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Mid-Term Evaluation of the AIMS- IDRC/DFID Program 2010-2017

Final Report

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Table of Contents

- 1 Introduction..... 6**
 - 1.1 Rationale for the evaluation 6
 - 1.2 The aim and scope of the evaluation..... 6
 - 1.3 The methodology7
 - 1.3.1 The limitations of the evaluation methodology7
- 2 Comprehensive overview of AIMS-NEI..... 8**
 - 2.1 A brief history 8
 - 2.2 Vision, mission of AIMS and objectives of the AIMS-IDRC-DFID program.....10
 - 2.3 Overview of activities.....10
 - 2.4 Previous assessments and their recommendations.....12
- 3 The overarching findings of the evaluation 13**
 - 3.1 Relevance13
 - 3.2 Sustainability.....13
- 4 Findings on the academic training pillar 15**
 - 4.1 Implementation15
 - 4.2 The training pillar outputs16
 - 4.2.1 Output: Skilled graduates16
 - 4.2.2 Output: Interns17
 - 4.2.3 Outcome: Employment opportunities and skilled employees17
 - 4.2.4 Other outcomes: An integrated learning community..... 20
 - 4.3 Discussion of evaluation questions for the academic training pillar..... 20
 - 4.3.1 Relevance of the academic training pillar 20
 - 4.3.2 Effectiveness of the academic training pillar 21
 - 4.3.3 Efficiency of the academic training pillar 21
 - 4.3.4 Impact of the academic training pillar 22
 - 4.3.5 Sustainability of the academic training pillar 23
- 5 Findings on the research pillar 24**
 - 5.1 Implementation 24
 - 5.2 The research outputs 24
 - 5.2.1 Output: Finished research projects..... 24
 - 5.2.2 Outcome: Scientific and Innovation related outcomes..... 25
 - 5.3 Discussion of evaluation questions for the research pillar 26
 - 5.3.1 Relevance of the research pillar 26
 - 5.3.2 Effectiveness of the research pillar 27
 - 5.3.3 Efficiency of the research pillar 27
 - 5.3.4 Impact of the research pillar 27
 - 5.3.5 Sustainability of the research pillar 27

- 6 Findings on the public engagement pillar28
 - 6.1 Implementation..... 28
 - 6.2 The public engagement outputs 28
 - 6.2.1 Output: Trained qualified teachers..... 28
 - 6.2.2 Outcome: Increased awareness of maths and science..... 28
 - 6.3 Discussion of evaluation questions for the public engagement pillar 28
 - 6.3.1 Relevance of the public engagement pillar 28
 - 6.3.2 Effectiveness of the public engagement pillar 29
 - 6.3.3 Efficiency of the public engagement pillar..... 29
 - 6.3.4 Impact of the public engagement pillar..... 29
 - 6.3.5 Sustainability of the public engagement pillar 30
- 7 Findings on the organisational development pillar 31
 - 7.1 Implementation31
 - 7.2 The organisational development pillar outputs.....31
 - 7.2.1 Output: Well run organisation31
 - 7.2.2 Output: New centres..... 33
 - 7.2.3 Outcomes: Visibility and excellence..... 34
 - 7.3 Discussion of evaluation questions for the organisational development pillar..... 34
 - 7.3.1 Relevance of the organisational development pillar 34
 - 7.3.2 Effectiveness of the organisational development pillar 34
 - 7.3.3 Efficiency of the organisational development pillar 35
 - 7.3.4 Impact of the organisational development pillar 35
- 8 Recommendations36

Figures

- Figure 1 AIMS network and DFID-IDRC contributions’ and main matching funds time line..... 9
- Figure 2 AIMS donors match-funding contributions above \$300,000..... 9
- Figure 3 Logical framework for the mid-term evaluation 11
- Figure 4 Budget dedicated to each of the pillars 2013-2015 (\$).....12
- Figure 5 Top 10 alumni researchers.....18
- Figure 6 Official awards received by alumni and non-admitted applicants19
- Figure 7 Comparison of alternative models to AIMS structured Master’s 22

List of Acronyms

AIMS	African Institute for Mathematical Sciences
AU	African Union
DAAD	German Academic Exchange Service
DFID	UK Department for International Development
IBOD	International Board of Directors
IDRC	International Development Research Centre
MCF	Master Card Foundation
MoU	Memorandum of Understanding
MTE	Mid-term Evaluation
NEF	Next Einstein Forum
NEI	Next Einstein Initiative
NEPAD	New Partnership for Africa's Development
OECD-DAC	Organisation for Economic Cooperation and Development - Development Assistance Committee
STEM	Science Technology Engineering and Mathematics
TISS	Tata Institute for Social Sciences
UNESCO	United Nations Educational, Scientific and Cultural Organization

Executive Summary

Background

The African Institute for Mathematical Sciences (AIMS) is a pan-African network of centres of excellence for postgraduate education, research and public engagement in mathematical sciences. AIMS was founded in South Africa in 2003; from 2011 onwards, four further AIMS centres were established (Ghana, Senegal, Cameroon and Tanzania), increasing the network's reach across the continent. AIMS activities are focused on four main pillars: training, research, public engagement and organisational development.

In 2010, AIMS received funding from the Canadian government through the International Development and Research Centre (IDRC), followed in 2013 by a match- funding grant from the UK Department for International Development (DFID).

This report is the mid-term evaluation (MTE) of the AIMS-IDRC-DFID Program, covering the 2010-2017 of operational period which was a time of significant expansion. The rationale for conducting this evaluation is to provide AIMS (the Secretariat, Centres and Chapters), the AIMS Board and stakeholders with information on the achievements of AIMS, on lessons learnt, on opportunities for change and - in a context of organisational and operational growth, on recommendations for the future. The evaluation also serves an important purpose of accountability for the main funders, IDRC and DFID.

This report gives an overview of the results of the evaluation across the four main pillars stated above. Guided by a core set of questions, the evaluation addresses relevance, effectiveness, efficiency, impact, and sustainability regarding AIMS's goals of promoting mathematics and science in Africa; recruiting and training talented students and teachers and; and building capacity in education, research, and technology.¹

Evaluation approach

The mid-term evaluation took place in three phases (inception, data collection, and analysis/reporting) and included quantitative and qualitative approaches to data collection and analysis. The evaluation started with an inception week at the AIMS-NEI Secretariat from May 25th to May 29th, 2015, in Cape Town, where the main evaluation questions were finalised and the intervention logic agreed upon. This drove the subsequent methods implemented in the evaluation. This visit was combined with a visit to AIMS South Africa and served effectively as a pilot for subsequent country visits. From May 2015 to August 2015, 3 country visits to Senegal, Cameroon and Ghana - featuring interviews with key internal/external stakeholders and focus groups with students and tutors, were organised in parallel; desk research was carried out using existing program file information; ninety-two interviews were conducted with AIMS's management team and the staff of all entities as well as with partner universities and stakeholders (AIMS board of directors, the main donors IDRC and DFID, additional funders like DAAD and the Bosch Foundation, government officials, and employers of AIMS alumni). In addition, 753 alumni and 2772 non-accepted applicants were surveyed with an overall response rate of 52 per cent for alumni. A bibliometric analysis of the alumni and AIMS researchers' publications was also conducted. Both IDRC and DFID indicators were populated and used to respond to the evaluation questions.

Key findings and the impact of activities

The AIMS training pillar offers a unique opportunity for African students to follow a fully-funded Master's program, making it an extremely attractive option for students in maths and computer sciences. The awareness of AIMS in Africa is growing, with an exponentially increasing number of applicants from across the continent. AIMS offers a learning environment that is completely different

1 <https://www.aims.ac.za/en/about/about-aims>

from any university in Africa, and the model is an innovative addition to the range of available postgraduate programmes. It excels in successfully challenging students to develop analytical rigour, critical thinking and communication skills, alongside the core domain skills in mathematical sciences.

There remain some challenges regarding the position of the AIMS Master's degree in relation to a Master's degree obtained in the classic university setting (it is not recognised consistently as a Master's II or Research Master's, which can prove difficult for graduates on their career paths). There is a number of reasons for this. There is a lack of understanding regarding the skills acquired by the students at during the ten-month program. There are also concerns regarding the general traditional approach to entry requirements at universities that expect a certain amount of research to have been undertaken as part of the Master's program if students are to be accepted directly into PhD programs. Another key finding relates to the competence levels of students when they enter the program. Students are accepted from a variety of related disciplines, which leads to a high variation in entry levels. Sometimes, this can cause challenges not only for the students but also for lecturers and tutors, especially given the high-pressure environment where there is little time for additional catch-up work.

Overall, the impact of AIMS on higher education policy and practice in host countries has been significant. There is good evidence from interviews with national stakeholders (including government officials) that political support is high and AIMS is an important flagship for countries that host a centre. - In many cases, this support comes with the commitment of additional funds. It is reasonable to argue that AIMS is likely to have a profound impact on mathematics teaching in higher education in Africa. A large number of AIMS students are now working their way up the academic ladder in Africa, having experienced new approaches to both teaching and learning, which they can put into practice.

While about 80 per cent of AIMS alumni focus on an academic career, with 26 per cent of them pursuing a PhD, interesting opportunities in African universities or research centres are still limited, and 30 per cent of alumni are still outside Africa ten years into their post-AIMS career. This is an important challenge. Alongside the main Master's program, AIMS has introduced the Industry Initiative, which provides the opportunity for student internship and for eventual industry careers. The Industry Initiative was set up in 2013 as a requirement for funding from DFID and is therefore still in the early stages of development across the network. This means few internships have so far been undertaken (Senegal is currently piloting a co-op education initiative in mathematical sciences, funded by the MasterCard Foundation, which forms part of the AIMS Industry Initiative). However, the Industry Initiative provides a new set of opportunities for AIMS and holds an important position within AIMS's plan for the future. In particular, it complements the training pillar, since an expansion of the number of openings for students will also mean that not all students will be able to follow a long-term academic career path. Therefore, routes into industry will become a vital part of an AIMS graduate's career progression, and an important measurable outcome of the program.

Under the **AIMS research pillar**, AIMS has succeeded in establishing two operational research centres, one in South Africa which dates back to 2008, and more recently - one in Senegal, which is fast winning recognition at the national and the regional/sub-regional level. AIMS offers valuable opportunities in the form of bursaries for post-AIMS students, continuing their studies by entering a Master's in Research program or a PhD program, and in the form of exposure to research topics through a number of workshops, short courses and weekly seminars. AIMS has not yet linked its research pillar extensively to industry but has recently launched the Maths in Industry Program with the goal of ensuring that part of the research conducted answers questions related to the needs of African industry. At this time, there are no evident links between the Industry Initiative (under the training pillar) and the efforts to link research to industry. Our findings show that research conducted through AIMS currently contributes to research excellence in Africa. The scientific output of AIMS' research centres in terms of academic publications is rising (since 2010, the number of publications per year has increased eightfold). AIMS ranks tenth in Africa according to the article account index, following 9 South African Universities and Institutes, although most publications are from visiting researchers (with only three out of the top ten AIMS researchers being of an African nationality). At the moment, there are few relevant publications aimed at solving African development challenges (disease modelling in public health is an exception). There is also little current evidence to suggest that AIMS's research activities have contributed to policy and innovation in Africa. Nevertheless, the evaluation notes some advancement in the policy fields of big data and biomaths, Future plans for research are already moving towards ensuring there is a greater critical mass of research and an emphasis on the "grand challenges" of Africa.

The **AIMS public engagement pillar** is one of the less coherent parts of AIMS, although there are some very important activities being undertaken. The evaluation found no clear overarching strategy, nor understanding, of what the public engagement and communication pillar intends to achieve. The clearest part of the public engagement pillar is the teacher training aspect. AIMS is offering an award-winning mathematics teachers' training program in South Africa through AIMSSEC. This program is very much in demand by teachers and is recognised by the South African government. The availability of teacher training in other AIMS centres is less well defined in its approach and vision. The evaluation takes note of the new teacher training initiative that is currently being implemented in Cameroon, and of the successful pilot of teacher training activities in Ghana. These examples show strong evidence in utilizing the lessons learnt from the implementation of AIMSSEC in South Africa. The Cameroon approach targets the trainers of teachers and the inspectorate, with the valid assumption that this will lead to additional spillover effects in the wider community of teachers. The other parts of public engagement are workshops, summer schools and work with the community at large. Many activities are organised at the centre level and are more ad-hoc and opportunistic in terms of the approach to implementation and delivery of the key objectives of AIMS. However, the AIMS brand and the growing awareness of stakeholders (and media coverage) has increased public knowledge and interest in STEM (Science, Technology, Engineering and Mathematics) in Africa. As indicated, more could be achieved by coherence and coordination of activities and the development of an overarching strategy for this pillar. The evaluation nevertheless found that work at the Secretariat level to influence policy resulted in high-level recognition of the initiative by the AU partnership and by UNESCO. The presence and recognition of AIMS at a continental and global level has been the result of a concerted strategic effort to position the network within this space in Africa and globally.

The final pillar is **organisational development**. AIMS has successfully opened four centres since 2010, some at great speed. There is clear evidence from the interviews with those involved in the setup of the new centres that this was made possible through the support of the Secretariat and the existing centres, which provided advice, personnel and lessons learnt. A key finding is the importance of political backing for setting up a new AIMS centre. Simultaneously with the centre's expansion, there has been significant consolidation within the Secretariat, which continues up to date. There are issues with running an organisational model across continents, but AIMS is successfully dealing with them. There are a number of new roles within the Secretariat, but many people are working across areas. This has resulted in an increase in communication and an increase in the coherence of the approach. In recent times, there has been a significant volume of work done in order to create and streamline new, as well as to introduce new policies. This work has been impressive, and in addition to these endeavours, there is a much stronger emphasis on monitoring and evaluation. The recent creation of an international board brings a global scope to network governance, as does the recently created international Academic Council. AIMS is planning to open two more centres in 2016 and 2017 in Rwanda and Morocco respectively, which is likely to require a significant share of attention and energy of AIMS-NEI staff.

Main recommendations

Training and career development pillar

1. Review student selection process in light of increasing application numbers.
2. Improve mechanisms to decrease the impact of heterogeneity of the entrance level of students.
3. Increase the length of the program to eighteen to twenty-four months; consider introducing a summer crash course.
4. Improve quality of tutoring. Tutors play an important role and bring continuity in the academic program, but their overall quality should be improved through better support, recruitment and selection.
5. Improve diversity of direct post-AIMS career opportunities through better career counseling, internships, etc.
6. Develop a brochure that explains the AIMS curriculum to education experts from partner universities in Africa and abroad to improve understanding of the AIMS degree. (Better align the values of AIMS with those of partner universities to ease the post-AIMS transition, and consider the establishment of a PhD program.)

7. Increase cooperation between AIMSSEC and the AIMS training pillar. Master's extensions should be considered as well as teaching and didactics as an option (since many graduates go into teaching), alongside the growing number of internships in industry and research.

Research pillar

8. Increase clarity and strategic focus of research activities and synergies with the education pillar, especially in relation to industry. Applied research and consultancy could improve synergies between education and research; a PhD school could be part of this in the longer term.
9. Develop a critical mass of AIMS research and publications as well as international visibility through concentrated development of research excellence in a limited number of centers with a clear focus on some applied areas (e.g. grand challenges), while ensuring that "non-research centres" can also benefit from their activities.

Public engagement pillar

10. Develop a comprehensive communication strategy, implementation plan and an updated monitoring and evaluation plan.
11. Improve communication and links between AIMS operational staff and students, as well as tutors and lecturers, by increasing the presence of AIMS centre staff on location and by organising common activities.
12. Produce and disseminate materials that describe the skill set of AIMS alumni and provides success stories.
13. Improve the overall understanding of the position and objective of an AIMS Master's degree in the African education and research context, and reflect on strategies to optimise macro-level educational efficiency for students through working on accreditation, optimisation of shared degrees, direct PhD opportunities, etc.
14. Expand AIMS' profile in North America and Europe.

Organisational development pillar

15. Maintain AIMS-NEI's positive spirit, vision and energy. This is a vital part of AIMS. The enthusiasm of students, staff and external stakeholders is a key component in the success of AIMS, and all newcomers should feel and be part of the same spirit.
16. Review the monitoring and evaluation system as well as the alumni monitoring strategy and database.
17. Develop more synergies between the three AIMS pillars.
18. Reflect upon and study the strategic implications of the planned expansion of the number of graduates from AIMS. When combined with a limited number of university and research positions in Africa, this could result in an unsustainable situation for alumni careers, especially given the very strong academic propensity of students.
19. Rethink and refocus the position of industry in AIMS activity and its development in both education and research. As it is at the beginning of its investment in tackling the links with industry, AIMS should prioritise improving links with industry and ensure this supports both education and research objectives (taking into consideration the outcomes of employability, skills, new knowledge, services and ultimately innovation).
20. Clarify the Secretariat's role at the network and local level as well as the line decisions between Secretariat and Centres.
21. Diversify funding sources, using tailored fundraising strategies for each pillar and across the pillars.
22. Decrease the pace of growth: creating fifteen centres too rapidly is likely to affect quality. AIMS should first concentrate on developing its visibility and recognition, on developing post-AIMS opportunities for its graduates and on building a sustainable model in the existing

centres.

Introduction

The African Institute for Mathematical Sciences (AIMS) is a pan-African network of centres of excellence for postgraduate education, research and public engagement in mathematical sciences. Its mission is to enable Africa's brightest students to flourish as independent thinkers, problem solvers and innovators capable of propelling Africa's future scientific, educational and economic self-sufficiency.² Currently five centres are operating - in South Africa, Senegal, Cameroon, Ghana and Tanzania, and the organisation has a goal to expand to a total of fifteen centres by 2025. The main funders of AIMS are the Canadian Government and the UK Department for International Development (DFID) through the International Development Research Centre (IDRC).

This report is the mid-term evaluation of AIMS (MTE). It presents progress assessment results of AIMS in terms of implementation as well as outputs and outcomes. It is timely as it provides an opportunity to clarify and assess the initiatives under the program after extensive growth. The Technopolis Group conducted this mid-term evaluation of the AIMS-IDRC-DFID program between May 2015 and August 2015 on behalf of the AIMS Internal Evaluation Committee.³

1.1 Rationale for the evaluation

The rationale for conducting this evaluation is to provide AIMS (the Secretariat and Centres), the AIMS Board and its stakeholders with the necessary information on program strengths and opportunities for change, in a context of organisational and operational growth and advancement towards its theory of change. It also serves the purposes of accountability and learning for IDRC and DFID.

The evaluation provides evidence to inform independent judgements of AIMS achievements and challenges. It also provides comprehensive insights into AIMS funded activities, as well as lessons learned. It also gives recommendations that will contribute to the planning and further implementation of the program to help the organization towards achieve its goals.

1.2 The aim and scope of the evaluation

The terms of reference of the independent external evaluation of this IDRC/DFID supported Program called for:

- An evaluation of the progress towards achieving the program's objectives and intended outcomes specific not only to the four programc pillars of AIMS, namely the training, research and public engagement pillars, but also to the AIMS operational plans and mechanisms
- Identification of early results and outcomes of the program as well as success stories
- Documentation of best practice opportunities, lessons and corrective actions, needed for the next phase of implementation and for guaranteed realisation of expected results. There are four locations in the scope of this evaluation: South Africa, Ghana, Senegal and Cameroon. (Tanzania is not included in this study as it is still too early to evaluate the new AIMS entity, only created in 2014).
- The evaluation therefore has both summative and formative elements with specific objectives echoing AIMS, IDRC, DFID MTE evaluation requirements:
 - To determine the extent to which the different pillars have met their objectives
 - To assess the outputs and outcomes of the Program highlighting early results, specific best practices, opportunities and lessons learned
 - To assess the relevance, effectiveness, efficiency, impact and potential sustainability of the Program (viewed from both the funders, AIMS and participants' perspectives)

² AIMS statement 2015

³ A public, competitive process commissioned the Mid-Term Evaluation. Full details of the terms of reference can be found in a separate report containing the Appendices.

- To review the mechanisms of implementing AIMS operational plans and mechanisms, AIMS Master's programs, AIMS Industry Initiative, the Research program, Teachers' Training and public engagement initiatives

The evaluation also looked at gender equality at AIMS to determine if there is equality of opportunity within all levels of the organization

1.3 The methodology

The mid-term evaluation was divided into three phases (inception, data collection, and analysis/reporting). It included a number of different data collection and analysis methods, linked to the evaluation themes and questions. The evaluation began with a three-day inception workshop with the AIMS Internal Evaluation Committee. The purpose of this inception workshop was to agree on the evaluation matrix and intervention logic that would serve as the basis for the evaluation. The approach taken during the three days included the refinement of the evaluation questions, with reference to the OECD DAC criteria⁴, to the assignment of methods and to the incorporation of DFID and IDRC performance indicators. The final questions and intervention logic were agreed with the AIMS Secretariat. It is this approach which has driven the methodology as well as our subsequent analysis and recommendations. Methods used in this evaluation included the following:

- Desk research and a review of the existing information on file to gain a good understanding of the activities undertaken by AIMS up to 2015, the performance of activities, delivering of outputs and results (including specific progress indicators) and of the financial organisation and governance. The information was analysed and reported, alongside the different evaluation themes and questions
- Logical framework analysis
- Activity mapping
- A pilot country visit in South Africa conducted from May 25th to May 29th 2015 included interviews with the management team of AIMS at the Secretariat level and at AIMS South Africa; interviews of program key personnel, such as heads of research groups; focus groups with tutors and students were also undertaken
- Country visits to Senegal, Cameroon and Ghana were conducted in parallel from June 8th to June 12th 2015 using the same methods piloted in South Africa
- Interviews with a comprehensive list of twenty-three made up of: Board Members, external partners and stakeholders (partner universities, main donors IDRC, DFID, additional funders, such as DAAD and the Bosch foundation, government officials, employers of AIMS alumni)
- An alumni survey with a counterfactual analysis. In total 753 alumni were contacted, as well as 2772 applicants who were not selected.⁵ 394 alumni and 520 non-selected applicants responded, giving an overall response rate of 52 per cent for alumni and 19 per cent for non-participants
- A bibliometric analysis of the publication outputs and patents of all the AIMS alumni and AIMS affiliates. This analysis was performed using Scopus, an abstract and citation database of peer-reviewed literature

The final analysis brought together all of the different findings from the evaluation methods in order to support our findings, conclusions and recommendations in a robust and reliable way.

1.3.1 *The limitations of the evaluation methodology*

The mid-term evaluation of AIMS was completed in a relatively short timeframe, in order to address certain points within the decision-making process. This issue, coupled with the need to deploy a number of different methods at the same time, has both positives and negatives. A positive is that the small team of consultants worked very closely, both together and with the AIMS internal evaluation

⁴ <http://www.oecd.org/dac/evaluation/daccriteriaforevaluatingdevelopmentassistance.htm>

⁵ In order to stimulate response rates, an incentive of an award was provided for those participating in the survey

committee throughout the evaluation to ensure that the deadlines were met. These open channels of communication also sped up knowledge accumulation within the evaluation team, providing an important mechanism for on-going clarification of evidence supplied throughout the evaluation. Running the country visits in parallel also gave the evaluation team the opportunity to reflect together in the evenings on the interviews and focus groups undertaken during the day and to readjust and refine the approach together.

The short timeframe also meant that the survey could not be run over a longer period to increase response rates. However, at the same time, the response rates were large enough to guarantee valid findings. Another issue with the short timescale of study was that it was not possible to get permission from the alumni to publish quotes from the survey in this report, even though many quotes have been collected and have been used as evidence in the evaluation.

It was also challenging to develop biographies of high-potential alumni and get their approval for publication. As such, it was difficult to fully assess the role of the program in supporting students to become future leaders contributing to the advancement of the African continent. However, the bibliometric analysis of publications and citations of research conducted by AIMS alumni did provide some evidence and identify potential leaders.

Another potential risk was being unable to provide a significant number of outputs within a short timeframe while still ensuring quality. The lack of time for reflection at the end of the process has also been an issue internally. The final presentation to middle management was a crucial step in the process to test the recommendations with the AIMS staff and to ensure the insights gained were reflected in the final evaluation. Although there are limitations, the support of the AIMS Secretariat and centres has helped in avoiding many issues through timely information and regular meetings.

The different methods used to respond to the evaluation questions are presented in a separate report containing the appendices.

Comprehensive overview of AIMS-NEI

2.1 A brief history

AIMS was founded in 2003 in Cape Town, South Africa, as a pan-African centre for education and research in mathematical sciences. Its mission is to recruit and train talented students and teachers, to build capacity for education and research in Africa and to promote mathematics and science in Africa. The Centre was established as a partnership project with six founding partners - three European universities (Universities of Cambridge, Oxford, Paris Sud XI) and three universities in Cape Town (Universities of Cape Town, Stellenbosch and Western Cape).

Building on its success, and in light of its recognition as a centre of excellence, in 2008, AIMS launched the Next Einstein Initiative (NEI) to push forward the expansion of AIMS through the opening of new centres. AIMS-Senegal was the first centre to open under the Next Einstein Initiative. Other centres followed in Ghana, Cameroon and Tanzania.

The Next Einstein Initiative developed a set of criteria crucial for the commitment for opening new centres:

- Political commitment (high levels of engagement)
- Financial engagement from governments to ensure the sustainability of the initiative (contribution)
- Key figures (professors) to support the set up of the initiative in the country
- Administrative feasibility and national academic recognition of the diploma (institute status and degree recognition)

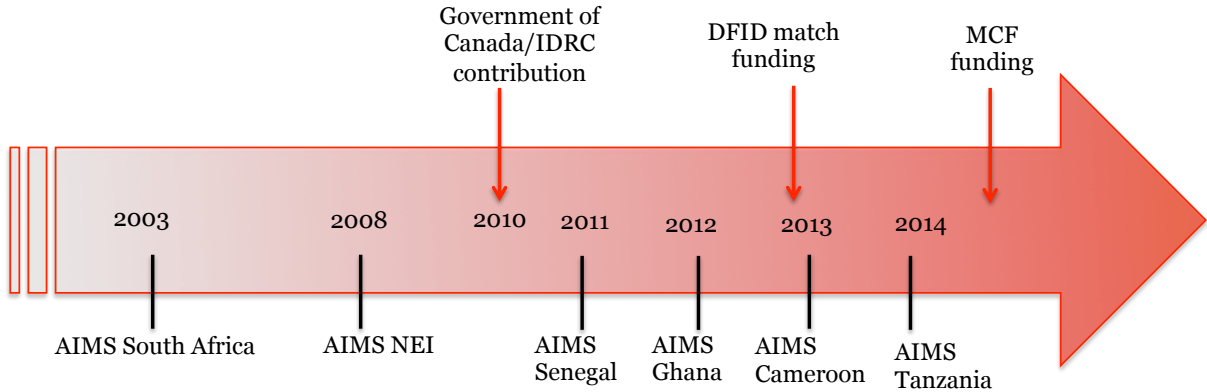
In July 2010, the Government of Canada contributed CA\$20 million. The International Development Research Centre (IDRC) administers the grant. It supported the establishment of new centres in Senegal, Ghana and Cameroon, and provides ongoing funding for AIMS-South Africa.

In November 2012, the UK Department for International Development (DFID) entered into a matching-fund arrangement with IDRC, contributing a sum of approximately £18,160,000, to complement and build on Canada’s contribution to AIMS-NEI.

The DFID funds are geared towards the establishment and initial operating costs of the AIMS centre in Tanzania, as well as another centre in the future. They also provide consolidation funding for the centres in South Africa, Senegal, Ghana and Cameroon and contribute to the enhancement of the AIMS curriculum and learning environment in order to facilitate career opportunities within relevant sectors and industries in Africa.

As part of the agreement, IDRC provided a further contribution of CA\$2 million to build the research capacity of the AIMS network. To facilitate efficient management and oversight of the program, IDRC is responsible for managing DFID’s contribution. One of the main matching-fund pledges was done by the Master Card Foundation (MCF) in late 2014 for \$24.8 million.

Figure Error! No sequence specified. AIMS network and DFID-IDRC contributions’ and main matching funds time-line



Source: Technopolis Group (2015) based on AIMS data

Figure Error! No sequence specified. AIMS Donors match-funding contributions above \$300,000

Name of donor	Type of donor organisation	Date of signature of pledge agreement	Amount in \$ (rounded)
Humboldt Foundation	Foundation	2012/12	686,000
Robert Bosh Stiftung	Foundation	4 pledges: 2013/03, 2013/06, 2014/03, 2014/10	2,808,000
Government of Canada/IDRC	Government	2013/05	2,000,000
SA National Skills Fund	Host Government	2013/05	1,795,000
Government of Cameroon	Host Government	2013/07	5,282,000
Government of Senegal	Host Government	2013/12	2,501,000
Government of Ghana	Host Government	2014/06	324,000
Master Card Foundation	Foundation	2014/11	24,859,000

Source: AIMS NEI data (2015)

2.2 Vision, mission of AIMS and objectives of AIMS-IDRC-DFID program

Africa will not develop scientifically unless its people have the opportunity to develop their scientific potential and utilize it on the continent. With this in mind, the mission of AIMS is “to enable Africa's brightest students to flourish as independent thinkers, problem solvers and innovators, capable of propelling Africa's future scientific, educational and economic self-sufficiency.”⁶

AIMS is pan-African. Students from across Africa work and live together in an environment focused on developing knowledge and expertise in applied mathematics, working on development problems and global challenges. For many students coming to AIMS, such an experience is completely new. AIMS wants its students to think about their future role in academia, industry, and research, leaving with the capacity to be leaders wherever they end up.

The overall goals of AIMS are:

- To promote mathematics and science in Africa
- To recruit and train talented students and teachers
- To build capacity for African initiatives in education, research, and technology⁷

The goal of the AIMS-IDRC-DFID program is to provide advanced training in applied mathematics to top African students, enabling them to pursue high quality postgraduate studies and eventually to contribute as future leaders to the further economic, political and educational advancement of the African continent.

Specific objectives of the AIMS-IDRC-DFID program

- **Support existing AIMS Centres**
- **Establish new AIMS Centres**
- **Update and implement a monitoring and evaluation plan**
- **Support and strengthen AIMS-NEI's Secretariat**
- **Develop a common set of administrative and operating procedures across the AIMS network**
- **Form a unified learning network with an appropriate balance between a central approach and local variation**
- **Enhance post-graduate opportunities for AIMS centre graduates, including complementing AIMS-NEI's curriculum with employability, entrepreneurship and business skills modules; and**
- **Improve the financial stability (sustainability) of AIMS-NEI**

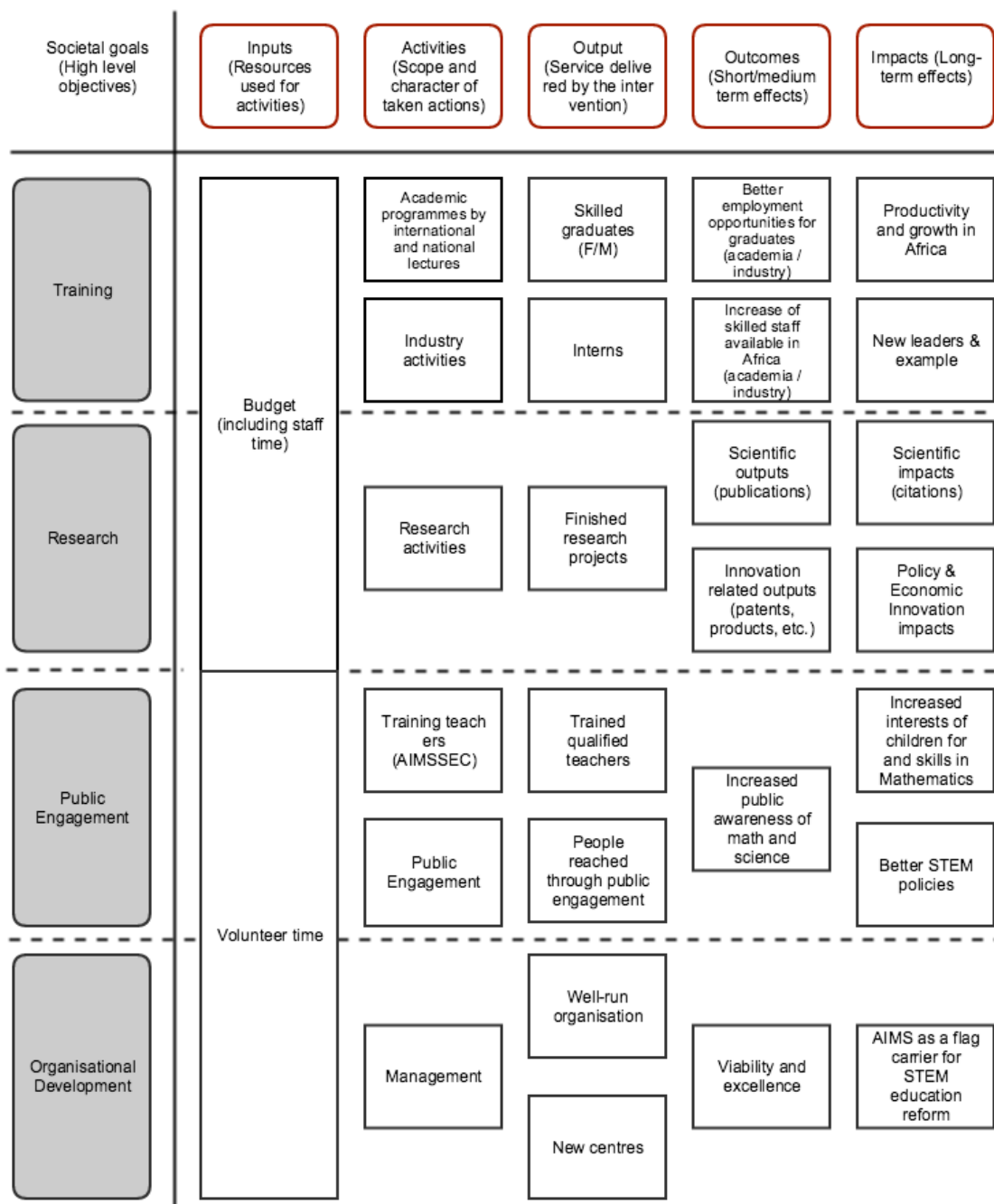
2.3 Overview of activities

AIMS activities are organised around four main pillars, Training, Research, Public Engagement and Organisational Development. The figure below sets out the logical framework, which was developed specifically for the mid-term evaluation in order to capture the expected outputs, outcomes and impacts across all four pillars for AIMS.

⁶ AIMS statement

⁷ <https://www.aims.ac.za/en/about/about-aims>

Figure **Error! No sequence specified.** Logical Framework for the Mid-term evaluation



Source: Technopolis Group (2015), based on documentation review of AIMS Program and inception workshop discussions with AIMS internal evaluation committee

AIMS-South Africa, as the oldest and most consolidated centre and the most consolidated, has deployed academic activities and, research activities as well as the teacher’s training AIMSSEC program at full scale. Other centres have developed activities under each of the four pillars but at different stages, according to the country context and resources.

AIMS-Senegal deployed academic activities in 2011 as a foundational pillar and added research in 2013. Senegal is also piloting a co-op education program in mathematical sciences, funded by the MasterCard Foundation. This forms part of the AIMS Industry Initiative. AIMS-Ghana and

AIMS-Cameroon have both set up academic activities respectively in 2012 and 2013; their research pillars are in the early stages of development. For all three centres the Public Engagement pillars are at a very early stage of development.

In the 2014/2015 academic year, there were between 39-52 students per centre with around 30 per cent of the students being female. Each cohort of students is supported by tutors, and in 2014/2015, there were between 7 and 10 per centre. There were around 30 lecturers teaching at each centre throughout the year and varying numbers of researchers and partners. The following figures present the key figures overall for the 2014/2015 year of operation.⁸

Figure Error! No sequence specified. Budget dedicated for each of the pillars 2013-2015 (\$)

Pillar	Budget 2013-2014	%	Budget 2014-2015	%
Academic training ⁹	5,346,159	37	7,123,821	45
Research ¹⁰	1,475,381	10	1,214,267	7,5
Public engagement ¹¹	1,437,322	10	1,212,883	7,5
Organisational development ¹²	4,159,428	29	4,037,331	25
Administrative support/overhead ¹³	2,056,587	14	2,353,078	15
Total	14,474,877	100	15,941,380	100

Source: AIMS data: budget allocation defined after Board Meeting

Overall, the largest proportion of the budget was allocated to the academic training pillar (37per cent and 45per cent respectively in the last two years), followed by the budget for the organisational development that has decreased in actual figures as well as proportionally in the last two years.

2.4 Previous assessments and their recommendations

During the first years of AIMS a number of internal and external assessments were performed. An international panel review on the South African Centre was conducted in 2010, followed by an external independent one in early 2012. The main findings and recommendations from each of these assessments were reviewed as part of this evaluation and were used to support the conclusions and recommendations.

8 Additional tables of key figures can be found in an additional report containing the appendices.

9 Corresponds to the “training and research programs” but excludes the “research center” and the “post-AIMS bursaries”

10 Corresponds to the “research center” and the “post-AIMS bursaries”

11 Corresponds to the “advancement” but excludes “resource mobilization” and part of “HR allocation” and part of “Utilities & Facilities allocation” based on summarized data from the five year budget - rounded

12 Corresponds to the “Center development”, “organisational effectiveness” and “resource mobilization” of the advancement budget and includes part of “HR allocation” and part of “Utilities & Facilities allocation” of the advancement budget based on summarized data from the five year budget - rounded

13 Corresponds to “corporate and administration”

The overarching findings of the evaluation

This section outlines the key findings of the evaluation. It starts with a presentation of the overarching findings in relation to the evaluation questions of relevance and sustainability. The findings of the evaluation are then presented by pillar, discussing the implementation, outputs/results and the evaluation themes.

3.1 Relevance

All three main pillars (training, research and public engagement) are considered relevant by virtually all interviewees. The greatest focus is currently on the education (Master's course) pillar, which has been the defining feature of AIMS in general. Outreach activities are considered especially relevant by national governments, whereas the research activities seem to be a lower national priority for now.

The three main areas have a potential for synergy which is currently not fully exploited. This is partly due to the fact that two pillars (research and public engagement) are still in an early stage of development. A positive example of synergy is the volunteering of AIMS students at local high schools and primary schools (part of the public engagement program). Presently, the research activities are the most disconnected from the other pillars. A further developed research centre could strengthen the links between the research side and the education side (linking with visiting lecturers, using MSc students on research projects as part of the essay phase, etc.), but could also provide a logical link to industry (e.g. applied research projects supported by students).

The fourth pillar, organisational development, was considered as crucial by all interviewees as it supports the other three pillars in the endeavour to create a mass of talented individuals whose work will have an impact on Africa's development.

3.2 Sustainability

The AIMS financial model has relied on donors from the beginning. There has been increased **government investment to support AIMS Centres financially.** The role of host governments' funding is core for AIMS as other donors do not fund the initial infrastructure investment and subsequent maintenance, which are prerequisites for AIMS operations, nor their continuity or AIMS attractiveness to students and staff. AIMS has been successful in raising funds over and above what was required to match the DFID grant, and since 2013, AIMS has raised over USD 40 million in pledges. However, it has been a challenge for AIMS to translate government pledges into actual contributions, which threatens the achievement of co-funding targets. The eventual financial model would be for government to pay operating costs and for AIMS to pay for the students. The brand, which is growing in Africa, could also make it more likely for governments to offer scholarships in the future.

Various donors and foreign institutions support AIMS. These include the MasterCard Foundation, Google and DAAD which consider AIMS as one of the best organisations to work with in Africa - not only for their good management of grants, but also as AIMS brings new approaches to tackling African challenges, new approaches to capacity building and a unique combination of activities for STEM advancement on the continent. Both DFID and IDRC are keen to see additional private sector investment.

The African Union (AU) has always recognised AIMS and recently made a more significant commitment. This year, the AIMS President and CEO obtained a written commitment from the AU to help mobilise support from aid agencies at a level of \$30 million over the next five years.

AIMS has managed to attract sixteen donors¹⁴ and other philanthropic funds, which brings a

¹⁴ Apart from IDRC and DFID funding, AIMS received funding from governments (Government of Ontario/U of Ottawa, Government of South Africa, Government of Cameroon, Government of Senegal, Government of Tanzania, Government of Ghana, Government of Benin, Government of Germany), Robert Bosch Stiftung, ICTPPI, DAAD/Humboldt Chair,

certain sustainability to the program; nevertheless, the needs of the donors are different. Catering to differing objectives can distract AIMS from its core goals, and AIMS has to work at keeping true to its overarching strategy.

There are a number of options for funding in the future, including introducing student fees in the form of long-term loans. The culture of “giving back” is already present at AIMS. Discussions have been held with students on how they would feel about taking a loan for part of their tuition fees, which they would have to commit to begin paying back within ten years of course completion. The students responded positively to this as they would like to contribute to AIMS. But they could not afford to pay up front. Based on research from the AIMS Secretariat, current thinking is to ask for around €3,000 over ten years,. Other ideas include revenue generating activities associated with the new buildings that can take place in some of the AIMS centres (conference facilities, etc.).

Interviewees mentioned that **government support brings more than just funds as it also provides a sense of legitimacy in each country.**

In line with AIMS’ pan-African model, each class is usually composed of no more than one third of nationals from the country in which the centre is based. Nevertheless, there are some **national stipulations that are put in place because of funding** that might threaten the AIMS model. Cameroon, in fact, took more Cameroonians this year because the Ebola crisis led many countries to withdraw their students.

Other risks, such as **leadership dependencies**, seem relatively low. Even though AIMS centres currently have a high-profile leadership, there seem to be enough engaged partners from local universities that could fulfil management and leadership positions at AIMS.

The **links with the local universities** are also a key factor in sustainability. Local recognition of AIMS training is key for the future career of AIMS alumni, and synergies add to the cross-fertilisation of academic staff and research. The centres are very different from universities but can work closely with the existing structures.

Many researchers interviewed mentioned the precariousness of their posts, which are secure for only three to four years. A **remaining challenge for AIMS is to offer permanent positions**, in order to attract and retain brilliant scientists.

Findings on the academic training pillar

4.1 Implementation

The AIMS Master's program was the first activity started by AIMS and is at the core of the entire AIMS philosophy. It began as a diploma in South Africa but following the 2011/2012 evaluation recommendations, it was changed to a structured Master's degree, backed by the South African Higher Education Qualifications Authority. This ensured the diploma would be recognised by the qualification authorities and students would be in a position to pursue their studies directly into a PhD program at some universities. The redesigned Master's program is now considered the equivalent of a Master of Science. In South Africa, the three partner universities¹⁵ accredited the diploma and were involved in the definition of the new Master's program.

AIMS has successfully **implemented its structured Master's program in South Africa, Ghana, Senegal and Cameroon**. The overall study program runs over a period of ten months and is structured in three parts: the skills courses, the review courses and the research phase. In addition to the classically structured Master's program, a "co-op master's" is being introduced in Senegal for the 2015-2016 academic year. This is a regular Master's program that also includes a six-month internship. The courses are also being adapted to ensure an overall coherence with the industrial element of the course (the internship). This represents an innovation for AIMS, which highlights not only the organization's its ability to respond to new needs but also its commitment to the organization's overall objectives of contributing to industry in Africa. A full independent academic assessment of the Master's curriculum is being commissioned by AIMS in early 2016.

The AIMS Master's program has grown in prominence in Africa and has become an attractive option for students wishing to pursue a postgraduate opportunity in mathematical sciences. The **number of applications has been growing exponentially**, doubling approximately every four to five years. Even though the number of accepted students has also tripled as new centres open up, this exponential growth means the acceptance rate has decreased from 34 per cent in 2003-2005 to 18 per cent in 2012-2013. **The overall average acceptance rate since the program began years is 21 per cent**. Women have an almost 15 per cent higher likelihood of being accepted given their lower total application numbers, and represent 36 per cent of the student body. The entry-level qualifications (in terms of discipline) of the students varies significantly across the centres, although many students have a Master's already.

AIMS provides a **unique opportunity for many African students** to gain an educational experience in an African country other than their country of origin. Interviews with current students showed that the majority would not have been able to afford a Master's abroad. The fully-funded model of AIMS, made available to a relatively large number of students annually, makes it an **extremely attractive program**. AIMS also provides a **unique learning environment** that excels in successfully challenging students to develop analytical rigour, critical thinking and communication skills. Virtually all students consulted (current and alumni) consider AIMS a very important transformative experience.

According to employers who were interviewed, AIMS students (and alumni) are universally considered to be motivated, ambitious, and hard working.

Students (past and present) and other stakeholders interviewed **are highly appreciative of the quality of international lecturers and the international exposure the experience brings. Tutors are an important source of guidance** and continuity for students, but there are concerns about both the low tutor to student ratio and in some cases, the quality of support given to the student during the course.

Other support to students, such as future career counselling, is of inconsistent quality and extracurricular activities (including sports) are inadequately promoted, thus affecting the physical and mental health of students.

¹⁵ University of Cape Town, Stellenbosch University and University of Western Cape

Alongside the main Master's program, AIMS has introduced the Industry Initiative. This started in South Africa where it is most developed and is being rolled out more systematically in the other centres. Senegal has the second most developed approach.

Overall, the Industry Initiative is still in the early stages of development across the network. There are very few completed internships to date. The aforementioned "co-op master's" which is being piloted in Senegal (funded by the MasterCard Foundation) will increase its prominence in the next year. Interviews with stakeholders support the findings that there are many opportunities for the development of the Industry Initiative in the future as well as, its importance within the AIMS program. The current plans for expansion will increase the number of AIMS graduates, and academia may not be able to absorb these students into an academic career path. **Providing opportunities for students to work in industry will become a significant part of AIMS in the future, leading to the need to help students develop entrepreneurial skills, and competences in order to become more employable.** AIMS has objectives which include creating leaders in industry.

4.2 The training pillar outputs

4.2.1 Output: Skilled graduates

Up to the years 2013/2014, **748 students have graduated from AIMS**, resulting in a graduation rate of 99.7 per cent. This is an excellent achievement and results in a substantial alumni body given the relatively small size of the mathematics discipline in Africa.¹⁶ The high graduation rate is testament to the intense guidance students receive from lecturers and tutors during their studies and also to the strong bonds they form with other students.

Students **increase their skills enormously during the academic year at AIMS**, particularly in their computer science skills (programming). There is less development seen in entrepreneurship and innovation skills. This may be because it is a short course and students are generally less interested in this aspect of the program. The focus groups undertaken at the AIMS centres during the evaluation highlight how most students are more interested in the academic courses. The exposure to cultural diversity and the international setting is also beneficial for students.

AIMS has taken the approach to exclude formal examination from the course. There are many assignments and a short research project to undertake under the supervision of a lecturer (and with support from the tutors). This has a number of implications. One is that it allows the students to concentrate more effectively on the transversal skills acquired as well as core skills in mathematical sciences. The academic directors at the centres and the interviews with international lecturers support the finding that the students who pass are of excellent quality. Another implication of the lack of formal examination is that it can create a concern externally as to the quality of AIMS graduates, particularly within the normal academic environment of the African universities. This, coupled with the fact that AIMS students only undertake a short research phase in their ten months at AIMS and may not be at the same standard as other Master's II graduates, was raised in the interviews. Some students have to follow up with a Research Master's degree post-AIMS before being able to enter a PhD program.

However, other interviews, both within Africa and with universities elsewhere, do not support this view entirely. There are many examples of AIMS graduates who have ably gone on to complete PhDs with little concern over their level of qualification on leaving AIMS.

¹⁶ There are incomplete figures on the number of mathematics graduates in Africa, however a report from the International Mathematical Union on Mathematics in Africa (2014) estimates there are fewer than 2000 PhD holders in Mathematics in Sub-Saharan Africa. (http://www.mathunion.org/fileadmin/CDC/cdc-uploads/CDC_MENAO/Africa_Report.pdf)

Results from the surveys highlighting the next academic steps for AIMS graduates

A substantial share of AIMS graduates have finished or are currently engaged in a Master's program post-AIMS (25%), while the largest share (41%) are currently engaged or have already finished a PhD. Women are slightly more likely to have a Master's as the highest degree and less likely to do a PhD, although the difference is relatively small. AIMS graduates are very successful in obtaining further educational opportunities at reputable institutes. In total 63 per cent of the first two cohorts (2003-2008) have finished a PhD or are currently engaged in a doctoral degree, while only 23 per cent of rejected applicants have achieved the same.

This discussion raises questions as to whether this concern regarding research ability is a real or perceived issue, based on the premise that it takes two years to complete a Master's degree. If it is a perceived issue, then more needs to be done to communicate information about the skills acquired during the AIMS Master's program, through either formal accreditation or more promotion of the concept in general. The alumni are also a testament to the AIMS program and in time may also help to mitigate these concerns through their career paths and role within academia (this is currently more of an issue for those pursuing academic career paths as there are few Alumni entering industry). Overall, this approach (ten-month, three phases) is a core aspect of the AIMS philosophy, to be inclusive and to focus on training rather than on a specific level of achieved knowledge.

The **background of the students is thoroughly pan-African** (with a stronger representation of Anglophone countries). Women make up 36 per cent of students. AIMS is, therefore, strongly contributing to the advancement of women in science and is above the 30 per cent target of AIMS. A recent report by the International Mathematical Union (2014) estimates that the ratio of women teaching mathematics at tertiary level in Africa is low, reporting that around 17 per cent of PhD holders in francophone Africa are women. In North African countries, this may increase to around 30 per cent.¹⁷

AIMS graduates **are very focused on academic careers**. Across all cohorts, 80 per cent of graduates are currently in an academic setting (second Master's, PhD or academic employment). As a result, AIMS graduates are less likely to be in paid employment, compared to non-participants in the first decade after graduating from AIMS. This has implications which need to be taken into account for the Industry Initiative in a number of ways. There will be a need for more opportunities for alumni in industry. This may require AIMS to adapt its courses accordingly. There also needs to be a change in attitude amongst the students at AIMS who are currently more inclined towards academic careers and therefore may be lost to Africa if there are no clear alternative opportunities to pursue.

4.2.2 Output: Interns

Alumni participating in internships were very positive about the contribution of their internship to the set of skills acquired at AIMS. In total, seventeen alumni indicated participating in an internship program facilitated by AIMS, during AIMS, and twenty-four after AIMS. **Alumni were less positive about the contribution of the internship towards finding a job.** This indicates that AIMS needs to building on the existing efforts of the Industry Initiative.

4.2.3 Outcome: Employment opportunities and skilled employees

AIMS graduates are **starting promising scientific careers**. The bibliometric analysis for the evaluation showed 110 alumni out of 753 have co-authored two or more published articles in international peer-reviewed journals. AIMS graduates publish more than rejected applicants.

The scientific output of alumni in terms of number of publications is rising each year, which is not surprising as the number of alumni and their years of experiences rise as well. The total number of published papers (up to June 2015) amounts to 574. Seventy-five percent of the published papers

¹⁷ International Mathematical Union (2014), Mathematics in Africa: Challenges and Opportunities

consist of articles in journals (including articles in press) and, 22 per cent consist of conference papers. The other 3 per cent include notes, book chapters, and reviews. The five main subject areas of papers are mathematics (19%), physics and astronomy (19%), computer Science (11%), engineering (96%) and medicine (9%).¹⁸

The table below sums the top 10 alumni according to their h-index and number of citations. The number of publications, citations and h-index are based upon their total research output during their career. One of the alumni, Mazandu Gaston Kuzamunu, currently is affiliated with AIMS.

Figure Error! No sequence specified. Top 10 alumni researchers

Name	Affiliation	Publications	Citations	h-index
Osalusi Emmanuel	Heriot-Watt University, International Centre for Island Technology, Edinburgh, UK	12	169	8
Abdussalam Shehu Shuaibu,	Abdus Salam International Centre for Theoretical Physics, Triestem Italy	12	285	7
Ndeffo Martial Loth Mbah	Yale University, Center for Infectious Disease Modeling and Analysis, New Haven, US	20	99	7
Mazandu Gaston Kuzamunu	African Institute for Mathematical Sciences, Muizenberg, South Africa	17	82	6
Mabiala Justin	Cyclotron Institute, College Station, US	29	72	6
Okeke Onyekwelu Uzodinma	Harvard University, Department of Physics, Cambridge, US	6	93	4
Hamdouni Yamen	N/A	10	92	4
Johnstone-Robertson Simon Peter	University of Melbourne, Parkville, Australia	6	85	4
Akofof Earnest	Syracuse University, Department of Electrical Engineering and Computer Science, US	9	79	4
Worku Dawit Solomon	University of Cape Town, UCT-CERN Research, Centre and Department of Physics, Cape Town, South Africa	4	71	4

Source: Technopolis 2015, Scopus

The bibliometric analysis undertaken as part of this evaluation also highlights the following:

- G. Mbianda's research is the most cited amongst the alumni with 112 citations of one paper in the field of physics¹⁹
- Tendai Mugwagwa's research is the second most cited amongst the alumni with 71 citations in the biomedical field²⁰
- Shehu S. Abdussalam's with three papers are the most cited in the field of physics²¹.

In total, **26.3 per cent of alumni are currently carrying out a PhD**, in comparison to only 7 per cent of non-participants. **Three alumni (12.5% of the oldest cohort) have made it to assistant professor**. Four alumni have a position as senior lecturer/researcher.

18 Papers can have multiple subject areas

19 Puckett, A. J. R., Brash, E. J., Jones, M. K., Luo, W., Meziane, M., Pentchev, L., ... & Huber, G. M. (2010). Recoil polarization measurements of the proton electromagnetic form factor ratio to $Q^2 = 8.5 \text{ GeV}^2$. *Physical review letters*, 104(24), 242301.

20 Den Braber, L., Mugwagwa, T., Vrisekoop, N., Westera, L., Mögling, R., de Boer, A. B., ... & Tesselaar, K. (2012). Maintenance of peripheral naive T cells is sustained by thymus output in mice but not humans. *Immunity*, 36(2), 288-297.

21 Conlon, J. P., Abdussalam, S. S., Quevedo, F., & Suruliz, K. (2007). Soft SUSY breaking terms for chiral matter in IIB string compactifications. *Journal of High Energy Physics*, 2007(01), 032. & Feroz, F., Allanach, B. C., Hobson, M., AbdusSalam, S. S., Trotta, R., & Weber, A. M. (2008). Bayesian selection of sign μ within mSUGRA in global fits including WMAP5 results. *Journal of High Energy Physics*, 2008(10), 064. & Feroz, F., Allanach, B. C., Hobson, M., AbdusSalam, S. S., Trotta, R., & Weber, A. M. (2008). Bayesian selection of sign μ within mSUGRA in global fits including WMAP5 results. *Journal of High Energy Physics*, 2008(10), 064.

In total, nine alumni (3%) have a managerial position in a non-academic organisation or a company. For non-applicants, this figure is 10 per cent, 2 per cent of which have reached director level. A high number of alumni have received specific awards (29%), mostly being academic honours or specific fellowships (standard academic grants are excluded).

Figure *Error! No sequence specified.* Official awards received by alumni and non-admitted applicants

	Applicants			
	Alumni	%	Non-admitted	%
One	66	19.19%	79	19.17%
Two	21	6.10%	16	3.88%
Three or more	11	3.20%	14	3.40%
Total sample	344	100%	412	100%

Source: Alumni survey & Non-admitted applicant survey 2015

A number of examples of AIMS alumni awards

- Schlumberger Foundation Faculty for the Future Fellowship for pursuing a PhD in mathematics at University of Glasgow.
- PostDoc fellowship from FWO (Flemish science foundation) Belgium & twice the best paper award
- Singapore International Graduate Award
- A merit award from Stellenbosch University for pursuing PhD studies. An exchange scholarship program at the University of Pittsburgh, sponsored by the Benter Foundation of Pittsburgh, Pennsylvania.
- Faculty for the Future Fellowship (by Schlumberger), Fellowship Funds Incorporated (Queensland Graduate Women)

Only a **minority (less than 15%) is engaged in non-academic employment**. Employers interviewed are positive about the skills of alumni and praise their ability in working with new IT developments. AIMS students **out-earn rejected applicants but are less likely to be engaged in entrepreneurship**. Only two alumni (1%, both from the most recent cohort) are full-time company owners. This figure is similar for non-participants. A small share of alumni are involved in patent applications at their work or as a result of their research. Around 10 per cent of alumni are involved in launching products and services in their current occupation.

Seven to ten years into their careers, around two thirds of alumni are working or studying in Africa. Around 40 per cent are working/studying in another African country (mostly South Africa). Roughly 25 per cent of students return to their home country. The reason around one third of alumni are working/studying outside of Africa is mostly due to the **lack of academic (research) career opportunities in many African countries**.

Alumni visions of their future careers²²

- 1) I am planning to start my own company in the near future in Africa. Having been involved in teaching and research abroad, I am also planning to give lectures and supervise research projects at local universities.
- 2) I would like to start a pan-African technical training institute focusing on intellectual property development (software, content creation for media, design).
- 3) I envision my future career as a part-time lecturer at University of Kinshasa in my country and other universities (if possible). I will have a non-governmental organisation which will promote and encourage gender equality for women in STEM in secondary and higher education, especially in francophone countries.

22 Quotes from different alumni in the survey

- 4) **Teaching is my passion, it is one of the reasons I've furthered my studies, to gain better knowledge to share with others because we also benefit from people who have been studying to improve the knowledge of others, and hence the societies we live in. So, I want to teach in the future.**
- 5) **I look forward to being a risk management consultant in 5 years time.**

It is **too early to identify excellent leadership among alumni**, given that most of them are still in the (very) early stages of their careers. A number of alumni are definitely in the position to achieve academically excellent careers. There is a **strong recognition amongst students of the importance of working on African-related issues**, as evidenced in their research presentations and through the focus groups, but also by the results of the electronic survey.

Due to time constraints with this evaluation, it was impossible to develop biographies of high-potential alumni and get their approval for publication, even though a list of these 'high-potentials' was generated in the evaluation process. The following stories collected through qualitative data collection provide some illustrative examples.

Alumni stories about their focus on Africa's challenges in their current occupation²³

HIV and TB diseases are the burden of Africa. The development is slow due to the workforce problem. If they are caught with HIV, it is difficult to work on full potential. At population level, I tried to see the trend of the population (with treatment and without).

Am currently working on insecurity in Africa. I hope from my research I will be able to come up with ways in which the problem can be solved.

My work will permit to minimise the conflicts caused by the lack of security in government data transmission, it will permit to act as a leader and convince Africans that for the development of our continent we have to be one, we have to stop conflicts and work together.

Education is the key to most of our problems. I try to be a good lecturer every day. And I try to counsel my students whenever the need arises. Of course working in a university has its challenges. Most of the students know what they want, but those who are still confused and ask me for advice will get it. I also try to encourage my young brothers, nieces and nephews to stay in school - that they can be almost anything they want if they work at it. I would hope that most believe me because they know where I come from: from walking barefoot to school to having a PhD!

It is sufficient for me to say that mathematics are essential for any sciences in the world, and by developing research in the continent, we can exploit the great resources we have to help our economy to grow, so that we can reduce poverty.

All stakeholders consulted agreed that AIMS graduates are dedicated and motivated team players with strong coding skills. **In general, AIMS graduates** are seen as **relatively academic** (with a strong interest in continuing a research career), which at times seems to hinder effective communication and entrepreneurship in a more applied professional career.

4.2.4 Other outcomes: An integrated learning community

AIMS contacts are quite important for alumni, with a majority indicating that other AIMS alumni or contacts developed during their time at AIMS are important for their current professional network. **In total, 40 per cent of alumni indicate that they are currently working with their peers to a significant or even great extent.**

4.3 Discussion of evaluation questions for the academic training pillar

4.3.1 Relevance of the academic training pillar

A strongly developed human capital base is generally accepted as a key driver of economic and social development. An adequate presence of STEM (Science, Technology, Engineering and Mathematics) skills will be a prerequisite for growth in African countries with a strong

²³ Quotes from different alumni in the survey

potential in developing medium and high-tech sectors, such as oil and gas extraction, manufacturing and high-tech services (such as ICT). However, recent studies show that STEM subjects are relatively unpopular with students when they decide to choose their university studies.²⁴

These identified problems illustrate that the goals of AIMS resonate with national policies in South Africa, Senegal, Ghana and Cameroon, even if not yet explicitly defined as such. **All stakeholders who were interviewed during the field missions in June 2015 strongly supported the relevance of the AIMS Master's program.** University partners generally agree that there is a lack of skilled mathematics graduates, although different countries have different reasons for this. Only a handful of MSc/MPhil students of mathematics in each of the main universities are willing to continue with research or applied mathematics. Also, **the need for increased problem solving and analytical skills - one of the core focal points of the graduate program at AIMS, was also confirmed.** AIMS Centres' staff strongly believes in the fact that strong science and mathematics programs are cornerstone of national education policies and that AIMS Centres play an important role in this.

The provision of bursaries is seen as a key component of the relevance of the AIMS program. University partners see affordability as a key barrier for students who want to continue their education after their BSc. It is common that MSc/MPhil students disappear during the program at local universities due to a lack of funds.

4.3.2 *Effectiveness of the academic training pillar*

AIMS has been very effective in establishing a unified learning network and has been overall effective in implementing professional recruitment, enrolment, lecturing and tutoring activities.

AIMS has been very effective in contributing to the training of skilled graduates, especially in the area of critical thinking and computer coding skills. Students indicate very high levels of satisfaction in the courses and their acquisition of skills and knowledge. There is a noticeable cultural change in students who complete the AIMS program. Graduates change from passive to active learners. AIMS has made a significant improvement in the number of opportunities for talented African undergraduates to continue a mathematics education in Africa and elsewhere. **AIMS has taken the first steps in setting up the Industry Initiative** by implementing entrepreneurship and innovation courses as well as organising internships, but these activities are still relatively minor in the overall picture. They are not always aligned with students' primary interests in continuing an academic career, as shown by the fact that 80 per cent of alumni are focused on an academic career.

AIMS has been very effective in teaching skills that improve employability, especially academic employability. AIMS alumni are generally successful in securing post-AIMS education opportunities.

The direct effect on African industry and productivity of AIMS academic training is unlikely to be substantial at this time. Only a few students focus on a career outside academia. It is possible, and even likely, that AIMS graduates will have an impact on African industry and productivity via the "long impact path," through better educational standards of children when AIMS alumni go into education or through the academic research of alumni leading to innovation; the size of this impact is hard to measure at this time.

4.3.3 *Efficiency of the academic training pillar*

The overall efficiency of the AIMS educational program is good and as such AIMS offers value for money. AIMS offers a high level of outcomes and impacts for the specific investment, when compared to alternatives, such as individual scholarship schemes. Some centres have higher student costs due to being in an establishment phase (e.g. Ghana), but those costs are likely to fall when centres become fully operational. The recent audit by Deloitte highlighted that AIMS meets international standards of accountability and transparency.

²⁴ <https://www.timeshighereducation.co.uk/news/ghanas-higher-education-sector-seeks-coherent-national-policies/2004320.article?page=0%2C1>

There are two rough categories of alternatives for the AIMS Master’s course:

- Sponsoring students at regular universities in Africa
- Sponsoring students with scholarships to study outside of Africa

The table below presents some of the costs of these alternatives. In general, the cost of studying outside Africa is comparable or higher than the cost of AIMS, which is relatively low, compared to international programs due to the access to volunteer lecturers. On the other hand, education at a regular university is generally cheaper. An academic partner indicated that, even though the cost per student was much higher, compared to local programs, value for money was still considered to be high. Possible alternatives, such as a bursary scheme for regular universities, had the drawback that local universities may actually lack the capacity to organise good courses for larger groups of students (e.g. lack of supervisors). The key driver of success in this regard is the AIMS access to an international network of good lecturers.

Figure Error! No sequence specified. Comparison of alternative models to AIMS structured Master’s

Name	Type	Cost per year	Details
AIMS	1-year taught Master’s program	• 10k USD – 30k USD per student	Costs vary substantially between the centres
MasterCard Scholarship	Scholarship for Africans	Average of 33.3k USD	Students can study in US or Africa All HE levels
DRD Scholarships for Sub-Saharan Africans	Scholarship for Africans	• Providing about €7,800 to €10,800 per student per year.	Students can study in Germany or in Africa Extra allowance for PhD
Ferguson Scholarship (UK)	Scholarship for Africans	• £25,000 for one year	
Eldred- Waverley Scholarship (UK)	Scholarships	• Tuition +£10,397 living costs	
Oppenheim Scholarship (UK)	Scholarship	• Tuition +£13,863	
MSc Mathematics in Ghana	Standard 2 – year Master’s program	Total cost: ±9,000 USD per student per year Tuition: ± 1,500 USD per year	Does not include living costs.
Msc Mathematics in Stellenbosch University (SA)	Standard 3 – years Master’s program	• Tuition: €833 Appendix A Total cost: €1,190 to €1,672	Does not include living costs.

Technopolis analysis (2015)

AIMS could potentially do more to improve efficiency by addressing the situation that most students have to complete another Master’s program (research Master’s), before being able to enter a PhD program. While this is inevitable for those students that change direction to a more specific field of mathematics, physics or another STEM field, more can be done for those students that could – in terms of their knowledge and skills – have entered a PhD program in any case. AIMS should be part of a movement towards higher overall educational career efficiencies, since too many students stay too long in education (e.g. doing three Master’s and a long PhD program) which represents a significant productivity loss for African research systems and economies.

4.3.4 Impact of the academic training pillar

The **impact of AIMS on higher education policy and practice in host countries has been significant**. There is good evidence from interviews with national stakeholders (including government officials) that political backing is high and that AIMS is an important flagship for countries that host a centre, in many cases with the commitment of additional funds. Alongside the **large network of stakeholders** on the African continent, there is **significant interest and involvement from other countries**, including the United Kingdom, Canada, Germany,

France, and the USA. The lecturers come from all over the world and rally behind the AIMS philosophy.

AIMS is likely to have a **profound impact on mathematics teaching in higher education in Africa**. Large cohorts of AIMS students are now working their way up the academic ladder in Africa, having experienced new approaches to teaching and learning, that they can put into practice. Many students, especially those interviewed during the country visits, espouse the virtues of the way in which they have been taught and how different it has been from methods used in the universities they have come from.

4.3.5 Sustainability of the academic training pillar

The issue of the *financial* sustainability of the academic training pillar is addressed elsewhere in relation to the overall financial sustainability of AIMS.

The high number of applications highlights the importance of AIMS as an educational career path for students in Africa and supports its sustainability in terms of potential students for this type of Master's program. Lack of access to good students is therefore not a likely risk factor in terms of sustainability.

Findings on the research pillar

5.1 Implementation

The research pillar was added as a second step to the AIMS South Africa academic activities as AIMS donors and staff perceived it as an important complement to training. Research brings credibility and excellence to academia and offers career opportunities for African talent. The South Africa Research Centre was launched in 2008, prior to the NEI, with the mission to conduct and foster outstanding research in mathematical sciences. AIMS South Africa was recognised as an intercontinental research institution by an act of Parliament. The South African National Research Foundation funds the Centre.

AIMS has thus succeeded in **implementing two operational research centres**, one in South Africa and more recently - one in Senegal, which is winning recognition fast at the national and sub-regional levels. The Ghana centre will soon have its first research chair and will move towards being a fully operational research centre (it already has two research chairs, which are shared with the South African Centre). The prospects for setting up a research centre in Cameroon are encouraging.

AIMS is offering **exposure to research topics to its own students and academic/research staff, in addition to other** students, academic staff and researchers through a number of workshops, short courses and weekly seminars.

The AIMS Centres are in the **process of defining research specialisations** that are relevant to challenges on the African continent. This defining of research specialisations will also avoid redundancies across AIMS centres.

AIMS has **developed links among its research centres** while intending to build capacities through intentional knowledge exchange activities as well as **links with other universities. This is expected to foster co-publications.**

5.2 The research outputs

5.2.1 Output: Finished research projects

Currently, six research chairs are funded for over three to four years. Two of the AIMS researchers are also AIMS alumni.

Research led by Research chairs being AIMS alumni

Dr. Gaston K. Mazandu has published 17 articles, which have been cited 89 times by a group of 54 documents. His h-index is 6, meaning he has published at least 6 articles that have been cited 6 or more times. His most successful article *Function prediction and analysis of mycobacterium tuberculosis hypothetical proteins* was published in 2012 in the International Journal of Molecular Sciences. This article was cited 15 times. Dr. Mazandu has 8 co-authors in total; he mostly co-published (15 times) with Dr. Nicola Jane Mulder, affiliated with the African Society for Bioinformatics & Computational Biology in Cape Town.

Dr. Antoine Tambue has published 7 articles, which have been cited 20 times by 24 documents. His h-index is 3, meaning he has published at least 6 articles that have been cited 3 or more times. His most successful article *An exponential integrator for advection-dominated reactive transport in heterogeneous porous media* was published in 2010 in the Journal of Computational Physics. This article was cited 12 times. Dr. Tambue has 6 co-authors in total; he mostly co-published (15 times) with Dr. Gabriel James Lord, affiliated with the Heriot-Watt University, Department of Mathematics in Edinburgh.

Funding was secured from the Von Humboldt Foundation for four more research chairs in South Africa, Ghana and Tanzania. **About eleven resident researchers, visiting researchers and post-doctoral fellows work under these research chair funds.**

AIMS is additionally offering bursaries for post-AIMS students continuing their studies with Master's in Research and PhDs. The alumni **survey finds that 26.3 per cent of alumni**

are currently completing a PhD program. This is compared to only 7 per cent of non-participants. AIMS-sponsored bursaries were given to 59 per cent of alumni who continued with research careers. .

Annually, about sixty AIMS alumni pursue their studies in a Master's in Research or PhD program thanks to post-AIMS bursaries.

Alumni stories about post-AIMS research opportunities

With the research opportunity, I enrolled for an MSc program at the University of the Western Cape, the successful completion of which led to doctoral studies, which I also completed in 2009. The post-AIMS bursary certainly opens doors to these opportunities.

The post-AIMS bursary is powerful enough to earn the title “turning point of my academic career.”

This funding opportunity was my single source of income. It helped me to pay for my university fees and to sustain my immediate family (consisting of a wife and kid). In times of need, I also used the funding to help my parents and my sibling who were unemployed at the time.

Receiving the post-AIMS bursary, even though not sufficiently enough to carry me through my PhD study, has actually facilitated a timely commencement of my academic program and encouraged me to seek more funding assistance. Well done to AIMS! The research opportunity opened my life, gave me the opportunity to continue my dream, especially in my domain of interest. I was not probably going to do Financial Mathematics if I did not attend the AIMS program.

AIMS Centres succeeded in creating a model that combined research activities with postgraduate training and development of young researchers as well as with an interdisciplinary research environment with focused themes. About eighteen workshops, conferences and summer schools as well as twenty-seven weekly seminars were delivered in 2014. These activities were not only attended by AIMS own students and alumni but also by the wider academic and research communities - at local and even sub-regional level. This high level of activity is a tool for raising the scientific community's interest in AIMS research as well as a testament of its success. **The majority of themes are however not yet focused on Africa's challenges**

5.2.2 Outcome: Scientific and Innovation related outcomes

The scientific output of the AIMS Research Centres in terms of the number of publications is rising in a trend correlated to the activity of the centres.²⁵ Since 2010, the number of publications per year of AIMS Research Centres has increased eightfold. Over eighty-five papers were published in 2014. These papers were mostly from researchers affiliated with the South African Centre and were published, mainly in journals with an above average impact factor and in journals that perform slightly better than other in similar fields.

The bibliometric analysis indicates that the 3 main subjects are Physics and Astronomy (34%), Earth and Planetary Sciences (21%) and Mathematics (16%).

Co-publications with International Research Centres (Switzerland, Denmark, UK, Finland, France and American Institutes) **or South African Centres are frequent. AIMS ranks tenth in Africa, according to the article account of the Nature Index**²⁶, following nine South African Universities and Institutes.

These statistics are good, but **the top researchers affiliated with the AIMS Research Centres are mostly not African.** The top researchers identified include visiting faculty

²⁵ This analysis excludes the publications by AIMS alumni.

²⁶ The Nature Index, compiled by the Nature Publishing Group (NPG), is a database of author affiliation information collated from research articles published in an independently selected group of 68 high-quality natural sciences journals. The 68 journals represent less than 1% of the journals covering natural sciences, but account for more than 30% of the total citations. This index is thus good indication of AIMS' research centre performance in the natural sciences.

members from other universities and two South African Research Chairs.

One of the recently-recruited African research chairs is leading promising research in Senegal.

Dr. Mouhamed Moustapha Fall, research chair at AIMS Senegal, has published 20 articles, which have been cited 58 times by a group of 41 documents. His h-index is 5, meaning he has published at least 5 articles that have been cited 5 or more times. His most successful article *Nonexistence results for a class of fractional elliptic boundary value problems* was published in 2012 in the *Journal of Functional Analysis*. This article was cited 17 times. Dr. Fall has 7 co-authors in total. He mostly co-published (3 times) with Dr. V. Felli, affiliated with the University of Milan and with Dr. Tobias Weth, affiliated with the Goethe University Frankfurt.

Very little research is moved into developmental or actual innovation stage. It generally stays in the fundamental scientific domain, and there appears to be no strategy for changing this, even in the South African Centre. AIMS is currently working on an overarching strategy to address this. More dedicated leadership is thus needed from the research side.

5.3 Discussion of evaluation questions for the research pillar

5.3.1 Relevance of the research pillar

Research and innovation are generally considered the key enablers of economic and social development of emerging countries. Adopted by African leaders in 1980, the Lagos Plan of Action required African countries to devote at least 1 per cent of their gross domestic product to research and development. But today, no African country meets this goal, Kenya coming closest with 0.98 per cent in 2010, but most other countries are far behind.²⁷

Since the early 2000s, numerous voices have pushed for the advancement of Africa through science and technology in partnership with other developing countries and with international organisations, such as the World Bank and donor countries. In 2005, the Commission for Africa called for the establishment of centres and networks of excellence, in collaboration with higher education institutions in other countries. The international community is backing them as one of the UN Millennium Development Goals recommends supporting the research areas that are underfunded in Africa, notably in STEM, or subsidising teams to conduct advanced research in the areas concerned. The research goals of AIMS are thus embedded in these international and African efforts.

AIMS' local university partners consider the relevance of the establishment of research centres to be very high. At the moment, countries such as Ghana and Cameroon do not have a dedicated research centre in the area of mathematics. While there are Departments of Mathematics at the universities in Senegal, Ghana and Cameroon, all stakeholders agree that the level of teaching pressure results in few academic staff members having time for research not to mention publishing. AIMS research workshops, conferences and weekly seminars are considered as catalysts for the wider local and sub-regional scientific communities.

AIMS staff and other stakeholders generally agree that the focus of the research centre should be a combination of applied and fundamental research, with the emphasis on applied research. According to the currently developed overarching AIMS strategy for research, staff and stakeholders all mention the importance of focusing on topics that are relevant for Africa's economies and societies. These topics include ICT, fisheries, and renewable energies in Senegal; mining, waste management, traffic management and other forms of operational research in Ghana as well as biomaths and energy optimisation in South Africa. The research centre should be internationally oriented with strong links to local universities, in order to also offer local researchers interaction with full-time researchers in an international setting. A system of joint positions would contribute to strengthening local research

27 <http://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS/countries?display=default>

systems as well. All concur that AIMS research centres are a tool to also attract African scientists in the international community back to Africa.

However, on the policy side, mathematics research centres are not always high on countries' agendas, according to university partners. In general, funding for research is very limited. **AIMS has not yet linked its research with industry** but has recently launched the Maths in the Industry Program which aims at ensuring that part of the conducted research answers some industry questions and needs. There may be significant potential for funding, which has yet to be assessed.

5.3.2 Effectiveness of the research pillar

AIMS has been effective in enhancing postgraduate opportunities for AIMS alumni through relatively small research grants. AIMS small research grants allow for the partial financing of PhD studies and can have a leverage effect on other grants.

AIMS has been relatively effective in providing postgraduate opportunities for AIMS alumni through research Chairs. Of six research chairs, two are AIMS alumni who may not have returned to Africa after their PhD and post-doctorate studies abroad if not for the AIMS Chairs opportunity. Research chairs are also financing PhD and post-doctorate opportunities to support their research.

AIMS has been effective in delivering research outputs (publications) and co-publications. These have increased over time, which can be explained by the relative delays in drafting research papers and publishing but is also a sign of current performance. The South African Centre performs best and the Senegalese Centre is very promising. **Nevertheless, the evaluation found that the publications are not focused on Africa's development challenges.**

5.3.3 Efficiency of the research pillar

AIMS has been quite efficient in implementing cost-effective, interdisciplinary research programs. **Despite limited resources, the centres have managed to attract some leading scientists.**

However, overall efficiency could be substantially **improved in the future if AIMS research activities move towards a more focused research strategy,** potentially with revenue-generating capabilities.

5.3.4 Impact of the research pillar

Interviews with internal and external stakeholders revealed that the impact of AIMS on mathematics and scientific research excellence in Africa has been significant and is showing signs of increasing.

AIMS research contributes to research excellence in Africa, **though only a minority of publications is of relevance to solving African development challenges (disease modelling in public health is an exception).**

The research pillar also has an impact on the academic training pillar, as it brings credibility and visibility in excellence to the AIMS Master's degree, as mentioned by many stakeholders.

As yet, there is little evidence of the impact of AIMS' research activities on policy and innovation in Africa. **Nevertheless, the evaluation did note some advancement in the big data and biomaths policy field.** A good example is the work of Dr. Ndifon Wilfred in South Africa and Ghana who has worked on the emerging field of computational immunology, working towards vaccine applications. Through his research, he is now also hired by the WHO to provide advice on vaccine development.

5.3.5 Sustainability of the research pillar

While the research centres seem to have support from various stakeholders, lack of national grant-based or structural research funding could mean a **very high dependency on foreign funding** beyond South Africa where the National Research Foundation (NRF) funds the South African AIMS research centre. There is a **clear need for a renewed research funding**

strategy that is thoroughly connected to AIMS new development in working more closely with industry (i.e. applied research). The strategy should **aim to gain research funding** through international collaborative research projects (e.g. EU Horizon), donor-funded research (e.g. DFID) and government applied research contracts (e.g. epidemiology) etc.

Findings on the public engagement pillar

6.1 Implementation

The Outreach Program was designed in parallel with the introduction of a structured Master's in South Africa. It started with the creation of the AIMS Schools Enrichment Centre (AIMSSEC) in 2004 with the aim of supporting teachers in their professional development. The program's specific objectives are to improve the teachers' content knowledge, to train them as subject leaders in their field and to establish networks of support among the teachers. Outreach activities then developed into other advocacy, visibility and communication activities in South Africa. In other centres, the teacher training and outreach activities are at very different but earlier stages of implementation.

The AIMS public engagement pillar is one of the less coherent parts of AIMS, although there are some very important activities being undertaken. The evaluation found no clear overarching strategy nor understanding of what the public engagement pillar intends to achieve.

The clearest part of the public engagement pillar is the teacher training aspect. AIMS is offering an award-winning mathematics teachers' training program in South Africa through AIMSSEC – which is very much in demand by teachers and recognised by the South African government. **The availability of teacher training in other AIMS centres is less well defined in its approach and vision.** The evaluation takes note of the new teacher training initiative currently being implemented in Cameroon and of the successful pilot of teacher training activities in Ghana. These examples show strong evidence of having taken on board lessons learnt from the implementation of the training program in South Africa in shaping their offers. The Cameroon approach goes upstream through targeting the trainers of teachers and the inspectorate, with the valid assumption this will lead to additional spillover effects in the wider community of teachers.

The other parts of public engagement activities are relatively ad-hoc and opportunistic in terms of the approach to implementation and delivery of the key objectives of AIMS. They are workshops, summer schools, work with the community at large and communication through media. Many activities are organised at the centre level.

6.2 The public engagement outputs

6.2.1 Output: Trained qualified teachers

Data on trained teachers and attendees of public engagement events is not easily accessible across the network as there is no full monitoring mechanism of all program aspects. Partial data showed that AIMS was successful in training at least 162 teachers in 2014 and organised eight training of trainers sessions. To date, few teacher training activities were organised by the Senegal, Ghana and Cameroon Centres. A full analysis of the teacher training program was outside the scope of this evaluation and will be part of a separate review.

6.2.2 Outcome: Increased awareness of maths and science

Along with the World Bank African STEM Centres of Excellence initiative, AIMS was **successful in raising awareness of the importance of maths and sciences** among governments and stakeholders in South Africa, Senegal, Cameroon and Ghana. **AIMS advocacy to the African Development Bank and the African Union** has recently resulted in these major bodies putting STEM on their agenda for development.

6.3 Discussion of evaluation questions for the public engagement pillar

6.3.1 Relevance of the public engagement pillar

If many countries in Africa still devote lower funding to STEM higher education and research, it is mostly due to a lack of appreciation for the true value of the return on capital invested in the field of science and technology. Deeply rooted in this are the gaps in mathematics teaching at primary and secondary school.

Based on interviews with the staff, students, partners and other stakeholders, **there is a high level of awareness of the necessity of public engagement and further communication.**

Specifically, supporting the training of maths teachers is considered as an absolute priority by the South African government, which is strongly backing the AIMSSEC activities. The Senegalese, Cameroonian, and Ghanaian governments are very supportive of the teacher training activities, and Ghana has the intention to jointly scale up these activities nationwide.

One of the initial reasons for establishing AIMS-Ghana²⁸ was the 2004 Tata Institute for Social Sciences (TISS) survey report showing that in 2004, Ghanaian children (at age 12) scored as very weak in mathematics, lower than any other of the five other African countries participating in the test²⁹. **While the mathematical skills levels of teachers are not the main issue, the inability to provide interactive and attractive teaching has been recognised as a clear issue that could be improved.**

Interviewees across all AIMS centres also generally confirm the need for teacher training. Academic partners confirm the need for the training of mathematics teachers.

6.3.2 Effectiveness of the public engagement pillar

AIMS has been effective in training teachers in South Africa through the delivering of the AIMSSEC Program. A remaining challenge is to link AIMSSEC to existing programs in education and to development of teachers.

AIMS has been effective in delivering the first programs of teachers' training courses in Senegal and Ghana. The governments have responded positively, and further support to expand this work is expected.

AIMS has to put more effort into other public engagement activities, such as raising awareness of school pupils about potential in mathematics and communication events. So far, activities have been implemented inconsistently across centres.

AIMS has been effective in raising awareness of the program with governments and stakeholders in maths and sciences. The presence and recognition of AIMS at a global level, notably by the AU partnership and UNESCO, have been the result of a concerted strategic effort to position the network within this space in Africa and globally.

More could be achieved through coherence and coordination of activities and an overarching strategy for this pillar.

6.3.3 Efficiency of the public engagement pillar

It is difficult to judge the economic efficiency of AIMS outreach activities due to their diverse nature. However, there are some good examples from the more mature South African set up of activities, based on the initial teacher training program, which highlight coherence, leading to efficiency. For instance, AIMSSEC has developed a large set of online learning tools and TV broadcasts to reach teachers from disadvantaged rural and township schools. The challenge will be to respond to the growing demand for professional training without significant additional resources.

²⁸ See AIMS-Ghana Strategic Plan

²⁹ Anamunah-Mensah et al. (2004). Ghana's participation in TIMSS-2003

6.3.4 *Impact of the public engagement pillar*

The impact of the public engagement activities organised by AIMS on the general awareness of local mathematical sciences has been significant. Alongside other STEM initiatives, AIMS has contributed to a broadening of the public's vision on the possible applications of mathematics and its contribution to society and to the economy.

The AIMS brand, along with the growing awareness of stakeholders (and the media coverage), has increased public knowledge and interest in STEM in Africa.

The impact of AIMSSEC and teacher training is difficult to measure because M&E indicators have yet to be defined to measure success. Nevertheless, **the AIMS model presents new pedagogical tools to local teachers from universities, secondary and primary schools.**

6.3.5 *Sustainability of the public engagement pillar*

Sustainability in terms of funding for the teacher training program does not seem to be in jeopardy for the next few years due to the willingness of the various governments to support these activities. **There is a bigger risk that a large-scale expansion of the teacher training program might stretch the organisational capacity of AIMS Centres.**

Findings on the organisational development pillar

7.1 Implementation

The AIMS Secretariat was created in 2011 and is mandated by the AIMS-NEI (UK Foundation) Board of Directors, following the need to create an overarching structure and provide centralised services, supporting the development of new AIMS centres and network coordination. It is principally located in Cape Town, South Africa, but Secretariat staff is also located in Toronto, London and Berlin. Secretariat activities are supported by the chapters in Canada, the UK and Germany, which have an advocacy, fundraising and recruitment role. The AIMS network is composed of all AIMS entities, including the Secretariat and chapters.

The IDRC-DFID grant supports the consolidation of AIMS as an organisation and a network. Indeed, five of the program objectives concern this pillar.

The Secretariat **has been consolidating rapidly** in the past two years. Many posts were created and filled at a fast pace, and the Secretariat had to adjust to the high turnover rate and location of its staff in several countries. **Standardisation of processes is under way** to facilitate operations, coordination and opening of new centres.

The focus on gender and inclusion has been reinforced recently at the Secretariat. An audit, carried out in 2013, highlighted the need for more efforts in promoting gender balance within AIMS activities and communications. The position of Director of Gender Equality and Inclusion was created in January, 2015, as a follow up to a baseline done by AIMS, following an in-depth program design approach. The Director provides leadership across the network on all gender-related matters: in policies, core training, research or public engagement.

Efforts to diversify funding is a key focus of AIMS. The organisation made initial attempts in 2011 with the “one for many” scholarship program, aimed at developing partnerships with universities abroad (in the USA, Canada or Europe), which would fund students. Even though it attracted some important partners, such as RIM (BlackBerry Platform) and tens of university partners, it did not reach full speed and is now rebranded and launched as the 4Excellence Program. There are now many parts of AIMS involved in these activities, including the Secretariat, the 4Excellence Program and, more recently, the Chapters (UK, Canada, Germany), which have a specific remit to identify new funding sources.

AIMS has successfully secured funds and **opened four centres since 2010**. After a pause, there are plans to open two more, one - in 2016 and the other - in 2017. In each case, government funding has been secured, and the centres are also responsible for identifying other local funding opportunities, including funding sources from industry. The plans for new buildings for some centres also bring possibilities for additional revenue generation at the country level.

The recent legal integration of the autonomous AIMS centres, each of which will be legally linked to and governed by the newly created AIMS International Board of Directors, **brings a global scope to the network governance** as does the recently **created international Academic Council**. Roles and interactions with local Boards are yet to be defined and communicated widely to AIMS staff and stakeholders.

7.2 The organisational development pillar outputs

7.2.1 Output: Well run organisation

7.2.1.1 Organisational processes

Some strategic documents were drafted - notably an overarching strategy, but **AIMS staff is not yet informed**, and thus does not have enough guidance particularly on communication, gender and IT issues. **Some strategies are yet to be finalised**, notably for the research pillar, or developed, notably for the public engagement pillar.

There is no knowledge management system as yet, but setting one up has been identified as an objective.

People with senior profiles and high qualifications have been hired in the past two years, in the fields of education (Director of Industry Initiative), research (International Academic Advisor and Research Manager), operations (Director of Network Operations), finance (CFO), communications (Coms Director) and gender (Gender and Inclusion Director). These recently filled positions concern coordinating and scaling activities at central and network level in an organic way. **But many posts are yet to be filled, and turnover has been high** – a challenge for the Secretariat in its attempt to keep up with a full agenda.

An HR consultant involved since 2014 on an interim basis has performed a **complete audit of the HR systems and practices and drafted recommendations for implementing necessary processes**. One of the recent recommendations is to hire a permanent HR manager.

There are organisation charts for all entities: although the organisation has been expanding quite rapidly, the documentation is up to date.

Finances and program finance

Financial systems have been recently changed, following a new approach to cost allocation. The value of the new systems will be assessed over time. The consolidation of accounts has been effectively implemented since 2014 and complies with donor requirements in terms of reporting systems and the codification of accounts. All financial information prior to this date was reprocessed. In early 2015, the 2014 accounts were approved by an independent Deloitte audit, which became a milestone in structuring financial management at AIMS.

Budget allocation and financial reporting to donors is well established. The Secretariat is responsible for allocating donor budgets in accordance with the grant agreement. Centres are provided with a budget each year against which they work, while they have to establish cost of work plans with strong support from the Secretariat. Centres submit monthly, quarterly, bi-annual and annual reports to the Secretariat. Accounts are also consolidated by the Secretariat on an annual basis and communicated to donors. These annual financial reports are presented in relation to the full grant budget. Annual reporting from Centres is consolidated and communicated to donors.

Communication

The evaluation found that a common infrastructure for communications has been built up recently: new websites, templates, tools with common identity, etc., greatly improve the coordination of communication activities. Part of the work is also to support the alumni in profiling themselves to increase the visibility of the whole initiative on the basis of their research achievements. **A communication strategy** has been recently drafted and reviewed by IDRC.

IT and logistics

Many support functions, such as logistics, management systems, staff performance, and IT are in the course of being standardised. These standards should ensure that the package offered to students, including accommodation, catering, classrooms, IT services and software as well as processes used by centres comply with the same minimum conditions. These endeavours are still quite recent and should provide results within a year or less.

Monitoring and evaluation

The M&E systems have recently been implemented; the Secretariat has a role to ensure the network maintains a high standard of excellence and reports to the Board. There is a need to learn and share best practice across the centres as part of a continuous process of quality improvement. External evaluations of the South African Centre were carried out in 2010 and again in 2011-2012. An M&E framework was drafted in 2013 and activities started with the

recruitment of a Monitoring, Evaluation and Learning Manager. M&E encompasses all centres' activities on a quarterly basis. A framework was created for regular data collection and management. M&E indicators feed the reporting, notably the alumni survey and database as well as other information of the indicators being tracked including the monitoring of all publications and the data of teachers reached through the AIMSSEC and other teacher training efforts across the network. Currently, one selected person in every centre collects the data. In the future, there is a plan that each centre will have an M&E officer. Recruitment for the post of Monitoring, Evaluation, and Learning Director is underway.

The M&E systems are nevertheless not yet optimal. Data collection for monitoring could be improved by harmonising the alumni database with M&E requirements and developing a better-structured database. A number of indicators in the logframes are too high-level and impossible to measure (e.g. GDP change) or too ambitious to be of any use in the next ten years (e.g. number of alumni as ministers, deans of universities, etc.).

7.2.1.2 Gender and inclusion

As a transversal issue, gender is present in all AIMS activities. Promoting gender equity and the position of African women in science is a major focus of AIMS-NEI and the centres. **As yet, no gender strategy** has been defined or drafted.

No less than 30 per cent of all students in the program are women. Part of the MasterCard Foundation funding is related to gender balance and involving women from underprivileged backgrounds. So far, targeted proactive search has not been possible, but applications are also considered with this focus in mind.

Gender parity has been reached amongst AIMS staff at centres and at the Secretariat level, but not for lecturers and researchers, given that many mathematicians are male.

7.2.1.3 Fundraising

Diversification of funding is a core focus and is being achieved. This is one of the key objectives for the Secretariat as the organisation heavily depends on donors. AIMS has new partners, such as the Humboldt Foundation, the MasterCard Foundation, Google and host country contributions, all of which have successful prospects. **AIMS was also successful at securing contributions to match the DFID funding.**

7.2.2 Output: New centres

Four centres were created in five years. Some initiatives were not pursued given that some countries could not meet all of AIMS' criteria to open centres. Two centres in Rwanda and Morocco are nevertheless planned to open in 2016 and 2017 respectively.

For Secretariat staff and Centre staff, **the existence of centralised processes appears absolutely necessary for the network's smooth functioning, consolidation of information at a central level and sharing of learning across the network.** In theory, centres are autonomous, with their own Board and Academic Council, and the Secretariat should only offer coordination. In practice, the Secretariat is directly responsible for the centres in some functions, such as student selection and lecturer recruitment, and control over support functions, such as IT and finances. For other operational functions (academic, research, public engagement) the Secretariat maintains coherence and coordination and has a role in implementing the strategic decisions of the AIMS-NEI Board. Nevertheless, the Secretariat position is only to provide oversight without any power to intervene, should it identify any deviation from the AIMS principles and strategies. At times this creates an internal tension in operating principles. **The challenge is for AIMS to maintain a shared understanding of its identity, ethos and values throughout all the centres.**

The recent creation of an international Board is a positive achievement as it brings a global scope to the network governance, as does **the creation of the international Academic Council.** Nevertheless, it also questions the role of the centres' Boards as well as their interactions. Some centre Board members perceive a contradiction in the governance model. Four of the five centres were set up within the same time frame as the Secretariat, before any specific procedures were adopted at the network level. This makes it more difficult for the Secretariat to

legitimise its role and enforce centralised systems, procedures, and ideas. This is a well-known difficulty for the Secretariat and may be resolved through internal communication.

7.2.3 *Outcomes: Visibility and excellence*

AIMS increased its visibility as a Centre of Excellence. This was achieved through media coverage thanks to the fifty-three articles and reports published since 2013 in the local and international media. Strategic partnerships play a significant role, at the government level (with officials in Higher Education, Education, Foreign Affairs or Industry), with industry (Barclays Africa, IBM, WWW Foundation, Future Talent, Homestrings, SONATEL, IKAGEL, NESTLE, ORANGE, IAM, Genie Conseils, CIFRES, IDYAL, SERCOM, SOLAR KA CRIC, SONARA, ECOBANK, etc.), and with international organisations such as the African Union and the African Development Bank.

However, many stakeholders consulted consider that visibility has yet to be achieved at the national level in the centre countries or at the international level.

7.3 Discussion of evaluation questions for the organisational development pillar

7.3.1 *Relevance of the organisational development pillar*

AIMS main donors, high officials and partner universities **recognise the relevance of the creation of several AIMS centres across the African continent, in order to create and sustain a critical mass of young scientific talent.**

The role of the Secretariat in advocating the creation of these new centres and of coordinating efforts and the network has been recognised by virtually all interviewees.

7.3.2 *Effectiveness of the organisational development pillar*

AIMS has been effective in creating the Secretariat and scaling up the network to four new centres (Senegal, Ghana, Cameroon, and Tanzania) in a very short period of time, and in obtaining accreditation of the AIMS degree in each country. Much remains to be done to consolidate the organisation. It is a challenge to recruit and retain the right staff at both Secretariat and centre level. The planned recruitment of an HR director should strengthen human resources management in the organisation, and the possible location of more staff together at Secretariat level should enhance team cohesiveness.

AIMS has been effective in setting up common administrative and operating procedures as well as policies in finance and program reporting. Changes implemented in the financial and program reporting were absolutely key to communicating results and key indicators with donors, contributing to the sustainability of the organisation. Several Secretariat operations have been thoroughly modified (finances) or newly established (gender, communications) in the past twelve months, which results in a number of changes taking place at the same time. This also implies the need for the structure and people to adapt to new ways of working. AIMS has yet to set them up across all other Secretariat functions, i.e. overall strategic planning, communications, IT, gender policy and logistics.

AIMS has been effective in establishing an overall governance structure (Academic Council and Board). One of the biggest challenges for AIMS is that of growing rapidly, while being a dispersed organisation. It is much harder to keep to high standards in such a setting. The organisation has done much to mitigate such risks establishing a strong governance structure. AIMS has yet to review the interactions between the IBOD and some of the centres and the governance of each centre. Nor has it communicated about roles.

AIMS has been effective in acquiring visibility as a flagship initiative for mathematics excellence in Africa with government officials in the countries of operation and with institutional partners both locally and overseas. It still needs to acquire more visibility, notably with industry partners. The recently defined strategy for the Industry Initiative is promising.

7.3.3 Efficiency of the organisational development pillar

Efficiency is expected to increase with the revision of decision procedures, recruitment of high calibre managers, opening of new centres, standardisation and capitalisation on lessons learned.

7.3.4 Impact of the organisational development pillar

The impact of AIMS as a flagship initiative for STEM educational reform in Africa has been recognised by a number of high officials consulted in this evaluation. Country initiatives, such as the government of Botswana benchmarking the AIMS model and engaging in setting up a similar institution, provide clear evidence of the impact of the AIMS model.

Recommendations

Recommendations were defined and organised per topic. They include strategic recommendations relating to long-term organisational goals that contribute to achieve AIMS mission and operational recommendations. Operational recommendations concern daily, weekly or monthly activities carried out to implement AIMS strategic objectives; they do not necessarily apply to all centres.

Training and career development pillar

1. Review student selection process in light of increasing application numbers.
2. Improve mechanisms to decrease the impact of heterogeneity of the entrance level of students.
3. Increase the length of the program to eighteen to twenty-four months; consider introducing a summer crash course.
4. Improve quality of tutoring. Tutors play an important role and bring continuity to the academic program, but their overall quality should be improved through better support, recruitment and selection.
5. Improve diversity of direct post-AIMS career opportunities through better career counseling, internships, etc.
6. Develop a brochure that explains the AIMS curriculum for education experts in partner universities in Africa and abroad to improve understanding of the AIMS degree. (Better align the values of AIMS with those of partner universities to ease the post-AIMS transition, and consider the establishment of a PhD program.)
7. Increase cooperation between AIMSSEC and the AIMS training pillar. Should Master's extensions be developed, consider adding teaching and didactics as an option (since many graduates go into teaching) alongside the growing number of internships in industry and research.

Research pillar

8. Increase clarity and strategic focus of research activities and cooperation with the education pillar, especially in relation to industry. Applied research and consultancy could improve ties between education and research; a PhD school could be part of this in the longer term.
9. Develop AIMS research and publications as well as international visibility through concentrated development of research excellence in a limited number of centres with a clear focus on some applied areas (e.g. grand challenges), while ensuring that "non-research centres" can also benefit from their activities.

Public engagement pillar

10. Develop a comprehensive communication strategy, an implementation plan and an updated monitoring and evaluation plan.
11. Improve communication and links between AIMS operational staff and students, as well as tutors and lecturers, by increasing the presence of AIMS centre staff on location and by organising common activities.
12. Produce and disseminate materials that describe the skill set of AIMS alumni and provides success stories.
13. Improve the overall understanding of the position and the objective of an AIMS Master's degree in the African education and research context, and reflect on strategies to optimise macro-level educational efficiency for students through working on accreditation, optimisation of shared degrees, direct PhD

opportunities, etc.

14. Expand AIMS' profile in North America and Europe.

Organisational development pillar

15. Maintain AIMS-NEI's positive spirit, vision and energy. This is a vital part of AIMS. The enthusiasm of students, staff and external stakeholders is a key component in the success of AIMS, and all newcomers should feel and be part of the same spirit.
16. Review the monitoring and evaluation system as well as the alumni monitoring strategy and database.
17. Develop cooperation between the 3 AIMS pillars.
18. Reflect upon and study the strategic implications of the planned expansion of the number of graduates from AIMS. When combined with a limited number of university and research positions in Africa, this could result in an unsustainable situation for alumni careers, especially given the very strong academic propensity of students.
19. Examine the position of industry in AIMS activity and its development in both education and research. AIMS should prioritise improving links with industry and ensure this supports both education and research objectives (taking into consideration the outcomes of employability, skills, new knowledge, services and ultimately innovation).
20. Clarify the Secretariat's role at the network and local level as well as the line decisions between the Secretariat and the centres.
21. Diversify funding sources, using tailored fundraising strategies for each pillar and across the pillars.
22. Decrease the pace of growth ambition: creating 15 centres too rapidly is likely to affect quality. AIMS should first concentrate on developing its visibility and recognition, on developing post-AIMS opportunities for its graduates and on building a sustainable model in the existing centres.