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WHAT WORKS

UGANDA

Millennium Science Initiative

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The World Bank

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PROJECT PERFORMANCE ASSESSMENT REPORT

UGANDA

MILLENNIUM SCIENCE INITIATIVE
(IDA CREDIT No. 41740)

April 7, 2016

Currency Equivalents (annual averages)

Currency Unit = Ugandan shilling (U Sh)

2007	$1.00	U Sh1,723.49
2008	$1.00	U Sh1,720.44
2009	$1.00	U Sh2,030.49
2010	$1.00	U Sh2,177.56
2011	$1.00	U Sh2,522.75
2012	$1.00	U Sh2,504.56
2013	$1.00	U Sh2,586.89

Abbreviations and Acronyms

AAUW	American Association of University Women
EU	European Union
GDP	Gross Domestic Product
ICR	Implementation Completion and Results Report
IDA	International Development Association
IEG	Independent Evaluation Group
M&E	Monitoring and Evaluation
MFPED	Ministry of Finance, Planning, and Economic Development
MSI	Millennium Science Initiative
NCHE	National Council for Higher Education
NCHE	National Council for Higher Education
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
PPAR	Project Performance Assessment Report
S&T	Science and Technology
TTL	Task Team Leader
UIRI	Uganda Industrial Research Institute
UNCST	Uganda National Council for Science and Technology
UNDP	United Nations Development Programme
WDI	World Development Indicators

All dollar amounts are U.S. dollars unless otherwise indicated.

Fiscal Year

Government: FY 07-FY13

Director-General, Independent Evaluation	:	Caroline Heider
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Contents

Tables

Principal Ratings

	ICR[a]	ICR Review[a]	PPAR
Outcome	Satisfactory	Satisfactory	Moderately satisfactory
Risk to Development Outcome	Significant	Significant	Significant
Bank Performance	Satisfactory	Satisfactory	Moderately satisfactory
Borrower Performance	Satisfactory	Moderately satisfactory	Moderately satisfactory

Note: PPAR = Project Performance Assessment Report.
a. The Implementation Completion and Results Report (ICR) is a self-evaluation by the responsible Bank department. The ICR Review is an intermediate product of the Independent Evaluation Group that seeks to verify independently the findings of the ICR.

Key Staff Responsible

Project	Task Manager or Leader	Division Chief or Sector Director	Country Director
Appraisal	Michael F. Crawford	Dzingai B. Mutumbuka	Judy M. O'Connor
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IEG Mission: Improving World Bank Group development results through excellence in evaluation.

About this Report

The Independent Evaluation Group (IEG) assesses the programs and activities of the World Bank for two purposes: first, to ensure the integrity of the Bank's self-evaluation process and to verify that the Bank's work is producing the expected results, and second, to help develop improved directions, policies, and procedures through the dissemination of lessons drawn from experience. As part of this work, IEG annually assesses 20–25 percent of the Bank's lending operations through field work. In selecting operations for assessment, preference is given to those that are innovative, large, or complex; those that are relevant to upcoming studies or country evaluations; those for which executive directors or Bank management have requested assessments; and those that are likely to generate important lessons.

To prepare a Project Performance Assessment Report (PPAR), IEG staff examine project files and other documents, visit the borrowing country to discuss the operation with the government, and other in-country stakeholders, and interview Bank staff and other donor agency staff both at headquarters and in local offices as appropriate.

Each PPAR is subject to internal IEG peer review, panel review, and management approval. Once cleared internally, the PPAR is commented on by the responsible Bank department. The PPAR is also sent to the borrower for review. IEG incorporates both Bank and borrower comments as appropriate, and the borrowers' comments are attached to the document that is sent to the Bank's Board of Executive Directors. After an assessment report has been sent to the Board, it is disclosed to the public.

About the IEG Rating System for Public Sector Evaluations

IEG's use of multiple evaluation methods offers both rigor and a necessary level of flexibility to adapt to lending instrument, project design, or sectoral approach. IEG evaluators all apply the same basic method to arrive at their project ratings. Following is the definition and rating scale used for each evaluation criterion (additional information is available on the IEG website: http://worldbank.org/ieg).

Outcome: The extent to which the operation's major relevant objectives were achieved, or are expected to be achieved, efficiently. The rating has three dimensions: relevance, efficacy, and efficiency. *Relevance* includes relevance of objectives and relevance of design. Relevance of objectives is the extent to which the project's objectives are consistent with the country's current development priorities and with current Bank country and sectoral assistance strategies and corporate goals (expressed in poverty reduction strategy papers, country assistance strategies, sector strategy papers, and operational policies). *Relevance of design* is the extent to which the project's design is consistent with the stated objectives. *Efficacy* is the extent to which the project's objectives were achieved, or are expected to be achieved, taking into account their relative importance. *Efficiency* is the extent to which the project achieved, or is expected to achieve, a return higher than the opportunity cost of capital and benefits at least cost compared to alternatives. The efficiency dimension generally is not applied to adjustment operations. *Possible ratings for Outcome:* Highly Satisfactory, Satisfactory, Moderately Satisfactory, Moderately Unsatisfactory, Unsatisfactory, Highly Unsatisfactory.

Risk to Development Outcome: The risk, at the time of evaluation, that development outcomes (or expected outcomes) will not be maintained (or realized). *Possible ratings for Risk to Development Outcome:* high, significant, moderate, negligible to low, and not evaluable.

Bank Performance: The extent to which services provided by the Bank ensured quality at entry of the operation and supported effective implementation through appropriate supervision (including ensuring adequate transition arrangements for regular operation of supported activities after loan or credit closing) toward the achievement of development outcomes. The rating has two dimensions: quality at entry and quality of supervision. *Possible ratings for Bank Performance:* highly satisfactory, satisfactory, moderately satisfactory, moderately unsatisfactory, unsatisfactory, and highly unsatisfactory.

Borrower Performance: The extent to which the borrower (including the government and implementing agency or agencies) ensured quality of preparation and implementation, and complied with covenants and agreements, toward the achievement of development outcomes. The rating has two dimensions: government performance and implementing agency(ies) performance. *Possible ratings for Borrower Performance:* highly satisfactory, satisfactory, moderately satisfactory, moderately unsatisfactory, unsatisfactory, and highly unsatisfactory.

Preface

This PPAR reviews the experience and achievements of World Bank support for science and technology in the Millennium Science Initiative in Uganda. It was approved on May 25, 2006, became effective on March 2, 2007, and closed on June 30, 2013. The project closed 18 months after the originally planned closing date of December 31, 2011, which permitted an additional unplanned round of grants and completed the procurement of scientific equipment for all grantees. The project was financed by an International Development Association (IDA) credit of $30 million equivalent and the government provided $2.8 million. This project was selected for a field-based assessment since it focused on tertiary education and research. The information gained will be applied to an evaluation of Bank support for higher education by the Independent Evaluation Group (IEG).

This report presents findings based on a review of the Project Appraisal Documents, the Implementation Completion and Results Reports, Implementation Completion and Results Reviews, aide-mémoires, World Bank reports, and other relevant materials. An IEG mission visited Uganda in 2015 between May 4 and 14 to interview government officials, the staff of the Uganda National Council Science and Technology and Uganda Industrial Research Institute, donor representatives, grantees, and other stakeholders (see appendix C for list of interviewees).

The assessment aims to verify whether the operation achieved its intended outcomes. The report provides additional evidence and data since project closure for a more complete picture of the outcomes and factors that influenced them.

IEG gratefully acknowledges the logistical assistance and support of the staff in the World Bank Kampala office, particularly Harriet Kiwanuka.

Following standard IEG procedures, a copy of the draft Project Performance Assessment Report (PPAR) was sent to the relevant government officials and organizations for their review and feedback. No comments were received.

Summary

Science and technology is a priority for the Ugandan government as it aspires to build a knowledge-based economy through investing in homegrown science and technology (S&T) graduates and research programs. At the time of project preparation, several challenges were apparent such as few science programs, a particularly low number of science and technology graduate students, limited national funding for science and technology research, and no system to improve conditions for research.

Millennium Science Initiative Project

The objectives of the Millennium Science Initiative Project (2007–2013) were for "Ugandan universities and research institutes to produce more and better qualified science and engineering graduates, and higher quality and more relevant research, and for firms to utilize these outputs to improve productivity for the sake of enhancing S&T-led growth."

The activities to attain the objectives included a science and technology funding facility with three windows: outreach, institutional strengthening, and project monitoring and evaluation (M&E). The principles of the funding facility were to support open, transparent, and rule-bound competition for resource allocation as well as merit-based selection of research proposals by the Technical Committee composed of eight internationally recognized researchers—half of whom were Ugandan. The grants supported research and created or upgraded science undergraduate programs with the objective of increasing the number of science and technology graduates and more relevant and better quality research. It was further expected that grants given to private sector firms working in collaboration with university researchers would bring the two groups together to solve areas of mutual interest, which would allow firms to utilize research and employ graduates to enhance productivity.

The relevance of objectives was substantial given the commitment expressed by the government in the National Development Plan (2010) for science and technology to transform the economy. The project's objectives were also substantially relevant to the 2011–2015 Country Partnership Strategy, which was current at project closure and aimed to increase private sector participation, strengthen human capital development, and increase agricultural productivity.

The National Science and Technology Policy developed by the Uganda National Council for Science and Technology (UNCST) was adopted by the government in 2009. UNCST was also instrumental in developing the National Biotechnology Policy, which was discussed in parliament in May 2015. The number of active researchers in Uganda more than quadrupled over the life of the project from158 to 700 between 2007 and 2012. The project supported student researchers who participated in research teams (57 graduate and 33 doctorate students). Research was aligned with priority areas within Uganda with a particular focus on agriculture. During the project, enrollment of S&T students increased with its support of more than 6,000 students through the establishment of new or improved programs. Scientists visited 86 secondary schools in Central, Eastern, Northern,

and Western Uganda over the course of the project. The School Visit Program brought awareness of science- and technology-related careers to young people.

The project's outcome is rated moderately satisfactory based on the substantial relevance of the objectives and modest relevance of design, substantial achievement in increasing the number of science and technology graduates, substantial achievement of producing higher quality and relevant science and technology research, and modest achievement of increasing firms' utilization of these outputs. Efficiency was rated substantial with the expected positive returns from upgrading technology and higher wages for more science and technology graduates. While the project demonstrated efficiency with three, instead of two, rounds of grants funded due to its effective use of additional resources as the result of gains from exchange rate variations, the efficiency of the use of grant money was not measured. To continue the advances made by the fund requires continuous and predictable resources for research and program development, which have been absent since the project ended. Thus the risk to development outcome is significant. The performance of the Bank is rated moderately satisfactory. While technical and implementation aspects at preparation and supervision were adequate, shortcomings emerged related to design and M&E. The borrower's performance is rated moderately satisfactory. While the project received high-level government support, delays occurred in follow-up actions by the Ministry of Finance, Planning, and Economic Development. UNCST implemented the competitive grant fund well, but shortcomings arose in procurement. Both government and implementing agency performance were moderately satisfactory.

Lessons

Based on the experience of this project, several lessons can be drawn:

- **While research funds are common in the member countries of the Organisation for Economic Co-operation and Development, it is also possible to establish and implement a world-class science research fund in a low-income country.** This project has demonstrated a competitive funding facility that promotes science and technology, and the UNCST implemented it consistently with a high degree of transparency. The government did not interfere in the process. The Technical Committee awarded grants based on a clear selection process consistent with international good practices. This environment led to high-quality proposals, a high level of competition, and accountability for the grants.

- **An appropriate cost-sharing agreement is needed at entry to facilitate sustainability.** An IDA grant was provided to the government for nearly all operational costs. It was believed that this arrangement would pose no threat to sustainability as the government was committed to science and technology and provided high-level support during the project. In the end, the government did not provide its own resources to maintain the research funding facility or request continued funding from the Bank. While these decisions by the government are beyond the Bank's control, the Bank has the ability to establish conditions upfront such as requiring the government to put more resources into the fund or requiring the government to take on an increasing share of resources each year.

- **The promotion of a knowledge-based economy requires an integral approach, involving several ministries as well as the private sector.** The project focused on the funding facility to promote science and technology as one component of the system. Simultaneously, additional efforts by the Bank—analytical work, other lending operations, and policy dialogue—addressed other aspects of the system. While the Bank advocated ministerial ownership of the topic and inter-ministerial coordination, it also worked on pipeline issues within secondary education and addressed research and linkages with the private sector. Despite these efforts, the national system remains weak and additional institutional strengthening is still needed to bring all elements of the system together. It is too early to know whether the new ministerial structure implemented in 2015 will have an effect on bringing these separate but integral pieces, together to work synergistically.

- **A research fund is a viable mechanism to increase research and create programs for science and technology graduates, but its impact may be enhanced by extending capacity-building and technical assistance to grantees.** Grantees benefited when they received capacity-building or technical assistance, suggesting the impact could be enhanced when financial grants are combined with technical support.

- **Requiring data collection for grants may also yield better impact or at a minimum a clearer understanding of what was achieved**. Ensuring the capacity building of grantee institutions to implement periodic tracer studies with consistent methodology may be a step toward providing relevant data to academic programs.

- **Given the low numbers of Ugandan women scientists, a gender focus is warranted.** Giving more prominence to gender could have further incentivized the supported programs and outreach activities to add activities to promote female participation and address the barriers. In addition, collecting gender-disaggregated data would have revealed the project's contribution, which is unknown.

Nicholas D. York
Director
Human Development and
Economic Management Department

1. Background and Context

1.1   This Project Performance Assessment Report (PPAR) reviews the experience and achievements of World Bank support for science and technology in the Millennium Science Initiative of Uganda 2006–2013. This project was selected for a field-based assessment since it focused on tertiary education and research. The information gained from this field-based study will be an input into IEG's upcoming evaluation of Bank support for higher education.

Socioeconomic Context of Uganda

1.2   Economic growth in Uganda has been steady and robust since 2004 with the annual rate of growth of gross domestic product (GDP) ranging from 6 percent to 10 percent, except in 2012 when it declined to 3 percent (Word Development Indicators). Industry and services, particularly financial services and construction, comprise two-thirds of recent GDP, while the share from agriculture has declined from 27 percent to 15 percent. Poverty has also declined in the past decade. The World Bank development indicators show a drop from 51 percent in 2006 to 37 percent in 2013, while the government records a larger decline of 31 percent to 19 percent (MFPED 2014). Persistent poverty continues particularly among those living in the Northern region. One reason for this is the prolonged conflict and restoration of peace only in 2006.

1.3   A high percentage of the government's revenue comes from official development assistance (ODA), although this is declining. ODA increased from $192 million in 1986 to $1.7 billion in 2007. Relative to GDP, total ODA to Uganda stood at 5 percent in 1986, peaked at 25 percent in 1992, and averaged 14 percent from 2004 to 2008 (World Bank 2011). Domestic revenue collection is 13 percent of GDP, which is low compared with neighboring countries (IEG and EU 2015). Donors financed approximately 30 percent of the government's annual budget between 2008 and 2009 through budget support of $800 million per year (IEG and EU 2015).

1.4   Uganda has high fertility and population growth rates. The growing population poses a challenge for the government to pay for the increasing numbers of people who utilize health and education services, while at the same time trying to increase the quality of these services (see paragraphs 1.7–1.9).

Education in Uganda

1.5   The education system includes preprimary, primary (compulsory seven years), secondary (six years), technical or vocational, and tertiary (three or four years to obtain a bachelors' degree). After completion of primary and secondary school, students attend technical or vocational school to gain technical or craft skills or go to higher education institutions.

1.6   Enrollments at all levels have remained steady in the last five years (see table 1.1). Previously, primary school enrollment expanded with the implementation of Universal Primary Education policy in 1997. As a result, primary enrollment is now universal.

1.7   The government implemented the Universal Secondary Education Policy in 2007 which was designed to expand enrollment through a public-private partnership model, reduce parental burden for school fees, and establish new schools. Data from the Ministry's Education Management Information System shows a five-fold increase in the number of students enrolled between 2000 and 2012 (161, 396 students in 2007 to 751, 867 in 2012) and an increase in the number of schools (1,155 in 2007 to 1,919 in 2012) (Barungi, Wokadala, and Kasirye 2015). The secondary enrollment rate has increased from 16 percent in 2000 to 27 percent in 2012.

1.8   Tertiary enrollment has ranged from 2 to 4 percent (see Table 1.1).[1] At the tertiary level, more students pursue degrees in social sciences and humanities rather than science and technology (UNCST 2014a; NCHE 2010). Fewer women are enrolled in agricultural sciences, medical sciences, engineering and technology, and natural sciences (ranging from 23 to 39 percent), while closer gender parity is found in social sciences and humanities (45 percent) (UNCST 2014a; NCHE 2010). Despite a number of private universities and colleges, science and technology is mainly offered at public universities, a few of which have science-related doctoral programs.

Table 1-1. Gross Enrollment by Level by Year (%)

Level	2000	2007	2010	2012
Pre-primary	—	10	14	—
Primary	129	117	117	103
Secondary	16	24	26	27
Tertiary	2	3	4	—

Source: World Bank education statistics database.
Note: — = not available.

1.9   The basic education system is challenged by lack of quality and a low completion rate. Student performance in mathematics and science has been poor in the Primary Leaving Examination. For example, 42 percent of pupils received a passing score in mathematics in 2009, but only 2 percent of them passed with distinction (UNCST 2014a). Primary school completion remains low with about half of the students finishing.

1.10   With enrollments increasing at the secondary level, some worry that quality will erode. Core science subjects are mandatory for all lower secondary students. Despite this policy, all schools are not equipped with laboratories and equipment or are filled with teachers competent in science and with knowledge of the curriculum. Less than half of secondary students passed biology, while only a third of them passed chemistry in 2011, with fewer than 5 percent of them earning distinction (UNCST 2014a). This suggests further efforts are needed to implement and realize the government's policy and have more students equipped to pursue science and technology fields within higher education.

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[1] UNCST has reported a higher tertiary enrollment rate of 9 percent in recent years (UNCST 2014a).

1.11   At the tertiary level, issues affecting quality are lack of qualified professors and low pay, which forces professors to supplement their salaries with other work NCHE2010).

1.12   While a larger share of the government's budget is directed to primary education, the allocation per pupil is higher for tertiary in comparison to other levels. In 2012, the government spent $415 for every student in tertiary, while a fraction of that amount was directed to secondary ($103) and primary ($33) students (World Bank 2015). Tertiary education predominantly benefits the richest—who receive up to 50 percent of subsidies compared to 2 percent of the poorest (Guloba, Nyende, and Wokadala 2010).

Science and Technology in Uganda

1.13   Science and technology policy involves the coordination of basic science education, tertiary education, research, development, and advanced training. It is governed by several ministries (Finance, Planning, and Economic Development; Health, Education, Commerce, and Agriculture), which has resulted in a fragmented system (MFPED 2009). While UNCST has responsibility for coordination of science and technology, it has no regulatory or management authority. Science and technology was assigned in 2015 within the newly restructured Ministry of Education, Science, Technology, and Sports. It is unclear how this will action improve the inter-ministerial coordination of science and technology, as this change was recent.

1.14   Limited resources are devoted to research and innovation. Uganda devotes 0.4 percent of GDP to research and development, which is similar to countries such as Kenya and Senegal but lower than Botswana, India, and South Africa (UNDP 2013). Most of the financing (66 percent) for government research and development is provided by foreign sources (UNCST 2014a). The private sector contributes a small amount to research and development as most business are informal and few of them carry out research and development (UNCST 2012a). In 2001, there were only 91 articles by Ugandan researchers in international journals (MFPED 2009). This figure is low compared with the research output of Southern African researchers (e.g., 928 articles in 2003) and West and Central African researchers (3,069 in 2003) (World Bank 2014). No new patents were granted, and nonresidents have filled most trademark applications in recent years (UNCST 2014a).

1.15   Studies have differing conclusions about the demand for science and technology graduates by employers. Nearly all medical doctors found employment within a year, while only half of the social scientist found employment (NCHE 2010. Yet, more jobs were advertised for social scientists compared with science and engineering fields (UNCST 2014a). This may suggest limited opportunities for science and technology graduates despite the government's keen interest in moving to a knowledge economy.

2. Objectives and Design

2.1   According to the financing agreement (World Bank 2007, 5) and the project appraisal document (World Bank 2006, 9), the project's objectives were for "Ugandan universities and research institutes to produce more and better qualified science and engineering graduates, and higher quality and more relevant research, and for firms to utilize these outputs to improve productivity for the sake of enhancing S&T-led growth."

Design

2.2   **Components.** The project has two components. Table 2.1 summarizes their main activities. The first component provided grants within three windows: researchers, science and technology programs, and technology platforms. The second component focused on outreach, institutional strengthening, and monitoring and evaluation (M&E).

Table 2-1. Activities within Each Component and Planned Costs

Component 1: Millennium Science Initiative Funding Facility ($16.69 million)	Component 2: Outreach and Policy Improvement ($16.65 million)
Window A: Senior or emerging researchers conduct relevant, high-quality scientific and technological research closely connected to graduate training.	Outreach program to promote understanding and appreciation of science for younger Ugandans to consider careers in science and technology: National Science Week, school visits by researchers, and media campaign.
Window B: Creation or upgrade of undergraduate programs in basic science and engineering at licensed public and private institutions.	
Window C: Firms and researchers solve problems of direct interest to industry through technology platforms and formal internships for students in science, engineering, and business administration.	Institutional strengthening of Uganda National Council for Science and Technology and Uganda Industrial Research Institute.
Equipment acquisition for training and research was permitted within Windows A and B.	Policy studies in key areas to promote policy actions.
	Monitoring and evaluation of project's progress.

Source: World Bank (2006).

Millennium Science Initiative Funding Facility

2.3   The first component is the Millennium Science Initiative Funding Facilityand its three Windows. The first window granted funds for senior and emerging researchers. Investigators with established expertise and research backgrounds were qualified for senior grants with a higher budget (about $800,000), while emerging researchers received a lower level ($250,000). Budgets were commensurate with proposed research activities and justified in the proposal. Approximately half of the resources could be used for equipment. A prescribed number of students were to be part of each team. These grants and the funded research activities were to conclude within three years.

2.4   The second window created new science and technology undergraduate education programs or upgraded existing ones. The programs were expected to develop curricula with internationally accepted levels of quality, create laboratories aligned with the curricula, develop staffing plans, and recruit students, including incentives to attract them into science disciplines and offer them remedial activities, if needed. All proposals were required to address how the institution would sustain the program at the termination of the grant.

2.5   The third window tried to create linkages between academia and industry to promote greater access to technology and skills. Technology platforms were to bring together firms and partners from academia or public research institutes to identify areas where technologies existed outside Uganda and could be transferred within the country or identify solutions to problems firms faced. The goal was to adopt or adapt technology to increase the company's productivity. Feasibility studies to understand commercial viability were permitted. Internships also were used to make university-industry linkages and provide practical training for students. Grantees under this window could receive up to $50,000, and thus, technology creation was not the aim.

2.6   Principles for the MSI Funding Facility were open, transparent, and rule-bound competition for resources. Merit-based selection criteria by the Technical Committee composed of eight internationally recognized researchers - half of whom were Ugandan. Proposals were to have a close connection between research, training, and use of the research output as well as accountability for the output.

Outreach and Policy Improvements

2.7   The second component addressed outreach, institutional strengthening, and project M&E.

2.8   To increase the understanding and awareness of science and technology and its role in national development as well as attract more students to science and technology professions, the project established a series of school visits by scientists; implemented an annual National Science Week; and conducted public information campaigns.

2.9   UNCST and the Uganda Industrial Research Institute (UIRI) received technical assistance and financial resources to enhance their capacity. UNCST was given responsibility for science policy nationally and the strengthening sought to transform UNCST into a focused organization promoting practical ways for growth in science and technology. For example, creation of policy research, collection of science and technology data, and ability to provide advice to government.

2.10   UIRI's mandate is industrial technology development and knowledge transfer. The resource centers developed under the project were to provide consultancy and incubation services to industry and firms. UIRI was also to strengthen its connection with other complementary agencies such as the National Bureau of Standards that had responsibility for enforcing and monitoring standards.

2.11   **Results Framework.** The Results Framework specified a mix of outcome and output indicators (table 2.2) to measure attainment of the objectives. Key performance indicators were changed through a Level-2 project restructuring in 2010. These changes were designed to bring consistency between the indicators in the legal agreement and the appraisal document, and to provide greater clarity to three key performance indicators and one output indicator. Key performance indicators were: (i) productivity of researchers; (ii) science and technology graduates; (iii) employing more S&T talent and technology; and (iv) more careers in science and technology by A-level graduates. Process indicators were used to assess project implementation such as effectiveness of and satisfaction with

UNCST and UIRI services; enrollment capacity of new programs; technical committee seated and calls issued; ratio of proposals and selected grants; and research goals on track.

2.12   The revisions neither changed the targets of outcome indicators nor changed how attainment of the objectives was measured. For these reasons, a split rating is not warranted. One output indicator was dropped (i.e., more students entering selecting S&T careers), which had limited attribution to project activities. However, other output indicators that were unclear and not plausibly attributable to the project were not addressed during the restructuring. The restructuring also did not drop indicators related to internship programs when it was clear that the project would only fund one internship grant.

Table 2-2. Original and Revised Project Results Framework

	More and Better Qualified S&T Graduates	**Higher Quality and Relevant Research**	**Utilization of S&T by Firms to Improve Productivity**
Outcomes	Increase number of S&T students by 50%. *Revised indicator:* Number of S&T undergraduates and postgraduates increases.	Increase publications by 50%. *Revised indicators:* Number of active researchers doubles. Percentage of researchers publishing in international peer-reviewed journals increases.	Technology firms employ 25% more S&T talent and enhance technology use. *Revised indicator:* Percentage of employees with S&T qualifications in firms active in technology development increases by 25%.
Intermediate Outcome	Upon graduation, 15% of interns receive employment offers. New programs with quality curricula admit S&T students at 70% capacity. Upgraded programs expand S&T enrollment.		
Outputs	More Uganda A-level students plan careers in S&T (dropped). UNCST and UIRI provide effective services. *Revised indicator:* Percentage of clients who are satisfied with responsiveness of UNCST and UIRI to their needs. Technical Committee seated; call for proposals issued. Ratio of applicants to proposals 3:1 or greater for Windows A and B. Research goals on track among 80% of grantees.	Number of patent applications, publications, and postgraduate theses.	Among the top 50 technologically active firms, 10% establish internship program and participate in Technology Platform. UIRI completes service demand assessment. UIRI generates fees for technological services offered to firms. Follow-up activities from technology platforms in at least 30% of cases. Among S&T students, 15% participate in internship programs. Technology initiatives related to new processes and products increase.

Source: Author adapted from World Bank (2006).
Note: S&T = science and technology; UIRI = Uganda Industiral Research Insttitute ; UNCST = Uganada National Council Science and Technology.

Relevance of Objective

2.13   Relevance of objective is rated **substantial**.

2.14   Science and technology is a priority for the government as it aspires to build a knowledge-based economy. The 2009 National Science, Technology, and Innovation Policy describes the government's commitment to research. The 2010 National Development Plan notes the government's desire to transform Uganda into a modern and prosperous country; it recognizes the role that science and technology plays in increasing competiveness to add value to unprocessed products and inefficient firms. One aspect of the government's interest is increasing the value and productivity within agriculture. Project objectives are particularly relevant because at the time of preparation there were few science programs and a particularly low number of science and technology doctorate students being nurtured to support the science and technology paradigm shift. The higher education system also had few qualified professors. Less than 50 percent of the faculty had a PhD (World Bank 2006). Internal funding for science and technology research was limited, and no system existed to improve conditions for research. As a result, prior to the project, only 91 articles were published in international scientific journals, and few patents existed for local inventions (MFPED 2009).

2.15   The 2005–2009 Uganda Joint Assistance Strategy, current at project preparation, included human development with specific science and technology indicators related to tertiary education. The 2011–2015 Country Partnership Strategy at project closure was consistent with the objectives and aims of this project. The country assistance strategy sought increasing private sector participation, strengthening human capital development, and increasing agricultural productivity. Thus, the objectives of the project were substantially relevant to both the Bank and the government over the life of the project.

Relevance of Design

2.16   Relevance of design is rated **modest**. The design was simple—composed of selected science and technology related activities that can be addressed through a grant facility. However, shortcomings were found in the activities and the results chain.

2.17   The theory of change underlying the project was that competitively awarded grants to conduct research and create new or upgrade existing programs could result in more S&T graduates and better and more relevant research. Furthermore, it was assumed that grants given to private sector firms in collaboration with university researchers would bring the two groups together to solve areas of mutual interest, which would allow firms to utilize research and graduates to enhance productivity. Given the low level of technology development within industry, the strengthening of the UIRI and the grants can be viewed as initial steps to promote private sector involvement and development. However, the project did not include activities to actively facilitate the connection between the private sector and researchers or new research programs, such as ensuring curricula were relevant to firms, developing internship programs, or developing incubators within universities.

2.18   While secondary education was a concern of many government officials, pipeline issues were addressed through other channels and may have spread the project too thin.

The African Development Bank had a secondary education project at the time of preparation and the World Bank subsequently implemented a post-basic education operation. Outreach activities were added to address the desire of the Ministry of Education, Science, Technology and Sports to see linkages between secondary education and the project. The outreach activities were fully integrated with the facility through the involvement of the Technical Committee and grantees in the National Science Week and the School Visit Program. For example, grantee scientists and their work were highlighted during the annual National Science Week. Outreach activities were designed to promote awareness and stimulate the interest of young people to pursue careers in science and technology.

2.19   Institutional strengthening permitted both parastatal agencies (i.e., UNCST and UIRI) to increase their capacity to implement their respective mandates as well as increase visibility within the country. Design gave a limited role to the UIRIbecause this organization was added at the request of the government at a later stage of preparation with the sole purpose of institutional strengthening. With hindsight, greater involvement by UIRI in project activities, particularly within Window C, may have been warranted given the institute's mission of socioeconomic transformation through enhanced technology use and its connection with the Ministry of Commerce.

2.20   Gender balance was not addressed in the design despite few women scientists in Uganda (UNCST 2014a). Persistent efforts are needed to change attitudes about women having careers in science and technology (Hamer, Frinking, and Horlings 2005; Taeb and others 2005) and address constraints such as unfriendly educational environments (AAUW 2001, Asiimwe 2008) and the lack of role models (Kwesiga 2002). Grants were not required to address this aspect. At a minimum, the project should have tracked gender-disaggregated data to understand if more women were leading research and studying science and technology.

2.21   The project's objectives, components, and outcome measures were generally logically linked, but weaknesses were found in the results chain. Most of the key performance indicators measured science and technology in Uganda rather than measures attributable to project interventions. For example, data related to undergraduate and graduate enrollment in S&T, and the numbers of researchers, publications, patents and intellectual property were countrywide. Given the limited nature of the grants, indicators restricted to measuring impact may have been more appropriate, such as S&T enrollment through grants, publications arising from grant funding, and number of scientists supported with grants. It is notable that the Results Framework contained an employment indicator, but the one selected (i.e., increasing the number of S&T graduates within technology firms) was not aligned with grant activities and thus outside the project's scope. A more appropriate measure may have been tracer studies of the students who benefitted from grant funding or the percentage of the grant-supported graduates who were employed in S&T fields within six months. No indicator was established to identify results of the research grants during the life of the project. Instead, only process-related aspects of the grants were tracked. As a result, researchers viewed the completion of the research as the result.

2.22   The intermediate outcome and output indicators generally aligned with the project activities. However, an assumption within the Results Framework was that grants would establish internship programs between technology firms and universities. This did not become a reality as only one grantee implemented an internship program connected to industry and the technical college. Thus, some of the indicators within the Framework were not relevant to the project (i.e., 15 percent of S&T students participate in internship programs 15 percent of interns receive employment offers upon graduation) and were not revised during restructuring. The prominence of the private sector and technologically advanced firms within the Results Framework was another assumption. Given the limited level of technology development, the project's emphasis on these firms may have been an incorrect assumption, as the more likely beneficiaries of Window C were small- and medium-size enterprises.

3. Implementation

3.1   The project was approved on May 25, 2006, became effective on March 2, 2007, and closed on June 30, 2013—18 months after the original date of December 31, 2011, which permitted an additional unplanned round of grants and completion of procurement of scientific equipment for all grantees. The project was restructured (Level 2) and neither development objectives nor key outcome targets were changed.

3.2   The project was implemented by UNCST, which had responsibility for coordination and implementation. The agency was led by an executive committee with oversight of the project. Staff from UNCST had day-to-day responsibility for all facets of project management, but the selection of grants was the responsibility of the Technical Committee. The committee's mandate was to ensure the peer review process was high quality, transparent, and competitive. While UIRI was also part of the project, it had no role in project management.

3.3   The project fully disbursed the $30.00 million IDA credit. The credit covered all project costs and financed both foreign and local expenditures, up to agreed limits for each disbursement category. The government provided $2.81 million through resources to the implementing agency, which was slightly less than the total amount anticipated at appraisal ($3.35 million). At the time of project preparation, the government requested, and IDA agreed, that IDA resources would cover total project costs. This arrangement was believed to pose no threat to project sustainability. In hindsight, while this financing arrangement permitted experimentation to see whether a research fund facility is a viable mechanism for Uganda, it did not facilitate ownership. Subsequently, the government neither provided its own resources nor did it request follow-up funding by the Bank, as it had promised before the third call for grant proposals was initiated.

Table 3-1. Appraisal and Actual Cost of Project by Component

Component	Appraisal Estimate	Actual Cost	Percentage of Appraisal
Grants (Windows A, B, and C)	16.69	19.29	116
Outreach, capacity building, and M&E	16.65	15.43	93
Total project cost	*33.35*	*34.72*	*104*

Source: World Bank (2013).

3.4   The project was rated satisfactory by the Bank on implementation progress and progress on achieving the development objective in nearly every Implementation Status Report. Disbursement took place at a pace close to the planned schedule. The IDA credit was fully disbursed. As table 3.1 shows, slightly more resources than planned went to the first component (grants), as three rounds of grants were provided rather than the two planned (World Bank 2013).

3.5   The project took some limited measures to advance women within science and technology. For example, the chair of the Technical Committee was a women scientist, which was a conscious decision of the task team leader. She and other female members of the Technical Committee were a visible part of each National Science Week. UNCST also conducted outreach activities to women scientists to increase the number of female applicants since the first call yielded few. According to respondents, women were part of research teams and enrolled in the supported programs; however, project monitoring did not track their number.

Implementation Experience

3.6   The MSI Fund was well implemented. The grant selection process was highly competitive. Across the three calls less than 10 percent of proposals were selected (table 3.2). Respondents consistently described the process as clear and transparent, which reflected the high caliber of the Technical Committee's members—four international and four Ugandan scientists. The Technical Committee reviewed all proposals. Those shortlisted presented full proposals and made presentations to the committee, which had autonomy to make its decisions with no interference from the government.

Table 3-2. Proportion of MSI Projects Received, Shortlisted, and Funded, 2007–2009

Window	2007			2008			2009		
	Received	Short-listed	Funded	Received	Short-listed	Funded	Received	Short-listed	Funded
A	105	20	7	77	20	8	58	22	8
B	58	10	4	48	9	3	38	10	3
C	22	10	1	21	21	4	11	11	1
Total	*185*	*40*	*12*	*146*	*50*	*15*	*107*	*43*	*12*

Source: UNCST (2012b).

3.7   A mid-term review was conducted in September 2010, at which time over half of the project funds had been disbursed ($17 million). Across the two rounds of grants, $23.2 million had been awarded.

3.8   The Bank team engaged actively in science and technology policy dialogue with the government over the course of the project, including on the issue of the inability of secondary schools to implement science curriculum mandates. The dialogue also revolved around broader issues such as funding for science, technology, and innovation in the national budget and the need for ministerial responsibility and coordination of science and technology. The Bank produced several economic and sector works (Brar and others 2011; Nanyonjo 2007) specific to Uganda which facilitated policy dialogue. During implementation, there was an active donor education roundtable with rotating leadership, coordinated by the Bank.

Implementation of Monitoring and Evaluation

3.9   UNCST was responsible for conducting policy studies and collecting and monitoring project performance indicators. Project indicators and policy studies were collected either by UNCST staff or consultants. Consultants prepared surveys related to the size and productivity of active research teams, client satisfaction with UNCST and UIRI services, and the impressions of high school students about science and technology careers. The survey of students included the districts of Apack, Arua, Buliisa, Gulu, Homa, Kampala, Lira, Luwero, Masaka, Masindi, Mubend, Mukono, Nadasongola, and Nebbi. UNCST supervised all survey collection.

3.10   The Implementation Supervision Reports rated M&E as satisfactory over the course of the project. Efforts were made during preparation to define terms to ensure consistent application of which tertiary education programs constitute science and technology (i.e., natural sciences, engineering programs, and medicine) as well as who was considered a researcher and what measured his or her productivity. Baseline data collection were predominantly completed during preparation and finalized within a few months of project effectiveness. Outcome indicators were routinely updated, which permitted assessment of attainment of objective during implementation. Important sources of data, previously unavailable, were collected over the course of the project. Since project closure, UNCST has continued to update annual surveys and publish annual science and technology statistics. The quality of the data collected was high—data collected by UNCST was consistent with those collected in the field during IEG's mission.

Safeguards

3.11   The project was classified as category "B" under OP/BP4.01 Environmental Assessment as the result of concerns about laboratory safety, safe disposal of waste, and potential construction of laboratories. The OP/BP 4.12 Involuntary Resettlement safeguard policy was also invoked to mitigate potential negative impact in the unlikely event of land acquisition. This was a precautionary measure because the types of grants to be selected were not known at preparation. No new land was acquired related to the new programs established with grants.

3.12   The National Environmental Management Agency was consulted during preparation as the entity responsible for monitoring laboratory safety. An Environmental and Social Management Framework was prepared by the government and specified mitigation measures for potentially negative impacts from project activities.

3.13   Satisfactory ratings for safeguard compliance were noted in Implementation Supervision Reports throughout the project, and no issues were identified in project records nor reported by respondents. The National Environmental Management Agency determined that the implementing agency met all the requirements of the Environmental and Social Management Framework. The implementing agency had to ensure grantees adhered to the framework with collaboration from the National Environmental Management Agency. These requirements were incorporated into the project operational manual. Respondents from the implementing agency and grantees reported compliance with them.

Fiduciary

3.14   The Bank assessed financial management and procurement capacity. The Country Financial Accountability Assessment showed improvements in Public Financial Management Systems. The assessment conducted for this operation concluded that the financial management arrangements satisfied the Bank's requirements, as long as the implementing agency maintained appropriate staffing throughout the project.

3.15   The project implementation plan and operations manual were developed and finalized during preparation. They provided details about financial management and procurement often not developed prior to project effectiveness, which established a solid foundation for fiduciary management. For example, the flow of funds and financial reporting cycle were outlined, including the responsibilities of grantees. Formats for submission of an annual budget, work plans, and interim financial reports were developed.

3.16   Ratings within implementation supervision reports were satisfactory for fiduciary compliance. During the course of the operation, financial statements were submitted on time, were unqualified, and of acceptable quality. The first annual budget was adequate, but subsequent ones improved. Regular internal audits were carried out. A few instances of insufficient project funds to pay suppliers suggest the need for better financial planning. There were also instances of poor fund management by grantees, such as payment of allowances in lieu of hiring new staff without the required approvals. Disbursements between UNCST and grantees were smooth.

3.17   After the unplanned third round of grants was awarded, the project faced a serious issue of financial resource constraints. The implementing agency had to determine available excess funding from previous rounds and estimate the gains made from exchange rate fluctuations in order to make a realistic assessment of the number of grantees that could be covered. Because there was likely to be a shortfall, the third round was initiated with the understanding the government would request additional IDA financing for the project and not utilize existing funds. However, the government did not provide additional resources nor make a request to the Bank.

3.18   During preparation, the procurement assessment detected several weakness in the procurement capacity of UNCST. A concern was expressed about the level of experience of the procurement staff who had no prior experience with World Bank procurement procedures or those of other similar international organizations. To remedy this concern, the project preparation facility provided intensive capacity building through a consultant

experienced with World Bank procedures. Staff participated in procurement training in Washington, DC and at the World Bank's offices in Ghana.

3.19   Despite the support provided, procurement challenges surfaced, specifically long delays. Most grantees did not feel their institutions had the capacity to undertake procurement. Thus, UNCST implemented all procurement, as grantees assumed that central procurement would be more efficient and bulk ordering would result in cost savings. Even though additional procurement officers were hired, delays occurred during each grant round. They decreased with the third round. Some of the delays were outside the control of the implementing agency, such as the time (six months) for the Tax Office to clear scientific equipment, which were tax exempt. In many cases, grantees did not provide the specificity of detail to complete the orders, and some grantees were tardy with their requests. Because the implementing agency decided to procure for all grantees together, grants were uniformly delayed because the weakest link set the pace. While all respondents pointed out the shortcomings in procurement and the negative impact of the delays created for grantees, they felt the delays should have been anticipated in the planning timeline given the complexity of the task of ordering specialized scientific equipment. Even so, procurement was predominantly rated satisfactory by the Bank, with a few ratings of moderately satisfactory.

4. Achievement of the Objectives

Objective 1: Produce more and better quality S&T graduates

4.1   The achievement of this objective is rated substantial. The project supported two activities to produce more and better quality S&T graduates: outreach activities and grants (both Windows A and B). Evidence of the implementation of these activities and their impact is presented below.

Outputs
4.2   **Outreach activities**. National Science Week was held annually during the course of the project. This fora brought together grantees, leading scientists, policy makers, and youth. The first event was held in Kampala and later events included other areas of the country, such as Busia, Gulu, Kabale, Kabarole, Mbarara, and Tororo. Activities included a National Conference for Researchers, science competitions, youth science activities (e.g., tree planting and various science camps), exhibitions, and policy dialogues. Interviewees reported this activity brought excitement and enthusiasm about the importance of science and technology.

4.3   Scientists visited 86 secondary schools in Central, Eastern, Northern, and Western Uganda over the course of the project. The School Visit Program was intended to bring awareness to youth of science- and technology-related careers. A survey to measure perceptions of secondary students was conducted before the project implemented its outreach activities. A follow-up survey was done in the same schools but with a different group of students. This revealed an increase in more positive attitudes by secondary students toward studying S&T. There were regional and gender attitudinal differences (UNCST 2010b). While 85 percent of students surveyed enjoyed studying mathematics and science, more boys than girls rated themselves as excellent and very interested in

mathematics and science. More than half of students selected these areas for A-level subjects.

4.4   **Grants.** Senior and emerging research grants required a specified number of students participating in the research. These grants supported 57 masters and 33 PhD students. Grant resources covered the students' stipend and tuition. R research topics covered the fields of health, biomedicine, agriculture, engineering, conservation, veterinary pathology, chemistry, and information science. Thus, the grants not only supported the students' academic studies, but also gave them practical research experience.

4.5   Not all of the student researchers were able to graduate during the grant period; however, by the time of the IEG mission, most of them were reported to have graduated. The duration of the research grant was not sufficient for students to complete their studies. Grantees told the IEG mission that the scientific equipment arrived at the final stage of the grant, and they had to find ways to deal with this. Several grantees reported to the IEG mission that they had to obtain funding for PhD students to complete the research at other institutions (often outside Uganda), which was an unforeseen expense. Other students had to wait to complete their research.

4.6   The project also supported university grants to establish new or upgrade existing S&T programs. Ten grants were awarded—four new programs and six upgraded programs. Half of these grants benefitted one institution—Makerere University, which has the largest share of science and technology programs. New bachelor degree programs at Gulu, Makerere, and Busitema universities included textile engineering, biosystems engineering, and biotechnology. Two programs at Kabale and Kyambogo universities trained secondary teachers in mathematics and science curriculum. Updated programs at Makerere and Mbarara universities included physics, medicine, surveying, and pharmaceutical sciences. As part of the grant applications, universities made a commitment to maintain the program once the grant ended. All of these programs have continued since the ending of the MSI project in June 2013 (see table 4.1).

4.7   Every program has increased or maintained the number of students enrolled every year except for one, which suggests sustained program capacity above the target of 70 percent established at preparation. The physics program at Makerere University experienced a drop in enrollment as the University expanded other programs, but enrollment stabilized and increased in recent years. The program that trained diploma students to become secondary mathematics and science teachers experienced a decreasing number of students as tuition assistance ceased at the end of the grant. This lack of assistance had particularly negative consequences on female and poorer students, as they were the first to drop out. While the program started out as distance learning, it has been merged within a teacher education program at Kabale University. (See appendix B for graduates of MSI-supported programs.)

Table 4-1. Enrollment in New and Upgraded Programs Supported by MSI Grants 2008-2014

	2008	2009	2010	2011	2012	2013	2014
New Programs							
Kabale University: Secondary Teacher Education	40	40	40	45	30	28	20
Gulu University: Biosystems Engineering	21	34	54	77	71	69	60
Busitema University: Textile Engineering	NA	20	39	57	65	65	66
Makerere University: Biotechnology	NA	NA	29	58	58	—	—
Upgraded Programs							
Makerere University: Physics	194	95	78	61	72	112	113
Makerere University: Medicine	200	200	203	258	—	—	—
Makerere University: Surveying and Construction Management	551	592	618	685	729	—	—
Kyambogo University: Secondary Teacher Education	134	80	70	75	107	—	—
Mbarara University: Pharmacy and Pharmaceutical Sciences	106	135	210	—	—	—	—
Makerere University: Survey	65	48	75	75	—	—	—
Total	*1,311*	*1,244*	*1,416*	*1,391*	*1,132*	—	—

Source: IEG mission note.
Note: — = IEG was unable to collect data despite attempts through telephone and email; NA = nonapplicable because program did not exist that year.

4.8   Curricula were developed by grants. All programs were, and continue to be, accredited by the National Council for Higher Education. The accreditation process is meant to validate that the program's content is of high quality based on international standards and relevant to Uganda's needs. However, no one reported to the IEG mission that curricula were developed in collaboration with the private sector, which could have provided an advisory or review function of practical relevance or involvement in internship programs.

4.9   Laboratories were established, faculties were trained, equipment was supplied, and infrastructure was developed. Several universities established partnerships with other universities in Europe, South Africa, and the United States. Respondents noted that visits to these schools were an important means of support and provided a model for program development. These additional sources of technical assistance combined with the grant resources were reported to be particularly effective in enhancing quality.

4.10   A minority of programs established linkages with the local community. For example, the medical program at Makerere University partnered with local health clinics. Representatives from Gulu University promoted extension, outreach, and training programs. However, the topic of local development was not commonly discussed among

the grantees interviewed by the IEG mission. There was no requirement for grantees to provide students with community service opportunities, provide technical assistance to local government or other institutions, or develop linkages with the private sector.

4.11   Nationally, there is an increasing enrollment trend of S&T students in Uganda (table 4.2). During the project period, more than 10,000 bachelor students, nearly 500 masters students, and over 300 doctorate students enrolled in science related fields. The project contributed by supporting 33 PhD, 57 masters of science, and more than 6,000 bachelor of science students, based on data collected during the IEG mission (see table 4.1).[2] Clearly, the biggest project impact was the increase in the number of new science-related undergraduates by about two-thirds.

Table 4-2. Science and Technology Enrollment by Level of Degree 2008-2012

Field of Science	Bachelor			Masters			PhD		
	2008	2010	2012	2008	2010	2012	2008	2010	2012
Agricultural	1,824	2,137	4,255	130	115	167	36	0	109
Medical	3,613	4,230	3,391	328	370	723	30	0	68
Engineering and Technology	3,767	5,482	4,256	95	128	146	4	0	35
Natural	8,294	12,137	17,427	625	770	598	9	2	190
Total	*17,498*	*23,986*	*29,392*	*1,178*	*1,383*	*1,634*	*79*	*2*	*402*
Other Fields									
Social Sciences	54,762	60,188	39,904	4,007	3,752	2,476	65	30	148
Humanities	7,802	14,259	19,894	224	682	1,090	7	41	50
Total	*62,564*	*74,447*	*59,798*	*4,231*	*4,434*	*3,566*	*72*	*71*	*198*

Source: UNCST (2014a).

Outcomes

4.12   The growth in science and technology fields between 2008 and 2012 outpaced those in the social sciences and humanities (table 4.2). The largest rate of growth was in PhD scientists (79 in 2008 to 402 in 2012). At the bachelor's degree level, science and technology enrollment more than doubled (12,498 in 2008; 29,392 in 2012), with a decrease in those enrolled in humanities. Science and technology masters enrollment also rose, although not at the rate of growth experienced at the other levels (1,178 in 2008; 1,634 in 2012). Given the time it takes students to complete a doctorate, all of these changes cannot be solely attributed to project activities. The government provides a scholarship program and in recent years has prioritized support for students studying within science and technology. Donors and other bilateral aid agencies, such as Sweden and the European Commission, have also provided student scholarships.

4.13   During the project, tracer studies were not conducted; however, grantees reported they had completed one since project closure. Respondents from three different university programs wanted to know if their students were employed and in what fields to assess program effectiveness. All students were employed within six months, according to their reports. Respondents believed that tracer studies, along with the time and resources to complete the studies, should have been part of the grant process. This type of evaluation

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[2] Students were supported through research or program grants.

was not costly, as they utilized student associations and social media to track students. Formal internal university reports documenting these tracer studies were not shared with IEG, thus the strength of these reports is unclear. The project did not collect data showing the percentage of the grant supported graduates that were employed in S&T fields within six months.

Objective 2: Produce higher quality and relevant research

4.14   The achievement of this objective is rated substantial. There were three activities that the project supported to produce higher quality and relevant research: the Better Research Program, grants to researchers, and institutional strengthening of UNCST.

Outputs

4.15   **Better Research Program**. UNCST provided training in writing grant proposals prior to each call. The program had a high level of participation with 303 researchers being trained. Researchers from all the public and leading private universities and major research institutes (i.e., agriculture, crops, and fisheries) participated. Respondents told the IEG mission that the Millennium Science Initiative was the most competitive process they had ever experienced. The quality of the proposals increased in each round, according to UNCST staff. IEG randomly selected and reviewed one-third of the grants across the three calls. Review of this sample confirmed the high quality of the initial application and closing reports. Principal investigators reported to IEG that their grant writing skills improved through the Better Research Program. They also reported that since the MSI grant process, they secured funding from the Gates Foundation, other donors, U.S. National Institutes of Health, and other programs. These claims are consistent with data collected by UNCST showing that 32 Ugandan researchers in 2012 received funding of more than $50,000—a marked increase over the 9 received in 2007 (UNCST 2013).

4.16   **Institutional strengthening of UNCST.** During the course of the project, Uganda's National Policy for Science and Technology (MFPED 2009) was developed by UNCST and was adopted by the government in 2009. UNCST was also instrumental in developing the National Biotechnology Policy. Policy studies, such as on science technology and innovation (UNCST 2010a), were developed and disseminated at a two-day policy workshop. Another policy study explored the topic of increasing participation of women in science and technology.

4.17   Training and capacity development were provided for 45 UNCST staff. Training was related to project implementation and management as well as S&T topics to improve staff capacity to implement its institutional mandate.

4.18   Science and technology statistics and publications begun during the project have been updated and published annually. For example, UNCST has continued collecting country-level data related to the number of researchers, publications, and intellectual property.

4.19   **Research Grants.** Twenty-five grants to senior researchers (about $800,000) and emerging researchers ($250,000) were awarded. Principal investigators commented

positively on the size of the grant, noting most of the aims of the research were achieved and capacity was built through the acquisition of scientific equipment. Researchers told the IEG mission that lack of resources and equipment were a constraint. With grant resources, they were able to upgrade laboratories, buy scientific equipment, and engage in more specialized research such as biogenetics. Every researcher stressed the importance of scientific equipment to sustainability as procured items remained in use. Capacity to maintain the specialized equipment was an identified constraint. Without this knowledge, expensive equipment may fall into disrepair and need to be replaced. The project operational manual noted that grantee institutions should have capacity and responsibility to maintain procured equipment.

4.20   Research was aligned with priority areas within Uganda with a special focus on agriculture studies (see table 4.3). Critical sectors for science and technology investment included environmental science and engineering, ecology science, food and agriculture science, health, and civil and transportation engineering (World Bank 2011). Agricultural research was highlighted in Uganda's National Development Plan (2010) to boost production and productivity. Consistent with the plan's emphasis on animal and crop disease, research grants focused on making cassava more disease-resistant and growing crops that can tolerate dry and drought conditions. As recommended by previous IEG evaluations (IEG 2007), the research focused on staple food products in order to meet dietary needs of Ugandans from crops such as maize and cassava, rather than export crops.

4.21   Some of the research outputs from the grants included malaria vaccine design and assessment that is expected to develop new vaccines; identification of genetic markers in the Nile perch; new crop varieties; model to assess climate variability and environmental degradation of Lake Victoria; human papilloma virus disease prevention and surveillance with applications for future health care education; cattle feed to enhance milk production; protocols for rapid multiplication of bananas; new diagnostics tools for domestic animals and poultry; new construction materials developed from local resources to improve chemical stabilization, strength, and durability; and creation of new models for scaling up access to wireless services (UNCST 2014b; World Bank 2013).

4.22   During the first round of grant selection, project records indicated few quality proposals for engineering fields or from women scientists. Through the Better Research Program, efforts were made to reach researchers in these disciplines as well as women scientists.

Table 4-3. Research Grants by Discipline (number and percent)

Research Area	Grants Awarded (number and %)
Environmental and Ecological Science	2 (8%)
Energy	1 (4%)
Food and Agriculture Science	11 (48%)
Civil Transport Engineering	0
Health and Medical Science	6 (26%)
Information and Computer Technology	1 (4%)
Veterinary Sciences	2 (8%)
Total awarded	*23*

Source: UNCST (2012b, 2014b)..

4.23   By a number of measures, research increased since the beginning of the project. The number of active researchers in Uganda more than tripled (i.e., 158 to 700) between 2007 and 2012 (UNCST 2012a,c,d). Uganda researchers demonstrate capacity in the areas of infectious disease, food science, tropical medicine, and biotechnology (World Bank 2011), which align with areas funded by the project. Publications from Makerere University, which received a large share of grants, rose between 2011 and 2012 (based on citation database tracking), which suggests dissemination of knowledge to a worldwide audience (UNCST 2014a). The research output in the East African region, which contains Ugandan researchers, grew by 12 percent between 2003 and 2012 along with highly cited articles,[3] which suggest that both the quantity and quality of research performance in the region has improved (World Bank 2014). While it should be recognized that the government increased its financial support for science and technology between 2005 and 2010 (UNCST 2014a), Ugandan research is almost entirely donor-funded (World Bank 2011). The project's contribution included 23 research grants that supported 250 scientists (i.e., principal researchers as well as student researchers within research teams and their thesis and dissertation research) (UNCST 2014b).

4.24   Several research grantees established formal and informal partnerships with foreign universities and research centers. The aim of most partnerships was knowledge exchange. More researchers in Uganda are publishing in international peer-reviewed journals. Over a four-year period, articles increased from 2 to 4 percent (World Bank 2013). The project contributed to this increase: every research grantee who met with the IEG mission reported that at least two publications in peer-reviewed journals had resulted from the grant.

4.25   While the operational manual permitted intellectual property application from the knowledge generated from grant-related research, none of the principal investigators reported applying for patents or other forms of intellectual property for the research affiliated with the grant. Ugandan regulations were viewed as a barrier to intellectual property rights. Researchers said there are challenges in obtaining intellectual property rights, particularly when the government funds research. This constraint was previously noted in relation to the uncoordinated legal frameworks for the commercialization and protection of innovation (World Bank 2011). Thus, fewer patents or intellectual property rights have been registered in recent years and none from Ugandan researchers (UNCST 2014a).

Outcomes

4.26   The IEG mission asked grantees to describe what was accomplished from the research. The IEG mission spoke with over one-third of principal investigators. They consistently reported new knowledge and the development of new research capacity as the achievements. For example, drought resistant varieties of plants were identified as well as the genome sequencing for various crops. Most researchers viewed publications as the measure of success. Every research grantee who was interviewed provided publications

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[3] Articles that meet the threshold for being considered among the world's top 10 percent or those in the 90 percentile in terms of citation count.

arising from the grant-funded study. While fewer grantees tried to connect the knowledge that was generated to users—policy makers, researchers, extension workers, farmers, or others such as health care workers and the private sector, analysis of grant completion reports shows practical impact from the research completed (e.g., new vaccination development; new crop varieties; applications for future health care education; cattle feed that enhanced milk production; new diagnostics tools; new construction materials developed from local resources that improved the chemical stabilization, strength, and durability; and creation of new models for scaling up access to wireless services (UNCST 2014b).

Objective 3: Utilize S&T by firms to improve productivity

4.27   The achievement of the project's objective is rated **modest**. Two activities were supported to attain it: institutional strengthening of UIRI and grants. The evidence of the implementation of these activities and their impact is presented below.

Outputs

4.28   **Institutional strengthening of the UIRI.** As a result of the project investments in UIRI, resource centers such as technology development, microbiology laboratory, chemistry laboratory, and engineering workshop were established or upgraded. From these centers, UIRI can provide support and incubation services, prototyping, and market testing to small- and medium-size firms. These centers gave hands-on training to over 1,500 people, including students through the relationships UIRI developed with universities (UIRI 2014). The centers have been used to develop low technology cottage industries for rural areas and support more incubators. During the IEG mission, examples were shown of UIRI's work with new firms in cosmetics (e.g., lotion, soap), food production and processing, craft (i.e., paper making, necklaces), and coffee roasting. The technology center has aided the development of new technology such as low cost medical diagnostic tools and mobile apps for police officers (UIRI 2014). The resources that UIRI has generated from these services annually have been $33,602 (UNCST 2012b). In the past year, UIRI has provided incubation services to 31 new firms.

4.29   **Innovations Grants**. Six grants were awarded to finance collaboration between industry and researchers. One grant established a student internship program between a technical college and a medium-size firm. This program supported 40 students during the two years of the grant and has continued each year to provide 10 students with an internship. Three grants funded feasibility studies to determine commercial viability for fishery, salt, and rice processing. No further commercialization efforts were made by these three grantees with their own resources. One grant tested the effect of supplements on milk production in cows. Another grant created a prototype for automating cargo for a transport firm. Technology transfer or adoption was only evident within two of the grants, based on interviews and project documents.

4.30   While the project collected data on the employment of science and technology graduates, and on firm's innovation, any changes were not plausibly attributable to the project. Thus, the utilization of science and technology outputs (i.e., research and graduates) by firms supported with grants is modest.

5. Efficiency

5.1   On balance, efficiency is rated **substantial**, but there is no measure of the efficiency in how grant resources were utilized.

Economic and Financial Efficiency

5.2   The appraisal document did not conduct an economic analysis. Instead, the economic justification for the investment was based on the positive returns that would be expected from upgrading technology. The annual project investment costs were compared to the losses experienced by the fisheries industry from the European Union's ban on Uganda's fish exports ($36 million in 1998 and the value in 2006 of more than $48.1 million). These losses resulted from lack of institutionalization of technology. The appraisal document suggested the expenses for MSI or investment in science and technology was a fraction of the losses experienced and had the potential to spark technology upgrading or new business opportunities. The Quality at Entry Review conducted by the Bank commented on the weak economic analysis that was conducted at appraisal.

5.3   A cost benefit analysis was conducted at closure. The internal rate of return was estimated to be between 31 and 33 percent with the net present value ranging from $69 million to $81 million. The assumptions were appropriate and included an unemployment rate ranging from 5 percent to 15 percent; public and private expenses for the number of students supported by the project; estimation of wages for a person working until 60 years; and a discount rate of 15 percent. Moreover, more science and technology graduates have been employed (UNCST 2014a) and their wages have risen more dramatically than those who have not completed secondary or post-secondary education. However, the percentage of grant-supported graduates who obtained employment in S&T fields within six months is unknown.

5.4   High rates of return (ranging from 10- to 0 percent) at the firm and industry level are seen in research and development in member countries of the Organisation for Economic Co-operation and Development (OECD) (World Bank 2006). Agricultural research and development was the main focus within grants (table 4.3). It has even higher estimated rates of return and the average rate across all types of commodities was 81 percent (World Bank 2006). This suggests the operation's investment in research and development provides value for money, but IEG could not assess the efficiency in how grants were utilized.

Administrative and Organizational Efficiency

5.5   Other aspects that demonstrated project efficiency were the full disbursement of the IDA credit, three rounds of grants funded instead of the two planned due to the efficient use of resources, and gains from the exchange rate.

5.6   Despite procurement delays, the decision to centralize procurement with the implementing agency was reasonable. International competitive bidding likely created cost savings in the purchase of scientific equipment. In contrast to other countries, such as

Indonesia and Vietnam, complex challenges emerged when procurement was decentralized to higher education institutions (IEG 2015a,b). Procurement delays created a serious risk to attaining development objectives within the Indonesia Managing Higher Education for Relevance and Efficiency Project (IEG 2015b), which was not the case in this operation.

6. Ratings

Outcome

6.1   The outcome rating is **moderately satisfactory**. Relevance of objectives are rated substantial, while design is modest. The government has prioritized science and technology within its strategies. Achievement of the first objective to increase the supply of S&T graduates was substantial. Achievement of the second objective to increase research is rated substantial, while the achievement of the third objective to facilitate firm's utilization of S&T outputs was modest. Ten academic programs were created or /upgraded. There has been an increasing enrollment in science and technology students in Uganda with the project supporting over 6,000 students. Efficiency is rated substantial. This outcome rating is consistent with minor shortcomings in preparation, design, and implementation.

Risk to Development Outcome

6.2   Several factors mitigate the risk to maintaining the improvements made and the development outcomes. First, the government remains committed to increasing its investment in science, technology, and innovation to achieve a knowledge-based economy. Science and technology has now been assigned ministerial responsibility within the newly restructured Ministry of Education, Science, Technology, and Sports. While questions remain about the inter-ministerial coordination of science and technology, the move signals the importance that science and technology holds for the government. It also has a relationship with South Africa where it can tap into technical assistance from research organizations and universities.

6.3   Second, the capacity of both parastatal organizations (UNCST and UIRI) has been strengthened and both continue to implement their respective mandates well. UNCST publishes annual reports and collects science and technology statistics. These data provide a useful yardstick to determine whether Uganda is transforming into a knowledge-based economy. UNCST has promoted practical ways for growth in science and technology, provided policy advice to the government, and is advancing lobbying efforts for a biodiversity regulation. UNCST has experience implementing a competitive funding facility; this knowledge remains within the staff. UIRI's resource centers developed under the project continue to be used to provide incubation services to industry and firms as well as training.

6.4   Third, university programs funded by grants have been sustained. As part of the grant application process, universities had committed to maintaining the program once the grant ended. This process was initiated during the grant—a decreasing percentage of resources were provided each year in the grant. Another aspect of project sustainability is the increased capacity of principal investigators and student researchers. Many principal investigators utilized the experiences gained in participating in competitive grant process

to pursue external resources such as the U.S. National Institutes of Health, Gates Foundation, and other bilateral agencies

6.5   Finally, Uganda will be part of a follow-up Bank project—the Regional Center of Excellence. Through a grant application process, universities can solicit additional funding to expand and improve programs. The experience previously gained will likely help universities participate in the follow-up operation.

6.6   Without continued annual funding at a level consistent to MSI, some reversals to gains were made during the project. While the appraisal document estimated the fiscal impact for the government to sustain the MSI Funding Facility to be 0.2 percent of government expenditures in 2011/2012, the government has not continued the fund at the same level. It has continued a science and grant fund via UNCST but at a reduced scope and level of financial support. Better Researcher Program, National Science Week, and other outreach activities ceased at project closure. The operating budget of UNCST cannot support these programs. The government has not maintained the level of resources to appropriately fund science and technology research. As well, considerable pipeline issues in post-basic education remain. Until these issues are resolved, remediation services may need to be provided by higher education institutions to facilitate a larger pool of students equipped to study science and technology at the tertiary level. The overall science and technology system remains fragmented and needs strengthening. In view of these factors, the risk to the development outcome is rated significant.

Bank Performance

6.7   Overall bank performance is moderately satisfactory.

6.8   Quality at entry is rated moderately satisfactory. Wide stakeholder consultations were initiated to understand the needs and ideas of various constituent groups across science and technology as well as develop government buy-in. The task team leader (TTL) arranged a special lunch and conference for members of parliament who were on the Committee on Science and Technology and Social Services. The initial design was shared with stakeholders, and after their feedback, design was revised.

6.9   The project benefited from the Bank's prior experience implementing science and technology funds in other countries such as Brazil, Chile, Mexico, and the República Bolivariana de Venezuela. These lessons were used during preparation. For example, the importance of competition and transparency as well as the size of the grants need to be sufficiently large to allow researchers to compete at international levels. The grants need to cover a variety of expenses: training, salaries, equipment, and stipends. International science and technology experts also provided advice during preparation. These consultations ensured the activities were aligned with areas of highest priority for Uganda and helped to develop a research fund consistent with international best practices, but gender could have been more prominent within project design.

6.10   Preparation was thorough, not just technical design, but also the implementation aspects. A number of activities were completed during preparation, which facilitated rapid implementation. These activities included the development of a detailed project operational

manual; project implementation plan; detailed plan of project costs and schedule of implementation activities; announcement of research grants; calls for proposals; modalities for announcement of research grants; procedures governing calls for proposals and procurement; contracts; and baseline data. The members of the Technical Committee were selected after a large consultation process between the Bank and Project Advisory Group. Nearly every implementation detail was described in the project implementation plan and operational manual completed prior to effectiveness. Because of this level of detail, the manual was the tool for answering questions from implementing agency staff and grantees that arose during implementation. However, there were shortcomings in relation to M&E.

6.11   The Bank team was proactive and sought additional resources. A grant from the Japanese government facilitated the restructuring and strengthening of UNCST and UIRI, extensive stakeholder consultations, and other project preparation activities. The aim of capacity building was defined. Capacity development included training on project management, procurement, financial management, as well as technical knowledge related to M&E and science and technology. This strengthening was designed to facilitate project implementation.

6.12   The Bank conducted all necessary assessments. Risks were appropriately identified as well as mitigation measures, except in the case of the fund's sustainability, which was neither identified nor mitigated. The fiduciary assessments identified weaknesses, including procurement, which were subsequently addressed with technical support or appropriately mitigated.

6.13   At the time of project preparation, the government requested, and IDA agreed, that IDA resources would cover total project costs. This arrangement was believed to pose no threat to the sustainability of the project. In hindsight, while this financing arrangement permitted experimentation to see whether a research fund facility is a viable mechanism for Uganda, it did not facilitate ownership.

6.14   Bank management provided active supervision of the preparation and did not rush the process. The manager signaled the early need for the Bank team to provide additional support with Bank procurement procedures, given the implementing agency's unfamiliarity with them.

6.15   Quality of supervision is rated moderately satisfactory. There were two TTLs over the course of the operation. The second was based in Uganda. The transition was smooth between the TTL who prepared the project and supervised it during the first year and the other TTL. The Bank team provided active supervision and support throughout the life of the project. TTLs routinely diagnosed issues and bottlenecks and proposed multiple options for the implementing agency to consider. During implementation, Bank staff gave feedback on the interim financial reports to offer greater clarity on how to present and organize information. Bank staff also provided suggestions to ease tracking and streamline procurement processes and mitigate a negative impact on project implementation aide-mémoires, and supervision reports were candid and insightful on implementation strengths and weaknesses. Ratings were also used as an appropriate signal to the implementing agency. Monitoring and evaluation data were routinely used to measure attainment of the objectives and gauge project implementation. TTLs visited grantees and participated in

every National Science Week. There was an evident focus on the development outcome among the Bank team. Even so, shortcomings were found in M&E which were not fully addressed during the 2010 project restructuring. Likewise, this restructuring was late in the project cycle to initiate the changes.

6.16   The Bank team engaged actively on science and technology policy dialogue with the government over the course of the project. This dialogue discussed pipeline issues that needed to be addressed, such as the secondary schools' inability to implement the science curriculum mandates, and broader issues such as funding for science, technology, and innovation in the national budget and the need for more ministerial responsibility and coordination of science and technology. The Bank produced several economic and sector works specific to Uganda, which facilitated policy dialogue (Brar and others 2011; Nanyonjo 2007).

6.17   Sustainability of the fund was advocated during supervision by the Bank team. It conducted multiple follow-ups with the Ministry of Finance, Planning, and Economic Development related to the process of making the request for additional funding.

Borrower Performance

6.18   Overall borrower performance is rated moderately satisfactory.

6.19   Government performance is rated moderately satisfactory. There was high-level government participation in project preparation, and the government was committed to advancing science and technology. It satisfied all conditions for effectiveness. The Ministry of Finance, Planning, and Economic Development completed the requisite actions during preparation including institutional strengthening of the implementing agencies, and it selected UNCST to manage the project. It correctly avoided the creation of new structures given an existing government entity with the mandate for coordinating science and technology policy across ministries, and it ensured that high-level staff filled key positions.

6.20   The operation received a high level of government support. The president of Uganda participated in the project launch. The vice president participated in the first National Science Week. The minister of finance participated in a project-closing event. A National Science Technology and Innovation Policy was brought to the cabinet by the Ministry of Finance, Planning, and Economic Development. The government has prioritized more scholarships to science and technology students, as these disciplines were viewed critical to national development.

6.21   There were, however, some shortcomings in the government's performance. Borrower contributions were in-kind recurrent expenses for the UNCST, slightly lower than anticipated. There were delays in follow-up actions from the Ministry of Finance, Planning, and Economic Development, and it did not request additional IDA financing for the third round of grants, even though the third round was initiated after the government expressed its commitment to do so. It did not follow up on the Bank's expression of interest to provide additional financing to sustain the Funding Facility and allow the government more time to incrementally allocate budget resources. It took considerable

time (six months) to clear the procured scientific equipment that was tax exempt from the Tax Office. Several instances of delays in clearing aide-mémoires and responding to actions needed follow-up attention. There was delay in appointing members of the Executive Committee of UNCST after terms ended.

6.22   The implementing agency performance is rated moderately satisfactory. During the course of preparation, UNCST was reorganized and a new Executive Secretary was appointed after the retirement of the previous one. The Technical Committee was established immediately upon effectiveness.

6.23   UNCST staff were part of the Project Advisory Group, which was charged with completing all facets of project preparation. Within the opening weeks of the project, calls for proposals were disseminated to the S&T community, and those received were expeditiously and transparently processed. The first call under the operation was announced by the president of Uganda at the February 2007 project launch. The first round of grantees was announced during the first National Science Week in September 2007, within six months of project effectiveness. The calls for grants were well advertised to solicit the interest of researchers. Additional efforts, such as a breakfast forum with industry as well as advertisements, were made to raise awareness among potential Window C applicants.

6.24   While fiduciary management was adequate, shortcomings were found in both financial and procurement management. Closer monitoring and guidance were needed by the implementing agency of grantees given instances of poor fund management. Procurement was delayed during every round, which had negative implementation implications as grant timelines were tight and delays were unanticipated. While delays persisted despite additional procurement staff, they were not solely attributed to the performance of the implementing agency given contributing factors beyond its control.

6.25   Overall, UNCST did an excellent job implementing the competitive grant fund. Proposal writing workshops were held prior to each call by the implementing agency. The process was efficient, transparent, and well organized. As a result, visitors from other countries such as Tanzania came to learn from Uganda's experiences. Safeguard compliance was monitored and ensured. Project indicators were continuously collected and used to assess implementation progress. The Technical Committee made site visits to grantees. Grantees also rated the performance of UNCST favorably.

Monitoring and Evaluation

6.26   The quality of monitoring and evaluation is rated substantial.

6.27   **M&E Design:** The appraisal document provided a detailed plan for monitoring and evaluation. Anticipated uses for the project's data included determining whether the project objectives were likely to be achieved, while other measures gave information to stakeholders in S&T- related ministries and agencies. A clear timeline for data collection and analysis was established along with explicit assignment of responsibility. The type of instrument that would be developed to generate project indicators was clearly identified. Baseline data were collected during preparation for several key performance indicators.

Definitions of key indicators and the survey plan were prepared to generate comparable data.

6.28   The project's objectives, components, and outcome measures were generally logically linked, but with weaknesses. M&E activities were designed to measure progress and attainment of objectives, as well as collect broader data related to national science and technology. This was an attempt to address the paucity of national data and information on science, technology, and innovation in Uganda that was noted during project preparation. Policy studies related to science and technology were also included. However, this resulted in limited outcome data to measure each objective.

6.29   Most of the key performance indicators measured science and technology in Uganda rather than that attributable to project interventions. For example, undergraduate and graduate enrollment of S&T students, researchers, publications, patents and intellectual property rights were measured across the country. Given the limited nature of the grants, indicators restricted to measuring the impact of the grants may have been more appropriate, such as S&T enrollment through grants, publications arising from grant funding, and number of grant-supported scientists. It is notable that the Results Framework contained an employment indicator, but the one selected (i.e., increasing the number of S&T graduates within technology firms) was not aligned with grant activities, thus outside the scope of the project. A more appropriate measure may have been tracer studies of the students who benefitted from the grant funding or the percentage of grant supported graduates employed in S&T fields within six months. The private sector and technologically advanced firms were prominent within the Results Framework. Given the limited level of technology development, the project's emphasis within these firms may have been an incorrect assumption, as the more likely beneficiaries of Window C were small and medium enterprises. No indicator was established to identify results of the research grants during the life of the project. Instead, process-related aspects of the grants were tracked. Gender disaggregated data were not designed, nor collected. As a result, it is unclear the contributions the project made to advance women's enrollment in science and technology programs

6.30   **M&E Implementation:** UNCST effectively monitored project indicators throughout the project. Within eight months of project effectiveness, baseline data were collected on all key performance indicators. Refinements to baseline data continued the following year, as the first round of surveys were implemented. Consultants prepared surveys related to the size and productivity of active research teams, client satisfaction with UNCST and UIRI services, and high school students' impressions of science and technology careers. UNCST supervised all survey collection. Project data were routinely monitored to assess implementation progress. An independent assessment was made by visiting experts familiar with the implementation of science and technology research funds. This was done to assess implementation progress of the fund. Comments from these experts indicated the grant program was implemented consistent with international best practices—transparent and a high level of competition. The quality of M&E was high as data consistency was found with the data collected by UNCST and during IEG's mission.

6.31   **M&E Utilization:** Science and technology statistics and publications begun during the project have been updated and published annually. For example, UNCST has continued

collecting country-level data related to the number of researchers, publications, and intellectual property. These publications provide trend data on science and technology within Uganda. UNCST has used this data in performing its mandate of policy advice to the government.

7. Lessons

7.1   Based on the experience of this project, several lessons can be drawn.

- **While research funds are common in OECD countries, it is also possible to establish and implement a world-class science research fund in a low-income country.** This project has demonstrated a competitive funding facility that promotes science and technology, and the Uganda National Council for Science and Technology implemented it consistent with a high degree of transparency. There was no government interference in the process. The Technical Committee awarded grants based on a clear selection process consistent with international good practices. This created high-quality proposals, a high level of competition, and accountability for the grants.

- **An appropriate cost-sharing agreement is needed at entry to facilitate sustainability**. An IDA grant was provided to the government for nearly all operational costs. It was believed that this arrangement would pose no threat to sustainability as the government was committed to science and technology and provided high-level support during the project. In the end, the government did not provide its own resources to maintain the research funding facility nor did request continued funding from the Bank. While these decisions are beyond the control of the Bank, the Bank has the ability to add conditions upfront such as requiring the government to put more resources into the fund or requiring the government to take an increasing share of resources each year.

- **The promotion of a knowledge-based economy requires an integral approach, involving several ministries as well as the private sector.** The project focused on the funding facility to promote science and technology as one component of the system. Simultaneously, additional efforts by the Bank—analytical work, other lending operations, and policy dialogue—addressed other aspects of the system. While the Bank advocated ministerial ownership of the topic and inter-ministerial coordination, it also worked on pipeline issues within secondary education and addressed research and linkages with the private sector. Despite these efforts, the national system remains weak and additional institutional strengthening is still needed to bring all of the elements of the system together. It is too early to know whether the new ministerial structure implemented in 2015 will have an effect on bringing these separate, but integral pieces, together to work synergistically.

- **A research fund is a viable mechanism to increase research and create programs for science and technology graduates, but its impact may be enhanced by extending capacity-building and technical assistance to grantees.** There were benefits when grantees also received capacity-building or technical assistance, suggesting the impact could be enhanced when financial grants are combined with technical support.

- **Requiring data collection for grants may also yield better impact or at a minimum a clearer understanding of what was achieved.** Ensuring the capacity building of grantee institutions to implement periodic tracer studies with consistent methodology may be a step toward providing relevant data to academic programs.

- **Given the low numbers of Ugandan women scientists, a gender focus is warranted.** Giving more prominence to gender could have further incentivized the supported programs and outreach activities to add activities to promote female participation and address the barriers. As well, collecting gender-disaggregated data would have revealed the project's contribution, which is unknown.

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Appendix A. Basic Data Sheet

Republic of Uganda Millennium Science Initiative Project (Loan C4174, P086513)

Key Project Data (US$, millions)

	Appraisal estimate	Actual or current estimate	Actual as % of appraisal estimate
Total project costs	33.35	34.72	104.10
Loan amount	30.00	31.91	106.36
Cancellation	—	2.09	—

Cumulative Estimated and Actual Disbursements (date of final disbursement: May 28, 2013)

	FY07	FY08	FY09	FY10	FY11	FY12	FY13
Appraisal estimate (US$, millions)	1.49	4.42	9.90	17.94	25.98	29.99	30.00
Actual (US$, millions)	2.95	3.13	6.70	14.82	20.94	26.85	31.91
Actual as % of appraisal	197.98	70.81	67.67	82.60	80.60	89.52	106.36

Project Dates

	Original	Actual
Initiating memorandum	07/30/2004	01/31/2005
Negotiations	01/28/2005	03/27/2006
Board approval	03/15/2005	05/25/2006
Signing	05/31/2006	08/11/2006
Effectiveness	03/02/2007	03/02/2007
Closing date	12/31/2011	06/30/2013

Staff Inputs (staff weeks)

Stage of Project Cycle	Staff Time and Cost (World Bank budget only)	
	Number of staff weeks	**US$, thousands (including travel and consultants costs)**
Lending		
FY04	0.00	8.77
FY05	35.70	165.97
FY06	50.00	226.45
Total	*85.70*	*401.19*
Supervision/Implementation Ccompletion and Results Report		
FY07	19.70	99.69

FY08	12.40	44.75
FY09	10.10	52.35
FY10	14.10	100.36
FY11	18.10	137.77
FY12	14.90	88.88
FY13	14.40	98.12
Total	*103.70*	*848.37*

Mission Data

Names	Title	Unit	Responsibility or Specialty
Lending			
Michael F. Crawford	Senior Education Specialist	LCSHE	Original TTL
Edith Ruguru Mwenda	Senior Counsel	LEGAF	
Eva K. Ngegba	Program Assistant	AFTHE	
Richard Olowo	Senior Procurement Specialist	AFTPC	
James A. Socknat	Consultant	AFTH1 - HIS	
Peace K. Tukamuhabwa	Program Assistant	AFMUG	
Patrick Piker Umah Tete	Senior Financial Management Specialist	AFTFM	
Johannes Widmann	Country Officer	AFCKE	
Supervision/ICR			
Hiroshi Saeki	Economist	AFTEE	ICR TTL
Akim Okuni	E T Consultant	AFTH1 - HIS	
Edith Ruguru Mwenda	Senior Counsel	LEGAF	
Eva K. Ngegba	Program Assistant	AFTHE	
Gary Scotland	Consultant	AFTH1 - HIS	
Gladys Akurut Alupo	Program Assistant	AFMUG	
Hege Hope Wade	Senior Operations Officer	AFMUG	
Howard Bariira Centenary	Senior Procurement Specialist	AFTPC	
Innocent Mulindwa	Education Specialist	AFTED	
Jayashree Chandramouli	Finance Assistant	CTRDM	
John McIntire	Country Director	AFCE1	
Kathryn Ann Funk	Country Program Coordinator	EACCQ	
Lalitha Sairam	Financial Analyst	CTRFC	
Marie Khoury	Consultant	CTRFC	
Patrick Piker Umah Tete	Senior Financial Management Specialist	AFTFM	
Paul Kato Kamuchwezi	Financial Management Specialist	AFTFM	
Rajat Narula	Senior Financial Management Specialist	EAPFM	
Richard Olowo	Senior Procurement Specialist	AFTPC	
Rosemary Mugasha	Team Assistant	AFMUG	
Sara Elizabeth Farley	Consultant	AFTED	
Sukhdeep Brar	Senior Education Specialist	AFTED	TTL

Appendix B. List of Persons Met

1.   Frederick Matyama, Assistant Commissioner, Ministry of Finance, Planning, and Economic Development
2.   Masaba Andrew, Senior Economist, Development Assistance and Regional Cooperation, Ministry of Finance, Planning, and Economic Development
3.   Kevin Balaba, Acting Commissioner of Education Planning, Ministry of Education, Science, Technology, and Sports
4.   Julius Ecuru, Assistant Executive Secretary, Uganda National Council Science and Technology
5.   Hellen Opolok, Science Officer, Uganda National Council Science and Technology
6.   Anthony Okimat Opolot, Head Procurement, Uganda National Council Science and Technology
7.   Tom Byarulanga, Senior Internal Auditor, Uganda National Council Science and Technology
8.   Deborah Kasule, Head, Science and Technology Outreach Unit, Uganda National Council Science and Technology
9.   Mylia Rubanzana, Head, Financial Management, Uganda National Council Science and Technology
10. Ismail Barugaliara, Assistant Executive Secretary, Uganda National Council Science and Technology
11. Dr. Dick Kamugasha, Director Technology Development Center, Uganda Industrial Research Institute
12. Prof. Charles Kwesiga, Executive Director, Uganda Industrial Research Institute
13. Deborah Wendiro, Head, Microbiology Department, Uganda Industrial Research Institute
14. Michael Crawford, Lead Education Specialist, World Bank
15. Elizabeth Ninan, Senior Education Specialist, World Bank
16. Sukhdeep Brar, Senior Education Specialist, World Bank
17. Howard Centenary, Senior Procurement Specialist, World Bank
18. Harriet Nannyonjo, Senior Education Specialist, World Bank

Grantees and Students

19. Dr. Settumba Mukasa, Department of Crop Science, Makerere University
20. Dr. Justus Rutaisire, National Agriculture Research Organization
21. Dr. David Osiru, Department of Crop Science, Makerere University
22. Dr. Julius Bunny Leju, Department of Biology, Mbarara University of Science and Technology
23. Dr. Yona Baguma, National Agriculture Research Organization
24. Dr. Titus Alicai, National Crops Resources Research Institute, Namulonge
25. Dr. Godfrey Asea, National Crops Resources Research Institute
26. Prof. Allen Babugura, Kabale University
27. Prof. Callistus Wehchy Baliddawa, Gulu University
28. Ben Waswa, Accounts Assistant, Gulu University
29. Jacob Wouorach, Student, Gulu University
30. Collins Okello, Student, Gulu University
31. Emily Atuhaire, Student, Gulu University
32. Dr. Florence Mutonyi D'ujanga, Department of Physics, Makerere University
33. Dr. Jerome Kubiriba, National Crops Resources Research Institute

National Agriculture Research Organization

34. Dr. Stanley Nkalubo, National Crops Resources Research Institute, Namulonge
35. Dr. Theordora Twongiyiwe Mondo, BM Technical Services
36. Johnnie Wandera, Busitema University
37. Geoffrey Lamtoo, Academic Registrar, Gulu University

38. J.H. Nyeko Pen-Mogi, Vice Chancellor, Gulu University
39. Samuel Okurut, Research Officer, National Agriculture Research Organization
40. GeraldKerali, Makerere University
41. Michael Mugabira, CEO, Eden Forestry Company
42. Daniel Musiitwa, JDG Africa Limited
43. Samuel Kyamanywa, Makerere University Crop Science
44. Henry Wagaba, Student

Others

45. Jason Mosomi Mochache, Chief Education Specialist, African Development Bank
46. Maria Nakachwa, Statistics Office, National Council Higher Education

Appendix C. Graduates of MSI-Supported Programs

Graduates in New and Upgraded Programs Supported by MSI Grants, 2009-2014

New Programs	2009	2010	2011	2012	2013	2014
Kabale University: Secondary Teacher Education	NA	NA	32	40	40	—
Gulu University: Biosystems Engineering	NA	NA	NA	18	11	17
Busitema University: Textile Engineering	NA	NA	NA	18	17	15
Makerere University: Biotechnology	NA	NA	NA	NA	—	—
Upgraded Programs						
Makerere University: Physics	99	71	53	63	56	60
Makerere University: Medicine	173	158	—	—	—	—
Makerere University: Surveying and Construction Management	70	107	132	91	—	—
Kyambogo University: Secondary Teacher Education	—	—	—	—	42	48
Mbarara University: Pharmacy and Pharmaceutical Sciences	12	18	20	35	—	—
Makerere University: Survey	18	18	11	10	—	—

Source: IEG mission.

Note: Graduation rates cannot be calculated or inferred since the IEG mission only updated a portion of the data and validated a portion of the original data. Enrollment data were not disaggregated for each class. NA = nonapplicable as program did not exist in that year; — = IEG was unable to collect data despite attempts made through telephone and email inquiries.