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Report No: PAD1818

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED LOAN

IN THE AMOUNT OF US$45.00 MILLION

TO THE

REPUBLIC OF PERU

FOR

# STRENGTHENING THE SCIENCE, TECHNOLOGY AND INNOVATION SYSTEM IN PERU

December 12, 2016

Trade and Competitiveness Global Practice
Latin American and the Caribbean Region

CURRENCY EQUIVALENTS
(Exchange Rate Effective April 1, 2016)

Currency Unit = Peruvian Nuevo Sol (PEN)
US$1 = PEN 3.3

FISCAL YEAR
January 1 – December 31

ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| AFO | Administrative and Finance Office |
| BPO | Budget and Planning Office |
| CONCYTEC | *Consejo Nacional de Ciencia, Tecnología, e Innovación Tecnológica* (National Council for Science, Technology, and Innovation) |
| COFIDE | *Banco de desarrollo del PERU*(Development Finance Corporation) |
| CPS | Country Partnership Strategy |
| CRI | Competitiveness Reinforcement Initiative |
| DA | Designated Account |
| DGIP | *Dirección General de Inversión Pública* (Directorate General of Public Investment) |
| EMF | Environmental Management Framework |
| EVA | National Directory of Evaluators in Science, Technology and Innovation |
| FONDECYT | *Fondo Nacional de Desarrollo Científico Tecnológico y de Innovación Tecnológica* (National Fund for the Development of Science, Technology, and Technological Innovation) |
| GDP | Gross Domestic Product |
| GII | Global Innovation Index |
| GRS | Grievance Redress Service |
| GVC | Global Value Chain |
| IC | Individual Consultant |
| ICB | International Competitive Bidding |
| IDB | Inter-American Development Bank |
| IE | Impact Evaluation |
| IFR | Interim Financial Report |
| IMF | International Monetary Fund |
| INEI | National Institute of Statistics |
| INGEMMET | *Instituto Geológico Minero y Metalúrgico* (Geological Mining and Metallurgical Institute) |
| INICTEL | *Instituto Nacional de Investigación y Capacitación de Telecomunicaciones* (National Institue of Research and Training for Telecomunication) |
| IT | Information Technology |
| LAC | Latin America and the Caribbean |
| M&E | Monitoring and Evaluation |
| MEF | Ministry of Economy and Finance |
| MINAG | *Ministerio de Agricultura* (Ministry of Agriculture) |
| NCB | National Competitive Bidding |

| | |
|---|---|
| NPV | Net Present Value |
| OECD | Organization for Economic Co-operation and Development |
| PCM | Presidency of the Council of Ministries |
| PDC | Project Directive Committee |
| PDO | Project Development Objective |
| PER | Public Expenditure Review |
| PI | Productive innovation |
| PIT | Project Implementation Team |
| PIP | *Proyecto de Inversión Pública* (Public Investment Project) |
| PNCTI | *Plan Nacional Estratégico de Ciencia, Tecnología e Innovación para la Competitividad y el Desarrollo Humano* (Plan for Science, Technology and Innovation for Competitiveness and Human Development) |
| PPD | Public-Private Dialogue |
| PRODUCE | Ministry of Production |
| PV | Present Value |
| R&D | Research and Development |
| R&I | Research and Innovation |
| RCT | Randomized Control Trials |
| SIAF | *Sistema Integrado de Información Financiera* (Integrated System of Financial Information) |
| SIG | FONDECYT's Tailor-Made Financial Information System |
| SINACYT | National System of Science, Technology and Technological Innovation |
| SME | Small and Medium Enterprises |
| SNIP | *Sistema Nacional de Inversión Pública* (National Public Investment System) |
| SOE | Statement of Expenditures |
| SS | Single Source |
| STI | Science, Technology, and Innovation |
| TA | Technical Assistance |
| TTL | Task Team Leader |
| TUP | Technology Upgrading Plan |
| VC | Value Chain |
| UNCTAD | United Nations Conference on Trade and Development |
| WEF | World Economic Forum |

| | |
|---|---|
| Regional Vice President: | Jorge Familiar |
| Country Director: | Alberto Rodríguez |
| Senior Global Practice Director: | Anabel González |
| Practice Manager: | Marialisa Motta |
| Task Team Leader: | Alberto Criscuolo and Javier Botero Álvarez |

**PERU**

**Strengthening the Science, Technology and Innovation System in Peru**

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**PAD DATA SHEET**

*Peru*

*Strengthening the Science, Technology and Innovation System in Peru (P156250)*

**PROJECT APPRAISAL DOCUMENT**

*LATIN AMERICA AND CARIBBEAN*

*GTC04*

Report No.: PAD1818

| **Basic Information** | | |
|---|---|---|
| Project ID<br>P156250 | EA Category<br>B - Partial Assessment | Team Leader(s)<br>Alberto Criscuolo, Javier Botero Alvarez |
| Lending Instrument<br>Investment Project Financing | Fragile and/or Capacity Constraints [ ]<br>Financial Intermediaries [ ]<br>Series of Projects [ ] | |
| Project Implementation Start Date<br>24-Apr-2017 | Project Implementation End Date<br>31-Dec-2021 | |
| Expected Effectiveness Date<br>31-Mar-2017 | Expected Closing Date<br>31-Dec-2021 | |
| Joint IFC<br>No | | |

| Practice Manager/Manager | Senior Global Practice Director | Country Director | Regional Vice President |
|---|---|---|---|
| Marialisa Motta | Anabel Gonzalez | Alberto Rodriguez | Jorge Familiar |

| | | | | | |
|---|---|---|---|---|---|
| Borrower: Republic of Peru` | | | | | |
| Responsible Agency: CONCYTEC | | | | | |
| Contact: | María Gisella Orjeda Fernández | | Title: | President | |
| Telephone No.: | 5113990030 | | Email: | gorjeda@concytec.gob.pe | |

| **Project Financing Data(in USD Million)** | | | | | |
|---|---|---|---|---|---|
| [ X ] | Loan | [ ] | IDA Grant | [ ] | Guarantee |
| [ ] | Credit | [ ] | Grant | [ ] | Other |

| | | | |
|---|---|---|---|
| Total Project Cost: | 100.00 | Total Bank Financing: | 45.00 |
| Financing Gap: | 0.00 | | |

| Financing Source | Amount |
|---|---|
| Borrower | 55.00 |
| International Bank for Reconstruction and Development | 45.00 |
| Total | 100.00 |

**Expected Disbursements (in USD Million)**

| Fiscal Year | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 0000 | 0000 | 0000 | 0000 |
|---|---|---|---|---|---|---|---|---|---|---|
| Annual | 0.60 | 11.10 | 14.70 | 12.80 | 5.80 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Cumulative | 0.60 | 11.70 | 26.40 | 39.20 | 45.00 | 45.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## Institutional Data

**Practice Area (Lead)**

Trade & Competitiveness

**Contributing Practice Areas**

Education

**Proposed Development Objective(s)**

The project development objective is to strengthen the science, technology and innovation system to improve research skills and firm-level innovation.

**Components**

| Component Name | Cost (USD Millions) |
|---|---|
| Improving the Institutional Framework of the National STI System | 4.00 |
| Strategic Programs: Productivity & Innovation Fund and Competitiveness Reinforcement Initiatives for Productive Innovation | 8.00 |
| Research and Innovation Capacity | 32.00 |
| Project Management and Monitoring & Evaluation | 1.00 |

## Systematic Operations Risk- Rating Tool (SORT)

| Risk Category | Rating |
|---|---|
| 1. Political and Governance | Moderate |
| 2. Macroeconomic | Low |
| 3. Sector Strategies and Policies | Moderate |
| 4. Technical Design of Project or Program | Substantial |
| 5. Institutional Capacity for Implementation and Sustainability | Moderate |
| 6. Fiduciary | Moderate |

| | |
|---|---|
| 7. Environment and Social | Low |
| 8. Stakeholders | Moderate |
| 9. Other | |
| **OVERALL** | Moderate |

## Compliance

**Policy**

| | |
|---|---|
| Does the project depart from the CAS in content or in other significant respects? | Yes [ ] No [ X ] |
| Does the project require any waivers of Bank policies? | Yes [ ] No [ X ] |
| Have these been approved by Bank management? | Yes [ ] No [ ] |
| Is approval for any policy waiver sought from the Board? | Yes [ ] No [ X ] |
| Does the project meet the Regional criteria for readiness for implementation? | Yes [ X ] No [ ] |

| **Safeguard Policies Triggered by the Project** | **Yes** | **No** |
|---|---|---|
| Environmental Assessment OP/BP 4.01 | **X** | |
| Natural Habitats OP/BP 4.04 | | **X** |
| Forests OP/BP 4.36 | | **X** |
| Pest Management OP 4.09 | | **X** |
| Physical Cultural Resources OP/BP 4.11 | | **X** |
| Indigenous Peoples OP/BP 4.10 | | **X** |
| Involuntary Resettlement OP/BP 4.12 | | **X** |
| Safety of Dams OP/BP 4.37 | | **X** |
| Projects on International Waterways OP/BP 7.50 | | **X** |
| Projects in Disputed Areas OP/BP 7.60 | | **X** |

**Legal Covenants**

| **Name** | **Recurrent** | **Due Date** | **Frequency** |
|---|---|---|---|
| Project implementation team (Schedule 2, Section I, A.2.a) | **X** | | CONTINUOUS |

**Description of Covenant**

(a) FONDECYT shall maintain during the life of the project a project implementation team (PIT) responsible for the management, coordination, supervision, monitoring and evaluation of the project

| **Name** | **Recurrent** | **Due Date** | **Frequency** |
|---|---|---|---|
| Hire key staff in the PIT (Schedule 2, Section I, A.2.b) | | 28-Apr-2017 | |

**Description of Covenant**

(b) FONDECYT shall hire one month after effectiveness the key staff in the PIT, as detailed in the operational manual

| Name | Recurrent | Due Date | Frequency |
|---|---|---|---|
| Project Directive Committee (Schedule 2, Section I, A.3) | X | | CONTINUOUS |

**Description of Covenant**

(c) CONCYTEC shall maintain the Project Directive Committee

| Name | Recurrent | Due Date | Frequency |
|---|---|---|---|
| Matching Grant Agreements (Schedule 1, Section I, B.1) | X | | CONTINUOUS |

**Description of Covenant**

(d) FONDECYT shall carry out the selection and supervision of the initiatives financed through Matching Grants and sign adequate Matching Grant Agreements with Beneficiaries

| Name | Recurrent | Due Date | Frequency |
|---|---|---|---|
| Operational Manual (Schedule 2, Section I, D.1) | X | | CONTINUOUS |

**Description of Covenant**

(e) FONDECYT AND CONCYTEC shall carry out the project in accordance with the operational manual

| Name | Recurrent | Due Date | Frequency |
|---|---|---|---|
| Environmental Management Framework (Schedule 2, Section I, D.2.a.) | X | | CONTINUOUS |

**Description of Covenant**

(f) FONDECYT shall carry out the project in accordance with the environmental management framework (EMF)

**Conditions**

| Source Of Fund | Name | Type |
|---|---|---|
| IBRD | Conditions for Effectiveness | Effectiveness |

**Description of Condition**

(a) The Project Directive Committee has been created and (b) the operational manual has been adopted by the Project Directive Committee (Article 4.01)

| Source Of Fund | Name | Type |
|---|---|---|
| IBRD | Conditions for Disbursement | Disbursement |

**Description of Condition**

(a) No disbursements under category (2) unless FONDECY has selected a Third Party for purposes of assisting FONDECYT in carrying out Part 3.1(i) of the project and signed a contract with said Third Party (Schedule 2, Section IV, B, 1 (b))

## Team Composition

| Bank Staff | | | | |
|---|---|---|---|---|
| **Name** | **Role** | **Title** | **Specialization** | **Unit** |
| Alberto Criscuolo | Team Leader (ADM Responsible) | Senior Private Sector Specialist | TTL | GTC04 |
| Javier Botero Alvarez | Team Leader | Lead Education Specialist | Co-TTL | GED04 |
| Sandra Ximena Enciso Gaitan | Procurement Specialist (ADM Responsible) | Procurement Specialist | Procurement Specialist | GGO04 |
| Nelly Ikeda | Financial Management Specialist | Financial Management Specialist | FM Specialist | GGO22 |
| Aarre Laakso | Team Member | Consultant | Consultant | GTC04 |
| Agnes I. Kiss | Safeguards Advisor | Regional Environmental and Safeguards Advisor | Regional Safeguard Advisor | OPSPF |
| Alonso Zarzar Casis | Safeguards Specialist | Senior. Social Scientist | Senior Social Scientist | GSU04 |
| Alvaro Larrea | Team Member | Lead Procurement Specialist | Senior Procurement Specialist | GGO04 |
| Ana Paula Cusolito | Team Member | Senior Economist | | GTC03 |
| Andrea Patton | Team Member | Program Assistant | | GTC04 |
| Catarina Isabel Portelo | Team Member | Senior Counsel | | LEGLE |
| Edon Vrenezi | Team Member | Senior Operations Officer | Senior Operations Officer | LCROS |
| Ernesto Franco-Temple | Team Member | Senior Private Sector Specialist | Operations Officer | GTCLA |
| Gabriela Grinsteins | Team Member | Counsel | | LEGLE |
| Isabella Micali Drossos | Counsel | Senior Counsel | Lawyer | LEGLE |
| Justin Piers William Hill | Peer Reviewer | Senior Private Sector Specialist | Senior Innovation Specialist | GTCIE |
| Kamal M. Siblini | Team Member | Senior Monitoring & Evaluation Specialist | Senior Monitoring & Evaluation Specialist | GTCOS |
| Lucero Del Carmen Burga Bravo De Rueda | Team Member | Young Professional | YP | GFM05 |
| Maria Virginia Hormazabal | Team Member | Finance Officer | | WFALA |
| Michael F. Crawford | Peer Reviewer | Lead Education Specialist | Lead Education Specialist | GED02 |

| | | | | |
|---|---|---|---|---|
| Micky O. Ananth | Team Member | Senior Operations Assistant | Program Assistant | GTCOS |
| Patricia De la Fuente Hoyes | Team Member | Sr Financial Management Specialist | Senior Financial Management Specialist | GGO22 |
| Raul Tolmos | Safeguards Specialist | Environmental Specialist | Environmental Specialist | GEN04 |
| Roberta Malee Bassett | Peer Reviewer | Senior Education Specialist | Senior Education Specialist | GED03 |
| Selene del Rocio La Vera | Team Member | Procurement Specialist | Procurement Specialist | GGO04 |
| Thomas Edward Haven | Peer Reviewer | Senior Private Sector Specialist | Senior Private Sector Development Specialist | GTC03 |
| Xavier Cirera | Team Member | Senior Economist | Senior Innovation Specialist | GTCIE |

**Extended Team**

| Name | Title | Office Phone | Location |
|---|---|---|---|
| Maria Ariano | Private Sector Development Expert (STC) | 4731399 | Washington, DC |
| Miguel Enrique Priale Ugas | Economist (SNIP Expert) - Consultant | +5114212392 | Lima |

**Locations**

| Country | First Administrative Division | Location | Planned | Actual | Comments |
|---|---|---|---|---|---|
| | | | | | |

**Consultants (Will be disclosed in the Monthly Operational Summary)**

Consultants Required? Consulting services to be determined

# I. STRATEGIC CONTEXT

## A. Country Context

1. **Peru has emerged as one of the fastest growing countries in Latin America and the Caribbean (LAC).** Its economy grew at an average of 6.4 percent per year during the last decade, the second fastest in the region. Over the same period, Peru doubled its per capita income, whereas the region as a whole increased per capita income by only half. Growth helped Peru reduce poverty from 54.8 percent to 25.8 percent of the population between 2001 and 2012, faster than other countries with similar incomes. Peru also made strides in terms of shared prosperity: between 2004 and 2013, the real income per capita of the poorest 40 percent of Peru's population grew at an average 6.8 percent, above the 4.4 percent national average.

2. **Strong macroeconomic and structural reforms over the last 20 years have driven these successes.** Macroeconomic stabilization in the 1990s included the introduction of a more flexible exchange rate regime, inflation-targeting, fiscal discipline, and continued public debt reduction. Structural reforms covered areas such as financial liberalization, trade, and product and factor market regulations. As a commodity exporter, Peru also benefited significantly from the commodity boom, particularly between 2004 and 2013. Relative to other countries in LAC, Peru used a significant part of the commodity boom for capital accumulation. Together with the demographic dividend, this provided Peru with enough inputs to fuel growth. Total factor productivity also contributed about a third of growth over the past 15 years.[1]

3. **Peru has a sound macroeconomic policy framework to face the headwinds of the new global context.** Growth slowed to 2.4 percent in 2014, but has since recovered to 3.3 percent in 2015, a trend that is expected to continue in 2016–2017. Ample macroeconomic buffers allowed the country to undertake moderate, prudent, and temporary counter-cyclical fiscal policy. The technocratic Government that took office on July 28, 2016 is expected to maintain a prudent macroeconomic stance and to continue and deepen key structural reforms.

## B. Sectoral and Institutional Context

4. **To sustain growth, Peru needs to spur productivity.** Overall progress notwithstanding, Peru still suffers from large income and productivity gaps in relation to high-income countries. Its output per worker is still only 25 percent of the United States, lower than that of Mexico (35 percent) and Chile (36 percent). Government efforts, therefore, will need to focus on fostering productivity gains, across and within firms (including process and product innovation), and accelerating private sector investments. The agenda in this area is significant, but Peru has started with simplification of regulation on business entry, operation, and exit, increased transparency of product market regulations, and implemented reforms that enable factors of production (labor, capital and land) to move seamlessly from the least efficient to the most innovative firms, which raises productivity.

5. **Firms' productivity growth depends on their ability to innovate effectively.** This, in turn, depends on the technologies, processes, human capital, and managerial skills available to

[1] All data presented in this section are from the World Bank Group 2015 Flagship Report "Peru: Building on Success, Boosting Productivity for Faster Growth," unless otherwise specified.

them, their own growth aspirations and internal capabilities, and the expected profitability of target markets. Peruvian firms invest only 2.5 percent of sales on innovation (compared to 3.5 percent in Chile and 5.6 percent in the EU), indicating that the innovation system might not be functioning properly. Shortcomings in Peru's innovation system (see below) limit reliable access to the technologies, human capital, and know how that firms need to innovate.

6. **To become more competitive and increase countrywide productivity, Peruvian firms need to invest in high-return innovation.** Firms that invest in innovation are more likely to introduce new products, but low returns deter investment. Peruvian firms that spend on innovation are more likely (53 percent) to introduce new products or processes than firms in other LAC countries (Colombia - 43 percent, Panama - 36 percent, Argentina - 26 percent) except Chile. However, Peruvian firms that introduce new products or processes see only about 38 percent higher sales per employee, compared to about 100 percent higher sales per employee in Colombia, Panama, Uruguay, Costa Rica, and Chile. Annex 5 analyzes the market failures associated with Peruvian firms' low investments in —and poor returns on—innovation.

7. **Peru's science, technology, and innovation (STI) system was created in the late 1960s and reformed in the mid-2000s.** The 2004 Science, Technology, and Technological Innovation Framework law (Law No. 28303) entrusted the National Council for Science, Technology, and Innovation (*Consejo Nacional de Ciencia, Tecnología, e Innovación Tecnológica*, CONCYTEC) with the responsibility for governing the STI system and for developing, promoting, and coordinating STI policy. The law also entrusted CONCYTEC with policy implementation through *Fondo Nacional de Desarrollo Científico Tecnológico y de Innovación Tecnológica* (National Fund for the Development of Science, Technology, and Technological Innovation, FONDECYT), its operational arm. FONDECYT manages programs to support basic and applied research, technology transfer, and higher education. Other public actors in Peru's STI system include the Ministry of Production (PRODUCE), the Ministry of Economy and Finance (MEF), the Ministry of Education, the Presidency of the Council of Ministries (PCM), the Development Finance Corporation (COFIDE), and the ministries and their respective sector-oriented research and technology organizations and funding programs (see annex 2 and figure 2.1). An eight-fold increase in CONCYTEC's budget—from US$5 million in 2012 to US$39 million in 2015—has supported the Government's priority to strengthen the STI system in Peru.

8. Progress notwithstanding, Peru's STI system main shortcomings can be classified into three groups:

(a) **The weak governance of the STI system undermines the effectiveness of public expenditures on innovation and the growth of effective research and technology transfer programs between firms and academia.** The institutional framework and governance of the national STI system is still underdeveloped compared to some of the peer countries in Pacific Alliance *Alianza Pacifico*, such as Chile and Colombia. In 2015, around 20 institutions implemented a public budget of US$150 million on STI programs. Absence of an institutional framework and governance structure contributes to low public investment in innovation. Peru spends significantly less on STI as a share of gross domestic product (GDP) than other LAC countries. STI budgets in Mexico, Chile, and Colombia are 20, 10, and 6 times larger than the STI budget in Peru. Public support

reaches less than 1 percent of firms, compared to 6 percent and 8 percent of firms in Brazil and Chile, respectively. Institutional rigidities and legalistic frameworks hinder the development and effectiveness of policy instruments. Peru also has one of the weakest systems of STI data in the region, hindering monitoring of policies and international benchmarking. The absence of a robust monitoring and evaluation (M&E) framework for innovation policies constrains policy learning and the ability to adapt and increase the effectiveness of public support.

(b) **Firms in Peru operate in isolation, could improve their strategic focus, and often compete in low-margin strategic segments.** Most Peruvian firms are not connected to research institutions and do not benefit from the knowledge flows and technology transfers typically associated with foreign direct investment and dynamic Global Value Chains (GVCs). Only 0.4 percent of Peru's exports are high tech, against 0.9 percent in Colombia, 2.2 percent in Argentina, 3.3 percent in Brazil, and 6.0 percent in Chile. In Peru, foreign companies locally source only 52.5 percent of inputs, whereas in Chile and Colombia, local sourcing by foreign firms reaches 58.6 percent and 61 percent, respectively. Similarly, university and industry collaboration in research and development (R&D) is the weakest in Peru among peer countries. (Peru ranks 108th out of 140 countries in the corresponding World Economic Forum (WEF) indicator while Colombia ranks 49th, Mexico 43rd, and Chile 39th). This suggests that Peru needs to exploit spillovers, increasing interactions between firms and research institutions.

(c) **At only 181 researchers per million inhabitants, Peru's number of STI university graduates and scientific researchers restricts firms' creation and adoption of knowledge and technology.** In fact, the lack of qualified human capital, particularly women, is one of the main constraints on productivity and innovation in Peru according to the 2012 National Innovation Survey. The supply of skills is insufficient (181 researchers per million inhabitants), especially when compared to 1,941 researchers per million inhabitants in Argentina, 551 in Chile, 1,200 in Brazil, and 346 in Colombia. Moreover, the quality of education remains poor. The fact that Peru has one of the largest gender gaps in the region (see annex 7) compounds the problem. It ranked 86 among 132 countries in the 2013 Global Gender Gap Report of the WEF. Only 26 percent of the students, 20 percent of the professors and 33 percent of the researchers in these areas are women. As a result, Peru performs worse than peers do across all indicators of science, technology, innovation and creativity. For, example, Peru produces 2.4 scientific articles per billion GDP (ranking 122 of 142 on the 2015 Global Innovation Index (GII)) and files 0.03 international patents per billion GDP (ranking 84 of 142 on the 2015 GII).

### C. Higher Level Objectives to which the Project Contributes

9. **The Project is consistent with the Government's determination to foster productivity growth by strengthening its national innovation system (STI system).** To that end, in 2014, the Government mandated that the CONCYTEC design the national STI strategy "*Crear para Crecer*" and implement it through a Public Investment Project (*Proyecto de Inversión Pública*, PIP) with the support of the World Bank.

10. The project is aligned with the latest Country Partnership Strategy (CPS) for FY2012–2016, discussed by the Executive Directors on February 1, 2012 (Report No. 66187-PE), and contributes to the CPS goal of "Sustainable Growth and Productivity", specifically results area 3.1: "Promoting productivity through enhanced labor skills and small and medium enterprises' (SME) competitiveness."

11. The project supports the overall World Bank Group productivity and innovation agenda in Peru. It complements: (a) the "Higher Education Quality Improvement" Project (P122194), which focuses on strengthening Peru's quality assurance system for higher education, (b) the "Supporting Peru Rise to Organization for Economic Co-operation and Development (OECD) Standards" Programmatic Approach (P158725), which supports the adoption of OECD Standards to improve priority policy areas including innovation, and (c) the Development Policy Financing operation "Boosting Productivity for Growth" (P156858), which focuses on improving between-firm productivity by removing regulatory distortions on areas such as business entry, operation, trade, and exit, and improving skills.

## II. PROJECT DEVELOPMENT OBJECTIVES

### A. PDO

12. **The project development objective (PDO) is to strengthen the STI system to improve research skills and firm-level innovation.**

### B. Project Beneficiaries

13. **The Project will directly benefit individuals, firms, research institutes and the agencies that form the STI system in Peru (see figure 2.1).** More specifically, it will benefit:

- Students, researchers and professionals who receive project funds to pay for PhD scholarships, postdocs and internships.
- Firms that receive project funds for investment in innovation projects and to pay for shared services at cluster level.
- Universities, research centers and technological institutes that receive project funds to buy equipment, undertake research or technology transfer, or buy technical assistance (TA).
- Public agencies, such as CONCYTEC, the *Instituto Geológico Minero y Metalúrgico* (INGEMMET), and the *Instituto Nacional de Investigación y Capacitación de Telecomunicaciones* (INICTEL), and Peruvian universities, which receive project funds to finance TA and equipment to improve their information, monitoring and planning systems.

14. The project will indirectly benefit (a) employees of firms, universities and research centers that receive project funds, (b) consumers, which will be able to access products and services of superior quality at lower prices, and (c) the Government, through increased revenues from the value added by new activities. The project will also benefit active researchers, and it will monitor the number of beneficiaries by gender for each year of implementation of component 3. Beneficiary feedback would be captured through participation in the public-private

dialogue (PPD) under component 2 and the review of public expenditures on innovation under component 1.

### C. PDO-Level Results Indicators

15. The key indicators to measure progress towards the achievement of the PDO are:

(a) Number of research papers submitted for Publication to internationally indexed journals

(b) Number of beneficiary firms that have introduced new or upgraded processes

(c) Number of beneficiary firms that have introduced new or upgraded products

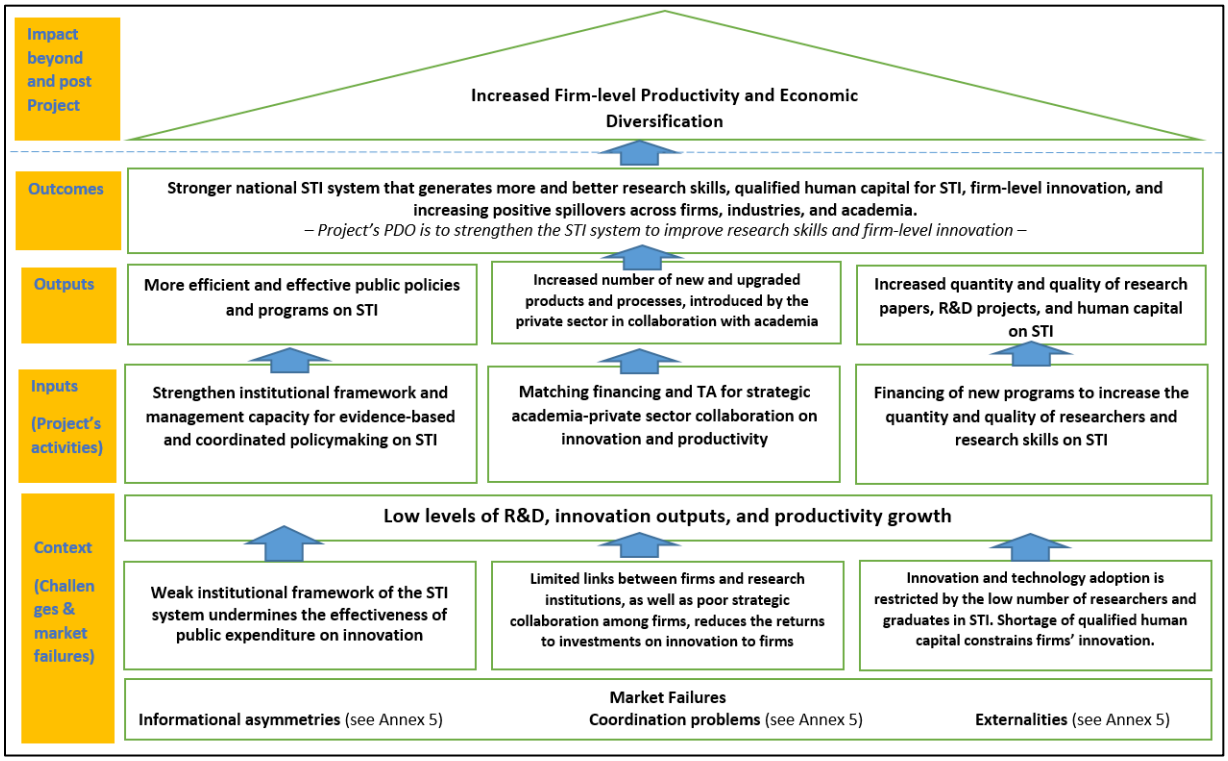
(d) Number of students enrolled in PhD programs supported by the project

## III. PROJECT DESCRIPTION

### A. Project Components

16. **The project comprises four components.** Each component will contribute to strengthening the STI system of Peru according to the "theory of change" presented in figure 1, which summarizes the causal chain of results for the project components described below. While Component 3 builds upon CONCYTEC's established record of promoting scientific research, Components 1 and 2 will provide novel and innovative contributions to initiate a systemic reform of the STI system in Peru and to re-align it with the priorities of the private sector.

**Figure 1. Theory of Change and Results Chain - Peru STI Project**




*Source:* World Bank Group, T&C GP Results Framework (2016). Staff adaptation.

17. **Component 1: Improving the Institutional Framework of the National STI System (US$10,571,791 - IBRD Financing US$4,265,791)** through (a) TA to strengthen the institutional design and governance capacity of the STI system, for it to become more integrated, efficient, coordinated and effective; and (b) TA and equipment to improve CONCYTEC's management capacity, including improved monitoring of STI programs and instruments. Initial activities of Component 1, such as STI data collection and transfer of methodology for Public Expenditure Review (PER) on Innovation to Government staff have been launched through trust fund funding.

(a) **Subcomponent 1.1: Improving the institutional framework of the STI system.** TA to assess the efficiency and effectiveness of STI public institutions (such as CONCYTEC, FONDECYT, PRODUCE, the Ministry of Agriculture—MINAG, universities, research centers, and others – see figure 2.1) and STI programs, and to provide recommendations to improve the overall functioning of the STI system, through the implementation of a PER on Innovation. This subcomponent will also incorporate an analysis of private sector expenditure on innovation based on the National Innovation survey for Manufacturing, produced by the National Institute of Statistics (INEI).

(b) **Subcomponent 1.2: Strengthening CONCYTEC and FONDECYT management capacity.** TA, training and financing of equipment (hardware and software) to design and implement information, M&E systems. About 60 percent of the resources will finance integrated information technology (IT) and monitoring systems (equipment, IT infrastructure, and subscriptions to scientific databases) needed to

monitor programs and instruments of the STI institutions. About 30 percent of the resources will be allocated to train staff on M&E functions, including the methodology of the PER, as well as training on innovation policy. The remaining 10 percent of the resources will be allocated to TA that will finance the preparation of: (a) a report to determine the baseline for existing infrastructure and equipment across STI institutions, (b) an assessment of the results of completed STI projects in Peru, and (c) a study of the current distribution and allocation of the national STI budget. (See annex 2 for a detailed description.)

18. **Component 2: Strategic Programs: Productivity and Innovation Fund and Competitiveness Reinforcement Initiatives for Productive Innovation (US$11,514,510 - IBRD Financing US$7,947,153)** aims to design, plan, and oversee the implementation of CONCYTEC's strategic STI programs, in line with national research priorities and private sector demands for innovation.

(a) **Subcomponent 2.1: Planning and capacity building for the strategic programs on technological innovation.** TA for the implementation of a Capacity Building Program and Public-Private Dialogue (PPD) mechanism. The program will focus on industries and clusters with the strongest potential to contribute to CONCYTEC's Strategic Programs on Innovation (which are the national programs on innovation approved by CONCYTEC) consistently with the territorial development policy priorities of Peru. The core activity of this subcomponent is training up to 40 CONCYTEC staff and relevant stakeholders of the STI system to implement a set of pilots for the development of industries and clusters. The Project Directive Committee (PDC) will identify 15 and approve up to eight pilots for the Competitiveness Reinforcement Initiatives for Productive Innovation (CRI for PI).

(b) **Subcomponent 2.2: Competitiveness reinforcement initiatives for productive innovation (CRI for PI).** TA to implement up to eight cluster-level CRI for PI pilots in different regions of Peru. A CRI for PI pilot coordinator selected from the participants in the training under Subcomponent 2.1 will manage the implementation of each CRI for PI pilot. Each pilot will (a) identify the challenges that firms in the selected industries and clusters face, (b) define a strategy to address these challenges, and (c) prepare a detailed Technology Upgrading Plan (TUP) for the cluster or industry in question. The private sector firms and academic institutions participating in the CRI for PI pilot will jointly prepare the TUPs. A TUP is a public, technical document that describes all the actions needed in a specific cluster or industry participating in a CRI for PI pilot. Participation in the CRI for PI pilots will be open to all interested firms, research institutions, and relevant stakeholders in a selected cluster or industry. The PDC will approve the TUPs for up to 5 CRI for PI pilot, with technical inputs from independent external experts.

(c) **Subcomponent 2.3: Productivity and innovation fund for technology transfer and upgrading.** Matching financing on a competitive basis to firms and research institutions. The matching funds will finance the actions under the cluster-level TUPs presented by the participants to the CRI for PI pilots under Subcomponent 2.2.

The Productivity and Innovation Fund will be administered by FONDECYT. The Productivity and Innovation Fund will finance:

(i) **Type 1 matching grants.**[2] Matching contributions to firm-level investment plans targeting among others R&D for technology development and commercialization projects, for new or improved technologies, processes, and products. Beneficiaries include any firm in Peru submitting a proposal aligned with the Strategic Programs on Innovation defined by CONCYTEC under Subcomponent 2.1. (Beneficiaries' matching contribution ranges from 50 percent to 10 percent depending on number of employees and annual turnover.) The PDC will evaluate proposals with technical inputs from international independent external evaluators.

(ii) **Type 2 matching grants.** Matching contributions to firms and research institutions participating in the CRI for PI pilots to access shared services that require economies of scale in delivery, such as use of research labs and equipment, access to prototyping and testing labs, or TA such as cluster-level quality certification programs, marketing and commercialization expenditures, or skills trainings among others. The TUPs approved by the PDC under Subcomponent 2.2 constitute the basis for determining which shared services will be provided. FONDECYT will manage a competitive bidding process according to World Bank procurement rules to select the Service Providers to provide the relevant shared services to beneficiaries. In most cases, procurement methods for Type 2 Matching Grants will be open to international competition. Beneficiaries include firms (minimum 3) and research institutions (minimum 1) participating in the CRI for PI pilots, which will receive co-financing for the shared services delivered by the Service Providers and will provide a matching contribution (ranging between 50 percent and 10 percent depending on the number of employees and annual turnover, as set in the Operational Manual of the project). The access to shared services will also be open to any firm and research institution in Peru at full market price.

The resources under Subcomponent 2.3 are earmarked notionally per type of matching grant (Type 1 and Type 2) with the objective of flexible reallocation among them based on beneficiaries' demand, and with the approval of the CRI for PI Component Coordinator.

(d) **Subcomponent 2.4: Impact evaluation to recalibrate the CRI for PI pilots.** Rigorous impact evaluation (IE) of the CRI for PI pilots (see annex 6).

19. **Component 3: Research and Innovation Capacity (US$73,564,318 - IBRD Financing US$31,939,638).** The main objective of this component is to strengthen the capacity of the national STI system to generate relevant new knowledge and technology to contribute to productive innovation. The funds of each subcomponent of Component 3 will be disbursed

[2] The term Matching Grants does not imply and equal contribution between the beneficiaries and the Project. Minimum and maximum contributions are specified in the Operational Manual of the Project.

through full grants and co-financing assigned by open competitive calls of two types: (a) integrated calls that will finance human capital, research equipment, and R&D research projects bundled together to support research that contributes to CONCYTEC's Strategic Programs on Innovation under Component 2, and (b) nonintegrated calls for proposals to separately finance either human capital, or research equipment, or R&D research projects in areas relevant for the Strategic Programs under Component 2, as well as in cross-cutting research areas and basic science. A detailed description of the allocation process is presented in annex 2. A Technical Evaluation Committee will evaluate proposals presented by universities, research centers, and researchers, and assign full grants and co-financing for all the competitive calls for proposals under this component. The Technical Evaluation Committee will be composed by representatives of the Development Unit (one), the M&E Unit (one), the Adjunct Technical Directorate (one) of FONDECYT, and by representatives of CONCYTEC, with technical inputs from independent external evaluators. The Project Operational Manual regulates the functioning of the Technical Evaluation Committee, as well as the selection process and eligibility criteria.

(a) **Subcomponent 3.1: Strengthening human capital for STI.** This subcomponent aims at strengthening human capital for STI by promoting research work and the number and quality of PhD programs. Specifically, this subcomponent will finance:

(i) **Provision of grants and co-financing for researchers.** This activity will provide grants and co-financing to researchers at various levels of experience (senior, postdoctoral and associate) through a competitive process. The grants will be assigned by open competitive calls of two types: (a) integrated calls, and (b) nonintegrated calls for proposals to provide grants and scholarships to researchers in areas relevant for the Strategic Programs under Component 2, as well as in cross-cutting research areas and basic science. This subcomponent will finance teams of researchers constituted at minimum by one senior researcher and by either one adjunct researcher or one postdoc researcher, who: (a) are already staff of universities or research centers in Peru, in which case the project will provide partial grants (co-financing) or (b) returnees or foreign researchers who at the moment of the call are working abroad (up to 70 percent of researchers), for whom the project will provide full grants, as specified in the Operational Manual.

(ii) **Provision of matching grants to Peruvian higher education institutions** to support the creation and consolidation of world class, high quality PhD programs in science and engineering related to CONCYTEC's Strategic Programs on Innovation under Component 2. The grants will be assigned by open competitive calls for proposals, and they will finance among others scholarships, supplies, and consulting services required for the creation or consolidation of up to eight PhD programs and scholarships for at most 10 students per program and for 3 years. FONDECYT's own funds would fund the possible extension of the scholarships beyond the duration of the project, and they would be regulated under the Operational Manual.

(b) **Subcomponent 3.2: Improving research equipment.** This subcomponent seeks to modernize, update and strengthen research equipment (among others laboratory

equipment, supplies, operational costs, consulting services) in universities and research centers by co-financing the acquisition of laboratory equipment with up to date technologies. The funds will be assigned by open competitive calls of two types: (a) integrated calls, and (b) nonintegrated calls for proposals to finance only research equipment (among others laboratory equipment, supplies, operational costs, consulting services) for research in areas relevant for the Strategic Programs under Component 2, as well as in cross-cutting research areas and basic science.

(c) **Subcomponent 3.3: Competitive and strategically oriented grants for research and innovation** to support basic and applied research and technological development projects (R&D projects). The co-financing grants will be assigned by open competitive calls of two types: (a) integrated calls, and (b) nonintegrated calls for proposals to finance R&D projects in cross-cutting research areas, as well as applied research and basic science. This subcomponent will finance among others expenditures of the selected R&D projects on human resources (different from those on Subcomponent 3.1 and including apprenticeships, visiting researchers, research assistants, technicians), test equipment and supplies, prototyping, maintenance, consultancies, travel expenses to present research results, bibliographic needs, training, custom expenses and administrative expenses not surpassing 5 percent of the total cost of project.

20. **Component 4: Project Management and Monitoring & Evaluation (US$4,237,090 - IBRD Financing US$847,418).** The management of the Project over its five-year tenure will be conducted by a team of technical and fiduciary specialists in areas including project coordination, technical, procurement, financial, and M&E specialists in line with the organizational structure described in annex 2 and in the Operational Manual of the project.[3]

## B. Project Financing

21. The total cost of the project is US$100 million, financed by the World Bank Group for US$45 million through an Investment Project Financing. Table 1 spells out the financing support.

**Table 1. Project Cost (US$100 million) and IBRD Financing (US$45 million)**

| Project Components | Project Cost | IBRD Financing | IBRD Financing as % of Total |
|---|---|---|---|
| 1. Improving the Institutional Framework of the National STI System | 10,571,582 | 4,265,791 | 40 |
| 2. Strategic Programs: Productivity and Innovation Fund and Competitiveness Reinforcement Initiatives for Productive Innovation | 11,514,510 | 7,947,153 | 69 |

[3] The composition and organigram of the Project Implementation Team (PIT) of the Project are specified in the the Declaration of Feasibility PIP "*Declaratoria de Viabilidad del Proyecto de Inversión Publica* (PIP)"Improvement and extension of the services of the National System of Science, Technology and Technological Innovation" "*Mejoramiento y Ampliación de los Servicios del Sistema Nacional de Ciencia, Tecnología e Innovación Tecnológica*" Code SNIP: 317848" approved by DGIP on April 1st 2016, and they are described in the Operational Manual.

| Project Components | Project Cost | IBRD Financing | IBRD Financing as % of Total |
|---|---|---|---|
| 3. Research and Innovation Capacity | 73,564,318 | 31,827,138 | 43 |
| 4. Project Management and Monitoring & Evaluation | 4,237,090 | 847,418 | 20 |
| Total Project Costs | 99,887,500 | 44,887,500 | 45 |
| Front-End Fees | 112,500 | 112,500 | 0.25 |
| Total Financing Required | 100,000,000 | 45,000,000 | 45 |

### C. Lessons Learned and Reflected in the Project Design

22. **This project's design benefits from previous World Bank Group STI projects.** The overarching principles used in the design of the project include: (a) pilots to test out new ideas and designs prior to large-scale implementation; (b) simplified design and implementation arrangements, with a focus on capacity building and support for Project management; (c) using rigorous M&E procedures, including an IE, to verify that outcomes are reached and adjust project design and implementation as needed; (d) investing in mobilization, communication, and awareness building to ensure a strong pool of Project beneficiaries via upfront capacity building programs in Components 1 and 2; (e) the need to focus on value chains (VCs) and locations with clear competitiveness potential; (f) results targets are set conservatively in line implementation capacity and best practices from similar World Bank projects; and (g) ensuring rapid disbursements through advance preparation of activities and previous experience of implementing agency in managing competitive research grants. A complete overview of the lessons learned from a number of previous and ongoing operation on innovation and from the literature, and reflected in the design of each component of the Project, is provided in annex 8.

## IV. IMPLEMENTATION

### A. Institutional and Implementation Arrangements

23. **The FONDECYT will be the implementing agency. FONDECYT is assigned (*adscrito*) to the CONCYTEC. FONDECYT will be responsible for all project implementation, technical, procurement, safeguards, financial management and disbursements.** As an independent agency under the PCM, CONCYTEC is the coordinating agency of the STI system of Peru, which includes highly specialized public institutions, among which are universities and public institutes (see figure 2.1). Law 28303 of 2004 made CONCYTEC responsible for developing, promoting, and coordinating STI policy.

24. **FONDECYT will implement Components 1, 2, 3, and 4.** In particular, *ad hoc* joint Technical Committees of CONCYTEC and FONDECYT will be created for the implementation of technical tasks such as the preparation of terms of reference and the evaluation of the quality of consulting services for the first three components. In addition, the fiduciary aspects of the whole project will be implemented by FONDECYT.

25. **FONDECYT** will manage the fiduciary aspects of the project through its Administrative and Finance Office (AFO) and the Budget and Planning Office (BPO).

26. **Both CONCYTEC and FONDECYT will be institutionally strengthened under Components 1 and 4.** To this end, the management, the technical team and the administrative team of FONDECYT will be strengthened.

27. **A PDC to be chaired by the President of CONCYTEC will be established** for strategic project management and coordination across ministries, agencies, and local authorities. The PDC will include the members of the Board of CONCYTEC, in addition to one permanent representative of the *Dirección General de Inversión Pública* (Directorate General of Public Investment, DGIP) of the MEF, and to one permanent representative of the *Dirección de Licenciamiento de la Superintendencia Nacional de Educación Superior Universitaria* (Licensing Department of the National Superintendency of Higher University Education). A Technical Evaluation Committee, including industry specialists, established in FONDECYT will be responsible for the competitive calls for proposals under Component 3.

28. CONCYTEC and FONDECYT have extensive experience with the implementation of this type of projects with multilateral donors. In addition, FONDECYT: (a) already counts on a team of highly professional experts for the implementation of Component 1; (b) has a solid track record in implementing the programs under Component 3; and (c) has prepared an institutional strengthening plan, included in the Operational Manual, for the implementation of Component 2, which will be financed under Component 4.

### B. Results Monitoring and Evaluation

29. The M&E framework for the project follows the results framework and monitoring outlined in annex 1. Building on CONCYTEC and FONDECYT's M&E system, a beneficiary management and data collection system will be developed and implemented to register all project beneficiaries and track the outputs and outcomes achieved through this project. In addition, under Component 2 a rigorous IE will be implemented to measure the additionality of the project, monitor performance, identify institutional and organizational critical success factors, and distill the lessons learned from the implementation of the CRI for PI pilots and of the Productivity and Innovation Fund (see annex 6).

30. FONDECYT will prepare semiannual reports with data for the results framework, to be reviewed and discussed with the World Bank Group. The results framework data will be captured in Implementation Status and Results reports that the World Bank team will prepare annually. Implementation support provided by the World Bank team will also enhance results M&E. Thus, progress against objectives will be assessed on an ongoing basis. A mid-term review will be held approximately 2.5 years into the project. Within 12 months of project's closing, the World Bank team will complete and disclose an Implementation Completion and Results Report.

### C. Sustainability

31. **The likelihood of sustaining the project objectives beyond the closing date of the project is high**. Sustainability of the project will largely be ensured through several factors: (a) the project contributes to the operationalization of the *"Política Nacional para el Desarrollo de la Ciencia, Tecnología e Innovación Tecnológica – CTI"* approved by the Government in 2016

(*Decreto Supremo* No 015-2016 PCM); (b) the new Government's commitment and support to increase investment in STI, and the capacity building program for CONCYTEC and FONDECYT will ensure the sustainability of the activities under Component 1. In particular, the analysis of the public expenditure on innovation will be repeated periodically. This will improve the overall innovation system through better institutional coordination and an improved design and implementation of programs; (c) Component 2 will contribute to the sustainability of the project by building capacity within the public administration to foster new productive linkages among firms and with academia, and new innovation capacity that will last beyond the life of the project; and (d) Component 3 will contribute to the creation of a dynamic and sustainable STI system in Peru by attracting highly trained personnel and strengthening the human capital working in STI and by promoting linkages between high-level research and innovation (R&I) groups and the productive sector. Finally, Component 4 will strengthen the management capacity of CONCYTEC through FONDECYT to provide better stewardship for the STI sector in Peru.

## V. KEY RISKS

### A. Overall Risk Rating and Explanation of Key Risks

32. Overall, the project risk rating is assessed as "moderate" (see the SORT table in the data sheet), as most of the risks are "common sector-level" risks, related to the intrinsic characteristics of the activities that the project aims to finance, with moderate risks coming from the political context, sector strategies and policies, and stakeholders' engagement. Key risks stem from the following key areas:

33. **Technical design.** While the Project design builds on substantial experience from other countries, the design is somewhat complex, therefore the technical design risk is rated as substantial. For Component 1, the main risk relates to the buy in of all stakeholders to the implementation of the PER, and, as mitigation strategy, CONCYTEC through FONDECYT will involve all the institutions responsible for STI programs at an early stage. For Component 2 the main risk is the low uptake by the private sector and local authorities. The mitigation strategy entails the establishment, under Subcomponent 2.1, of a structured public-private consultative mechanism since the beginning of the project. A second risk relates to the novelty of the design of the Productivity and Innovation Fund and the mixed track record of matching grants (Subcomponent 2.3). The mitigation measures include a "hands-on" capacity building program for the preparation of the TUPs, and the design of the Productivity and Innovation Fund has been informed by the lessons learned on matching grants from a recent evaluation of the World Bank (2016). For Component 3, the main risk relates to the possible limited synergies between Components 2 and 3 on the Strategic Programs on Innovation. The mitigation measures include the participation of independent industry specialists in the Technical Evaluation Committee for the competitive calls for proposals, and the inclusion of relevance for the private sector among the key evaluation criteria. A final risk relates to possible low disbursement of the TA activities of the project (5.5 percent of loan amount). The mitigation measure is that the TA focuses prominently on training and field tutoring (4.3 percent of loan amount), which tend to have a solid disbursement track record.

34. **Institutional capacity for implementation and sustainability.** CONCYTEC and FONDECYT's institutional capacity risk to implement the Project is rated as moderate. During the last three years CONCYTEC has been empowered by the Government of Peru to coordinate the STI system in Peru, and it has managed a rapidly increasing budget (from US$5.6 million to US$38.3 million). CONCYTEC through FONDECYT also has experience in administering Inter-American Development Bank (IDB) loans, which indicates good expertise in working with multilateral institutions. However, CONCYTEC and FONDECYT's capacity to engage with the private sector remains low. As a mitigation measure, the implementing agency's capacity to engage with the private sector will be strengthened through the capacity building under Component 2.

35. **Fiduciary, environment, and social.** The environmental and social risks are low. According to the safeguard policy on Environmental Assessment (OP/BP 4.01) it was concluded that the Environmental Management Framework (EMF) prepared by CONCYTEC through FONDECYT is adequate to mitigate the limited potential environmental impacts of the Project. The fiduciary risk is considered moderate.

## VI. APPRAISAL SUMMARY

### A. Economic and Financial Analysis

36. An Economic and Financial Analysis indicates that the development impact benefits of the project are expected to exceed project costs (see annex 5). Overall, the project net present value (NPV) is estimated at US$21.33 million at a 9 percent social discount rate, and the internal rate of return of the project is 11.33 percent. The data and the assumptions are based on the feasibility study of the project: *"Proyecto: Mejoramiento y ampliación de los servicios del Sistema Nacional de Ciencia, Tecnología e Innovación Tecnológica - Estudio de Pre inversión a nivel de Factibilidad. Código SNIP: 317848 - Año 2016"* approved by the MEF of Peru.

37. Public sector financing to achieve these benefits is justified, and World Bank Group involvement offers significant value to the proposed project activities. Project activities address numerous market failures usually associated with underinvestment in the area of STI, including (a) the intrinsic nature of the innovation process, which produces intangible assets that are not amenable to traditional valuation and revenue models to access finance, and which provides highly uncertain returns on innovation investments; and (b) the presence of asymmetric information, positive externalities, and coordination failures associated with the innovation process that make markets provide less financing for innovation than would be socially desirable. A full analysis of the market failures that this project aims to address is presented in annex 5.

### B. Technical

38. **The technical design of the project is supported by analytical work carried out by the World Bank Group and other literature reviewed.** Six main studies have been conducted over the course of project preparation: (a) the feasibility study of the project: *"Proyecto: Mejoramiento y ampliación de los servicios del Sistema Nacional de Ciencia, Tecnología e Innovación Tecnológica - Estudio de Pre inversión a nivel de Factibilidad. Código SNIP: 317848 - Año 2016"*; (b) the Economic and Sector Work "Peru. Boosting Productivity for Faster Growth" World Bank Group Flagship Report of 2015; (c) the World Bank Group background paper "Innovation System in Development: The Case of Peru" of 2015; (d) the strategy report *"Crear para Crecer"* of CONCYTEC of 2014; (e) the report *"Mapeo de Clusters en Peru"* of the MEF and of the National Council for Competitiveness of Peru of 2015; and (f) the report *"Diagnostico de la Demanda de las Empresas para la Innovación Tecnológica y la Capacidad de Oferta a Corto y Mediano Plazo"* of CONCYTEC of 2015.

### C. Financial Management

39. FONDECYT is the budget executing unit of CONCYTEC and has administrative and financial autonomy. The financial management responsibilities of the project will be under FONDECYT with the assistance of a third party that will be hired after project signing to manage the funds under Component 3.1. FONDECYT will be responsible for registering and executing project budget and also for the management and administration of the fiduciary funds of Components 1, 2, and 3 of the project while a third party, following a legal agreement that has the no objection of the Bank, will administer the funds for Component 3.1. In addition, FONDECYT will be responsible for the implementation of the technical aspects of all project

components. The financial management and disbursement arrangements of the project will include: budgeting and planning, accounting and financial reporting, internal controls, flow of funds, and external audit. The responsibility for supervising these arrangements will be under the AFO and the BPO of FONDECYT. Project implementation will fully comply with the national laws governing budget and financial management, including the use of the financial information system *Sistema Integrado de Información Financiera* Integrated System of Financial Information, (SIAF) and the General Chart of Accounts established under SIAF. The project will be responsible for preparing unaudited interim financial reports (IFRs) every semester and annual financial statements that will be subject to an external audit by an independent audit firm.

FONDECYT has experience in implementing competitive funds for science and innovation projects (competitive funds) under local norms, and it has also worked with other multilateral financial institutions such as the IDB. Nonetheless, there are FM arrangements that still need to be implemented and finalized for Component 3.1 before any disbursements can be made for this component. In order to bring the FM arrangements for the project into full compliance with the Bank requirements, FONDECYT will need to complete the actions specified in annex 3.

### D. Procurement

40. Procurement would be conducted according to the World Bank's "Guidelines: Procurement of Goods, Works and Non-Consulting Services under IBRD Loans and IDA Credits and Grants by World Bank Borrowers," dated January 2011 and revised in July 2014, for the supply of goods and non-consulting services and the "Guidelines: Selection and Employment of Consultants under IBRD Loans and IDA Credits and Grants by World Bank Borrowers," dated January 2011 and revised in July 2014, for TA and other consultant assignments. The structures responsible for carrying out procurement activities, monitoring, and supervising the fiduciary arrangements, as well as the final procurement risk rating, were defined as a result of the capacity assessment carried out on March 31, 2016. The assessment confirmed that FONDECYT will be responsible for procurement activities under the project. FONDECYT is the unit of budget execution of CONCYTEC, with its own assets, administrative and financial autonomy, responsible for capturing, managing, administering and channeling resources domestic and foreign sources, for the activities of the National System of Science, Technology and Technological Innovation (SINACYT) in Peru. The analysis concluded that given that FONDECYT has no previous experience in dealing with projects funded by the World Bank, its institutional and organizational capacity should be strengthened for the purpose of implementing the project. Nevertheless, FONDECYT is an entity that operates under a clearly defined legal framework and internal procedures established. For the implementation of the Project, FONDECYT will manage the procurement aspects that will include, the hiring of a dedicated and experienced procurement specialist for the project. At the subproject level, the procurement would be carried out by the beneficiaries. The main issues and risks are identified in annex 3.

### E. Social (including Safeguards)

41. None of the social safeguard policies has been triggered for the project is not expected to have involuntary resettlement or the involuntary use of land, or impacts on assets. The safeguard policy on Involuntary Resettlement (OP/BP 4.12) is not triggered because the Productivity and Innovation Fund under subcomponent 2.3 will exclude proposals that would require land

acquisition that could entail physical or economic displacement. No civil works will be financed outside of existing research facilities therefore there will be no need for land acquisition. Similarly, the safeguard policy on Indigenous Peoples (OP/BP 4.10) is not triggered because the project will operate in main urban areas where the IPs do not meet the requirements of the policy. The project supports the objective of mainstreaming gender practices by (a) monitoring project performance indicators by gender wherever feasible, thus helping to raise awareness about the contribution of women scientists and innovators. Institutions that receive project grants would be asked to provide data disaggregated by gender (b) ensuring that grant proposals be reviewed to avoid any gender bias, (c) including gender sensitivity training as part of capacity building activities, and (d) prioritizing gender informed proposals in competitively financed activities.

### F. Environment (including Safeguards)

42. In accordance with OP/BP 4.01 on Environmental Assessment, an EMF was completed. The project was classified as category B, since its components were found to have relatively limited potential environmental impacts. The following environmental operational policy has been triggered: Environmental Assessment (OP/BP 4.01). Given that location and type of STI subprojects are still unknown, an EMF has been prepared by the Borrower, reviewed by the Bank and disclosed on September 21, 2016 in country and September 19, 2016 on the Bank's website. The EMF includes the legal and regulatory framework applicable to the project as well as the institutional arrangements to ensure compliance of national environmental regulations and World Bank environmental safeguard policies. Most project components are unlikely to have significant, if any, environmental effects. It is expected that most environmental effects, although limited, might be associated with the installation and operation of some equipment in academic research centers. As stated in the EMF, beneficiary academic institutions receiving funding for purchasing of applied research equipment will have to prepare a matrix containing potential risks and impacts on the environmental, health and safety as well as corresponding mitigation measures.

### G. World Bank Grievance Redress

43. **Communities and individuals who believe that they are adversely affected by a World Bank supported project may submit complaints to existing project-level grievance redress mechanisms or the World Bank's Grievance Redress Service (GRS).** The GRS ensures that complaints received are promptly reviewed in order to address project-related concerns. Project affected communities and individuals may submit their complaint to the World Bank's independent Inspection Panel which determines whether harm occurred, or could occur, as a result of World Bank non-compliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the World Bank's attention, and Bank Management has been given an opportunity to respond. For information on how to submit complaints to the World Bank's corporate Grievance Redress Service (GRS), please visit http://www.worldbank.org/GRS. For information on how to submit complaints to the World Bank Inspection Panel, please visit www.inspectionpanel.org.

## Annex 1: Results Framework and Monitoring

## Country: Peru

## Project Name: Strengthening the Science, Technology and Innovation System in Peru (P156250)

## Results Framework

**Project Development Objectives**

PDO Statement

**The project development objective is to strengthen the STI system to improve research skills and firm-level innovation.**

| **These results are at** | Project Level |
|---|---|

**Project Development Objective Indicators**

| | Cumulative Target Values | | | | | |
|---|---|---|---|---|---|---|
| Indicator Name | Baseline | YR1 | YR2 | YR3 | YR4 | End Target |
| Number of research papers submitted for Publication to internationally indexed journals | 0 | 0 | 0 | 20 | 60 | 80 |
| Number of beneficiary firms that have introduced new or upgraded processes[4] | 0 | 0 | 5 | 10 | 10 | 25 |
| Number of beneficiary firms that have introduced new or upgraded products[5] | 0 | 0 | 2 | 5 | 8 | 15 |
| Number of students enrolled in PhD programs supported by the project | 0 | 0 | 10 | 20 | 26 | 56 |

**Results Indicators**

| | Cumulative Target Values | | | | | |
|---|---|---|---|---|---|---|
| /Indicator Name | Baseline | YR1 | YR2 | YR3 | YR4 | End Target |
| Number of CONCYTEC's and other officials trained | 0 | 15 | 15 | 10 | 0 | 40.00 |
| Number of SMEs' owners that have been engaged in strategic PPD | 0 | 15 | 20 | 10 | 5 | 50.00 |
| Academia engaged in PPD (Number) | 0 | 4 | 4 | 2 | 0 | 10.00 |

[4] Sources of data*: Encuesta Nacional de Innovación de la Industria Manufacturera*, Government of Peru, and World Bank Enterprise Surveys.
[5] See footnote 3.

| | | | | | | |
|---|---|---|---|---|---|---|
| Private sector capital leveraged (Amount(US$ Million)) | 0 | 0 | 1 | 2 | 1 | 4 |
| Number of programs evaluated under the PER | 0 | 20 | 0 | 0 | 0 | 20.00 |
| Number of PER recommendations incorporated in official Government documents to make public expenditure more efficient | 0 | 0 | 1 | 2 | 3 | 6 |
| Number of new or upgraded processes created by beneficiary firms | 0 | 0 | 7 | 10 | 13 | 30 |
| Number of new or upgraded products created by beneficiary firms | 0 | 0 | 4 | 6 | 10 | 20 |
| Number of patents submitted by beneficiaries | 0 | 0 | 0 | 2 | 8 | 10 |
| Number of active researches supported by the project during each year of implementation (% of women) | 0 | 100 (20%) | 150 (20%) | 0 | 0 | 250 (20%) |
| Number of PhD programs in areas covered by the Strategic Programs on Innovation supported by the project | 0 | 2 | 3 | 3 | 0 | 8 |
| Number of laboratories updated and fully operational supported by the project | 0 | 0 | 10 | 15 | 5 | 30 |
| Number of University-Industry Research Partnerships supported by the project during each year of implementation | 0 | 2 | 8 | 10 | 0 | 20 |

## Indicator Description

**Project Development Objective Indicators**

| Indicator Name | Description (indicator definition and so on) | Frequency | Data Source/Methodology | Responsibility for Data Collection |
|---|---|---|---|---|
| Number of research papers submitted for Publication to internationally indexed journals | Number of research papers submitted to peer reviewed international journals by researchers supported by this project | Annual | Project data | FONDECYT |
| Number of beneficiary firms that have introduced new or upgraded processes | Number of beneficiary firms that have introduced new or upgraded processes (as defined by the Oslo Manual) | Annual | Project data | FONDECYT |
| Number of beneficiary firms that have introduced new or upgraded products | Number of beneficiary firms that have introduced new or upgraded products (as defined by the Oslo Manual) | Annual | Project data | FONDECYT |
| Number of students enrolled in PhD programs supported by the project | No description provided | Annual | Project data | FONDECYT |

**Results Indicators**

| Indicator Name | Description (indicator definition and so on) | Frequency | Data Source/Methodology | Responsibility for Data Collection |
|---|---|---|---|---|
| Number of CONCYTEC's and other officials trained | No description provided | Annual | Project data/FONDECYT | FONDECYT |
| Number of SMEs' owners that have been engaged in strategic PPD | No description provided | Annual | Project data | FONDECYT |
| Academia engaged in PPD | Number of universities, research centers, and knowledge organizations that have been engaged in strategic PPD | Annual | Project data | FONDECYT |
| Private sector capital leveraged | Private sector capital leveraged for innovation activities through the participation of beneficiary firms in the | Annual | Project data | FONDECYT |

| | | | | |
|---|---|---|---|---|
| | Productive Innovation Fund (US$ Mln). It includes the matching contributions by the beneficiaries of the project, and the expenditures for fixed assets related to the provision of a shared service by the Service Providers in a supported CRI for PI | | | |
| Number of programs evaluated under the PER | No description provided | Annual | Project data | FONDECYT |
| Number of PER recommendations incorporated in official Government documents to make public expenditure more efficient | No description provided | Annual | Project data, Official documents | FONDECYT |
| Number of new or upgraded processes created by beneficiary firms | Number of new or upgraded processes created by beneficiary firms (as defined by the Oslo Manual) | Annual | Project data, Official documents | FONDECYT |
| Number of new or upgraded products created by beneficiary firms | Number of new or upgraded products created by beneficiary firms (as defined by the Oslo Manual) | Annual | Project data, Official documents | FONDECYT |
| Number of new patents submitted by beneficiaries | No description provided | Annual | Project data, Official documents | FONDECYT |
| Number of active researches supported by the project during each year of implementation (% of women) | Active researchers are defined as those that have submitted at least three papers for Publication in peer reviewed, indexed journals or have one submitted patent for approval in the last two years. | Annual | Project data, Official documents | FONDECYT |
| Number of PhD programs in areas covered by the Strategic Programs on Innovation supported by the project | Number of PhD programs in the areas covered by the National Strategic Priority Programs on Innovation by CONCYTEC | Annual | Project data, Official documents | FONDECYT |
| Number of laboratories updated and fully operational supported by the project | No description provided | Annual | Project data, Official documents | FONDECYT |
| Number of University-Industry Research Partnerships | No description provided | Annual | Project data, Official documents | FONDECYT |

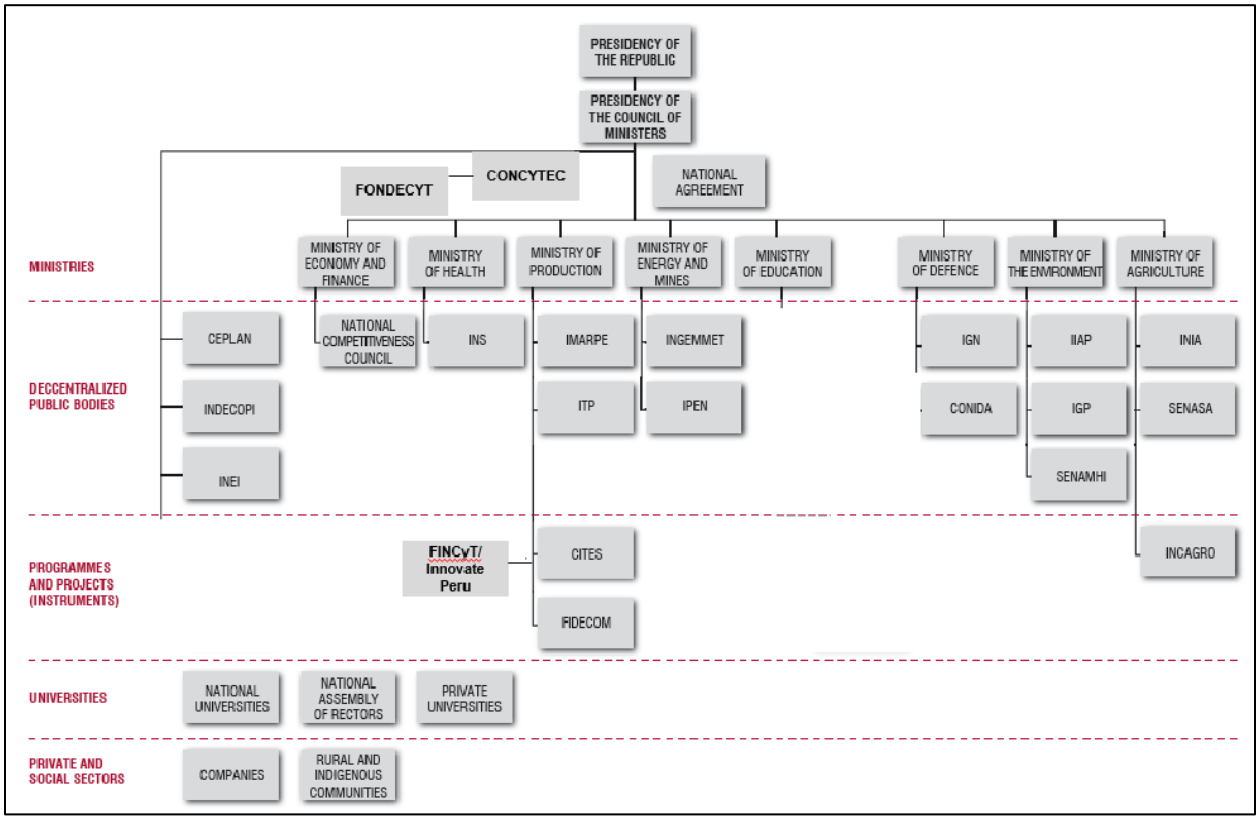
| | | | | |
|---|---|---|---|---|
| supported by the project during each year of implementation | | | | |

## Annex 2: Detailed Project Description

### PERU: Strengthening the Science, Technology and Innovation System in Peru (P156250)

1. **Peru created its STI system in the late 1960s and reformed it in the mid-2000s.** In addition to the 2004 Science, Technology, and Technological Innovation Framework law (Law No. 28303), which created the current structure (Figure 2.1.), Peru has taken steps to develop a national vision and policy agenda for STI. The National Strategic Plan for Science, Technology and Innovation for Competitiveness and Human Development (*Plan Nacional Estratégico de Ciencia, Tecnología e Innovación para la Competitividad y el Desarrollo Humano*) (PNCTI 2006-2021) was the first such plan. Peru conceived the plan with a long-term horizon, and several actors from the innovation system participated in developing it in order to provide a more demand-oriented approach to STI policy. The initiative, however, remained mainly a long list of needs with weak implementation due to the lack of a concrete action plan and budget allocation.

**Figure 2.1. National STI System - Peru**




2. **The main implementing agencies for STI policy, CONCYTEC and the PRODUCE, both design and implement innovation policies.**[6] PRODUCE targets firm innovation more

[6] Innovation in this context is defined as the creation of new (or upgrading of existing) products (good or services), processes and/or business models which are new to Peruvian or to other markets. Precisely, as defined in the "Oslo Manual", 3rd edition, 2005, innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations. The main types of innovation are as follows:

broadly, while CONCYTEC mainly focuses on science and human capital at research organizations. Both institutions have published national strategies for STI and productivity. CONCYTEC recently published "*Crear para Crecer*" –which aims to be the national strategy for STI. More than an action plan, the document is an updated diagnostic of the national innovation system and identifies key challenges. PRODUCE developed the National Plan for Diversification of Production (*Plan Nacional para la Diversificación Productiva*). Compared to previous strategies in these areas, these policy agendas have advanced in their planning and design and provided target measures, budget requirements, and a description of concrete mechanisms to achieve their objectives. However, lack of a proper M&E framework and the short-term horizon (three years) of the strategies cast some shadows on the possibility of effective operationalization.

3. **There are weak interactions between agencies and programs.** Mechanisms for policy coordination and collaboration, such as bilateral participation in evaluations and committees and follow-up on projects and firms, are lacking. Generally, policy coordination is a weakness for the articulation of innovation policies and Peru's innovation system. (OECD, 2009; UNCTAD, 2011). As the OECD study (2009) stresses, major handicaps in governance of Peru's innovation system are: (a) confusion between policy design and program funding and management, both of which still overlap in several agencies, creating conflicts of interests regarding the use of resources; (b) excessively broad missions of executing agencies and funds; and (c) prevailing institutional rigidities and overwhelming legalistic frameworks that hinder the development and the effectiveness of policy instruments.

4. **Peru has one of the weakest statistics bases in the region on STI investment**, hindering monitoring of policies and international benchmarking. The last year that Peru gathered STI statistics was 2004, and data collection was discontinued. The lack of measurement hinders the monitoring of policies and international benchmarking as well as possibilities for policy learning and recalibration. Furthermore, Peru has not developed an M&E framework for innovation policies.

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(a) A *product innovation* is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics. Product innovations can utilize new knowledge or technologies, or can be based on new uses or combinations of existing knowledge or technologies.

(b) A *process innovation* is the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software. Process innovations can be intended to decrease unit costs of production or delivery, to increase quality, or to produce or deliver new or significantly improved products.

(c) A *marketing innovation* is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing. Marketing innovations are aimed at better addressing customer needs, opening up new markets, or newly positioning a firm's product on the market, with the objective of increasing the firm's sales.

(d) An *organizational innovation* is the implementation of a new organizational method in the firm's business practices, workplace organization or external relations. Organizational innovations can be intended to increase a firm's performance by reducing administrative costs or transaction costs, improving workplace satisfaction (and thus labor productivity), gaining access to non-tradable assets (such as non-codified external knowledge) or reducing costs of supplies.

5. Peru's supply of scientists and engineers is insufficient (figure 2.2) and the quality of education remains poor (table 2.1). As a result, Peru performs worse than peers do across all indicators of science, technology, innovation and creativity (table 2.2).

**Figure 2.2. Peru's Limited Availability of Scientists and Engineers to Firms**

(1=among the worst in the world, 7=among the best in the world)

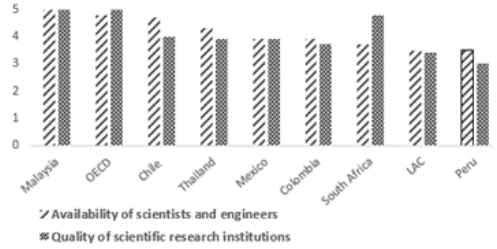



**Table 2.1. Human Capital and Knowledge Capabilities**

| | Argentina | Brazil | Chile | Colombia | Mexico | Peru |
|---|---|---|---|---|---|---|
| Expenditure on Education (percent of GDP) | 5.8 | 5.8 | 4.5 | 4.4 | 5.2 | **2.8** |
| PISA scales in reading , math, & Science | 396.7 | 402.1 | 436.3 | 392.9 | 417.3 | **375.1** |
| Tertiary Enrollment, percent Gross | 74.8 | n/a | 74.4 | 45 | 27.7 | **42.6** |
| Graduates in S&E (percent) | 13.5 | 12 | 19.2 | 21.5 | 26.8 | **n/a** |
| Researchers, headcounts/mn. Pop. | 1941.9 | 1202.8 | 551.2 | 346.4 | 386.4 | **181.2** |
| R&D (percent of GDP) | 0.6 | 1.2 | 0.4 | 0.2 | 0.4 | **0.1** |

*Source:* WEF Executive Opinion Survey. 2013–14 weighted average. *Sources:* UNESCO Institute for Statistics, UIS online database (2004–13) and OECD Program for International Student Assessment (PISA) (2010–2012) and World Bank Development Indicators. R&D and researchers data for Peru correspond to 2004.

**Table 2.2. STI Outputs**

| | Argentina | Brazil | Chile | Colombia | Mexico | Peru |
|---|---|---|---|---|---|---|
| Domestic resident patent appl. /tr. PPP $GDP[a] | 1 | 2.1 | 1.1 | 0.4 | 0.7 | 0.2 |
| PCT resident patent application/tr PPP $ GDP[a] | n/a | 0.3 | 0.4 | 0.1 | 0.1 | 0 |
| S&T articles/bn PPP $GDP[b] | 10.3 | 14.9 | 17.1 | 6.1 | 5.9 | 2.1 |
| Citable documents H index[c] | 222 | 305 | 194 | 133 | 232 | 109 |
| High and medium high tech manufactures (%)[e] | n/a | 39.6 | 21.7 | 22.1 | 40.3 | 10 |
| Royalty & License fees receipts, percent of total trade[f] | 0.2 | 0.2 | 0.1 | 0.1 | n/a | 0 |
| High-tech exports less re-exports (%)[g] | 2.2 | 3.3 | 0.6 | 0.9 | 14.7 | 0.4 |
| Communications, computer & info. services exports (% trade)[h] | 2.3 | 0.3 | 0.4 | 0.5 | 0.1 | 0.3 |
| Domestic resident trademark app./bn. PPP$ GDP[i] | 83.2 | 51.7 | 88.9 | 37.4 | 42.3 | 56 |
| ICTs & Business model creation[j] | 45.7 | 61.3 | 67 | 59.2 | 59.8 | 55.8 |

*Sources*: GII (WIPO) 2014 - which builds on several international databases.

6. Building the capacity of Peru's STI system is critical to build the effective framework conditions that facilitate increasing the returns on firm-level innovation in the country. Coordinating the STI system under an overarching strategic vision with a proper institutional framework, effective governance, and rigorous M&E and learning mechanisms would allow Peru to facilitate the transfer innovative technologies to firms, accelerating the creation, diffusion and adoption of productive knowledge and thereby contributing to sustained growth.

## Project Components

7. **The project comprises four components.** Each component will contribute to strengthening the STI system of Peru according to the "theory of change" presented in figure 1. While Component 3 builds upon the established record of CONCYTEC of promoting scientific research, Components 1 and 2 will provide novel and innovative contributions to initiate a systemic reform of the STI system in Peru and to re-align it along the priorities of the private sector.

***Component 1: Improving the Institutional Framework of the National STI System (US$10,571,581 - IBRD Financing US$4,265,791)***

8. The objective of Component 1 is to support the design and implementation of a new institutional framework and a new strategic plan to strengthen the SINACYT, and enhance the contribution of SINACYT to innovation and productivity growth. Private sector innovation requires a healthy and coordinated STI system, where the institutional framework is articulated and supportive of entrepreneurs. To this end, STI programs and projects should follow international best practices in design and implementation: evidence-based, efficiency in spending, no duplication of functions and good articulation within and between institutions, and most importantly, private sector participation.

*Subcomponent 1.1. Improving the institutional framework of the STI system*

9. Several diagnostic reports have stressed policy coordination as one important handicap in the articulation of innovation policies in Peru (OECD, 2012; UNCTAD, 2011). As discussed by Kuramoto (2014),[7] the elements are there but the capacity of actors to fully undertake innovation activities in formal ways remains limited, and the system as a whole is weakly articulated. This subcomponent will finance TA to assess the quality, efficiency and effectiveness of public institutions and programs on STI, and to provide recommendations to improve the overall functioning of the STI system, through the implementation of a PER on Innovation. The PER will identify the systemic failures that prevent the proper design and implementation of policies within the Peruvian innovation system, as well as assessing interagency coordination to ensure that such policies are aligned and coordinated across all members of the system. The PER is expected to lead to an integrated, coordinated and effective STI system. The activities of the first subcomponent are the following:

(a) Improvement of the institutional framework of the STI system:

(i) TA to conduct an assessment of the STI system to identify gaps, especially in terms of (a) the formulation of STI policy, (b) service delivery and (c) sustainable funding of STI activities.

(ii) TA to assess and improve the issue of inter-institutional coordination within SINACYT. In this activity, institutional and organizational models that promote better coordination between sectors and agencies will be evaluated. Furthermore, an organizational structure that improves coordination of the formulation and implementation of STI policy among the various levels of Government and that promote decentralization will be suggested.

(iii) TA to improve the normative and regulatory aspects of the systems by reviewing the existing legal framework.

(iv) TA to analyze private sector expenditure on innovation based on the National Innovation survey for Manufacturing produced by the National Institute of

[7] As quoted in Zuniga. 2015. "Innovation system in Development: The Case of Peru," Background paper for the Peru flagship, World Bank.

Statistics (INEI). The analysis will focus on drivers for expenditure on innovation, type of funding, outcome and impact of the investment, and all other relevant aspects.

(b) Improvement of the quality of the implementation, design and governance on STI public spending:

(i) TA for the implementation of the PER on innovation methodology:[8] This activity aims at improving the design and implementation processes, and governance, of the various STI programs and instruments, in order to ensure their proper functioning, efficiency and effectiveness. It will do so by implementing a diagnostic tool that has been implemented in Colombia and Chile and that allows identifying the main weaknesses in innovation policy making. One of the main outputs of this activity will be the development of an action plan to improve the design, implementation and governance of STI programs. In addition, the review will focus on identifying gaps in the system, redundancies, lack of efficiency and evidence of impact. This analysis will also provide guidelines for reforming the country's innovation strategy, since it will serve as a tool to provide the Government with the necessary information and justification for decisions regarding the allocation of STI resources.

(ii) The steps to implement the PER methodology are the following:

- **Economic context and portfolio analysis.** The first part of the analysis focuses on describing the demand for innovation based on a brief economic analysis of the innovation ecosystem. This includes analysis of inputs for innovation (for example, R&D, skills, management quality), innovation outputs (for example, innovation incidence, patents); and outcomes such as productivity or diversification; as well as the existing institutional framework. In addition, the starting point of the STI analysis is the portfolio mapping of all STI instruments, including information on the objectives, budgets, beneficiaries for each instrument. This allows a first identification of concentration patterns, gaps, redundancies and scale effects of the innovation policy mix.

- **Functional and governance analysis.** The functional analysis will assess the quality of the design, implementation and governance of STI programs in relation to international best practice according to an evaluation of 31 elements, including issues such as justification of the instruments, logical framework, M&E framework, selection of beneficiaries, quality of implementation practices, relation with other instruments and institutions, or external constraints.

[8] The methodology that will be used was developed using the approach developed in: Correa, P. 2014. "Public Expenditure Reviews in Science, Technology, and Innovation." World Bank.

- **Efficiency analysis.** It is a selective analysis of the most important programs in relation to their administration cost, the quality of delivery to beneficiaries, the relationship between program inputs and expected outputs, and assessment based on the efficiency with which the program is implemented.

- **Effectiveness analysis.** Analysis of the impact of the most important STI programs, based on existing IE studies and implementing potential ex post evaluations when data is available.

- **Policy recommendations and implementation plan**, including: (a) alternatives to the existing mix of policies that aim to improve complementarities and reduce redundancies and gaps found, (b) specific design and implementation practices that contribute to improve the performance of the recommended mix of instruments.

**Box 1. Innovation PER in Colombia and Chile**

The World Bank recently implemented a similar exercise in Colombia and has another ongoing in Chile. Therefore, results obtained for these countries can illustrate the type of results expected in the case of Peru. The type of information obtained in the case of Colombia and Chile allowed the World Bank to assess the performance of the innovation system and provide recommendations on the following areas:

- Concentration of the budget
- Relationship between level of budget assigned and desired goals of the program
- Degree of overlap in instruments having the same objective and/or the same beneficiary
- Justifications and identification of market failures that might lead to better targeting of programs
- Presence of weaknesses of operation
- Heterogeneity of performance of instruments within institutions, by function and budget size
- Coordination between instruments and among Government entities

In the case of Colombia, the recommendations provided through the PER have been directly incorporated in the *Consejo Nacional de Política Económica y Social* of STI, which is a strategic document that lays the foundation for STI Policy in Colombia for the next 10 years. The *Consejo Nacional de Política Económica y Social* also stated that the Government will replicate this exercise periodically. The World Bank has provided training on the methodology to public officials, so that they are able to apply it themselves next time they carry out the PER assessment.

*Subcomponent 1.2: Strengthening CONCYTEC management capacity*

10. This subcomponent will provide financing to strengthen leadership and management capabilities of CONCYTEC and other entities of SINACYT and to provide it with adequate management tools and information to effectively perform their duties. This component adopts some of the recommendations that arise from section 1.1.2. The result of this subcomponent will be reflected in the financing and implementation of a planning system of public expenditure in STI and a system of knowledge management in the training of officials of the entities that comprise SINACYT. This component will finance the following activities:

(a) **Baseline for Knowledge Management System (10 percent of funds – expense category: consulting services).** This activity will provide TA to develop baselines, in order to establishing the starting points for the knowledge management and information system. These include: a baseline for monitoring and evaluating Government spending and R&D expenditure.

(b) **Design Knowledge Management System (60 percent of funds - expense categories: equipment, IT infrastructure, and subscriptions to scientific databases).** This activity will provide financing to strengthen the generation of information for decision-making within SINACYT, and implement monitoring and control system actions, both (a) internal information requirements and (b) external information requirements. More specifically, this subcomponent will finance the following activities.

(i) Activities related to internal information needs:

- Financing to develop a budget application that improves the monitoring of STI expenditure of the various public entities of the National Science Technology and Innovation system by providing a better disaggregation and classification of STI activities.

- Financing to develop an integrated information system and implement the equipment and infrastructure needed to monitor programs and instruments of the entities involved in STI activities. This activity will fund a central internal system for CONCYTEC that generates relevant information using national surveys, polls and other data to provide timely and accurate information on the status of the STI activities in the country.

(ii) Activities related to external information needs:

- TA to conduct an assessment of the system's information needs. The main output of the TA will be a report on the process for the development of STI indicators in Peru

- Financing to increase access to virtual libraries and other information sources by all STI agencies including universities and research centers.

(c) **Training activities (30 percent of funds).** The implementation of the PER and M&E activities will require training CONCYTEC and other entities' staff. For this reason, the project will finance three types of training:

(i) Training on the application of the PER methodology.

(ii) Training on M&E functions. While in recent years CONCYTEC has taken important steps to incorporate M&E tasks as part of its routine management functions, it is necessary to deepen CONCYTEC's staff knowledge on M&E. Together with the development of a platform for monitoring the programs and

activities of STI, the training should include specific aspects of the management and use of databases.

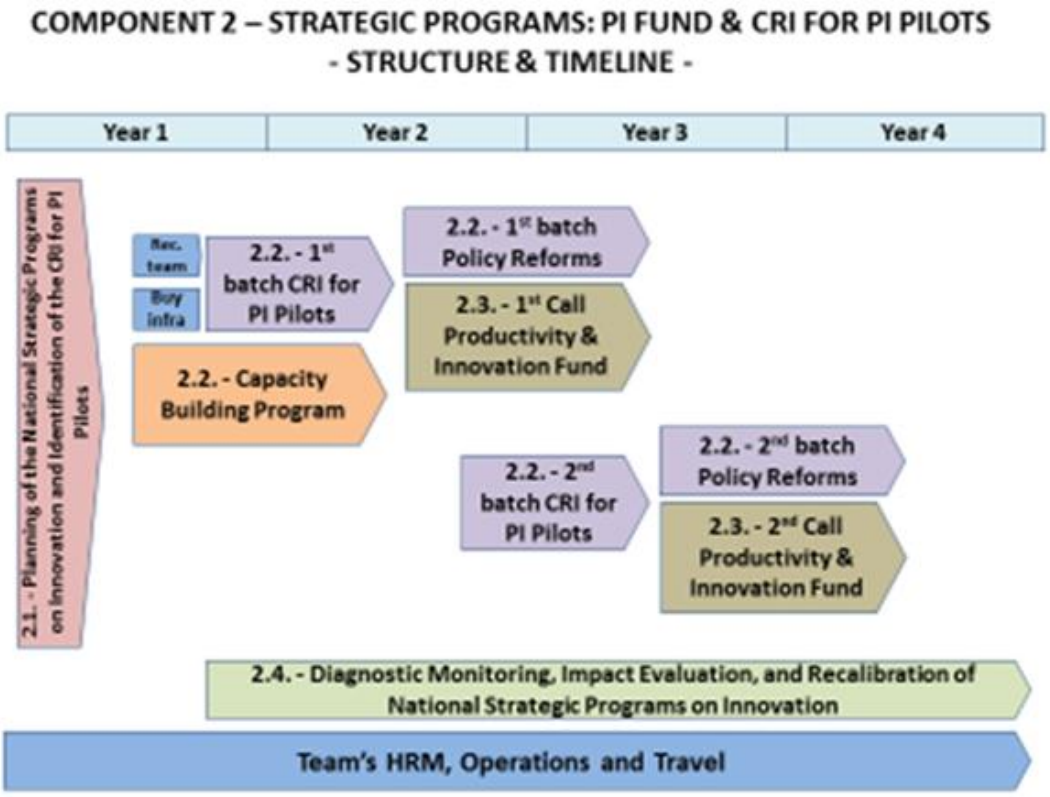
(iii) Training on STI policies and programs both to CONCYTEC staff and to staff of other Government agencies (for example, INGEMMET, IIP, INIA, and so on).

***Component 2: Strategic Programs: Productivity and Innovation Fund and Competitiveness Reinforcement Initiatives for Productive Innovation (US$11,514,510 - IBRD Financing US$7,947,153)***

11. The main objective of this component is to design, plan, and oversee the operationalization of the strategic programs on science, technology and productive innovation of CONCYTEC, in line with the national research priorities and demands for innovation of the private sector. In particular, this component will support the operationalization of the Strategic Programs on Innovation, which are the national programs on innovation approved by CONCYTEC. The Strategic Programs on Innovation are: Biotechnology, Materials Sciences, ICT and ICT-enabled services, Climate Change and Energy Efficiency, and Basic Science, because they contribute to the national priorities on (a) Industrial Competitiveness and Productive Diversification, (b) Agribusiness and Food Security, (c) Health, and (d) Climate Change and Sustainability as set out by the Government of Peru.[9] It will establish a Productivity and Innovation Fund to encourage research-industry technology transfer, and it will finance the implementation of up to five CRI for PI at industry and cluster levels. Component 2 complements Component 1 on the reform of the institutional framework and governance of the STI system, and strengthens the focus on industry-academia collaboration on technology transfer and productive innovation in support of Component 3, on strengthening the human capital and research capabilities of the STI system.

[9] For a full analysis and references on the national strategic priorities on innovation of the Government of Peru see: "*Proyecto: Mejoramiento y ampliación de los servicios del Sistema Nacional de Ciencia, Tecnología e Innovación Tecnológica", Estudio de Pre inversión a nivel de Factibilidad. Código SNIP: 317848. Año 2016*.

**Figure 2.3. Structure and Timeline for Component 2**



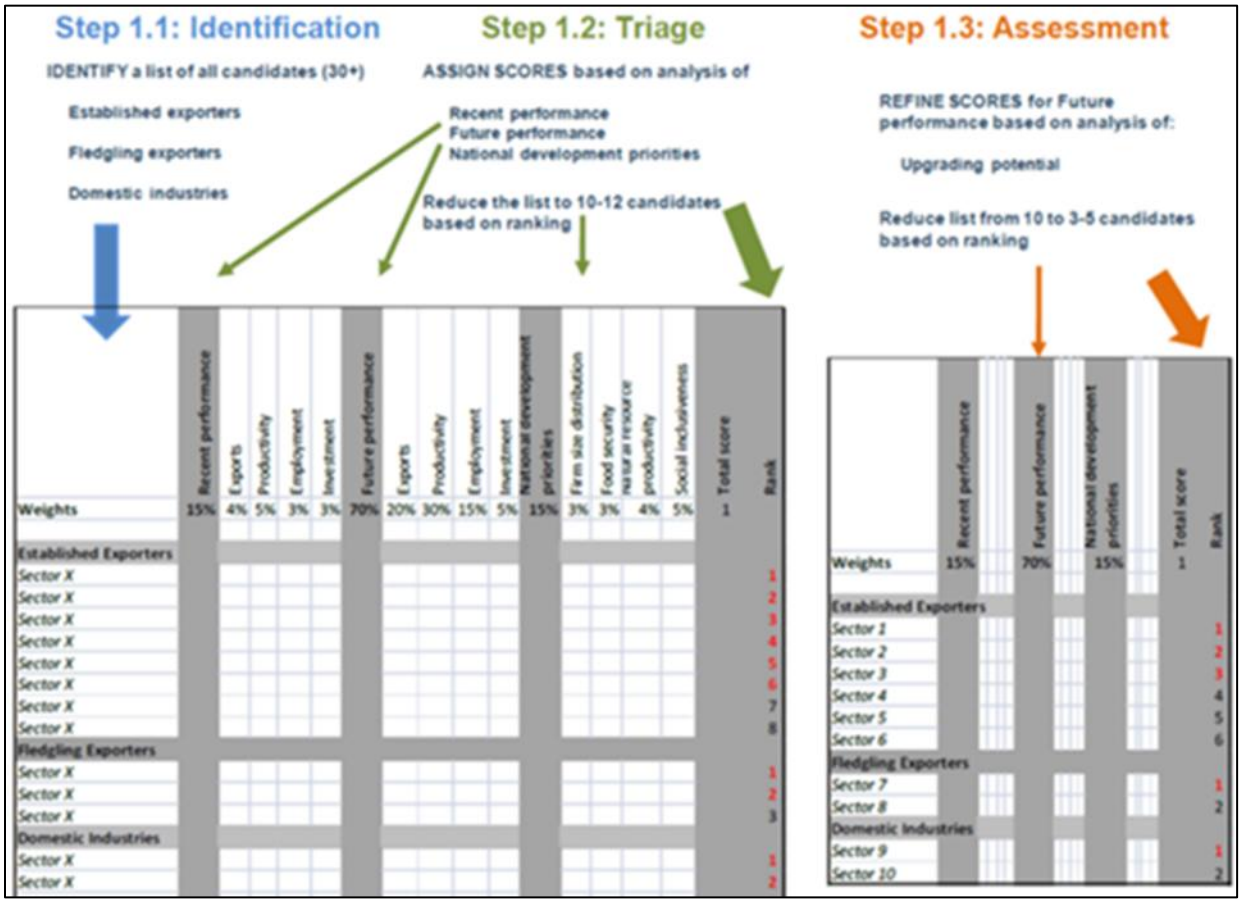

*Subcomponent 2.1: Planning and capacity building for the strategic programs on technological innovation*

12. This subcomponent will finance TA for the establishment and implementation of a Capacity Building Program and PPD mechanism led by CONCYTEC. The objective of the capacity building and PPD is to assess the demand for productive innovation by the private sector in Peru. Building upon the existing analytical work and ongoing policy dialogue of CONCYTEC,[10] it will conduct an identification, triage, and prioritization of the industries and clusters with the strongest potential to contribute to the objectives of the five National Strategic Programs on Innovation of CONCYTEC. The PDC will identify 15 and approve up to 8 pilots for the CRI for PI. The decision-making process will be informed by the Competitiveness Assessment Matrix (CAM) methodology,[11] which will enable to identify the CRI for PI pilots based on an iterative, quantitative, evidence-based process (see figure 2.4) in line with the policy priorities of the strategic programs of CONCYTEC.

[10] For a full analysis and references on the national priorities on productive diversification, innovation, and cluster policy prioritization of the Government of Peru see: *"Proyecto: Mejoramiento y ampliación de los servicios del Sistema Nacional de Ciencia, Tecnología e Innovación Tecnológica", Estudio de Pre inversión a nivel de Factibilidad. Código SNIP: 317848. Ano 2016*.

[11] The Competitiveness Assessment Matrix analytical tool is a standard tool to support industry-specific decision-making used in several World Bank Group lending and advisory operations in Mexico, Jamaica, Uruguay, Croatia, Bosnia & Herzegovina, Moldova, and India among other countries.

**Figure 2.4. CRI for PI Pilots Identification Process**




(a) The identification of the CRI for PI pilots will also be informed by the territorial development policy priorities of Peru and will include the criteria for territorial cluster identification set by the MEF, the National Council for Competitiveness, the PRODUCE, and CONCYTEC that have led to the identification of 41 clusters of national interest.[12]

(b) The core activity of this subcomponent is training up to 40 CONCYTEC and FONDECYT staff, private sector representatives, and relevant stakeholders of the STI system to implement a set of pilots for industries and clusters' development. The capacity building program will enable participants to implement the CRI for PI pilots according to a well-tested methodology[13] to help small networks of

[12] The criteria for the identification of the 41 clusters of national interest include (a) critical mass of firms, (b) growth potential, (c) competitive advantage of the cluster, (d) spillover effects on technology upgrading, jobs, and supplier development, and (e) institutional set up. These criteria have been set forth in the *"Plan Nacional de Diversificación Productiva"* of the PRODUCE, the *"Mapeo de Clusters en Peru"* of the MEF and of the National Council for Competitiveness of Peru, and in the *"Diagnostico de la Demanda de las Empresas para la Innovación Tecnológica y la Capacidad de Oferta a Corto y Mediano Plazo"* of CONCYTEC. For a full description of the criteria see: *"Proyecto: Mejoramiento y ampliación de los servicios del Sistema Nacional de Ciencia, Tecnología e Innovación Tecnológica", Estudio de Pre inversión a nivel de Factibilidad. Código SNIP: 317848. Año 2016.*

[13] One proven methodology for the implementation of CRI for PI initiatives is the one developed under the European Union's Cluster Excellence Initiative, (www.clusterexcellence.org) and now available as open source.

entrepreneurs—mostly SMEs—with developing a sustainable technology upgrading and competitiveness strategy investment plan. The training program is designed according to a "learning by doing" approach, in which participants receive six-week in-class training, and carry out their innovation and VC diagnostics in the field, all while receiving continuous support from coaches over a period of six months during which the design of the CRI for PI pilots under Subcomponent 2.2 are finalized.

(c) The capacity building program will provide CONCYTEC and FONDECYT staff, and all participants with the business strategy and management tools and skills to complement their scientific and technical expertise. The capacity building program will enable participants to: (a) map current positioning of the relevant productive networks within the regional and global industry and identify main innovation and technological trends; (b) conduct in-depth analysis of the key strategic segments within the main VCs Peru feeds into, to assess the competitive dynamics, the VC repositioning and technological upgrading options, the VC innovation gaps and technological driven productivity growth options, and (c) finalize the selection of CRI for PI initiatives to be implemented under Subcomponent 2.2. Through their training, participants will qualify to become the CRI for PI Pilots Coordinators of Subcomponent 2.2 and will be able to gather an understanding of the business models, strengths, weaknesses, opportunities, risks and binding constraints facing these entrepreneurs, individually and at cluster level.

*Subcomponent 2.2: Competitiveness reinforcement initiatives for productive innovation*

13. Subcomponent 2.2 will finance TA to focus on the implementation of up to eight CRI for PI pilots and deliver a detailed TUP for each pilot. The focus of the CRI for PI pilots will be on local networks of firms (predominantly SMEs) that need—and are willing—to redefine their strategic positioning in national or international markets, and have the potential to reduce their productivity gaps through a collaborative effort with research institutions and technology services providers. Participation to the CRI for PI pilots will be open to all interested firms, research institutions, and relevant stakeholders in a selected cluster or industry. The implementation of the CRI for PI pilots will be carried out by the CRI for PI Pilot Coordinators trained under Subcomponent 2.1 with the backing of the Project. The CRIs for PI will (a) identify the challenges that firms in the selected industries and clusters are facing; (b) define the strategy to address these challenges and (c) prepare a detailed TUP for the cluster or industry in question. At the end of each phase, the main results are presented to all cluster members in a public event.

(a) **First phase: Identification of challenges and the cluster's position along the relevant GVC.** This phase will entail defining the industry and dynamics of the sector/value chain in which the cluster operates, as well as the current situation in Peru, the cluster and companies, with the identification of their future challenges. The objectives of this phase are to identify the cluster/s position along the relevant GVC, motivate the cluster agents to participate in the initiative, help them understand the need for change, and learn about the cluster and the industry.

(b) **Second phase: Definition of the strategy to address the challenges.** This phase will provide a diagnostics of the current competitiveness position of the cluster and of innovation gaps in the relevant strategic segments, by using quantitative benchmarking references, sophisticated buyers analysis, and experts' panels to identify the best strategic options for the cluster. During this phase, the CRI for PI Pilot Coordinators will create strategy workgroups to engage the relevant local actors in the definition of the strategic lines of action through the following steps: 1. Cluster Mapping, 2. Strategic Segmentation, 3. Strategic Segment Attractiveness Evolution, 4. Advance Buyer Purchase Criteria Analysis, 5. Generic Strategic Options for the Future, 6. Critical Success Factors of the most Innovative Option, 7. Benchmark against the Ideal VC, 8. Benchmark against the Ideal Cluster Diamond, 9. Feasible Strategic Options for Cluster Companies, 10. Definition of Areas to Improve at Cluster Level.

(c) **Third phase: Definition of the cluster-level TUP.** This phase will entail the finalization of the TUPs with a detailed action plan emerging from the strategic analysis. The CRI for PIs Pilot Coordinators will build the capacity of the local private sector and research institutions to identify reforms, investments, and capacity building needs to enhance technological upgrading and firm competitiveness. It is the role of the CRI for PI Pilot Coordinators to identify the local cluster agents and bring them together through public meetings. At the end of this phase, each CRI for PI initiative will have:

(i) A set of policy recommendations on how to address the regulatory and implementation constraints that prevent firms in the specific industry/cluster from adopting new processes and technologies, and introducing new products in partnership with academia and innovation services providers, and

(ii) A detailed TUP to address cluster-level innovation and technology gaps. The TUPs will be prepared jointly by the private sector firms and academic institutions participating in the CRI for PI pilot. The TUP is a public, technical document that describes and justifies all of the activities needed in a specific CRI for PI pilot in a specific cluster or industry.

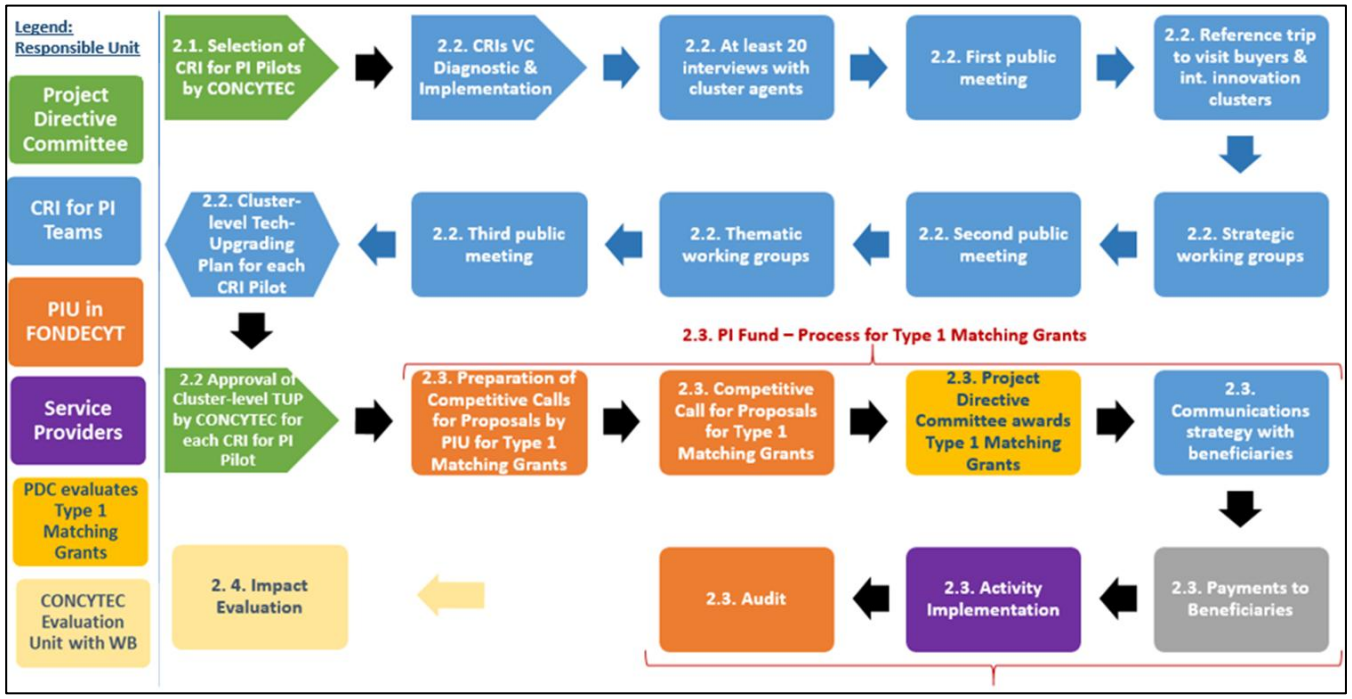
(d) **The TUPs for up to 5 CRI for PI pilots will be evaluated and approved by the PDC** with technical inputs from independent external experts.

*Subcomponent 2.3. Productivity and innovation fund for technology transfer and upgrading*

14. This subcomponent will provide matching financing to firms and research institutions through the establishment of the Productivity and Innovation Fund. The resources under Subcomponent 2.3 are earmarked notionally per type of matching grant with the objective of flexible reallocation among instruments based on beneficiaries demand, and with the approval of the CRI for PI Component Coordinator. The matching funds will finance the actions under the cluster-level TUPs presented by the participants to the CRI for PI pilots under Subcomponent 2.2. The Productivity and Innovation Fund will be established under CONCYTEC and administered by FONDECYT. The Productivity and Innovation Fund will finance:

(a) **Type 1 matching grants.** See Figure 2.5.for the implementation process. Matching contributions to firm-level investment plans targeting, among others R&D for technology development and commercialization projects, for new or improved technologies, processes, and products. Beneficiaries include any firm in Peru submitting a proposal aligned with the Strategic Programs on Innovation defined by the PDC under Subcomponent 2.1. Beneficiaries' matching contribution ranges from 50 percent to 10 percent depending on number of employees and annual turnover as set in the Operational Manual of the project. The evaluation criteria will provide additional scores to proposals that contribute to the objectives of the Strategic Programs on Innovation approved by CONCYTEC, and are specified in the Operational Manual of the project. The PDC will evaluate proposals with technical inputs from international independent external evaluators. To qualify for funding under Type 1 Matching Grant Productivity and Innovation Fund, the investment proposals must among others: (a) be proposed by a firm operating in the industries or clusters relevant to the five Strategic Programs for Innovation of CONCYTEC; (b) demonstrate how the activities proposed for funding lead to new or improved products/services or production processes, thus ultimately enhancing export competitiveness or domestic value added; (c) provide counterpart funding; (d) demonstrate positive economic returns; and (e) demonstrate how the interventions will be made sustainable over time.

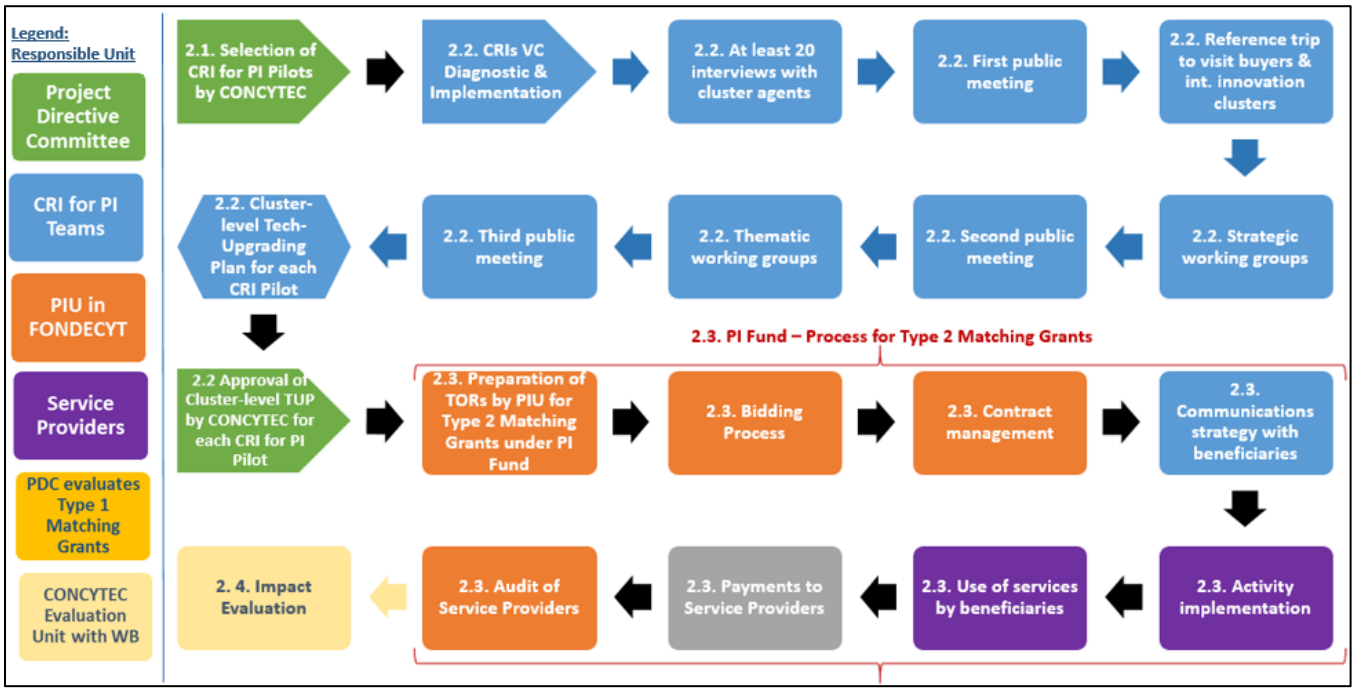
**Figure 2.5. Implementation Process for Type 1 Matching Grants**




(b) **Type 2 matching grants.** See Figure 2.6. for the implementation process. Matching contributions to firms and research institutions participating in the CRI for PI pilots to access shared services that require economies of scale in delivery, such as use of research labs and equipment, retraining of human resources to operate such equipment, access to prototyping and testing labs, or TA such as cluster-level quality

certification programs, marketing and commercialization expenditures, or skills trainings, among others. The TUPs approved by the PDC under Subcomponent 2.2 constitute the basis for determining which shared services will be provided for each CRI for PI pilot. FONDECYT will manage a competitive bidding process according to World Bank procurement rules to select the Service Providers to provide the relevant shared services to beneficiaries. In most cases, procurement methods for Type 2 Matching Grants will be open to international competition. Beneficiaries include firms (minimum 3) and research institutions (minimum 1) participating in the CRI for PI pilots, which will receive co-financing for the shared services delivered by the Service Providers and will provide a matching contribution between 50 percent and 10 percent depending on the number of employees and annual turnover as set in the Operational Manual of the project. The access to shared services will be also open to any firm and research institution in Peru at full market price. Overall eligibility criteria, percentages of matching contributions, list of financeable activities and investments, proposals evaluation procedures and criteria, and procurement and disbursement rules are specified in the Operational Manual of the project.

**Figure 2.6. Implementation Process for Type 2 Matching Grants**




*Subcomponent 2.4. Impact evaluation to recalibrate the CRI for PI pilots*

15. This subcomponent will finance TA to implement a rigorous IE and framework to identify counterfactuals and, assess the impact of design program features, and both additionality and attribution of the five CRI for PI pilots and Productivity and Innovation Fund (see annex 6).

***Component 3: Research and Innovation Capacity (US$73,564,318 - IBRD Financing US$31,827,138)***

16. The main objective of this component is to strengthen the capacity of the national STI system to generate relevant new knowledge and technology and to contribute to productive innovation. The component will achieve this objective by financing three subcomponents: (a) strengthening human capital by giving proper incentives to national and foreign researchers to work in Peruvian universities and research centers and by improving and increasing the number of PhD programs in Peruvian universities, (b) improving research equipment, especially up to date laboratory equipment, and (c) providing competitive and strategically oriented funds for research and R&D projects. Up to 77 percent of the funds of Component 3 will be allocated to support research that contributes to CONCYTEC's Strategic Programs on Innovation under Component 2 and the rest of the funds will be allocated to cross-cutting research areas and basic science. It is expected that 83 percent of the funds of Subcomponent 3.1, 67 percent of the funds of Subcomponent 3.2 and 69 percent of the funds of Subcomponent 3.3 will be dedicated to projects related to the strategic areas. A Technical Evaluation Committee will evaluate the proposals and assign the grants and co-financing for all the competitive calls for proposals under Component 3. The Technical Evaluation Committee will be composed by representatives of the Development Unit (one), the Monitoring and Evaluation Unit (one), the Adjunct Technical Directorate (one) of FONDECYT, and by representatives of CONCYTEC, with technical inputs from independent external evaluators. The functioning of the Technical Evaluation Committee, as well as the selection process and eligibility criteria, are regulated under the Operational Manual of the Project.

*Subcomponent 3.1: Strengthening human capital for STI*

17. This subcomponent aims at strengthening human capital for STI by promoting research work and the number and quality of PhD programs. All grants will be offered through international calls and will ensure the proper integration of researchers in academic institutions and research centers. The calls will prioritize proposals from research teams including all the three profiles, senior, postdoctoral and associate, according to the procedures and scientific profiles established in the Magnet Program.[14] The duration of the grants will be designed to ensure proper integration with existing research groups or consolidation of new groups. The grants will be allocated taking into account the diagnosis conducted under Component 2 for the Strategic Innovation Programs of CONCYTEC and the corresponding demand from sectors, the installed capacity and the demand from research institutions. Specifically, this subcomponent will finance:

(a) **Provision of grants and co-financing for researchers.** This activity is designed to provide grants and co-financing to researchers at various levels of experience (senior, post-doctoral and associate) through competitive process. The grants will be assigned by open competitive calls of two types: (a) integrated calls that will finance human capital, research equipment, and R&D research projects bundled together to

[14] The Magnet Program is CONCYTEC's program to attract researchers non-residents in Peru or Peruvians researchers who have recently returned to Peru, to work in research centers and universities on research projects on priority areas, http://www.cienciactiva.gob.pe/cienciactiva/convocatorias/innovacion-transferencia-tecnologia/magnet

support research that contributes to CONCYTEC's Strategic Programs on Innovation under Component 2; and (b) nonintegrated calls for proposals to finance grants and scholarships for researchers in areas relevant for the Strategic Programs under Component 2, as well as in cross-cutting research areas and basic science. This subcomponent will finance teams of researchers constituted at minimum by one senior researcher and by either one adjunct researcher or one postdoc researcher, who are already staff of universities or research centers in Peru or returnees from abroad (up to 70 percent of researchers), as specified in the Operational Manual. For returnees, the terms of reference will encourage the incorporation of participating researchers as regular staff before the end of the project to ensure sustainability. Similarly, the terms of reference of the calls will include as a requirement for full funding of the fourth year, that the beneficiaries submit proposals to other external sources of funding no later than the third year. Three types of grants will be provided:

(i) **Grants for senior researchers.** These grants will be of two types: (a) full grants for senior researchers who will be hired by a third party (chosen through a competitive process) and paid by the project, who will work in research centers or universities; and (b) partial grants for senior researchers who are, at the time of the call, staff members or that will be hired as staff members by universities or research centers, as specified in the Operational Manual.

(ii) **Grants for postdoctoral researchers.** These grants are for recent PhD graduates and will be for up to two years according to scientific profile.

(iii) **Grants for associated researchers.** These grants aim at supporting young researchers with a PhD and at least 5 years of research/innovation experience in areas related to by the Strategic Innovation Programs of CONCYTEC under Component 2. There will be two types of grants: (a) full grants for senior researchers who will be hired by a third party (selected through a competitive process) and paid by the project, who will work in research centers or universities; and (b) partial grants for senior researchers who are, at the time of the call, staff members or that will be hired as staff members by universities or research centers, as specified in the Operational Manual.

(b) **Provision of matching grants to Peruvian Higher Education Institutions** to support the creation and consolidation of world class, high quality PhD programs in science and engineering related to CONCYTEC's Strategic Programs on Innovation under Component 2. The grants will be assigned by open competitive calls for proposals, and they will finance, among others, scholarships, supplies, and consulting services required for the creation or consolidation of up to 8 PhD programs and scholarships for at most 10 students per program and for 3 years. The possible extension of the scholarships beyond the duration of the Project will be funded by FONDECYT's own funds, and it will be regulated under the Operational Manual.

*Subcomponent 3.2: Improving research equipment*

18. This subcomponent seeks to modernize, update and strengthen research equipment in universities and research centers by co-financing the acquisition of laboratory equipment with up to date technologies. Priority will be given to laboratories and equipment for research in areas related to, or required by, the Strategic Innovation Programs of Component 2 by developing distinctive and complementary research capabilities for each CRI for PI pilot as defined by the relevant Technology Upgrading Investment Plan. The funds will be assigned by open competitive calls of two types: (a) integrated calls that will finance human capital, research equipment, and R&D research projects bundled together to support research that contributes to CONCYTEC's Strategic Programs on Innovation under Component 2; and (b) nonintegrated calls for proposals to finance only research equipment (among others, laboratory equipment, supplies, operational costs, consulting services) for researches in areas relevant for the Strategic Programs under Component 2, as well as in cross-cutting research areas and basic science.

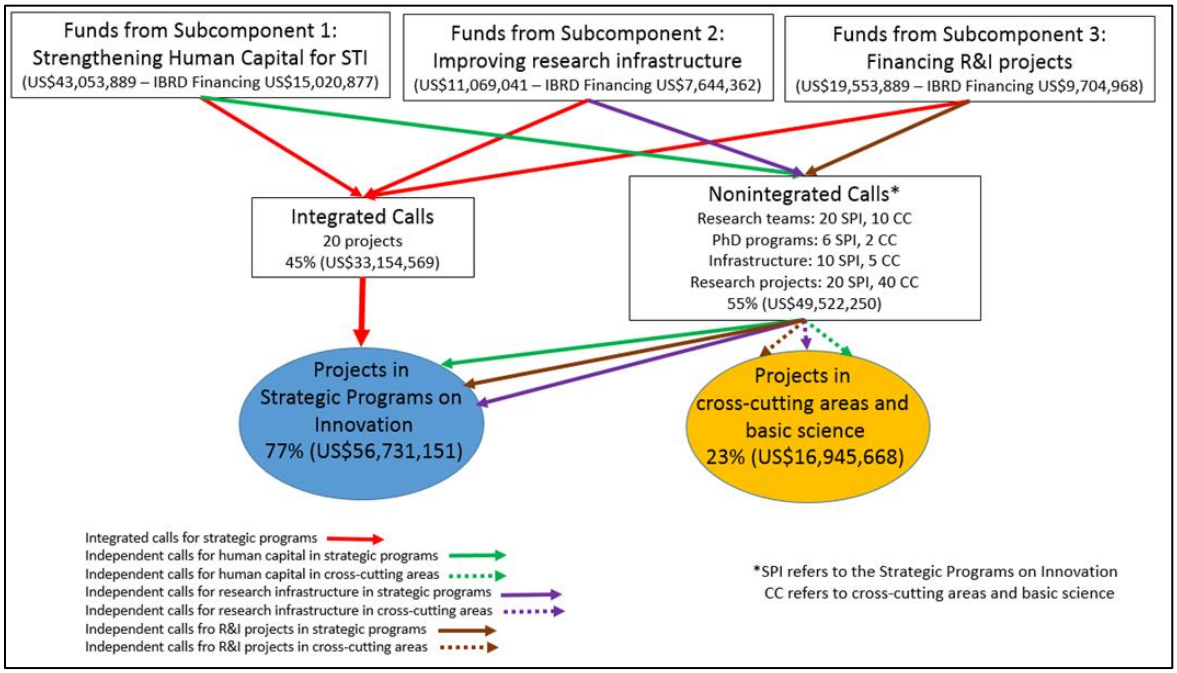
*Subcomponent 3.3: Competitive and strategically oriented grants for research and innovation*

19. This component will finance open calls to support basic and applied research and technological development projects (R&D projects) by funding those research expenses not covered by Subcomponents 3.1 and 3.2. The co-financing grants will be assigned by open competitive calls of two types: (a) integrated calls that will finance human capital, research equipment, and R&D research projects bundled together to support R&D projects that contributes to CONCYTEC's Strategic Programs on Innovation under Component 2; and (b) nonintegrated calls for proposals to finance R&D projects in cross-cutting research areas, as well as applied research and basic science. Financing schemes will prioritize strategic alliances and broader cooperation between the proponents and with the corresponding productive sector, as specified in the Operational Manual. This subcomponent will complement existing funding mechanisms of FONDECYT, and the same procedures will be used as defined in the Operational Manual. This subcomponent will finance expenses not covered by Subcomponents 3.1 and 3.2, which will include among others, expenditures of the selected R&D projects on human resources (different from those on Subcomponent 3.1 such as apprenticeships, short-term visiting researchers, research assistants, technicians), test equipment and supplies, prototyping, maintenance, consultancies, travel expenses to present research results, bibliographic needs, training, custom expenses and administrative expenses not surpassing 5 percent of the total cost of project.

*Funding Allocation Process for Integrated Calls and Nonintegrated Calls*

20. **The funds of each subcomponent of Component 3 will be disbursed through grants and co-financing assigned by open competitive calls of two types:** (a) integrated calls that will finance human capital, research equipment, and R&D research projects bundled together to support research that contributes to CONCYTEC's Strategic Programs on Innovation under Component 2, and (b) nonintegrated calls for proposals to separately finance either human capital, or research equipment, or R&D research projects in areas relevant for the Strategic Programs under Component 2, as well as in cross-cutting research areas and basic science. Figure 2.7 provides an overview of the resource allocation between the three subcomponents of Component 3, and between integrated and nonintegrated competitive calls.

**Figure 2.7. Funding Allocation between Integrated and Nonintegrated Calls**




### (a) Integrated Competitive Calls for Strategic Programs on Innovation

(i) Resource allocation through open competitive calls for projects related to the Strategic Programs on Innovation that bundle grants of the three subcomponents (human capital, research equipment and R&I projects). This form of resource allocation is based on competitive bidding, selecting and financing comprehensive proposals that include:

- Funding for the incorporation of a research team consisting at most of one (01) senior researcher, two (02) associate researchers and two (02) postdocs (Subcomponent 3.1).

- Funding for strengthening or updating equipment for research and technological development (Subcomponent 3.2).

- Funding for applied R&D projects. The evaluation criteria set in the Operational Manual prioritize proposals with a clear identification of market potential and capacity to leverage additional external resources (Subcomponent 3.3).

(ii) The Technical Evaluation Committee established in FONDECYT (composed by representatives of the Development Unit (one), the M&E Unit (one), the Adjunct Technical Directorate (one) of FONDECYT, and by representatives of CONCYTEC, with technical inputs from independent external evaluators) will implement the following evaluation process: (a) Assessment of eligibility, in which the formal requirements and application documents will be verified; (b) Strategic review of the proposals correspondence with the strategic areas; (c)

Technical evaluation by external peers, which includes a first independent evaluation by each member of a panel of external peer reviewers (scientific and/or innovation specialists) for each priority area and a second overall evaluation by the full panel which will assign a rating to each proposal of the corresponding area; and finally (d) an assessment by the Technical Evaluation Committee, which will evaluate all proposals that exceeded a minimum score on the previous stage. The Committee performs a technical and strategic assessment, resulting in a prioritized list of proposals to be funded. External evaluators and members of the Technical Evaluation Committee must be registered with CONCYTEC's National Directory of Evaluators in Science, Technology, and Innovation (EVA) and other international directories of evaluators.

(iii) These integrated calls will support the implementation of the CRI for PI pilots to be determined in Component 2. Proposals must include at least one major research institution and an institution linked to a different region. About 45 percent of the funds of Component 3 will be used to finance integrated calls. The number of integrated proposals expected to be funded is 20.

**(b) Nonintegrated Competitive Calls for the Strategic Programs on Innovation**

(i) Resource allocation through open competitive calls for projects related to the Strategic Programs on Innovation that include grants of one of the three subcomponents (human capital, research equipment and R&I projects). This form of resource allocation is based on competitive bidding, selecting and financing proposals of one of the following:

- Funding for the incorporation of a research team consisting of at most one (01) senior researcher, two (02) co-investigators and two (02) postdocs (Subcomponent 3.1).

- Funding for doctoral programs in Peruvian universities on issues related to the strategic areas (Subcomponent 3.1).

- Funding for strengthening and upgrading of equipment for research and technological development. (Subcomponent 3.2).

- Funding for R&D projects. (Subcomponent 3.3). This subcomponent will provide goods, especially laboratory equipment and those goods needed in upgrading of existing laboratories; supplies and consulting services required for those processes. Specifically, this subcomponent will finance expenses directly related with the corresponding research project on human resources (different from those on Subcomponent 3.1 and including apprenticeships, visiting researchers, research assistants, technicians), test equipment and supplies, prototyping, maintenance, consultancies, travel expenses to present research results, bibliographic needs, training, custom

expenses and administrative expenses not surpassing 5 percent of the total cost of project.

(ii) Evaluation of proposals by the Technical Evaluation Committee of FONDECYT (composed by representatives of the Development Unit (one), the M&E Unit (one), the Adjunct Technical Directorate (one) of FONDECYT, and by representatives of CONCYTEC, with technical inputs from independent external evaluators) for nonintegrated calls will follow the following steps: (a) Assessment of eligibility, in which the formal requirements and application documents are verified; (b) Strategic assessment of correspondence of the proposal with the priority and/or related areas; (c) Technical evaluation by external peers from CONCYTEC's EVA and other international directories of evaluators and (d) strategic evaluation of prioritization by a technical committee, on the basis of the prioritization criteria defined in the call for proposals.

(iii) About 35 percent of the funds of Component 3 will be allocated through nonintegrated competitive calls for strategic areas. It is expected that 20 research teams, 6 doctoral programs in Peruvian universities, 10 grants for equipment and 20 applied research projects or technological development will be supported.

**(c) Nonintegrated Competitive Calls for Cross-cutting Research Areas and Basic Science**

(i) Resource allocation through open competitive calls for projects in cross-cutting research areas and basic science that include grants of one of the three subcomponents (human capital, research equipment and R&I projects). The resource allocation process is based on competitive bidding, selecting and financing proposals of one of the following:

- Funding for the incorporation of a research team consisting of at most one (01) senior researcher, two (02) co-investigators and two (02) postdocs. (Subcomponent 3.1. Strengthening human capital for STI).

- Funding for doctoral programs in Peruvian universities on general areas. (Subcomponent 3.1. Strengthening human capital for STI).

- Funding for strengthening and upgrading of equipment for research and technological development. (Subcomponent 3.2. Strengthening and updating of research equipment).

- Funding for R&D projects. (Subcomponent 3.3. Competitive funds, general and strategically oriented R&I). This subcomponent will provide goods, especially laboratory equipment and those goods needed in upgrading of existing laboratories; supplies and consulting services required for those processes. Specifically, this subcomponent will finance

expenses directly related with the corresponding research project on human resources (different from those on Subcomponent 3.1 and including apprenticeships, visiting researchers, research assistants, technicians), test equipment and supplies, prototyping, maintenance, consultancies, travel expenses to present research results, bibliographic needs, training, custom expenses and administrative expenses not surpassing 5 percent of the total cost of project.

(ii) Evaluation of proposals by the Technical Evaluation Committee of FONDECYT for nonintegrated calls will follow the following steps: (a) Assessment of eligibility, in which the formal requirements and application documents are verified; (b) Strategic assessment of correspondence of the proposal with the priority and/or related areas; (c) Technical evaluation by external peers from CONCYTEC's EVA and other international directories of evaluators and (d) strategic evaluation of prioritization by a technical committee, on the basis of the prioritization criteria defined in the call for proposals.

(iii) About 20 percent of the funds of Component 3 will be allocated through nonintegrated competitive calls for general areas. It is expected that 10 research teams, 2 doctoral programs in Peruvian universities, 5 grants for equipment and 40 research projects or technological development will be supported.

*Component 4: Project Management and Monitoring & Evaluation (US$4,237,090 - IBRD Financing US$847,418)*

21. The management of the Project over its five-year tenure will be conducted by a team of technical and fiduciary specialists in areas including project coordination, technical, procurement, financial, and M&E specialists in line with the organizational structure described in annex 3 and in the Operational Manual of the project.

## Annex 3: Implementation Arrangements

### PERU: Strengthening the Science, Technology and Innovation System in Peru (P156250)

### Project Institutional and Implementation Arrangements

1. The full institutional and implementation arrangements of the project are specified in the "*Declaratoria de Viabilidad del Proyecto de Inversión Pública (PIP) "Mejoramiento y ampliación de los servicios del Sistema Nacional de Ciencia, Tecnología e Innovación Tecnológica" Código SNIP: 317848*" approved by DGIP on April 1st 2016 and are described in the Operational Manual of the project. The FONDECYT will be the implementing agency. FONDECYT is assigned (*adscrito*) to the CONCYTEC. FONDECYT will be responsible for all project implementation, technical, procurement, safeguards, financial management and disbursements.

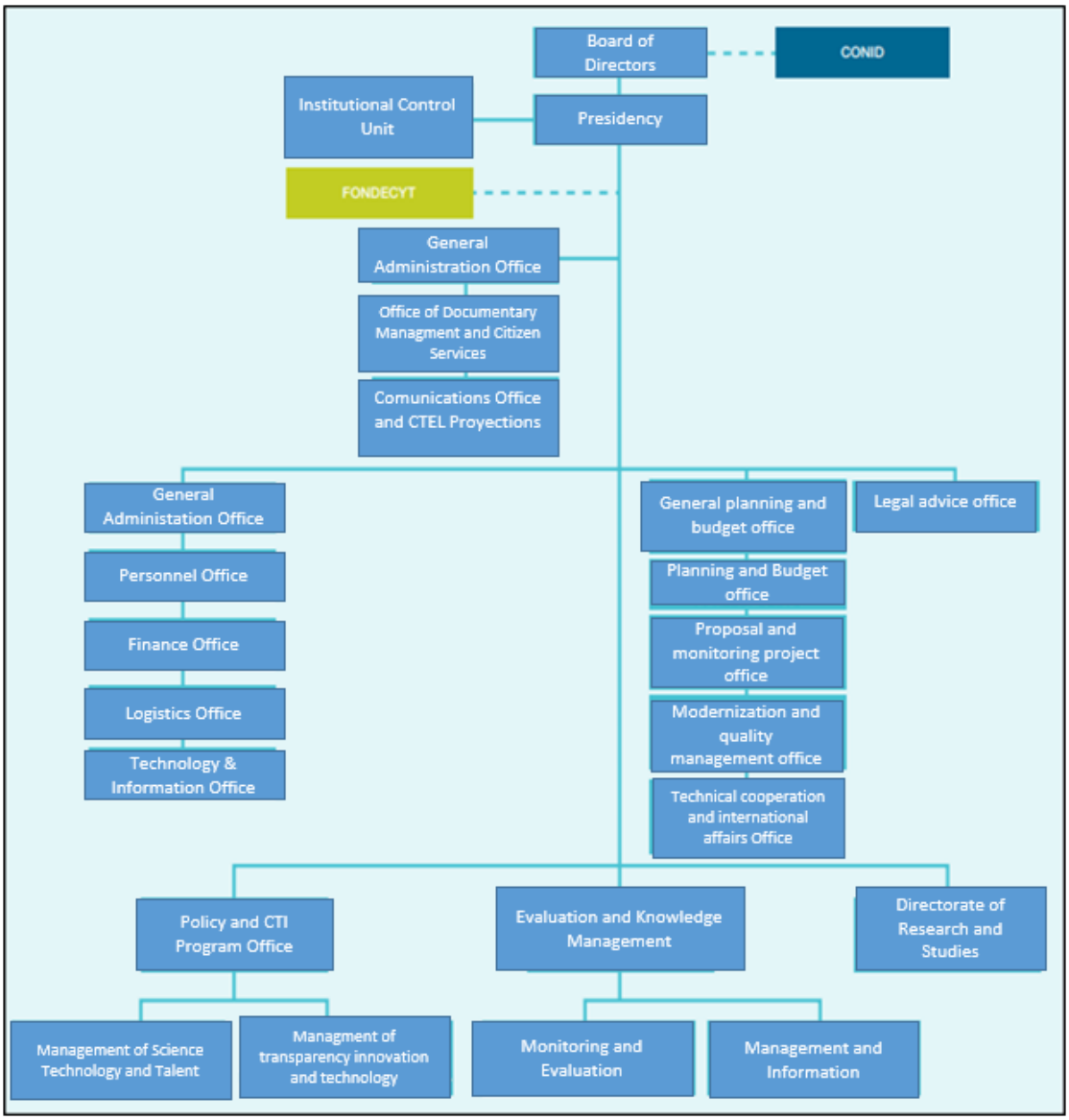
2. Figure 3.2 shows the institutional structure of CONCYTEC, which is an independent agency under the PCM. It is the coordinating agency of the national STI system of Peru.

3. CONCYTEC is led by a President who also chairs the Board of CONCYTEC, which includes representatives from public institutions, line ministries, local Governments, public and private universities, representatives of the private sector, and of the National Academy of Science.

4. CONCYTEC's institutional structure includes the following three technical areas: a Department of Programs and Policies, a Department of Evaluation and Knowledge Management, and a Research Department.

5. Under the Presidency of CONCYTEC, a program and budget execution unit, FONDECYT, was established in 2013. The role of FONDECYT, which was initially created to support the administrative and budget aspects of the activities of CONCYTEC, grew over time through *Resoluciones de la Presidencia*, which expanded FONDECYT's objectives, functions and structure.

**Figure 3.1. Institutional Structure CONCYTEC and FONDECYT**

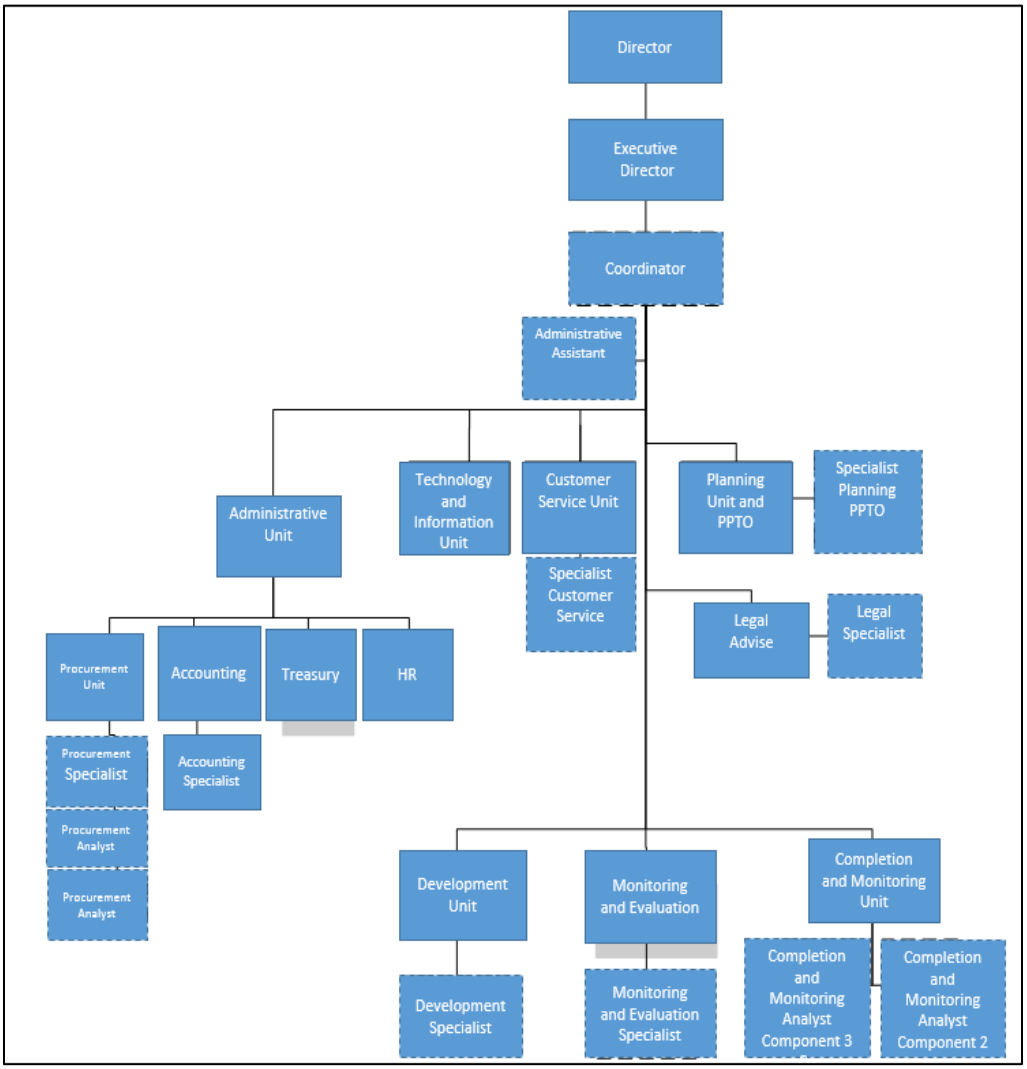



6. FONDECYT will implement the technical aspects of Components 1, 2, 3, and 4. In particular, CONCYTEC and FONDECYT will create joint *ad hoc* Technical Committees for the implementation of technical tasks. In addition, the fiduciary aspects of the whole project will be implemented by FONDECYT.

7. FONDECYT will manage the fiduciary aspects of the project through its AFO and the BPO.

8. Both CONCYTEC and FONDECYT will be institutionally strengthened under Components 1 and 4. To this purpose, FONDECYT will be staffed with a coordinator, an expert in development policy, an expert in M&E, experts on the evaluation and selection of innovation grants, two M&E analysts, administrative personnel and a lawyer. Figure 3.2 illustrates the organigram and the areas of FONDECYT that will receive institutional strengthening.

**Figure 3.2. Organigram of FONDECYT**




*Note:* *All units and positions in the boxes with dotted lines will be created and funded by the project.

9. A PDC to be chaired by the President of CONCYTEC will be established for strategic project management and coordination across ministries, agencies, and local authorities, and escalation of any issues. The PDC will include the members of the Board of CONCYTEC, in addition to one permanent representative of the DGIP of the MEF, and to one permanent representative of the *Dirección de Licenciamiento de la Superintendencia Nacional de Educación Superior Universitaria*. Overall, the PDC will include, among the others, two representatives of MEF, and a representative of Public Research Institutes, of local Governments, of public and private universities, of the private sector, and of the National Academy of Science.

10. The PDC will oversee the implementation of all Components of the Project. A Technical Evaluation Committee will also be established in FONDECYT to be responsible for the competitive calls for proposals under Component 3.

## Financial Management, Disbursements and Procurement

### *Financial Management*

11. The Bank has conducted its Financial Management Capacity Assessment[15] for the project. Based on the work done with FONDECYT, this section presents a description of the financial management and funds flow arrangements that will be put in place by FONDECYT and reflected in the Operational Manual.

*Summary of Financial Management Arrangements*

12. FONDECYT is a PIU with budgetary, administrative and financial autonomy and it is the budget executing unit of CONCYTEC. FONDECYT will be responsible for the financial management of the project in addition to a third party that will be hired to administer the funds under Component 3.1. FONDECYT will also be responsible for the implementation of the technical aspects of the project components. The financial management and disbursement arrangements of the project will include: budgeting and planning, accounting and financial reporting, internal controls, flow of funds, and external audit. The supervision of these arrangements will be under the responsibility of the AFO and the BPO of FONDCEYT.

FONDECYT has experience in implementing competitive funds for science and innovation projects (competitive funds) under local norms, and it has also worked with other multilateral financial institutions such as the IADB. FONDECYT has been able to put in place most of the necessary FM arrangement to implement the project which will include different types of grants. To this purpose, FONDECYT has defined (a) the necessary internal controls to record and manage the funds of the project, has also defined the financial reports (IFRs) and annual financial reports) that will be prepared by the FONDECYT's AFO; (b) the draft project Operational Manual that clearly define roles and responsibilities between CONCYTEC and FONDECYT to manage the technical and fiduciary aspects of the project, including identification of key controls to strengthened adequate project implementation; and (c) draft version of the FM chapter of the Operational Manual.

13. These arrangements are considered satisfactory to the Bank. Nonetheless, some FM arrangements for Component 3.1(i) need to be implemented by FONDECYT. In order to bring the FM arrangements for the project into full compliance with the Bank requirements, FONDECYT will need to complete the following actions:

(a) **By effectiveness.** Adoption of the Operational Manual by the PDC in form and substance satisfactory to the Bank.

(b) **Disbursement condition.** The financial management arrangements for implementation of Subcomponent 3.1(i) will be subject to a disbursement condition that will require FONDECYT to (i) select a third party in accordance with the provisions of the legal agreement for purposes of assisting FONDECYT in the carrying out Subcomponent 3.1; and (ii) a contract has been signed between

[15] In accordance with Financial Management Manual for World Bank Investment Project Financing (December 11, 2014) and OP/BP 10.00.

FONDECYT and a third party, on terms and conditions acceptable to the Bank, that includes the obligation of the third party to assist FONDECYT in managing Part 3.1 (i) of the Project.'

14. Overall conclusion of this assessment is that the project has a Moderate Fiduciary Risk. Furthermore, once the mitigating measures have been put in place and the pending activities under staffing, budgeting, accounting, reporting and internal controls have been accomplished, then the proposed Financial Management arrangements will meet the Bank's minimum fiduciary requirements.

*Detailed Financial Management Arrangements*

15. **Organization and staffing.** The fiduciary aspects of the project will be under the responsibility of FONDECYT's AFO and BPO. The AFO and BPO have qualified and experienced staff in national regulation. However, it has been considered that these offices will be strengthened with additional staff (project implementation team - PIT) to support project implementation. Therefore, FONDECYT will have to recruit additional fiduciary staff that will include a Budget Specialist, an Accountant/Financial Management Specialist, and Procurement Specialist. In addition, FONDECYT will recruit a Project coordinator, an adjunct Project coordinator, at least three technical experts; a legal specialist; and a communication officer to support project implementation. The recruitment of this additional staff will be under terms of reference approved by the Bank. Recruited staff should have previous experience in working with Bank projects. Specific roles and responsibilities of the participant entities are established in the project Operational Manual.

16. **Planning and budgeting.** Preparation of annual work program and budgets will be in accordance to the procedures established by MEF through its *Dirección General de Presupuesto Publico* (Public Budget General Directorate). These national procedures will be complemented by specific processes and procedures established in the Operational Manual for the project (preparation of an annual operating plan with at least semi-annual budget, including all source of financing – IBRD and counterpart funds). FONDECYT will be responsible for ensuring: (a) timely provision of resources for each year established in the work plan and budget formulation for approval; (b) proper recording of the approved budget in the respective information systems following a classification by project component/subcomponent; and (c) timely recording of commitments, accruals, and payments, to allow an adequate budget monitoring and provide accurate information on project commitments for programming purposes. The Loan Agreement clearly states that FONDECYT will make the necessary budget provision for the project funds (external and counterpart budget funds) according to the annual operational plan.

17. **Accounting and information systems.** FONDECYT complies with Peru's laws governing budget and financial management, including the use of SIAF and the General Chart of Accounts established in SIAF. Accounting and payment transactions of the project will be recorded in SIAF. FONDECYT has developed a tailor-made financial information system (SIG) to complement the use of SIAF to provide subprojects information for monitoring purposes. SIG will be adjusted to be able to provide the financial reports and statement of expenditures (SOE) of the project according to the functional classification of the project by component/subcomponent and in U.S. dollars.

18. **Internal controls and internal auditing.** The Internal Control Office of CONCYTEC has oversight of FONDECYT fiduciary transactions. The Internal Control Office of CONCYTEC may conduct ex post internal control reviews of project transactions. CONCYTEC and FONDECYT has to comply with the internal control standards and procedures issued by the *Contraloría General del Peru* (Comptroller General Office of Peru). In addition, FONDECYT has to comply with its own internal control procedures and at the same time should put in place the internal control and procedures specifically prepared for this project. Project internal control processes and procedures are described in the Operational Manual showing clear segregation of roles and responsibilities among participating implementing entities (technical and fiduciary entity) and beneficiaries of competitive funds.

19. **Financial reporting.** IFRs will be issued from the Project's financial management information system in a format acceptable to the World Bank. The IFRs will include: (a) a statement of sources and uses of funds, including reconciling items, cash balances and bank reconciliations, with expenditures classified by project component/ subcomponent/category; (b) a statement of uses of funds; and (c) a subproject statement, detailing the amount disbursed, the amount documented, and outstanding balances. The IFRs will include updated information on the use of loan proceeds as well as counterpart funds. The IFRs will be prepared in U.S. dollars and will be submitted to the World Bank on a bi-annual basis no later than 45 days after the end of each period. In addition, the PIU will prepare annual Financial Statements, in U.S. dollars, no later than 60 days after the end of the fiscal year. These FS will be submitted to the auditors in time to meet the audit report deadline (see External Audit).

**Table 3.1. Deadlines for Financial Reporting**

| Period | Due Date |
|---|---|
| Semester 1 IFR | August 15 of each year |
| Semester 2 IFR | January 15 of each year |
| Annual FS | February 28 of each year |

20. **Auditing.** Financial Audits of the financial statements of the Project will be conducted in accordance with International Standards of Auditing issued by the International Federation of Accountants. Audits will be performed by independent audit firms acceptable to the World Bank, under terms of reference approved by the World Bank. Each audit of the financial statements will cover a period of one fiscal year of the Government of Peru (ending December 31) or other period agreed with the Bank. The audited financial statements of the Project, including the associated management letters, will be submitted to the World Bank no later than six months after the end of each fiscal year. The cost of the audits are eligible expenditures (consulting services) that can be financed using loan proceeds. The audit scope will be defined by the audit terms of reference (TOR) approved by the World Bank and based on Project-specific requirements. The project financial statements and the opinions that the auditors will be required to issue will include the Statement of Sources and Uses of Funds, Statement of Cumulative Investments and SOE. The auditors will also prepare a management letter regarding the internal controls of the project including those that apply to grants financed under Subcomponent 3.1. Documentation used in the preparation of financial statements will be maintained by the

FONDECYT and the third party administering funds under Component 3, and made available to World Bank supervision missions and to external auditors. Audit requirements to be reflected in the legal agreement are the following:

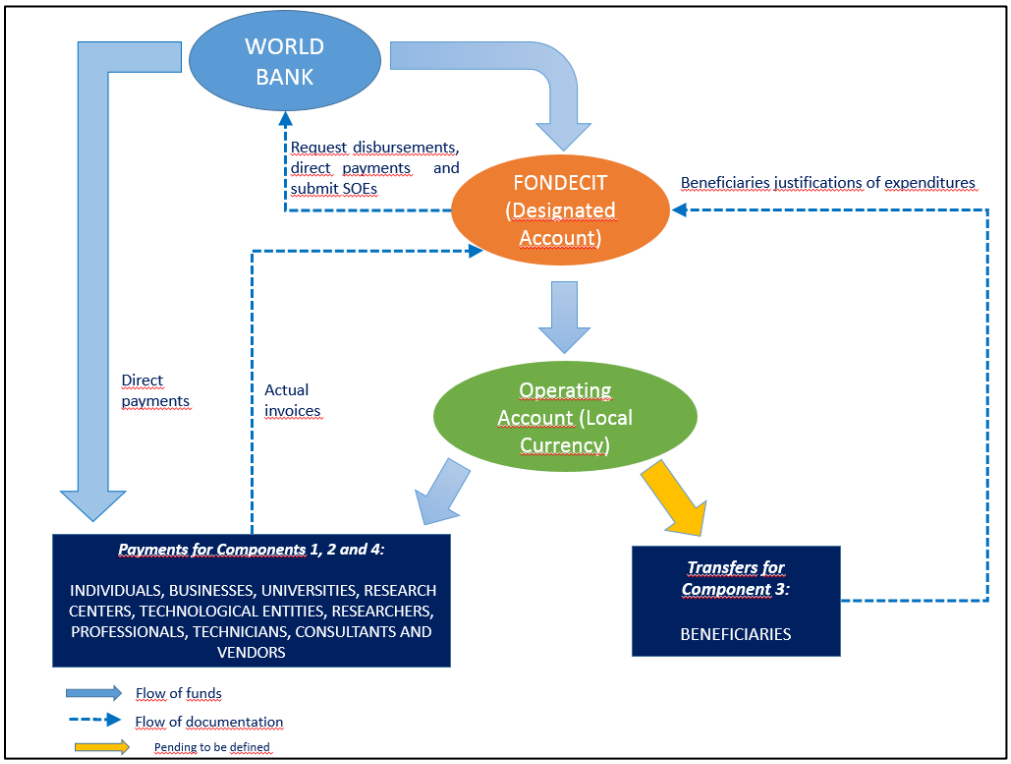
**Table 3.2. Audit Reports and Due Dates**

| Audit Type | Due Date |
|---|---|
| Project financial statements | June 30 |
| Special Opinion:<br>SOE | June 30 |

*Funds Flow and Disbursement Arrangements*

21. FONDECYT will open a designated account (DA) in bank in U.S. dollars at *Banco de la Nación* that will be segregated meaning the funds disbursed into the DA cannot be comingled with other funds. The DA ceiling, which establishes the maximum amount that can be disbursed into the account, will be based on a three-month forecast. The PIU will also open a local currency (Peruvian Soles) operating bank account at the same financial institution. The PIU will use the operating account to make payments and disbursements for subprojects. The administration of Bank loan proceeds will follow Bank's disbursement policies and procedures, including documentation requirements, as described in the Disbursement Letter. The Bank will disburse Loan proceeds using Advance, Reimbursement, and Direct payment methods (figure 3.3).

**Figure 3.3. Funds Flows Diagram by Component**




22. The disbursement criteria are described in the following paragraphs:

(a) Advance method. The DA will have a variable ceiling based on three months forecasts. A DA in U.S. dollars will be opened and maintained in the *Banco de la Nación* (Bank of the Nation) by FONDECYT, which will have direct access to funds advanced by the World Bank to the DA. Funds deposited into the DA as advances, will follow World Bank's disbursement policies and procedures, to be described in the Legal Agreement and Disbursement Letter. To process payments, FONDECYT will be able to withdraw the required amount from the DA to a local currency bank account (operating account) from where payments will be made to consultants, suppliers, and beneficiaries' bank accounts.

(b) Direct payment. The minimum application size for direct payment request will be US$1,000,000.

(c) Reimbursement method. The minimum application size for reimbursement method will be US$1,000,000.

23. **Disbursement arrangements under Components 1, 2, and 4.** Under these components, all payments will be processed by FONDECYT. Justification of expenditures will be submitted in accordance with the instructions specified in the Disbursement Letter.

24. **Disbursement arrangements under Subcomponent 3.1(i) (Grants for researchers).** FONDECYT will select a third party (selected through a competitive process) which will manage the funds of the project to pay beneficiary expenses under this subcomponent. These expenses include: Training required for Matching Grants, which comprises: workshops and training expenditures under the Project, purchase and publication of materials, rental of facilities, course fees, study tours, scholarships, stipends, travel and subsistence for participants of workshops, trainers and trainees (if applicable), as it is specified under the Disbursement Letter. FONDECYT will advance funds to the third party under an agreement subject to the World Bank's approval that will include (i) a disbursement plan, (ii) specific requirements for the fiduciary controls that will apply, and (iii) reporting requirements consistent with World Bank's requirements as expressed in the loan agreement. The third party will then disburse funds under grant agreements that will also be subject to the World Bank's approval and will include minimum requirements for the grantee to report the use of the funds.

25. **Disbursement arrangements under Subcomponents 3.1(ii), 3.2, and 3.3 (Grant for subprojects).** Under these subcomponents, FONDECYT will disburse loan proceeds for implementation of subprojects. Disbursement instructions for subprojects will be reflected in the Operational Manuals under a section/chapter dedicated to subprojects. Following the initial disbursement (advance) to a given subproject, requests for additional disbursements to the same subproject should be supported by documentation of expenses incurred based upon the disbursement schedule or payment plan established in the subproject's legal agreement. Amounts disbursed to subproject beneficiaries will be recorded as expenditures and monitored through the tailor-made accounting information system named SIG. The beneficiaries will be responsible for the execution of subprojects in accordance with procedures established in the subproject agreements.

26. **Counterpart Funds.** FONDECYT will manage the counterpart funds for the project using the Single Treasury Account stablished by the Government. Funds for the project will be identified with a specific project code and account in SIAF to process payments.

27. **Bank supervision.** Financial Management supervision will be done using a risk-based approach and include on-site and off-site supervision. On-site supervision will be carried out at least twice a year. Off-site supervision will comprise desk review of interim financial reports and audited financial statements.

***Procurement***

28. **General.** Procurement for the project will be carried out in accordance with the World Bank's "Guidelines Procurement of Goods, Works and Non-Consulting Services under IBRD Loans and IDA Credits and Grants by World Bank Borrowers," dated January 2011 and revised in July 2014 and the World Bank's "Guidelines Selection and Employment of Consultants under IBRD Loans and IDA Credits and Grants by World Bank Borrowers," dated January 2011 and revised in July 2014; and the provisions stipulated in the Loan Agreement. The items under different expenditure categories are described below. For each contract to be financed by the Loan, the different procurement methods or consultant selection methods, estimated costs, prior review requirements, and timeframe are agreed between the Borrower and the Bank in the Procurement Plan.

(a) **Procurement of works.** No civil works are expected under the Project.

(b) **Procurement of goods.** Goods procured under this project would include, among others, scientific equipment (research labs and equipment) with installation and adjustments necessary to security, environment and/or hygiene standard to ensure proper operation, software, networking equipment, and furniture. Procurement of goods would be carried out by the FONDECYT and at the subproject level by the beneficiaries.

(c) **Procurement of non-consulting services.** All contracts for services not related to consultant services (among others, logistics, organization of seminars and workshops, printing services, dissemination activities) may be procured under the same methodologies and thresholds specified for goods and would be carried out by FONDECYT and at the subproject level by the beneficiaries.

The procurement of goods and NCS would be done using the World Bank's standard bidding documents for all International Competitive Biddings (ICBs) and National standard bidding documents satisfactory to the World Bank for all National Competitive Biddings (NCBs); for shopping a document acceptable to the Bank will be used.

(d) **Selection of consultants.** The Project would require consulting services under the four Components, among others, studies, evaluations, and other types of TA for: strategic and sector planning, policy definition, designing and developing IT

systems, M&E, peer review of subprojects, design dissemination activities. The participation of public and/or private universities, public or private non-profit research institutions, technical and/or specialized public institutions, consulting firms and nongovernmental organizations in some specialized fields of expertise is expected.

(e) Under Component 1, there will be interagency agreements (*Acuerdos Inter-institucionales*) between CONCYTEC and STI entities carrying on the same or similar activities of CONCYTEC for advice and knowledge transfer. Only the incremental costs generated are recognized. This activity will not have a procurement process.

(f) Specialized advisory services would be provided by individual consultants (ICs) selected by comparison of qualifications of at least three candidates and hired in accordance with the provisions of paragraph 5.1 to 5.6 of the World Bank Consultant Guidelines. ICs would be hired as external evaluators of the proposals submitted through open calls to award the grants under the subprojects. Under Component 3, the ICs will be selected from the EVA, which registers scientists, technologists, entrepreneurs and/or professionals with proven track record in areas related to knowledge and development of science activities, technology and innovation, with the condition of evaluator, (EVA is the name of the directory platform. It was created under Presidential Resolution No. 204-2014-CONCYTEC-P). If necessary, these consultants may be hired using the single source (SS) method per paragraph 5.4 of the World Bank's guidelines.

(g) Short lists of consultants for services estimated to cost less than US$350,000 equivalent per contract may be composed entirely of national consultants in accordance with the provisions of paragraph 2.7 of the Consultant Guidelines. Regardless of the method used or the estimated cost of the contracts, selection and contracting of consultant firms would be done using the Bank's Standard Request for Proposals.

(h) **Operating costs.** Operating costs refer to reasonable recurrent expenditures that would not have been incurred by the implementing agency in the absence of the project. They may include but are not limited to transportation fares, travel expenses and per diem related to supervision activities, operation and maintenance of office equipment purchased under the project, as well as nondurable/consumable office materials, as needed for the implementation of the project. All these activities would be procured using the implementation agency's administrative procedures, which were reviewed and found acceptable to the World Bank.

(i) **Grants for subprojects.** Grants for subprojects would be financed through competitive processes. Procurement of goods, non-consulting services and consulting services would be carried out in accordance with the procedures set forth in the Operational Manual. Under subprojects, beneficiaries would decide what investments to make according to their business plans and competitively selected proposals. The grant application will contain a business plan including a simplified

procurement plan with a list of the goods and services to be procured and their estimated cost. The hiring of consultant firms and highly specialized ICs would also be listed in the grant application and will follow the procedures for hiring firms and individuals established in the Operational Manual. Grants under the program shall follow the procedures established in the Operational Manual. Achieving the objectives of the subproject, requires financing both procurable (goods, services, and consultants' services) and non-procurable items (such as scholarships and stipends). The Operational Manual specifies the documentation the beneficiaries must keep and submit as part of the regular reporting process.

(j) Under Subcomponent 2.3., the project will finance two types of matching grants. For type 1, procurement processes will be carried out by the beneficiaries in line with the previous paragraph. For type 2, FONDECYT will be responsible for carrying out the entire competitive procurement processes, including the planning stage and contract administration. The technical definitions and the type of procurement required (NCS or consulting services) will be defined during the implementation of Subcomponent 2.2. Once the necessary definitions are completed, the relevant option of procurement under Framework Contracts acceptable to the World Bank, in accordance with procedures of the guidelines, will be selected.

(k) Under Subcomponent 3.1.1, the procurement plan specifies that the contract to hire a "third party" to manage the resources under Subcomponent 3.1.1 will be carried out as a competitive process of a NCS, starting in April 2017, once the project has entered into effectiveness.

(l) In addition to the contract of the "third party", no procurement actions were identified under this Subcomponent 3.1.1., the expenses are related to scholarships, stipends, travel and subsistence for researchers. These activities should be executed under the Training expenditure category. It's important to clarify that the "third party" will not have to develop any procurement activity.

29. **Assessment of the agency's capacity to implement procurement.** The assessment confirmed that FONDECYT will be responsible for procurement activities under the project. FONDECYT is the unit of budget execution of the CONCYTEC, with its own assets, administrative and financial autonomy, responsible for capturing, managing, administering and channeling domestic and foreign resources, for the activities of the STI system in Peru. The assessment reviewed the organizational structure, the staff responsible for procurement, the relationship between the procurement, technical, administrative, and financial offices, the operating manuals, and the systems used for supervising and controlling. The analysis concluded that FONDECYT has no previous experience in dealing with projects funded by the Bank. Thus the institutional and organizational capacity of FONDECYT should be strengthened to implement the project. However, FONDECYT operates under a clearly defined legal framework, has established internal procedures, and currently is implementing "Management for Results", which involves strengthening its internal processes and units.

30. For the implementation of the Project, FONDECYT will manage procurement through the AFO that will include a dedicated and experienced procurement specialist for the project. At

the subproject level, the procurement would be carried out by the beneficiaries in accordance with the rules set forth in this annex and detailed in the Operational Manual. FONDECYT will be responsible for the procurement at the central level and monitoring and supervising procurement conducted by the beneficiaries. FONDECYT will guarantee during Project implementation that its own specialized staff or consultants with significant experience in World Bank-funded procurement will supervise procurement.

31. Key procurement issues and risks include: (a) definition of roles and responsibilities of CONCYTEC and FONDECYT to the project implementation; (b) lack of staff with expertise in procurement processes with the World Bank's guidelines; (c) an important part of the procurement actions will be implemented through beneficiaries of subprojects and need to establish a regulatory and supervision mechanism for FONDECYT to guide grant beneficiaries in Bank procurement procedures; (d) the hiring of a "third party" to manage the resources that will be implemented under Subcomponent 3.1.1.; (e) the implementation of type 2 matching grants under Subcomponent 2.3.

32. **Risk mitigation plan**. The following table summarizes the mitigation actions proposed for the procurement-related risks identified above.

**Table 3.3. Procurement Improvement Action Plan**

| Risks - Areas for Improvement | Mitigation Actions | Responsible | When |
|---|---|---|---|
| Programming project procurement for the first 18 months of execution. | A comprehensive, detailed Procurement Plan for the first 18 months of project execution, has been presented by the project and approved by the Bank. | FONDECYT | By Appraisal and Before negotiations<br><br>Completed |
| Management project | The operational manual is finalized. It contains the definition of the processes, roles, and responsibilities of CONCYTEC and FONDECYT. The chapter o Procurement clearly reflects the procurement arrangements. | FONDECYT | By Appraisal and Before negotiations<br><br>Completed |
| Lack of staff with expertise in procurement processes with the World Bank's guidelines. | Hire a procurement specialist experienced in World Bank procedures under terms of reference acceptable to the World Bank that will be responsible for selecting and contracting with Bank's guidelines and transfer knowledge to the FONDECYT team. | FONDECYT | Effectiveness |
| | It should periodically review the workload of staff hired to manage procurement to properly respond to the predictable work load and provide assistance on procurement matters to the grants' beneficiaries. | | During project implementation |
| An important part of the procurement actions will be implemented through beneficiaries of subprojects | The agreements signed between FONDECYT and each of the grant recipients under the competitive fund must include a statement in which the beneficiaries agree, that the procurement of goods, non-consulting services and consulting services would be carried out in accordance with the procedures set forth in the Operational Manual. | FONDECYT | During project implementation |

| Risks - Areas for Improvement | Mitigation Actions | Responsible | When |
|---|---|---|---|
| Need to establish a regulatory and supervision mechanism for FONDECYT to guide grant beneficiaries in procurement procedures. | The procurement section of the Operational Manual clearly defined the roles, responsibilities, rules, reviews (ex-ante and ex-post) and reporting requirements on procurement. The criteria for selecting subprojects' beneficiaries are described in the relevant section of the Manual. | FONDECYT | By Appraisal and Before negotiations<br><br>Completed |
| | The Operational Manual establishes FONDECYT periodic and specialized procurement reviews by independent procurement reviewers or specialized FONDECYT' staff that should be carried out, at least one a year, and should include visits to the subprojects and reporting of procurement regulations, until procurement under subprojects financed by the loan is completed. | FONDECYT | |
| | A specific operation manual for the implementation of subprojects by the beneficiaries will be developed by the project. It will include the procurement procedures approved in the Project Operational Manual. | | Effectiveness |
| The hiring of a "third party" to manage the resources to be implemented under Subcomponent 3.1.1. | It is recommended, that the project begins the competitive procurement process soon and in the most efficient way (clear identification of the needs, market research, budget, and so on), so that no delays arise in implementing the subcomponent | FONDECYT | Effectiveness and starting the project implementation |
| The implementation of matching grants type 2 under Subcomponent 2.3 | FONDECYT needs to clarify how to implement these grants, design the necessary tools, review the market conditions according to the type of procurement, internal procedures, funds flow, and so on. | FONDECYT | During project implementation |

33. The overall project risk for procurement is Substantial, considering the agency's capacity to implement procurement, the implementation arrangements and the complexity of the project. The level of risk for the project will be reassessed once there is evidence that the above-mentioned mitigating measures have been properly conducted.

34. **Procurement Plan, thresholds for procurement methods and World Bank review**. FONDECYT presented a detailed procurement plan for project implementation. The Procurement Plan will be updated at least annually or as required to reflect the actual project's implementation needs and improvements on institutional capacity. The capacity assessment of the Implementing Agency has recommended two supervision missions per fiscal year to visit the field to carry out post review of procurement actions. The size of the sample for post review will be defined before each mission.

35. The Procurement Plan will be available at the Systematic Tracking on Exchanges in Procurement – STEP which is the Bank's system for the execution of procurement plan. The

Borrower, through FONDECYT, shall: (a) supply the STEP with the information contained in the initial Procurement Plan within sixty (60) days after the date of this Agreement; and (b) update the Procurement Plan at least once a year, or as needed through the duration of the project, to reflect the actual Project implementation needs and progress, and, supply the STEP with the information contained in the updated Procurement Plan immediately thereafter.

- Bank's approval Date of the Procurement Plan: October 12, 2016
- Date of General Procurement Notice: after effectiveness, 2017
- Period covered by this Procurement Plan: 18 months

22. Thresholds for the use of the different procurement methods and recommended thresholds:

**Table 3.4. Thresholds for Procurement Methods and for Recommended Bank Review**

| Estimated Value Contract Threshold | Procurement Method | Bank Prior Review |
|---|---|---|
| **Goods:**<br>≥US$2.000,000<br><US$2.000,000 and >US$50,000<br>≤US$50,000<br>Any estimated cost | <br>ICB<br>NCB<br>Shopping<br>Direct contracting | According to procurement plan |
| **Non-consulting Services:**<br>≥US$2.000,000<br><US$2.000,000 and >US$50,000<br>≤US$50,000<br>Any estimated cost | <br>ICB<br>NCB<br>Shopping<br>Direct contracting | According to procurement plan |
| **Consulting Firms:**<br>Any estimated cost<br>≥US$300,000<br><US$300,000 | <br>SS<br>QCBS, QBS, FBS,<br>LCS<br>QCBS, QBS, FBS,<br>LCS, CQS | According to procurement plan |
| **Individual Consultants:**<br>Any estimated cost<br>Any estimated cost | <br>SS<br>3 CV's | According to procurement plan |

*Note:* Abbreviations in the table include: Selection Based on the Consultant's Qualifications (CQS), Selection under Fixed Budget (FBS), International Competitive Bidding (ICB), Individual Consultant (IC), Least-Cost Selection (LCS), National Competitive Bidding (NCB), Quality-Based Selection (QBS), Quality- and Cost-Based Selection (QCBS), and Single Source (SS).

23. Grants for subprojects:

(a) The procedures would be carried out in accordance with the Operational Manual.

(b) The Operational Manual would establish the scope of the prior review of contracts that the FONDECYT's procurement team would conduct in regard to subprojects' beneficiaries.

**Environmental and Social (including Safeguards)**

36. None of the social safeguard policies has been triggered because the project is not expected to have involuntary resettlement or the involuntary use of land, or impacts in assets. Specifically, the safeguard policy on Involuntary Resettlement (OP/BP 4.12) is not triggered because the Productivity and Innovation Fund under subcomponent 2.3 will exclude proposals that would require land acquisition that could entail physical or economic displacement. No civil works will be financed outside of existing research facilities therefore there will be no need for land acquisition. Similarly, the safeguard policy Indigenous Peoples (OP/BP 4.10) is not triggered because the project will operate in main urban areas where the IPs do not meet the requirements of the policy.

37. In accordance with OP/BP 4.01 on Environmental Assessment, an EMF was completed. The project was classified as category B, since its components were found to have relatively limited potential environmental impacts. The following environmental operational policy has been triggered: Environmental Assessment (OP/BP 4.01). Given that location and type of STI subprojects are still unknown, an EMF has been prepared by the Borrower, reviewed by the Bank and disclosed by September 21, 2016 in country and September 19, 2016 on the Bank's website. The EMF includes the legal and regulatory framework applicable to the project as well as institution arrangement to ensure compliance of national environmental regulations and World Bank environmental safeguards. Most project components are unlikely to have significant, if any, environmental effects. It is expected that most environmental effects, also limited, might be associated to installation and operation of some equipment in academic research centers. As stated in the EMF, beneficiary academic institutions receiving funding for purchasing of applied research equipment will have to prepare a matrix containing potential risks and impacts on the environmental, health and safety as well as corresponding mitigation measures.

38. As illustrated in Annex 7, the project supports the objective of mainstreaming gender practices by (a) monitoring project performance indicators by gender wherever feasible, (b) capturing data disaggregated by gender, whenever possible and available, (c) enforcing that every grant proposal be reviewed to avoid any negative potential gender bias, (d) including gender sensitivity training as part of capacity building activities supported under the project; and (e) placing preferences for gender informed proposals in competitively financed activities supported by the project.

**Monitoring & Evaluation**

39. M&E of outcomes and results during implementation will follow standard World Bank Group practice. Leveraging the expertise and infrastructure built through Component 1, Subcomponent 2.4, and Component 4, FONDECYT will monitor and evaluate progress against the project's indicators through regular reports. FONDECYT will report on the PDO and intermediate indicators as set out in annex 1 on a semi-annual basis. The data will come from the internal reporting systems of CONCYTEC and FONDECYT, which will also liaise with relevant stakeholders to gather indicator data. Discussions during supervision missions related to the status of implementation of project components will also provide effective means of monitoring progress. CONCYTEC and FONDECYT have experience in conducting M&E for projects, but additional technical expertise and capacity building will be provided to the FONDECYT as needed to support implementation.

## Annex 4: Implementation Support Plan

## PERU: Strengthening the Science, Technology and Innovation System in Peru (P156250)

### Strategy and Approach for Implementation Support

1. **The Implementation Support Plan articulates the Bank's approach to help Peru achieve the expected project results based on the project's nature and risk profile.** It identifies the inputs and actions required to facilitate better risk management, better results, and increased institutional development, while ensuring compliance with the legal agreements to meet the Bank's fiduciary obligations. Resources have been identified keeping in mind the need for (a) providing the necessary technical advice to the implementing agencies to build capacity; and (b) monitoring and evaluating results on the ground, focusing in particular on the IE.

2. **The project is expected to have a Task Team Leader (TTL) from the World Bank Group Trade and Competitiveness Global Practice, a co-TTL from the World Bank Group Education Practice, and a mix of local and international technical experts assigned to each of the components.** The team will be based in Washington, DC, and the Bank's country offices. The team will be supported by procurement, financial management, and safeguards team members. The team members will travel periodically to the country, with approximately 2–4 missions per year. The blend of staffing in headquarters, and country offices will ensure an appropriate balance between local and regional knowledge and responsiveness and global expertise.

### Implementation Support Plan

**Table 4.1. Implementation Support Plan (Annual)**

| Time | Focus | Skills Needed |
|---|---|---|
| First twelve months | Implementing the assessments and diagnostics needed, including the PER methodology. | TTL<br>Co-TTL<br>Innovation Specialist<br>Procurement Specialist<br>FM Specialist<br>Safeguard Specialist |
| 12–48 months | Implementing competitive funds and matching grants. | TTL<br>Co-TTL<br>Innovation Specialist<br>Procurement Specialist<br>FM Specialist<br>Safeguard Specialist |

**Table 4.2. Skills Mix Required**

| Skills Needed | Number of Staff Weeks | Number of Trips Per Year |
|---|---|---|
| Task Team Leader-DC | 12 | 3 |
| Co-TTL DC | 8 | 2 |
| Innovation Specialist-DC | 6 | 2 |
| Procurement Specialist- Bogota | 4 | 2 |
| FM Specialist- Lima | 2 | 0 |
| Safeguards Specialist-Lima | 5 (3 social and 2 environmental) | 0 |

## Annex 5: Economic Analysis

### PERU: Strengthening the Science, Technology and Innovation System in Peru (P156250)

### Rationale for Public Intervention

1. **Peru has emerged as one of the fastest growing countries in LAC.** However, in order to continue growing, the country needs to increase firm productivity and diversify its exports. This requires overcoming significant binding constraints such as the low capacity of Peru's STI system, a key factor for the envisioned goals.

2. **Government interventions in the area of STI are justified for several reasons, including the intrinsic nature of the innovation process and the market failures associated with innovating.** Two characteristics of innovation make it more difficult to finance:

(a) **Innovation produces an intangible asset.** Intangible assets do not typically constitute accepted collateral to obtain external funding. Much of the knowledge created in innovation processes is tacit rather than codified, and embedded in the human capital of firms' employees (who can leave) and in its organizational capital. Even when this knowledge is codified and registered, for instance, in the form of a patent, its value is hard to measure. In contrast to tangible assets such as machinery, which can easily be redeployed into other uses, the value of intangible assets is difficult to separate from the other assets in the firm. Intangible assets thus have limited salvage value in the event of a business liquidation (for example, how much is a brand or a patent worth on its own if the firm goes bankrupt?). Ongoing attempts to create more liquid intellectual property (IP) markets may ameliorate some of these problems.

(b) **The returns to innovation investment are highly uncertain.** The distribution of returns for an innovative project is unknown. Therefore, not only is innovation a risky activity, with failure being a common outcome, but its outcomes are also uncertain. In other words, it is not typically possible to quantify the probability of success and failure, and thus the expected return to that investment cannot be reliably estimated. This uncertainty creates significant problems for standard risk-adjustment methods used by funding providers. Specifically, two types of uncertainty are typically present: technological uncertainty and market uncertainty, although the proportion of each varies by industry sector. For instance, developing a new pharmaceutical often carries considerable technology risk, however the market is usually easy to define because the number of people with a particular medical condition and the system for purchasing drugs in each country can both be easily identified.

3. The deleterious effects of these two characteristics — the intangibility of innovation and the relatively low utility of traditional valuation and revenue models vis-à-vis IP-based businesses — on access to finance for innovative projects depend on a variety of factors:

(a) **The nature of the innovation activity and the innovator's industry sector.** Some types of innovation activity have an uncertain chance of success and/or require large

financial resources, while others involve little risk and require fewer resources. For instance, developing new drugs or clean energy technologies requires large investments and involves significant uncertainty. In contrast, creating a new mobile app involves low investment, limited downside risk, and a potentially large upside.

(b) **The stage of the innovation process.** Early stages of the innovation process are typically more difficult to finance, since both uncertainty and intangibility are high, while at the later stage much of the uncertainty may have been resolved and investments are focused on tangible assets. Knowledge creation and idea generation may be costly and uncertain (for example, the large R&D investment required to develop a new drug) or inexpensive and low-risk (for example, running a few brainstorming sessions and conducting some desk research to improve a service offering).

(c) **The size and age of the firm.** While some sources of funding are linked to specific undertakings, as in project-based finance, most of them are dependent on the recipient's ability to provide sufficient collateral, typically a firm's assets. The characteristics of the firm—including in particular its size and age—thus inevitably impact its ability to fund innovation. Small and young firms typically face high obstacles because their product/technology is generally immature, they lack hard assets for collateral, and the management team may be new and unproven.

4. In addition, there are important market failures that make innovation to happen, which are related to the difficulty of financing it. Markets generally provide less financing for innovation than would be socially desirable, providing a justification for Government intervention in this space. Specifically, there are several reasons why markets underinvest in innovation (even if, as discussed below, the severity of the market failure varies depending on the stage of the innovation process):

(a) **Asymmetric information.** Not only is there limited information about the likelihood of success of a particular innovation project, this information is also asymmetric. The entrepreneur (or firm) seeking financing has more accurate information both about the true prospects of an innovation project, as well as the resources and decisions that will be required to develop it. This leads to two classical sources of market failure:

(i) **Adverse selection.** If banks do not know the default risk of a particular borrower, they can only price a loan based on the average default risk. As a result, low-risk borrowers face higher interest rates than they would if there was perfect information, and they may thus choose not to seek a loan. This increases the risk of the remaining pool of borrowers, since those who are willing to pay high interest rates are usually also high-risk. Therefore, this pushes up the interest rate that the bank needs to charge to break even. In turn, this may discourage lower-risk borrowers from applying for funding, increasing the default risk in the remaining pool in a vicious circle.

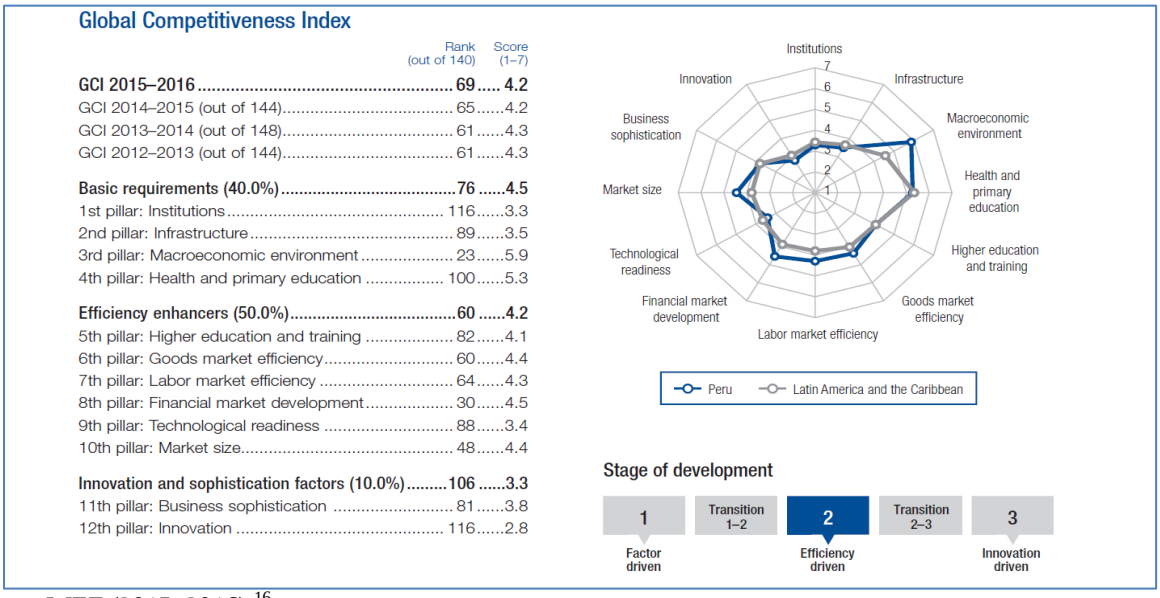
(ii) **Moral hazard.** Banks cannot perfectly monitor the activities of the inventor after the loan has been approved. As a result, an inventor may be tempted to undertake a riskier project than the one originally evaluated by the lender, since in case of success she gets of all the upside, while in case of failure the loss is capped. Moreover, if the firm is close to being in financial distress, the cost to the inventor of taking on additional risk becomes negligible, which can lead to her choosing recklessly risky projects. In other words, debt may induce firms to take on more risk than is optimal, although it may also have the opposite effect. Specifically, debt can have a disciplining effect in comparison to equity, since monthly payments and the possibility of losing control in case of bankruptcy can help focus an inventor's mind.

(b) **Positive externalities.** Innovation activities create spillover effects, or externalities, since inventors rarely can fully appropriate the returns their innovation activities generate. Inventors can use IP, secrecy, or first-mover advantage (among other strategies) to capture the returns from their innovation activities. However, this cannot prevent other firms from learning about an inventor's success and/or failures and replicating, fully or partially, some of her successes. As a result of these externalities, the social return on innovation investment is frequently higher than the private return, a state of affairs that suggests markets often invest less in innovation than would be socially optimal. This market failure is a common rationale for several innovation policy interventions, such as the ones proposed in this Project Appraisal Document.

(c) **Coordination failures.** Innovation activity occurs with ecosystems composed of individual actors and networks, as well as underlying infrastructure and institutions. Entrepreneurs come up with ideas, investors back them with their funding, a cycle that creates new firms that try to attract talent, suppliers, partners, and customers. If successful, they expand and eventually even go through an IPO or are acquired in a profitable trade sale. Most (if not all) parts of the ecosystem need to be in place for it to function well, and missing parts may not emerge in the absence of deliberate attempts to create them. The main rationale for public policies to promote innovation through a cluster-based approach including infrastructure and knowledge-based investments, networking activities and training, is an increase in knowledge spillovers among actors in clusters and thus the generation of a collective pool of knowledge that results in higher productivity, more innovation and an increase in the competitiveness of firms.

5. In the particular case of Peru, evidence of the existence of market failures and underinvestment in innovation are reflected in the position that Peru has on the competitiveness global landscape. According to the WEF, Peru is 69th in the global competitiveness ranking out of 140 countries in 2015–2016. As can be observed in figure 5.1 Peru is very low in the ranking in terms of innovation, technological readiness, business sophistication, and higher education and training, with values below the average of the LAC region.

**Figure 5.1. Peru in the Global Competitiveness Landscape**




*Source:* WEF (2015–2016).[16]

## Rationale for the Use of World Bank Resources and World Bank Value

6. As a long-term strategic partner in Peru's national innovation system development, the World Bank is well positioned to complement and advance these initial efforts by the Government. The Government has sought World Bank involvement for three main reasons: (a) the ability of the Bank to mobilize and bring international best practices and global knowledge and expertise to bear on the strengthening of the national innovation system; (b) the need for long-term, strategic, and stable financing to implement a range of integrated programs that will help to achieve long-term and sustainable economic growth; and (c) the capacity of the World Bank to financially leverage Government efforts to support innovation and, therefore, productivity growth and export diversification.

7. The value added by the World Bank is both financial and technical. On the financial side, budgetary constraints have been identified as a relevant impediment to the development of R&I in Peru, in light of the forecasted growth slowdown due to a less favorable external environment. In addition to filling in the financing needs, the proposed project would also provide needed technical and implementation support, drawing from the Bank's recent Economic and Sector Work "Peru. Building on Success: Boosting Productivity for Faster Growth" Flagship Report for the 2015 Annual Meetings of the World Bank Group, and from World Bank Group's experience in similar projects.

8. The proposed project is a core element of the latest CPS (FY2012–2016) and contributes to the CPS goal of "Sustainable Growth and Productivity", specifically results area 3.1: "Promoting productivity through enhanced labor skills and SME's competitiveness" by supporting the Government's capacity to generate productive innovation, strengthen human capital formation and foster collaboration with the private sector.

[16] http://reports.weforum.org/global-competitiveness-report-2015-2016/economies/#economy=PER.

## Cost-Benefit Analysis

### *Costs of the Project at Market Prices*

9. This section presents the analysis of the costs and benefits of the project for each of the three components. The information about costs has been provided by CONCYTEC and FONDECYT.[17]

(a) **Costs of Component 1.** Table 5.1 shows the costs associated with Component 1, which aims to improve the institutional and governance framework of the national innovation system. The estimated costs is the result of two activities: (a) improving the institutional framework and governance of STI system (US$1,250,000) and (b) strengthening of the managerial capabilities of CONCYTEC (US$9,321,581). The estimated total cost associated to this component is US$10,571,581, which has been calculated assuming an exchange rate of 3.3 sol per U.S. dollar.

**Table 5.1. Estimated Costs for Component 1, US$**

| | |
|---|---|
| **1.1 Improvement of institutional and organizational STI framework** | **1,250,000** |
| 1.1.1 Implementation of improvements done to the institutional and organizational framework of SINACYT | 450,000 |
| • System diagnosis I+D+i | 150,000 |
| • Diagnosis and proposal of the New Law of the SINACYT | 150,000 |
| • Diagnosis and New STI National Strategic Plan | 150,000 |
| 1.1.2 Design of Public Expenditure Planning System (PER) | 800,000 |
| • 3 documents on STI public expenditure analysis (Functionality, Effectiveness and Efficacy) | 400,000 |
| • Design of the public expenditure follow-up and analysis system in STI | 400,000 |
| **1.2 Strengthening of CONCYTEC capacity management** | **9,321,581** |
| 1.2.1 Knowledge Management System Baseline | 1,200,000 |
| • Public expenditure tracking baseline | 300,000 |
| • I+D+i surveillance baseline | 300,000 |
| • Regional baselines (more general than only the monitoring, assessment and | 600,000 |
| • expenditure programs; it includes infrastructure) | 300,000 |
| 1.2.2 Implementation of Knowledge Management System | 6,921,581 |
| • Application development to track public expenditure in STI | 500,000 |
| • Application development to monitor and assess (includes surveillance) | 500,000 |
| • Training in the use of the application of public expenditure tracking in STI (Sectors, GRs, GLs, only for operations) | 400,000 |
| • Enlargement of Access to scientific literature | 3,521,581 |
| • Mounting and infrastructure of CONCYTEC Knowledge Management System | 2,000,000 |
| 1.2.3 Strengthening of SINACYT capabilities | 1,200,000 |
| • Training on the analysis methodology of public expenditure (PER) | 300,000 |
| • Training on monitoring and assessment | 300,00 |
| • STI management courses and training | 600,000 |

[17] A complete economic analysis of the project is included in the feasibility study approved by SNIP: "*Proyecto: Mejoramiento y ampliación de los servicios del Sistema Nacional de Ciencia, Tecnología e Innovación Tecnológica", Estudio de Preinversión a nivel de Factibilidad. Código SNIP: 317848. Año 2016*, and it is summarized in this Annex.

(b) **Costs of Component 2**

(i) Table 5.2 presents the costs associated with Subcomponent 2.1, which aims to finance the planning and capacity building for the strategic programs on productive innovation. The total estimated cost is $415,860. The largest costs are projected for the activity related to selecting, recruiting, and financing international trips to international professors ($195,840).

**Table 5.2. Estimated Costs for Subcomponent 2.1, US$**

| **2.1. Identification of opportunities of technological innovation, through the relationship between academy and industry** | **415,860** |
|---|---|
| International experts: Selection, recruiting and international trips of international Professors (2 per week) | 195,840 |
| Local experts: selection, recruiting and organization of the activities of local professors | 24,000 |
| Teaching materials | 7,020 |
| Logistic support for the training course (6 weeks) and transport for professors and trainees | 189,000 |

(ii) Table 5.3 presents the costs associated with subcomponent 2.2, which is geared to promote the collaboration between the scientific community and the private sector. The total estimated cost is US$3,085,650.

**Table 5.3. Estimated Costs for Subcomponent 2.2, US$**

| **2.2 CRI for PI Pilots between Academy and Industry** | **3,085,650** |
|---|---|
| Selection of management teams: recruiting process of local teams | 56,250 |
| CRI Pilots management teams | 877,500 |
| Tutoring: a local consultant for every two initiatives (110 Days) and one senior project coordinator (International Consultant) (220 days) | 936,000 |
| Reference trips: a tutor travelling with the team for internal training and follow-up trips | 49,500 |
| Consultancy service for policy reform: legal local specialist for input Consultancy on the linking initiatives between academy and industry- through policy reforms (30 days) | 60,000 |
| Specialized technical and industry consultancies | 278,400 |
| Trips for organizing, companionship and logistics, including all the travel, transport and lodging costs | 648,000 |
| Operating costs including field operations | 180,000 |

(iii) Table 5.4 presents the costs associated with the creation of the Productivity and Innovation Fund for technology transfer and upgrading. 93 percent of the costs is related to the creation of the Productivity and Innovation Fund, while the rest will be allocated to management and functioning of the Productivity and Innovation Fund.

**Table 5.4. Estimated Costs for Subcomponent 2.3, US$**

| **2.3. Implementing the Innovation and Productivity Fund** | **7,488,000** |
|---|---|
| Innovation and Productivity Fund | 7,000,000 |
| Innovation and Productivity Fund: costs of fund management and strengthening of local capacities to manage it | 244,000 |
| Competitive Calls | 101,538 |
| Selection process (payment to foreign evaluators) | 116,308 |
| Follow-up expenses | 26,154 |

(c) **Costs of Component 3.** Table 5.5 presents the costs associated with Component 3, which aims to improve R&I capacity through: (a) the strengthening of human capital for STI, (b) the improvement of research equipment, and (c) the allocation of funds to support basic and applied research and technological development in areas related to Component 2. The total cost is US$73,564,318, of which 58 percent corresponds to activity (a), 14.8 percent corresponds to activity (b) and the rest to activity (c).

**Table 5.5. Estimated Costs for Component 3, US$**

| Component 3 - Research and Innovation Capacity | Total Costs | IBRD Financing |
|---|---|---|
| 1.1. Strengthening Human Capital for STI | 43,016,388 | 14,839,852 |
| 1.2. Improving Research Equipment | 11,031,541 | 7,463,340 |
| 1.3. Strategic Research Funds | 19,516,389 | 9,523,946 |
| **Total** | **73,564,318** | **31,827,138** |

(d) **Costs of Component 4.** Table 5.6 presents the costs of managing, monitoring and evaluating the project. The total costs is US$4,237,090.91. The largest proportion of the cost is associated with the technical staff, 43 percent, and travel and communication, which account for 29.4 percent of the total costs.

**Table 5.6. Estimated Costs of Component 4, US$**

| | |
|---|---|
| **1. Technical Team** | **1,825,455** |
| *Project Coordination* | *298,182* |
| • General Project Coordinator | - |
| • Joint Coordinator | 210,909 |
| • Administrative Assistant | 87,273 |
| *Management Area* | *567,273* |
| • Administrator, | - |
| • Accountant | - |
| • Accounting Specialist, | 145,455 |
| • Treasury Specialist, | - |
| • Procurement Specialist, | 160,000 |
| • Procurement Analyst 1 | 130,909 |
| • Procurement Analyst 2 | 130,909 |
| • Patrimony Analyst, | - |
| • Budget Analyst; | - |
| *Counseling Area* | *436,364* |
| • Planning, Budget and Monitoring Specialist | 174,545 |
| • Legal Specialist | 130,909 |
| • Communications Specialist, | 130,909 |
| *Technical Area, Thematic Specialist* | - |
| • Development Specialist | - |
| • Evaluation and Selection Specialist | - |
| • Specialist in Monitoring and Follow up | - |
| *Institutional Technical Support Area* | *523,636* |
| • Development Analyst | 130,909 |
| • Evaluation and Selection Analyst | 130,909 |
| • Monitoring and Follow-up Analyst 1 | 130,909 |
| • Monitoring and Follow-up Analyst 2 | 130,909 |
| **2. Evaluations and Audits** | **466,667** |
| • M&E System | 45,455 |

| | |
|---|---|
| • Project baseline | 106,061 |
| • Mid-term evaluation of the project | 30,303 |
| • Evaluation of project's outputs | 212,121 |
| • Audits | 72,727 |
| **3. Communication and Trips** | **1,248,485** |
| • Project's launching events, annual result presentation, and so on | 151,515 |
| • Tickets for M&E Analyst and travel allowances of the technical team | 36,364 |
| • Publication | 60,606 |
| • Dissemination activities | 1,000,000 |
| **4. Equipment and Services** | **696,485** |
| • Administrative system and document management | 154,545 |
| • Materials | 98,909 |
| • Infrastructure updating | 185,455 |
| • Equipment and licenses | 133,939 |
| • Services | 123,636 |

10. To summarize, the expected total cost of the project at factor prices is US$100,000,000. Table 5.7 presents a summary per component and aggregate category. Most of the costs are related to Component 3, which represents 73 percent of the total costs of the project. The most important category is associated with the increase in human capital for STI, which accounts for 42.9 percent approximately of the total projected costs (table 5.7).

**Table 5.7. Summary of Estimated Costs Per Component and Main Activity, US$**

| | |
|---|---|
| Component 1 | 10,571,581 |
| Component 2 | 11,514,510 |
| Component 3 | 73,564,318 |
| Component of Project Management | 4,237,091 |
| **Total cost of the project** | **100,000,000** |

*Social Costs of the Project*

11. The social costs of the project have been calculated according to the evaluation parameters of *Sistema Nacional de Inversión Pública* (National Public Investment System, SNIP), which are provided in annex 10 of the Feasibility Study of the Project approved by SNIP.[18] Given that the services that will be provided under this project fall in the category of non-tradable, their price is determined by the domestic demand and supply. Thus, the social price associated to the services is the market price net of taxes (for example, general sales tax, which has a rate of 18 percent).

**Table 5.8. Social Costs of the Project**

| **Component 1** | **Social Prices** |
|---|---|
| 1.1 Improvement of SINACYT institutional and organizational framework | 3,495,763 |
| 1.1.1 Implementation of SINACYT Institutional and Organizational Framework | 1,258,475 |
| 1.1.2 Design of Public Expenditure Planning System (PER) | 2,237,288 |

[18] A complete economic analysis of the Project is included in the feasibility study approved by SNIP: "*Proyecto: Mejoramiento y ampliación de los servicios del Sistema Nacional de Ciencia, Tecnología e Innovación Tecnológica", Estudio de Preinversión a nivel de Factibilidad*." Código SNIP: 317848. Año 2016, and it is summarized in this Annex.

| | |
|---|---|
| 1.2 Strengthening of CONCYTEC management capacities | 26,068,828 |
| 1.2.1 Knowledge Management System Baseline | 3,355,932 |
| 1.2.2 Implementation of Knowledge Management System | 19,356,964 |
| 1.2.3 Strengthening of SINACYT Capacities | 3,355,932 |
| **Component 2** | **Social Prices** |
| 2.1. Identification of technological innovation opportunities by linking Academy and industry | 1,124,660 |
| 2.2 Formulation of linking initiatives between academy and industry | 8,629,360 |
| 2.3. Implementation of initiatives to link academy and industry | 20,941,017 |
| 2.4. Evaluation and follow-up of initiatives to link academy and industry | 1,468,220 |
| **Component 3** | **Social Prices** |
| 3.1. Increase human capital availability for I+D+i | 119,957,627 |
| 3.1.1. Strategic and Priority Areas | 95,447,458 |
| 3.1.2. General Areas | 24,510,169 |
| 3.2. Modernize and strengthen investigation infrastructure in universities and Investigation centers | 30,508,474 |
| 3.2.1. Strategic and Priority Areas | 25,423,729 |
| 3.2.2. General Areas | 5,084,746 |
| 3.3. Production of I+D+i quality projects | 54,237,288 |
| 3.3.1 Strategic and Priority Areas | 37,288,136 |
| 3.3.2 General Areas | 16,949,153 |
| 3.4. Call | 1,042,373 |
| 3.5. Beneficiary Selection | 299,576 |
| **Project Management** | **Social Prices** |
| 1. Technical team | 6,024,000 |
| Project Coordination | 984,000 |
| Administration Area | 1,872,000 |
| Counseling Area | 1,440,000 |
| Technical Area, Thematic Specialists | - |
| Institutional Technical Support Area | 1,728,000 |
| 2. Evaluations and audits | 1,305,085 |
| 3. Communication and trips | 3,491,525 |
| 4. Equipment and Services | 1,947,797 |

*Private and Social Benefits of the Project*

12. The potential private and social benefits associated with this project can be large. Innovation is at the center of the development process. It is the engine of the "creative destruction" process needed to spur economic dynamism and transformation (Schumpeter, 1942).[19] Innovation increases employment more than contracting it with technological change (Harrison et al., 2008).[20] It is an important prerequisite for successful participation and upgrading of SMEs in GVCs, and a key driver of productivity growth at the firm level.

13. Further, innovation can contribute to poverty reduction, as it can generate large productivity gains. Evidence shows that not all transitions from poverty require a change in the type of work undertaken, but an increase in workers' wages, which can be obtained through efficiency improvements gained through innovation. Innovation can also contribute to shared prosperity. By fostering productivity and employment growth, innovation can directly increase

[19] Schumpeter, J. (1942). "*Capitalism, Socialism, and Democracy*. Harper and Row (reprinted 1980), New York.
[20] Harrison, R., J. Jaumandreu, J. Mairesse, and B. Peters. 2008. "Does Innovation Stimulate Employment? A Firm-Level Analysis Using Comparable Micro-Data from Four European Countries." NBER Working Paper No. W14216. Cambridge, Mass: National Bureau for Economic Research.

the income of the bottom 40 percent of a nation's population. Innovation can increase the purchasing power and well-being of the bottom 40 percent if process innovation reduces the price of products that represent a disproportionate share of the consumption basket of low-income households and if product innovation (for example, quality upgrading) allow these households to have access to better products at the same price.

14. **The following sections describe the quantitative private and social benefits associated with Components 2 and 3**, as there are no reliable quantitative data available to quantify the benefits associated with components 1 and 4. However, the lack of quantifiable information to properly assess ex-ante the quantitative social benefits linked to Components 1 and 4 does not imply that the benefits from these components are negligible. In this respect, there is consensus in the literature[21] that conducting a PER on innovation, such as the one envisaged under Component 1, can deliver non-minor benefits in terms of (a) proposing ways to reduce program costs, which leads to save public money, (b) inducing a more efficient allocation of resources across programs, and (c) identifying programs that are not effective so they can stop crowding out resources for alternative more productive initiatives. Further, the IE implemented as part of the PER will help identify better ways to design future programs to make them more effective. It is also an effective tool to make the Government accountable for the use of public resources, as it presents evidence of whether the intervention has crowded-out private investments, by subsidizing activities that firms were planning to undertake anyway, or lead to pure private gains rather than generating the spillovers and social gains that were expected from the program.

(a) **Private and Social Benefits of Component 2**

(i) **Component 2 - Competitiveness Reinforcement Initiatives for Productive Innovation**

- The estimation of the benefits associated to this subcomponent is based on the methodology proposed by Mansfield et al. (1977)[22] that takes into consideration both private and social benefits of innovating.

- Under this framework, private benefits account for the additional gains obtained in terms of sales by the innovating firm, as well as the additional fiscal revenues the state can collect associated to those gains; while social benefits are related to the additional consumer surplus obtained by the reduction in product prices and/or the increment in the quality of existing goods, which are sold at constant prices.

- Table 5.9 shows that the private net annual value related to this subcomponent is US$1,195,127 (3,943,920 soles) under standard assumptions like the likelihood of being successful when innovating, the cost of the investment, sales gains, and the rate of return for the innovator.

[21] See Correa, P. 2014. "*Public Expenditure Reviews in Science, Technology, and Innovation*." World Bank.
[22] E. Mansfield, J. Rapoport, A. Romeo, S. Wagner, and G. Beardsley. 1977. "Social and Private Rates of Return from Industrial Innovations," *Quarterly Journal of Economics*, 91(5).

Table 5.9 shows that the social benefit linked to this subcomponent is US$3,584,136 (11,827,649 soles).

**Table 5.9. Private Benefits of Subcomponent 2**

| Private benefits (0–10) | |
|---|---|
| Success probability | 50% |
| Investment Costs | 19,150,631 |
| (I+D+i)/(Sales) | 0.10 |
| Innovator's profitability rate | 10% |
| Sales General Tax (SGT) | 18% |
| Discount rate | 9% |
| Net sales revenue for innovative product | 95,753,153 |
| State collection | 17,235,568 |
| Sales present value (PV) | 435,335,056 |
| State PV collection (SGT) | 78,360,310 |
| PV private benefits of technological innovative projects | 35,697,475 |
| Private NPV of technological innovative projects | 3,943,920 |

**Table 5.10. Social Benefits of Subcomponent 2**

| Social benefits (0–10) | |
|---|---|
| Constant elasticity | 1 |
| Price reduction for innovation | 10% |
| Discount rate | 9% |
| P*Q = Sales | 81,146,740 |
| Consumer's surplus | 8,520,408 |
| PV of the consumer's surplus | 38,737,441 |
| PV social benefits of technological innovative projects | 38,737,441 |
| Social NPV of technological innovative projects | 11,827,649 |

(b) **Private and Social Benefits of Component 3 - Research and Innovation Capacity**

(i) **Subcomponent 3.1**

- The private benefits associated with Component 3.1 are calculated using the same methodology for innovation projects, which means a probability of being successful of 20 percent and a 10 percent rate of return. The social benefits are calculated based on the expected increase in consumers' surplus due to a reduction in the price of new products. The NPV of private benefits is -18,676,319 soles (-$5,659,490), while the NPV of social benefits is 50,553,644 soles ($15,319,286).

**Table 5.11. Private Benefits of Subcomponent 3.1**

| Private B (0–10) | |
|---|---|
| Success probabilities | 20% |
| Investment cost | 99,724,000 |
| (I+D+i)/(Sales) | 0.1 |
| Innovator's profitability rate | 10% |
| General Sales Tax (GST) | 18% |
| Discount rate | 9% |

| | |
|---|---|
| Net sales revenues for innovative product | 199,448,000 |
| State collection (GST) | 35,900,640 |
| Sales Present Value (PV) | 988,386,355 |
| State PV Collection (GST) | 177,909,544 |
| PV private benefits of the integral projects of technological investigation | 81,047,681 |
| Private NPV of integral projects of technological investigation | -18,676,319 |

**Table 5.12. Social Benefits of Subcomponent 3.1**

| Social Benefits (0–10) | |
|---|---|
| Constant elasticity | 1 |
| Price reduction for innovation | 15% |
| Discount rate | 9% |
| P*Q = Sales | 169,023,729 |
| Consumer's surplus | 27,255,076 |
| VA of consumer's surplus | 135,065,508 |
| VA of social benefits of integral projects of technological investigation | 135,065,508 |
| NPV of integral projects of technological investigation | 50,553,644 |

### (ii) **Subcomponent 3.2**

- Private and social benefits associated with Subcomponent 3.2 are based on 10,000 simulations conducted about the potential contribution to the total benefits coming from each category (for example, researchers, equipment, and workforce for innovation projects). The NPV of private benefits is -9,111,372 soles, (−US$2,761,021) while the NPV of social benefits is 3,451,751 soles (US$1,045,985).

**Table 5.13. Private Benefits of Subcomponent 3.2**

| Private Benefits (0–10) | Investment Costs | Contribution of Production Factor (%) | Private NPV of Nonintegrated Projects |
|---|---|---|---|
| Total of nonintegrated projects | 111,060,767 | 100 | -9,111,372 |
| Investigators | 66,097,233 | 60 | -7,427,217 |
| Equipment | 10,918,273 | 20 | -408,955 |
| Funds for I+D+i | 34,045,261 | 20 | -1,275,200 |

**Table 5.14. Social Benefits of Subcomponent 3.2**

| Social Benefits (0–10) | Investment Costs | Contribution of Production Factor (%) | Social NPV of Nonintegrated Projects |
|---|---|---|---|
| Total of nonintegrated projects | 94,119,294 | 100 | 24,662,947 |
| Investigators | 56,014,605 | 60 | 20,104,224 |
| Equipment | 9,252,774 | 20 | 1,106,972 |
| Funds for I+D+i | 28,851,916 | 20 | 3,451,751 |

### (iii) **Subcomponent 3.3**

- The benefits derived from investment in human capital formation are reflected in the increased productivity that researchers acquire after their doctoral studies. Thus, benefits are defined as the expected productivity

change or salary variation after completing their graduate education. Then, assuming a job horizon of 25 years, a discount rate of 9 percent, an opportunity cost of studying during 3 years of US$8,100,143 (26,730,472 soles), and an investment costs of US$2,652,203 (8,752,273 soles), the NPV associated to this subcomponent is US$1,383,386 (4,565,177 soles).

**Table 5.15. Private Benefits of Subcomponent 3.3**

| | |
|---|---|
| Increase in ratio | 100% |
| Bachelor degree's holder annual estimated salary | 132,000 |
| PhD's holder annual estimated salary | 198,000 |
| Estimated annual increase of an intern | 66,000 |
| Number of interns | 80 |
| Number of periods | 25 |
| Discount rate | 9% |
| PV of the Increased Benefits in the availability of Human Capital for I+D+i | 40,047,922 |
| Investment Cost | 8,752,273 |
| Opportunity Cost (of 3 years) | 26,730,472 |
| NPV of the Increased Benefits in the Availability Of Human Capital for I+D+i | 4,565,177 |

## Economic Evaluation of the Project and Sensitivity Analysis

15. The economic evaluation of the project indicates that the development impact benefits of the project are expected to exceed project costs. Overall, the project NPV is estimated at US$21,332,793 at a 9 percent social discount rate. Taking into consideration all the components, except Component 1, the internal rate of return of the project is 11.33 percent. This rate has been calculated through cash-flow simulations under the assumptions used to calculate project benefits and costs for each component.

16. The sensitivity analysis conducted as part of the feasibility study of the project approved by MEF shows that the project has a positive social NPV under all of the 200 alternative scenarios explored, except when the assumption about the probability of success of research project is equal or below 15 percent or when the efficiency gains obtained through the "price reduction after completion of innovation/research projects" is equal or lower than 10 percent. The full sensitivity analysis performed as part of the feasibility study for MEF (DGIP-SNIP) is included in the Project Appraisal Document package.[23]

## Fiscal Sustainability

17. The last Article IV for Peru, which was conducted by the International Monetary Fund (IMF) in May 2015, shows that Peru remains one of the best performing economies in Latin America, with solid macroeconomic policies and fundamentals. The strong policy framework and solid fundamentals allowed the authorities to loosen the macroeconomic policy stance in

[23] The full sensitivity analysis of the Project is available in the feasibility study approved by SNIP: "Proyecto: Mejoramiento y ampliación de los servicios del Sistema Nacional de Ciencia, Tecnología e Innovación Tecnológica", Estudio de Preinversión a nivel de Factibilidad. Código SNIP: 317848. Año 2016.

order to speed the economic recovery and neutralize the effects of external shocks such as the decrease in commodity prices coupled with a slowdown of the external demand.

18. The authorities embarked on a series of fiscal and structural packages, including tax cuts, increases in fiscal spending, and structural measures to support investment, consumption, and growth. IMF Directors agreed "that the 2015 fiscal stimulus was timely, and concurred that the immediate priority is executing the existing package with a focus on boosting investment, rather than developing new measures". They encouraged the authorities to implement a careful expenditure management and revenue mobilization to return to the original fiscal path by 2018. The primary fiscal deficit projected for 2015 and 2016 is negative, -0.9 percent and -0.6 percent of the GDP, respectively, according to IMF projections.

19. There are at least three important reasons to believe that the current project will not have a significant negative impact on Peru's fiscal sustainability. The first is that the total cost of the project for the Government, which is estimated at US$54.569 million, represents only 0.02 percent of the GDP for 2015. The second is that all the activities that this project will finance are geared to increase productivity and foster growth. This will enlarge the tax base and contribute to expand fiscal revenues. The third is that this project will finance a PER in the area of STI to improve the allocation of public funds and foster their efficient use.

## Annex 6: Impact Evaluation to Recalibrate the CRI for PI Pilots (Subcomponent 2.4)

## PERU: Strengthening the Science, Technology and Innovation System in Peru (P156250)

### Objective of Subcomponent 2.4

1. **The objective of this subcomponent is to establish a continuous learning and feedback mechanism to monitor and evaluate project performance, measure impact of the proposed interventions, and distill the lessons learned from the implementation of the CRI for PI pilots and of the Productivity and Innovation Fund.** Among the main objectives of this subcomponent is to conduct an impact evaluation of the cluster intervention with the purpose of measuring the additionality of the services provided under this project.

### Why an IE of Cluster Interventions?

2. **Cluster interventions to spur innovation have become a common policy instrument, used in developed and developing countries, to increase productivity, create more and better jobs, and foster sustainable economic growth.** Despite all the resources spent on this type of programs, there is currently very little credible evidence as to whether or not they spur firms to undertake productivity-enhancing activities that they otherwise would not have done-creating, therefore, additionality-or merely subsidize firms for actions they would have taken anyway, without any justification for Government intervention.

3. **As a result, rigorous IEs of cluster programs are very important for evidence-based policymaking.** First, an IE will help identify better ways to design future programs to make them more effective. Second, they are an effective tool to make Governments accountable for the use of public resources, as they present evidence of whether the intervention has crowded-out private investments, by subsidizing activities that firms were planning to undertake anyway, or lead to pure private gains rather than generating the spillovers and social gains that were expected from the program and originally justified public support.

### Details of the Cluster Intervention Subject to the IE

4. The World Bank team envisions to conduct the IE on the "Type 2 matching grant component" associated with project Subcomponent 2.3, which aims to support firms and research institutions participating in the CRI for PI pilots for the provision of shared goods and services that require economies of scale in delivery, such as research labs and equipment, human resources to operate such equipment, prototyping and testing labs, or TA such as cluster-level quality certification programs, marketing and commercialization expenditures, or skills trainings, among others.

5. The TUPs approved by CONCYTEC under Subcomponent 2.2 are the basis for determining which shared goods and services will be provided for each CRI for PI pilot. CONCYTEC will manage a competitive bidding process according to World Bank procurement rules to select the Service Providers to provide the relevant shared goods and services to beneficiaries. In most cases, procurement methods for Type 2 Matching Grants will be open to international competition. Beneficiaries include firms and research institutions participating in the CRI for PI pilots, which will receive co-financing for the shared goods and services delivered

by the Service Providers and will provide a matching contribution between 50 percent and 10 percent depending on the number of employees and annual turnover. The provision of shared goods and services will be also open to any firm and research institution in Peru at full market price.

6. **The team seeks to empirically explore the following policy questions:**

(a) **Effectiveness.** Is the matching grant scheme effectively reaching its development outcomes in terms of promoting private R&D expenditures, innovation, and ultimately new jobs? What is the additionality of the intervention?

(b) **Heterogeneous effects.** Are there heterogeneous effects across different types of beneficiaries?

(c) **Short- versus long-run effects.** How long does it take to observe the project's effects? Do project effects vary in the short-run versus the long-run?

(d) **Dosage effects.** Do project effects depend on the intensity of the treatment?

(e) **Multiple treatments.** Are the effects different if combined with other type of support?

(f) **Externalities.** Does the program produce any positive or negative externality?

**Methodology**

7. **The main question that an IE aims to answer is whether the cluster program delivered the expected results.** Given that cluster programs typically have two main objectives-solving coordination problems and implementing coordinated private and public investments to maximize results at the aggregate level—an IE should address both objectives. Exploring the first objective requires capturing the creation and/or strength of linkages between key cluster actors, using network analysis. Evaluating the second objective requires to measure performance variables at the firm level, for those who have benefited either directly or indirectly from the program.

8. **The main challenge of an IE is to determine "what would have happened (in terms of firms' development outcomes such as sales, profits, productivity, jobs, innovation, technology adoption, and so on) to the beneficiaries of the cluster program if the program had not existed."** A beneficiary's outcome in the absence of the intervention would be its counterfactual, which implies the need of having a credible group to measure it. A program or policy intervention seeks to alter changes in the well-being of intended beneficiaries. *Ex post*, one observes outcomes of this intervention on intended beneficiaries, such as expenditure on R&D, innovation, sales, and employment. Does this change relate directly to the intervention? Has this intervention caused R&D expenditure, innovation, or employment to grow? Not necessarily. In fact, with only a point observation after treatment, it is impossible to reach a

conclusion about the impact. At best one can say whether the objective of the intervention was met. But the result after the intervention cannot be attributed to the program itself.[24]

9. **The problem of evaluation is that while the program's impact (independent of other factors) can truly be assessed only by comparing actual and counterfactual outcomes, the counterfactual is not observed.** So the challenge of an impact assessment is to create a convincing and reasonable comparison group for beneficiaries in light of this missing data. Ideally, one would like to compare how the same household or individual would have fared with and without an intervention or "treatment." But one cannot do so because at a given point in time an entrepreneur or researcher cannot have two simultaneous existences—an entrepreneur or researcher cannot be in the treated and the control groups at the same time. Finding an appropriate counterfactual constitutes the main challenge of an IE.

10. **Randomized Control Trials (RCTs) are the gold standard rule for an IE, as they allow the statistician to control for endogeneity due to self-selection into the treatment.** Thus, randomized experiments do not suffer from selection bias and offer the potential to provide more credible estimates of the impacts of cluster programs.

11. **For cluster programs, theoretically, randomization would have to be performed at two different levels (double randomization): (a) to select the geographic location where the cluster program would be applied and (b) to select the firms in the selected locations that would receive the policy benefits.** Once the program has been randomly assigned, two comparisons can be done to evaluate the effect of the program. The first comparison provides the direct impact of the program, by comparing direct beneficiaries vis-à-vis its control group. The second comparison focuses on program effects on indirect beneficiaries, as the results of the knowledge spillovers that happen at the cluster level, vis-à-vis its control group. When policymakers cannot control who participates in the program and who does not, a useful alternative to the RCT is randomized promotion or encouraged design, where the program is randomly promoted.[25]

**Challenges**

12. A review of the attempts to conduct RCTs for programs for start-ups and SMEs shows that the causes for the inability to complete randomized experiments are quite simple:

(a) Government unwillingness to randomly select beneficiaries of the program (Challenge 1).

(b) Low take-up as the application rates to the program often are low and there is not enough statistical power to measure impact (Challenge 2).

[24] See "Handbook on Impact Evaluation: Quantitative Methods and Practice" by Shahidur R. Khandker, Gayatri B. Koolwal, and Hussain A. (2009). The World Bank Group.
https://openknowledge.worldbank.org/bitstream/handle/10986/2693/520990PUB0EPI1101Official0Use0Only1.pdf?sequence=1

[25] Maffioli, A., Pietrobelli, C., and R. Stucchi. (2016). "The Impact Evaluation of Cluster Development Programs: Methods and Practice.". IDB. Bibliographic references # 978-1-59782-254-1

(c) Implementation delays that do not allow the statistician to collect data on time and finally evaluate the program (Challenge 3).

13. In the particular case of Subcomponent 2.4, these are the potential challenges the World Bank team has identified to evaluate the program:

(a) **Challenge 1. Endorsing randomization as a selection mechanism.** The first challenge is to convince the Government of Peru that randomization is the most appropriate selection mechanism to measure program impact. This means to change frequently used selection mechanisms for public programs, such as those based on ex-ante evaluation of candidates' performance, in favor of randomization after a screening phase aimed to verify eligibility.

(b) **Challenge 2. Low take-up to measure impact.** The second challenge is to guarantee enough take-up for the program, as this is required to have enough statistical power to measure impact. In order to determine the sample size or number of beneficiaries needed to measure impact through a RCT, the Project team will clarify the following issues with the Client and have access to the following baseline data.

(i) **Outcome variable.** There has to be a clear understanding about the variable of interest to evaluate impact. This should be strictly related to the "market failure" that the cluster program wants to address and the expected outputs and outcomes coming from overcoming the identified market failures. Although Subcomponent 2.1 will provide more insights about the challenges Peru faces to strength its clusters, preliminary evidence shows that the observed underinvestment in R&D and innovation activities is a byproduct of the lack of collaboration between the scientific community and the private sector due to coordination failures and informational asymmetries that creates a lot of difficulties for start-ups and small and medium-sized firms to get access to external sources of funding.

- Matching grants allow the innovator, either the entrepreneur or researcher, to share the risks embedded in an innovation project. In case of failure, innovators only lose the own matching contribution or do not repay the grant in case that was a requirement). They can also help firms speed up the commercialization process, making it more likely that the business will beat competitors to market.

- Matching grants can also be an effective instrument for stimulating collaboration between research institutions and the private sector. Collaboration among firms and between firms and universities is crucial to foster innovation, avoid duplication of innovation efforts, and stimulate knowledge spillovers. Matching grants can help to overcome barriers that hamper collaboration. For example, companies may have insufficient information about the capabilities of research institutions or universities. They often assume that academic organizations do not understand their

needs, and that their services are expensive, of low quality, and not always delivered on time. To address these barriers, grants may be awarded only to scientific consortia that include participation of research institutions or universities and the private sector, or be contingent on businesses employing and embedding graduates or researchers within their businesses. Collaborative grants can also focus on collaboration between large companies and SMEs, or between local and multinational companies.

- **Previous evaluations explore the impact of innovation matching programs on four dimensions, which are precisely the dimensions that are also the ones the team will explore in this project.** R&D input additionality, behavioral additionality, increases in innovative output, and improvements in performance.[26] These evaluations do not find crowding out effects on private R&D investment. Indeed, in three cases, the Technology Development Funds have multiplier effects. The results suggest that in most of the cases, low cost credit for R&D projects have a clearer positive effect than matching grants. Data available for Chile and Panama show that there is behavioral additionality in the sense that the programs positively affect a firm's willingness or capability of interacting with external sources of knowledge and financing. In Chile and Argentina, beneficiaries used the programs as a signaling mechanism to obtain funds from the private sector. In most of the cases (Brazil is an exception) the programs were not very effective in terms of innovative outputs such as patents and new product sales, probably due to the existence of time lags between program participation and changes in innovative outputs. The programs have positive effects on firms' growth but not on firms' productivity.

(ii) **Baseline data.** Estimations of sample size to make a program evaluable requires to have ex-ante information about the "mean" and "standard deviation" of the outcome variable. Therefore, the first task of the project team will be to identify the availability of this information for existing beneficiaries and it will validate the possibility of matching beneficiaries' data with other national databases such us customs and tax databases.

(c) **Challenge 3: Implementation delays.** If project implementation is not subject to any delay due to Peru's political cycle, then no risk is expected from this front.

[26] Hall and Maffioli (2008) analyze the impact of Technology Development Funds in four Latin American countries: Argentina (targeted credit: FONTAR-TMP 1; matching grants: FONTAR ANR), Brazil (targeted credit: ADTEN; matching grants: FNDCT), Chile (matching grants: FONTEC-Line 1), and Panama (matching grants: FOMOTEC).

## Annex 7: Gender

### PERU: Strengthening the Science, Technology and Innovation System in Peru (P156250)

1. **Peru is one of the countries in the region with a large gender gap**. It ranked 86 among 132 countries in the 2013 Global Gender Gap Report of the WEF, only above Guatemala, Belize, El Salvador, Chile, Paraguay and Honduras in the LAC region. Although the gender gap of the population older than 25 is still large, only 29.7 percent of women in the age range had finished upper secondary education in 2014, compared to 39.9 percent of men,[27] the gap is decreasing, as seen by the gender gap in secondary education, where 48.7 percent of the student are female.

2. **According to a recent study,[28] there is a large gender gap among higher education students at all levels**, professors and researchers in the areas of Natural and Agricultural Sciences, Engineering, and Technology in Peru. Only 26 percent of the students, 20 percent of the professors and 33 percent of the researchers in these areas are women. The gender ratio (number of researchers who are men/those who are women) varies among disciplines, going from 1.33 in Health Sciences to 3.86 in Engineering and Technology. The study also found that the gender ratio did not depend much on the academic degree reached (2.05 for Bachelors, 2.03 for Masters and 2.46 for Ph. D's), suggesting that the gender gaps among higher education students and researchers could have been generated by previous levels of education.

3. **In this regard, the project supports the objective of mainstreaming gender practices in the following ways:**

(a) Monitoring project performance indicators by gender wherever feasible, thus helping to raise awareness about the contribution of women scientists and innovators;

(b) Capturing data disaggregated by gender, whenever possible and available. To this order, institutions that receive project grants would be asked to provide data disaggregated by gender;

(c) Enforcing that every grant proposal be reviewed to avoid any negative potential gender bias;

(d) Including gender sensitivity training as part of capacity building activities supported under the project; and

(e) Placing preferences for gender informed proposals in competitively financed activities supported by the project.

[27] World Bank Gender Data Portal (http://datatopics.worldbank.org/gender/indicators)
[28] CONCYTEC (2013): "Doctorados: Garantía para el Desarrollo Sostenible del Peru"

## Annex 8: Lessons Learned and Reflected in Project Design

### PERU: Strengthening the Science, Technology and Innovation System in Peru (P156250)

1. **This project's design benefits from previous World Bank projects in STI**. The overarching principles used in the design of the present project include: (a) ensuring rapid disbursements through advance preparation of activities and previous experience of implementing agency; (b) pilots to test out new ideas and designs prior to large-scale implementation; (c) simplified design and implementation arrangements, with a focus on capacity building and support for Project management; (d) using rigorous M&E procedures, including an IE, to verify that outcomes are reached; (e) investing in mobilization, communication, and awareness building to ensure a strong pool of Project beneficiaries; (f) clearly defined rules of the game given that it is crucial to design and to implement clear mechanisms and transparent processes in order to reduce the possibility of misallocation of resources; and (g) the need to focus on VCs and locations with clear competitiveness potential. This project will help Peru focus its innovation capacity and resources on the industries of highest potential.

2. **The project builds on a number of World Bank STI projects**, including previous and current operations in Chile (P055481, P088498 and P111661), India (P072123 and P102549), Argentina (P034091), Uruguay (P095520) and Mozambique (P146602), among many others, that have succeeded in improving the quality and relevance of scientific and technological R&I and in getting higher education institutions and research centers closer to the needs of society and industry by giving proper incentives, and by monitoring and evaluating their results.

3. It is a good practice for STI projects to address and integrate different pillars of the STI system by including actions that affect both demand and supply of knowledge and innovation.[29] This project replicates that good practice by including activities that simultaneously promote institutional strengthening, human capital accumulation, and innovation in the productive sector. The integration of different mechanisms to promote STI as part of the changes in the governance of the system will allow for positive spillovers between activities, increased knowledge exchange opportunities, reduced operative costs, setup of a smooth system for continuous learning, and early detection of opportunities.

4. **Specifically for Component 1**, the project design seeks to incorporate early proactive action by the implementing agency to develop a partnership culture with other public agencies and the private sector. Regarding the implementation of the PER, a lesson learned from other countries where the methodology has been applied by the World Bank Group (Colombia - P144510 and Chile) is that strong Government support is crucial for quick and smooth implementation. At the same time it is key for the Government to take ownership of the assessment to guarantee its success and sustainability over time. To achieve this, Component 1 is designed to have CONCYTEC drive the coordination with other relevant stakeholders and deliver training in the implementation of the methodology for future exercises.

[29] Promoting Innovation to Enhance Competitiveness Project- Uruguay ICR (P095520)

5. **The design of Component 2** incorporates the implementation arrangements and lessons learned from several World Bank Group lending and reimbursable advisory services projects in countries with different levels of sophistication and income, such as Haiti (P123974), Mexico (P158672), Croatia (P127308, P154353) Uruguay (157902), Macedonia (P128378), Pakistan (P155963), and Kazakhstan (P147705). It also draws upon the experience and good practices on cluster policies of the OECD and of the European Union,[30] as well as upon the main findings of IEs of previous cluster initiatives in Latin America.

6. The main rationale for public policies to promote innovation through a cluster-based approach including infrastructure and knowledge-based investments, networking activities and training, is an increase in knowledge spillovers among actors in clusters and thus the generation of a collective pool of knowledge that results in higher productivity, more innovation and an increase in the competitiveness of firms.

7. In this regard, most OECD countries promote a cluster-based approach to innovation. Argentina, Belgium, France and Portugal have made cluster policies an integral element of their national innovation strategies or plans. Other countries have programs to promote the creation of new clusters or to strengthen existing clusters. Recently, Belgium, Germany and the Netherlands have explicitly targeted specific sectors/industries in their national innovation strategies or plans. Several policy tools have been adopted to support clusters and specialization as summarized in table 8.1 below.

[30] See the European Union's Cluster Excellence Initiative, (www.clusterexcellence.org).

**Table 8.1. CRI-Based Innovation Support Policies and Specialization Patterns in Selected OECD Countries - 2012[31]**

| | | |
|---|---|---|
| Creating and consolidating clusters | Creation of new clusters through co-ordinated action for R&D activities (*e.g.* through public funding programmes). | Argentina, Canada, Chile |
| | Promotion of network structures, service support for entrepreneurs, cluster co-ordination | Argentina, Austria, Australia, Belgium, Canada, China, Colombia, Denmark, France, Germany, Greece, Ireland, Japan, New Zealand, Sweden |
| Networking platforms | Science-science (*e.g.* promotion of collective research centres, centre of excellences) | Belgium, Canada, France, Norway, South Africa, Spain, Switzerland |
| | Industry-science (*e.g.* promotion of public-private networks) | Argentina, Australia, Belgium, Canada, Colombia, Denmark, Finland, France, Germany, Italy, Norway, Poland, Portugal |
| | Industry-industry: promotion of sectoral networks | Belgium, Colombia, Denmark, Germany, Poland, Portugal, Spain |
| Technology specialisation[1] | Relative specialisation in biotechnology and nanotechnology | Australia, Belgium, Canada, Denmark, Ireland, Israel, Netherlands, New Zealand, Poland, Spain, Switzerland, United States, Singapore |
| | Relative specialisation in environment-related technologies | Australia, Austria, Canada, Czech Republic, Denmark, France, Germany, Hungary, Japan, Norway, Poland, Russian Federation, Singapore and Spain |
| | Relative specialisation in ICTs | Canada, China, Finland, Ireland, Israel, Japan, Korea, Malaysia Singapore and Sweden |
| Internationalisation | Cluster competition and cluster excellence programmes | Austria, Belgium, Germany, France, Ireland, Japan, Netherlands |
| (Towards) smart specialisation | Australia, Austria, Belgium, Czech Republic, Estonia, Finland, Germany, Ireland, Israel, Poland, Russian Federation, Spain, Turkey, United Kingdom | |

8. Recent IEs[32] of cluster upgrading programs in Argentina, Brazil, Chile, Germany, Japan, and France (with a similar design to the one of Component 2), show positive direct and significant effects on: (a) Employment: about 20 percent increase in 3–5 years, (b) Probability to export: about +5 percent per year relative to the original proportion of exporting firms, (c) Export levels: between 50 percent and 80 percent for each exporter for beneficiary firms. Effects persist and grow overtime, (d) Indirect effects on firms localized in the area of influence of clusters, especially on the probability to export and less on export levels.

9. Finally, the design of Component 2 incorporates lessons learned on the matching grants for MSMEs which include: (a) clearly identify the market failures and barriers to be overcome based on research work, baseline studies, and sector specific diagnostics to avoid their distortion and political capture; (b) provide matching grants with clearly defined eligibility criteria, adequate and attractive grant amounts, simple procedures and appropriate marketing. A communications campaign with clear, simple and accessible messaging geared towards MSMEs encourages take-up of matching grants programs; (c) TA at the application stage leads to greater beneficiary satisfaction and success of matching grants programs; (d) close monitoring of

[31] Source: Country responses to the OECD Science, Technology and Industry Outlook 2012 policy questionnaire and OECD (2010), OECD Science, Technology and Industry Outlook 2010, OECD, Paris.
[32] "The Impact Evaluation of Cluster Development Programs. Methods and Practices", Maffioli A., Pietrobelli C., Stucchi R. (eds), 2016, IDB.

matching grants implementation helps to solve last-mile challenges faced by MSMEs; and (5) Invest in an IE to claim results from a matching grants program.

10. **Component 3** is based on discretionary competitive funds, an instrument that has proven to be powerful for change and improvement in higher education, STI systems. As concluded by an Education Working Paper of the World Bank Group,[33] which reviewed six projects based on discretionary funds in Chile, Ethiopia, Ghana, Mozambique, Uganda and Vietnam, discretionary funds are highly effective mechanisms for improving the transparency and efficiency of the budget allocation process in higher education systems, and for boosting educational quality and relevance within tertiary institutions. However, they have limited capacity to promote system-wide restructuring or policy reform. In the case of Chile, the World Bank has supported a series of three projects (P055481, P088498 and P111661) which have contributed to the improvement of the quality and relevance of research in higher education institutions. Other countries where the World Bank has supported projects with components based on discretionary funds include India (P072123 and P102549), Argentina (P034091) and Mozambique (P146602). As flexible additions to normal operating budgets, they offer rare opportunities for steering and innovation. For instance, some of the best practices on discretionary competitive funds used in Chile are incorporated in the Project design.

11. Finally, it is well-known among STI scholars, policy makers and practitioners that innovation systems by their very nature are subject to non-linear scaling effects. The reason for this non-linearity is the presence of network effects that can be explained as follows: results from an innovation system are derived from the complex network of two kinds of elements – the nodes (research centers, universities and enterprises, consumers) and the links between the nodes (flow of funds, flow of information, decision-making), which constitutes a sub-network. The project focuses on one set of nodes and on improving the quality and strength of some links – strengthening academia and private sector links and consequently investments. It is inherent in the very nature of networks, that intervention in a sub-network produces multiplier effect in terms of overall results and impact.

[33] William Saint, "Innovation Funds for Higher Education: A User's Guide for World Bank Funded Projects", Education Working Paper No 1, May, 2006, The World Bank.