the social

conditions for companies to become a new employer of PhDs in the country. This *convocatoria* had two modalities: Early Insertion and Research Internship, which in total employed 27 doctors. The *convocatoria* also included support for beneficiaries of the Labor Insertion Program throughout the process of integration into the company

Another *convocatoria* was implemented to stimulate connections between the Colombian scientific diaspora and key actors in the National System of Science Technology and Innovation. This *convocatoria* permitted the international transfer of knowledge and technology to Colombia. Ten subprojects from this *convocatoria* were financed with IBRD resources.

Five *convocatorias* were conducted to intensify scientific cooperation and internationalization and the strengthening of the country's scientific and technological capacity through the generation of strategic links between Colombian researchers abroad and those that belong to entities in the National STI System. These *convocatorias* supported international travel for research and/or innovation projects developed jointly between national researchers and the diaspora. These *convocatorias* financed 44 subprojects.

The Project supported the development of the *Ondas* Program in 2011, 2012 and 2013 in 32 of Colombia's departments and the Capital District. *Ondas* promoted the development of scientific competences in primary and secondary education.

The Project provided the guidelines for a pilot to develop scientific spirit and critical thinking in early childhood – i.e. pre-school. The pilot program was carried out in 7 departments.

The Project provided the policy guidelines for research “nurseries” to develop the scientific abilities of undergraduate students in institutions of Higher Education.

Component 3: Strengthening of COLCIENCIAS' capacity to promote research and innovation

The Project supported the development of STI plans in the Electronics/ICT and Biodiversity sectors in Colombia.

A *convocatoria* was conducted to support the development of projects to strengthen capacity for research, innovation and technological development in the areas of sustainable energy, biofuels and biological inputs for agriculture. One subproject was supported by this *convocatoria*.

A *convocatoria* was conducted to support the functional validation and technical and scientific feasibility of new biological, biomedical and energy technologies that are of high technological risk, but have high commercial potential, and to strengthen the capacity of technological research and/or development groups in universities, participation from companies from different productive sectors and university spin-offs as a platform to

accelerate the processes of innovation in different regions and productive sectors of the country. This *convocatoria* supported 19 subprojects.

A *convocatoria* was conducted to support subprojects to construct prototypes of transformative technologies that incorporate locally developed scientific and technological knowledge for commercial pre-validation and that, at the same time, contribute to strengthening the links and technology transfer between universities and research and/or technological development centers with companies in different productive sectors for innovation with high commercial potential. The goal is that these companies increase their probability of realizing extraordinary growth. This *convocatoria* supported 10 subprojects.

Two *convocatorias* were conducted to consolidate the innovation management capacity of Colombian companies and strengthen the specialization of national groups and entities in the provision of services to support innovation management. This *convocatoria* financed 21 subprojects.

One *convocatoria* was conducted to implement product innovation processes and service or business models based on scientific or technological knowledge. This was done through the strengthening of the innovation management capacity of Colombian companies and organizations. This *convocatoria* financed 49 subprojects.

Component 4: Promote the social appropriation of science, technology and innovation and institutional communication.

A *convocatoria* was conducted to support Science and Technology Communication subprojects for the comprehension, dialogue and the development of public opinion about topics related to science, technology and innovation in society. This *convocatoria* financed 10 subprojects.

A *convocatoria* was conducted to support subprojects that promote the social appropriation of science and technology in specific communities through alliances and active participation with research groups and organizations that specialize in the promotion of social appropriation. This *convocatoria* financed 6 subprojects.

A *convocatoria* was conducted to carry out communication projects with a focus on science, technology and society in order to develop a culture of knowledge in Colombia. This *convocatoria* financed 3 subprojects.

A competition was conducted for the monitoring and support of each of the subprojects that were developed by the communities that won a competition based on their experiences in designing and implementing scientific solutions on the local level.

A strategic communication model was designed to help position COLCIENCIAS internally and externally as the Administrative Department responsible for the direction and promotion of scientific and technological knowledge and innovation in Colombia, as well as for the administration of the Francisco José de Caldas Fund—a flexible, novel and effective

instrument to finance the National System of Science Technology and Innovation at the local, regional, national and international levels.

THE WORLD BANK'S AND GOVERNMENT'S PERFORMANCE IN THE DESIGN AND IMPLEMENTATION OF THE PROJECT.

The project to “Strengthen the National System of Science, Technology and Innovation” is in line with the development plan of the Colombian government and the Bank's policies regarding science, technology and innovation. The Colombian government's performance, acting as the borrower of the Project, throughout design and implementation was in line with the regulations established by the World Bank regarding disbursements, procurement, procurement of goods and was in compliance with the indicators set out in the Project Appraisal Document.

The World Bank, acting as a lender, provided the necessary support during the implementation period and during the project's execution, and was in direct contact with the borrower through visits and supervisions missions. Monitoring and supervision were performed by a highly skilled team, which brought important lessons and insight to the project.

Annex 8. Comments of Cofinanciers and Other Partners/Stakeholders

N/A

Annex 9. List of Supporting Documents

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Annex 10. Causal Linkages between the PDO, Revised Key Indicators, and the Project's Components (according to Review during the ICR Stage)

Outcome	Output (Intermediate outcome)	Component	Key Indicators and Targets	Intermediate Indicators and Targets	Additional Indicators (collected at ICR stage, figures reflect actual values)	Specific activities financed (inputs)
Strengthen COLCIENCIAS capacity to promote human capital for the knowledge economy, research and development and innovation	Institutional strengthening of the STI National System	1	<ul style="list-style-type: none"> - 60% of COLCIENCIAS annual investment budget committed by the end of the second quarter of the calendar year - 3 instruments designed or redesigned and approved by COLCIENCIAS' Board of Directors (dropped in 2013) - Lessons learned summary completed based on the results of the evaluations (dropped in 2013) 	<ul style="list-style-type: none"> - 80 staff trained according to a revised competencies model - 10 management units using the Balanced Scorecard - Revised COLCIENCIAS' <i>convocatoria</i> processes - 8 research papers, short policy papers, or technical papers completed by the internal policy unit -420 beneficiaries who have completed short course 	1.11 as ratio of performance of COLCIENCIAS programs financed by this Project relative to the average performance of STI programs in Colombia, as per scores obtained in the Functional Analysis (World Bank, 2016)	<ul style="list-style-type: none"> - Optimization of the <i>convocatorias</i> process - Reorganization of COLCIENCIAS' organizational structure - Balanced Score Card system - Development of the Policy Unit - Design of a revised competencies model, and training - Short courses to regional STI stakeholders
	Development of human capital for science and technology	2	<ul style="list-style-type: none"> - 30 new ideas or innovations developed by Labor Market Insertion, Diaspora, Innovation Management, Open Innovation and Priority Area program 	<ul style="list-style-type: none"> - 1.2 million students covered yearly by <i>Ondas</i> - Design of monitoring and evaluation framework for <i>Ondas</i> - 29 doctoral graduates participating in the Labor 	<ul style="list-style-type: none"> - \$CO 1.7 pesos invested by the private sector for each CO\$ 1 invested by COLCIENCIAS under the Labor Market Insertion program -48% of PhDs hired by the same firm participating in the program 	<ul style="list-style-type: none"> - <i>Inserción laboral</i> - Diaspora - <i>Ondas</i>

Outcome	Output (Intermediate outcome)	Component	Key Indicators and Targets	Intermediate Indicators and Targets	Additional Indicators (collected at ICR stage, figures reflect actual values)	Specific activities financed (inputs)
			activities reflected in components 2 and 3	<p>Insertion programs</p> <ul style="list-style-type: none"> - 37 subprojects involving researchers residing abroad participating in collaborative research projects - 2 evaluations for the <i>convocatorias</i> corresponding to the Labor Insertion and Diaspora pilots completed 	<ul style="list-style-type: none"> - 16 scientific articles produced under the Diaspora program -23 graduate thesis supported under the Diaspora program 	
	Investment for research and innovation	3		<ul style="list-style-type: none"> - 100 proposals financed for innovation- management capacity building subprojects - 2 R&D and innovation subprojects in priority areas for which Project resources have been committed - US\$ 4 million of project resources committed to finance R&D and innovation subprojects in which there is at least one firm participating (dropped in 2013) - 3 evaluations for the calls-for -proposals corresponding to the R&D and innovation pilots completed 	<ul style="list-style-type: none"> - 93% of the beneficiary firms thinks the capacity building received was useful/very useful (Innovation Management) + 113% in the participating firms' budget allocation to STI investment of firms with respect to the pre-program levels (Innovation Management) + 44% in the number of employees with PhD with respect to the pre-program levels (Innovation Management) + 68 % in the number of employees assigned to STI activities with respect to the pre-program levels (Innovation Management) + 87 % in the number of STI 	<ul style="list-style-type: none"> - Priority areas - Innovation Management

Outcome	Output (Intermediate outcome)	Component	Key Indicators and Targets	Intermediate Indicators and Targets	Additional Indicators (collected at ICR stage, figures reflect actual values)	Specific activities financed (inputs)
					projects financed with respect to the pre-program levels (Innovation Management)	
Raise awareness of science, technology and innovation in the Colombian society	Social Dissemination of Science, Technology and Innovation and Institutional Communication	4	<ul style="list-style-type: none"> - 2674 grant applications for R&D and innovation subprojects received yearly by COLCIENCIAS (Dropped in 2013) - 76% of the population agrees that Colombia creates Science and 73% that it creates Technology 	<ul style="list-style-type: none"> - Monitoring and evaluation framework for social dissemination of STI defined - 8,500 citizens directly participating in COLCIENCIAS' citizen participation activities financed by the Project - 39,500 document downloads from COLCIENCIAS' Web page per year (dropped in 2013) - 429,000 unique visits to COLCIENCIAS' web page per year 	<ul style="list-style-type: none"> - 2,512 citizens participating to Social Appropriation - 25,000 citizens participating to <i>A Ciencia Cierta</i> - 50% increase in the number of citations of COLCIENCIAS and/or its activities in the media - 59,737 followers in COLCIENCIAS Facebook page - 100,403 followers in COLCIENCIAS Twitter account 	<ul style="list-style-type: none"> - Social Appropriation - <i>A Ciencia Cierta</i> - Institutional communication

MAP

