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Eastern Africa Universities
Mathematics Programme

Evaluation Report of the Eastern Africa Universities Mathematics Programme

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MAKERERE UNIVERSITY

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Abbreviations and acronyms

AIMS	African Institute for Mathematical Sciences
AIMS-NEI	African Institute of Mathematical Sciences - Next Einstein Initiative
CDC	Committee for Developing Countries, a committee of the IMU
CIMO	Centre for International Mobility, Finland
CIMPA	Centre International de Mathématiques Pures et Appliquées
COSTECH	Commission for Science and Technology, Tanzania
DAAD	Deutsche Akademischer Austauschdienst (German Academic Exchange Service)
EAUMP	Eastern Africa Universities Mathematics Programme
HoD	Head of Department
ICTP	International Centre for Theoretical Physics, Italy
IMU	International Mathematical Union
IPMS	International Programme in the Mathematical Sciences (ISP funding programme)
ISP	International Science Program, Uppsala University
KIST	Kigali Institute of Science and Technology, Rwanda (no longer independent, part of UR)
LMS	London Mathematical Society
LOC	Local programme (PhD)
MAK	Makerere University, Kampala, Uganda
MARM	Mentoring African Research in Mathematics, LMS grant scheme
MSc	Master of Science
N/A	Data not available
NAPRECA	National Products Research Network for Eastern and Central Africa
NUR	National University of Rwanda, Butare, Rwanda (no longer independent, part of UR)
PhD	Doctor of Philosophy

SAMSA	Southern Africa Mathematical Sciences Association
SAREC	Swedish Agency for Research Cooperation
SEAMaN	South-East Asia Mathematical Network (supported by ISP from 2015)
SEK	Swedish Krona
Sida	Swedish International Development Cooperation Agency
SWC	Sandwich (PhD programme)
ToR	Terms of Reference
TWAS	The World Academy of Sciences
UDSM	University of Dar es Salaam, Tanzania
UNZA	University of Zambia, Lusaka, Zambia
UoN	University of Nairobi, Kenya
UR	University of Rwanda, Kigali, Rwanda

Executive summary

The Eastern Africa Universities Mathematics Programme (EAUMP) was launched in 2002 by the International Science Programme (ISP) with support from the Swedish International Development Cooperation Agency (Sida) in collaboration with the Departments of Mathematics at University of Nairobi, Kenya; University of Dar es Salaam, Tanzania; and Makerere University, Uganda. The Mathematics Departments of the University of Rwanda and the University of Zambia joined the EAUMP network in the late 2000s.

The main activities of the network have consisted of capacity building via training PhD and MSc students; organizing mathematics Conferences and Summer schools; network exchange visits and coordinator meetings; research visits for postdocs to Sweden and elsewhere; as well as support for building up equipment and for research expenses. The total ISP support to EAUMP for the period 2002-2016 was 29,259,902 SEK or (at the current exchange rates) EUR 2.99M or USD 3.12M.

This Report is the result of an evaluation of the EAUMP network commissioned by ISP in order to assess its relevance, efficiency, effectiveness, impact and sustainability, as well as to provide the network with an independent review that can be used in planning for its future. The evaluation consisted of desk studies, site visits to all the network nodes, and a substantial set of interviews with beneficiaries and stakeholders.

It is the view of the Evaluation Team that the EAUMP network has played an absolutely essential and transformative role, at a reasonable and proportionate cost, in building mathematics research and teaching capacity throughout the Eastern African region, introducing new areas of mathematics and strengthening existing ones. There are signs of consolidating and emerging research groups, regular activities becoming embedded and finding additional support, as well as new types of activity. The continuing support, in a suitable form and shape, and taking into account the recommendations below, of mathematics, the most fundamental of enabling sciences, in the East African region is a worthwhile endeavour fully in accordance with the aims and objectives of ISP and its main funder Sida.

Capacity building

Recommendation 1: Maintain the sandwich PhD studies model as a good way to grow teaching and research capacity, with a high completion rate and rate of return to the region. Work with University administrators at African departments to maintain a development programme for young members of staff that includes a contract before embarking on a PhD.

Recommendation 2: Increase the number of female PhD candidates within the EAUMP network, aiming for a minimum of 30%. Establish mechanisms to help on-course female students. Explore ways EAUMP can help in working towards better gender balance within mathematics and in creating career pathways for female scientific staff leading to promotion to senior level.

Recommendation 3: Encourage node Departments to give as much teaching relief as possible to on-course sandwich PhD students; a total or almost total release from teaching should always be considered, when local teaching capacity allows this. Think of time spent at the home institution also as research time; make small research funds available during this time also (e.g. for data collection).

Recommendation 4: Maintain good communications with participating Swedish mathematics departments that provide PhD advisors, rewarding them appropriately. Improve communications between Swedish and local advisors, for example by making funds available for short visits of local advisors to Sweden. Work towards increasing the role of local advisors in PhD training. Harmonize to the extent possible the requirements for the Licentiate degree for EAUMP students. Encourage Swedish host departments to integrate SWC students into the local academic community.

Research Collaboration

Recommendation 5: Work towards increasing inter-node collaboration and visits for teaching and research purposes.

Recommendation 6: Build capacity strategically at the different nodes, leading to viable research groups. Strategic planning should identify gaps in teaching/research provision, and drive recruitment to PhD positions in these selected areas (e.g. by advertising in specific areas).

Research environment

Recommendation 7: Maintain the allocation for library, computer equipment and electronic journal subscriptions. Monitor closely the usage of library funds towards open access publication fees, and always check against lists of predatory journals.

Recommendation 8: Develop an active EAUMP site as an information portal and research database, that includes a list (with links) of the papers produced by the those who have been supported by the program, teaching materials from Summer Schools, etc., creating a teaching and research resource for the network and beyond.

Recommendation 9: Maintain networking and fundraising activity with an exit-plan in mind. Explore opportunities to work more closely with AIMS-NEI.

Recommendation 10: Maintain and possibly increase the postdoctoral programme as more PhD students graduate from the network.

Scientific output

Recommendation 11: Aim for 1-2 publications/person per year for each research-active member of the node departments. Use targeted postdoctoral positions and teaching buy-outs strategically for this purpose. Consider small financial rewards for publications in legitimate journals (such as support towards participation to an international conference, money for books).

Recommendation 12: Work on improving the quality of publications. Avoid predatory journals. Opt for open source publications through legitimate mathematical journals, preferably those covered by MathSciNet. Improve dissemination of research through the arXiv, personal webpages and the Mathematics Genealogy Project. Work with ISP to arrange for all SWC students to be given training in these matters.

Conferences and Summer Schools

Recommendation 13: Maintain the Conference series. Work towards a regular series of smaller, research-based meetings organized by different research groups within the network.

Recommendation 14: Maintain Summer Schools, but work towards improvements in the following areas: early announcement of topic, with supporting materials and school plan; course credit transfer; uniform standard and management of the Schools.

Network administration

Recommendation 15: Explore ways to conduct coordinators' business also via virtual meetings.

Recommendation 16: Improve reporting to ISP by providing a yearly report that includes financial details of in-year spending, short stories about activities, successes, papers written, etc. Produce also a shorter version that can be circulated more widely to stakeholders.

Resource allocation

Recommendation 17: Coordinate the research visits of SWC PhD students to Sweden with semester dates. Should funds allow, consider the possibility of longer stays. Cooperate with the bilateral programmes, especially in PhD training, considering carefully subject balance and financial incentives in particular. Re-think resource allocation at the nodes that have bilateral programmes, perhaps focusing on activities that benefit the entire Department.

Recommendation 18: Continue to improve on the reporting of the allocation of resources. Think strategically about resource allocation, considering in particular allocating more resources to research activities and website development.

Impact

Recommendation 19: Explore more extensive ways to spread EAUMP impact to Universities in the five countries beyond the nodes, with special emphasis on research activities.

Recommendation 20: Find ways to lobby members of University Administration and eventually Government to provide better teaching and research resources at participating Universities and beyond.

Recommendation 21: Improve mathematics research engagement with industry, public institutions and civil society. Find ways to spread the impact of the network to the teaching of mathematics at elementary and intermediate (high school) level.

Sustainability

Recommendation 22: Explore ways to obtain further financial support, leading to a weaning away from sole IPS support to a more balanced financial base and shared projects with other funders.

It has been the strong impression of the Evaluation Team that after an initial *capacity-building phase*, the network is ready to move into a *consolidation phase,* with the possibility of making detailed strategic decisions, extending the financial base, and generally building on the achievements of the period 2002-2016. It is hoped that this Evaluation Report will help the network continue to achieve its initial objectives, and to find further ways to improve mathematics teaching and research, in the widest possible sense, in East Africa.

Detailed report

1 Introduction

1.1 The evaluation

The present Report is a result of desk studies, site visits to all the network nodes, and a substantial set of interviews with beneficiaries and stakeholders. The Evaluation Team would like to thank all EAUMP representatives and ISP staff, and in particular the EAUMP Coordinators Prof Patrick Weke and Prof John Mango, all Node Coordinators, as well as the IPMS Programme Director, Prof Leif Abrahamsson and the ISP Project Coordinator, Rebecca Andersson as well as the ISP Mathematics Reference Group for all their help at the different stages of the evaluation.

1.2 The role of mathematics in development

It proved impossible in the given timeframe for the Evaluation Team to fully articulate the case for supporting Mathematics capacity building and research development in the developing world and in East Africa in particular. In place of a full discussion, the following quotes should suffice to give context to the evaluation.

"Science and technology (S&T) capabilities are fundamental for social and economic progress in developing countries. Unfortunately, many developing countries, particularly the poor countries of Africa, do not have the human resources, physical and economic infrastructures, and access to capital to take full advantage of the S&T expertise and achievements of […] industrialized countries. Nevertheless, countries at all levels of development have a strong desire for more robust S&T capabilities. […] S&T capacity on its own will be of little significance in developing countries. But when effectively integrated into the mainstream of development, S&T can make significant contributions to social and economic progress. […] Without continuing access to some level of S&T, no country will be able to reach a level of development that fulfils the most basic aspirations of its people[1]."

"Research in the enabling sciences is a public good, and often a global public good. […] Good enabling science is a necessary condition for development and poverty alleviation[2]."

It is a strongly held belief of the Evaluation Team that the continuing support, in a suitable form and shape, and taking into account the recommendations below, of mathematics, the most fundamental of enabling sciences, in the East African region is a worthwhile endeavour fully in

[1] *The fundamental role of science and technology in international development*, National Research Council of the National Academies, Washington DC, 2006.
[2] *Report on the Evaluation of the International Science Programme*, Sida, 2011. Annex C of this document fully articulates the case for good basic science within development.

accordance with the aims and objectives of ISP and its main funder Sida. The Evaluation Report should be read in this spirit.

2 Purpose, scope and methodology

2.1 Purpose and scope of the evaluation

"The purpose of the evaluation is to analyze and assess the EAUMP network and its node institutions in order to provide EAUMP and ISP with indications of the progress and development of the network, and to provide input and recommendations on future directions and improvements"
(From the Terms of Reference [ToR] of the EAUMP evaluation, attached as Appendix F)

While the evaluation was commissioned by ISP, it was intended to serve two parties. On one hand, ISP, the main funder, wishes to assess the relevance, efficiency, effectiveness, impact and sustainability of the EAUMP network in relation to its stated main objective[3],

"*to increase the contribution of mathematical research and training to sectors important for local and global development",*

and in relation to ISP's Strategic Plan (2013-2017). On the other hand, the evaluation was tasked with giving the EAUMP network itself and its nodes, as recipients of ISP support, a clear picture of the their achievements so far and to provide a valuable independent review that can be used in particular when planning for the next funding period (2018-2020) and beyond.

The ToR required the evaluation to result in the following outcomes.

1) An overview of how EAUMP functions, its activities and progress based on relevance, efficiency, effectiveness, impact and sustainability, where strengths and weaknesses are clearly outlined.

2) Recommendations and improvements (long and short term) to EAUMP and to ISP, respectively, on future directions of the network and its activities, including outputs, outcomes and impact.

3) In addition, the evaluation should include a brief tracer study of the (ISP supported) PhD graduates from the network.

The Evaluation Team have opted for the most complete time frame possible, starting at the inception of the network in 2002 and leading to the end of 2016, where data allows, in order to give the best up-to-date picture of the project. Exceptions to this time frame are noted everywhere below.

[3] As stated in the 2013 application to ISP for 2014-2016 funding.

2.2 Evaluation Team

The Evaluation Team consisted of the following members:

- Associate Professor Martin Singull, Department of Mathematics, Linköping University
- Professor Balázs Szendrői, St Peter's College and Mathematical Institute, University of Oxford
- Professor Antonella Zanna, Department of Mathematics, University of Bergen

2.3 Methodology: desk study, field visits and interviews

The ToR asked the evaluation to include the following:

- *A preparatory desk study*
- *Field visits to the node institutions*
- *Interviews should be held with the following stakeholders involved in the network activities:*
    - *The overall EAUMP Network Coordinator*
    - *The Node Coordinators*
    - *The Inter-network Coordinator*
    - *Staff members at the node institutions involved in the network*
    - *Relevant people in university management at node institutions*
    - *PhD and MSc students*
    - *PhD graduates*
    - *Director of the Mathematics Program (IPMS) at ISP*
    - *The IPMS Reference Group members*

The first phase of the evaluation was a desk study, conducted in the summer and early fall of 2016. It was based on self-evaluations provided by the network as a whole and by the individual nodes (see templates attached in Appendix G). The self-evaluations followed a structured format. In addition, the following extra documentation and data was reviewed:

- Allocations by ISP and costs for PhD students to visit Sweden
- List of supported students, duration of their PhD studies and stays in Sweden (attached as Appendix C.2)
- Links to Licentiate[4] and PhD theses by EAUMP students
- List of publications by EAUMP PhD students (attached as Appendix D)
- Written feedback collected at recent EAUMP summer schools (attached as Appendix B.2)

[4] In Sweden, the Licentiate is an intermediary degree between an MSc and a PhD. A Licentiate is a proof of completed education for those students who, for some reason, do not wish to or do not have the possibility to complete a third-cycle education (PhD). (Source: Swedish Council of Higher Education)

As a result of the desk study, the Evaluation Team produced an Inception Report that summarized preliminary findings, as asked for some further documentation. The Inception Report formed the early basis of the present document and is thus not included separately.

The second phase of the evaluation consisted of site visits. All the nodes participating in the network were visited by at least one member of the Evaluation Team. The field visits were accomplished in two rounds. The first one was a visit to the UR node, completed in July 2016 in conjunction with the 2016 ICTP-EAUMP Summer School in Kigali. The second field visit was organized around the 3rd EAUMP Conference held in Kampala, 26-28 October 2016, and included visits by members of the Evaluation Team to the UNZA and UDSM nodes before the Conference, interviews at MAK immediately before the Conference, and a visit to the UoN node after the Conference. During the field visits, interviews based on a semi-structured template (see Appendix A.3.1-2) were conducted with stakeholders listed above (see Appendix A.1 for a full list of interviewees).

A presentation of interim findings was given by the Evaluation Team at a meeting on 27 October 2016 during the 3rd EAUMP Conference. The participants at the meeting included the ISP and IPMS program directors and support staff, the Evaluation Team, the IPMS Reference Group members, the EAUMP coordinator, node coordinators, inter-network coordinator, advisors, and other relevant staff. EAUMP representatives were given the opportunity to respond to the findings, and the meeting allowed for a clarification of some points that had emerged.

The last phase of the evaluation included a second Desk Study, when the interviews were written up and reviewed. The scientific output of mathematicians at EAUMP nodes, and ISP supported graduates in particular, was also assessed, using the MathSciNet database, a widely used comprehensive database of quality mathematics publications, as well as a list of predatory journals and a register for scientific journal series and publishers that is used to evaluate research performance at Nordic universities.

The draft Report was completed in December 2016. It was discussed at the EAUMP Coordinators' Meeting on 18-20 January 2017, and commented on by ISP, its Mathematics Reference Group, and representatives of the EAUMP network and it nodes. The Report was revised in light of these comments to arrive at the present final version.

The report aims to answer the questions posed by the ToR, discussing also a variety of other points that have emerged during the evaluation process. Some questions could not be adequately answered due to lack of time, resources or the availability of data; instances of this are noted in the different sections.

3 Description of the EAUMP network

3.1 History of the EAUMP network

In June 1995 Sida/SAREC and Uppsala University organized an international conference entitled *Donor Support to Development Oriented Research in the Basic Sciences* in Uppsala, Sweden. At this conference, it was recognized that in the majority of Third World countries, particularly in the least developed ones, research and higher education in the basic sciences have received but a negligible share of the available resources from domestic and foreign sources. As a result, the indigenous base for education and technology has remained precariously weak. Another result was that the scientific communities in these nations had a limited influence on externally funded research being carried out within their own countries.

To begin to address these challenges, it was agreed to organize conferences on basic sciences for development at the sub-regional level, to lay the foundations in the basic sciences for research in the applied sciences and for long-term sustainable development. A *Conference on Basic Sciences for Development in Eastern and Southern Africa* was organized in March 1999 in Arusha, Tanzania. Organizers included COSTECH (Tanzania Commission for Science and Technology), TWAS, and ISP; the main funder was Sida/SAREC. This conference highlighted the status and problems of the basic sciences in Eastern and Southern Africa.

A further conference entitled *International Conference in Mathematics in Africa South of the Sahara* was held in November 2001 in Arusha, Tanzania, to address the problems in mathematics specifically. It was organized by UDSM in collaboration with COSTECH, the Tanzania Ministry of Science, Technology and Higher Education, TWAS and ISP. One outcome of this conference was the recognition that the situation of mathematics in East Africa was worse than in other parts of Sub-Saharan Africa. It was agreed to start a programme that addresses the precarious situation of mathematics in East Africa.

The Eastern Africa Universities Mathematics Programme (EAUMP) was formally launched by ISP at a meeting in Dar es Salaam held on 4-7 April 2002, in collaboration with the Departments of Mathematics at University of Nairobi (UoN), Kenya; University of Dar es Salaam (UDSM), Tanzania; and Makerere University (MAK), Uganda. This network was one of the first[5] under the recently established International Programme in the Mathematical Sciences (IPMS) of ISP. The first coordinating node for EAUMP was the Mathematics Department of UDSM. The overall coordinator was Dr C. B. Alphonce, the Head of the Department of Mathematics at UDSM. He was assisted by three coordinators from the participating departments.

[5] IPMS currently supports two other networks: *PDE, Modelling and Control*, with nodes in Burkina Faso, Senegal, Mauritania, Mali and Ivory Coast; and the much more recent *SEAMaN*, with nodes in Cambodia, Laos and Myanmar.

The programme had a Steering Committee whose function was to provide guidance and advice on policy issues and programme activities. The first Steering Committee consisted of the following members.

- Prof. L. Abrahamsson, ISP
- Dr. C. B. Alphonce, UDSM
- Prof. L. S. Luboobi, MAK
- Prof. V. G. Masanja, UDSM
- Dr. F. Nabugoomu, MAK
- Prof. J. W. Odhiambo, UoN
- Prof. W. Ogana, UoN

The Departments of Mathematics at the National University of Rwanda (NUR), and the Kigali Institute of Science and Technology (KIST), Rwanda joined the network in 2008. In 2013, these institutions themselves merged to form the University of Rwanda (UR), and will mostly be treated as one institution (and one node) for the purposes of the review. In 2009, the Department of Mathematics, University of Zambia (UNZA) also joined the network. The network has been in sporadic discussions with the University of Juba, South Sudan, to establish a new node, but these discussions have so far been inconclusive.

The second EAUMP Conference, and the 10th Anniversary of EAUMP, held at Nelson Mandela African Institute of Science and Technology, Arusha, Tanzania, 22-25 August 2012

The main activities of the EAUMP network have consisted of the following:

- Training of MSc students
- Training of PhD students
- Conferences
- Summer schools
- Network exchange visits and coordinator meetings
- Research visits for postdocs to Sweden and elsewhere

Moreover, ISP has provided financial support for the following:

- Equipment (such as laptops)
- Books and journal subscriptions
- Publication costs
- Conference attendance

The EAUMP network is funded by ISP in 3-year cycles, the most recent ones being 2008-2010, 2011-2013 and 2014-2016 (extended to 2017). Towards the end of each cycle, the EAUMP network submits a new project proposal to the board of ISP. The next period, for which an application is in preparation, will be 2018-2020.

The total ISP support to EAUMP for the period 2002-2016 was 29,259,902 SEK or (at the current exchange rates) EUR 2.99M or USD 3.12M.

3.2 Objectives of the network

The objectives of the EAUMP network[6] are the following:

1. Enhancement of postgraduate training with special emphasis on PhD training.
2. Establishing and strengthening collaborative research in Mathematics areas of interest in the region.
3. Strengthening the collaborating Mathematics Departments in terms of equipment and literature.
4. Development of resources for the collaborating Mathematics Departments.
5. Postdoctoral training of academic staff.

3.3 Environment

The EAUMP network is working in the East African region in a constantly changing but not particularly supportive environment. Several interviewees have reported on the difficulty of making the case for basic sciences. Even when there is support for mathematics, Government

[6] See http://www.isp.uu.se/what-we-do/mathematics/networks/eaump/

and University decision makers prefer “marketable programmes”, which may well exclude fundamental mathematics (pure or applied).

Of the five countries involved in the network, the Government in Rwanda appears most supportive[7] of mathematics and sciences in general, as evidenced by recent investments in this sector (such as a variety of new initiatives with AIMS-NEI, ICTP, etc). There appears to be support for staff training in particular. The Government of Uganda is reported to have a positive attitude towards mathematics and science in general, but there is no specific funding to support graduate work or staff development. In Tanzania, the Government is reported to have a positive attitude towards mathematics, and two staff members have been on a committee for National Basic Sciences; new staff positions have recently been released, and generally staffing appears to be improving. In Kenya, the Government is not particularly supportive; preference is given rather to basic training (primary and secondary school mathematics). The Government is also reducing basic funding to the universities; UoN itself has been severely affected by recent funding cuts[8]. Finally in Zambia, the Government is not reported to be particularly supportive towards mathematics; UNZA has frozen recruitment due to inadequate funding.[9]

At the same time, demand for higher education across the region is at an all-time high, due to population pressures and the value[10] sub-Saharan Africans place on education as a means to further opportunities. This, together with hiring freezes, leads to very high teaching loads for University staff all across the region.

Kenya and Uganda in particular, but to some extent all East African countries, are undergoing huge expansions in University provision (with different balances between Government and private providers). For example, between 2002 and 2016 the number of public Universities in Kenya has grown from 6 to 23. This means employment opportunities to graduates from the network, and a continuing demand for MSc and PhD degrees, but also further problems in staffing and teaching and high administrative loads for PhD graduates in particular.

As a consequence of these issues, relationships between Government, public Universities and their students can be particularly fraught at times. As stark evidence of this stand the recent closures of entire Universities in the region. UNZA was closed[11] from early February to 24 April 2016. MAK was closed[12] from early November 2016 to January 2017. In broad terms, the reasons for the closures in both cases were strikes and student protests ultimately over the

[7] See for example http://www.scidev.net/global/enterprise/opinion/rwanda-takes-long-view-invest-in-african-science.html
[8] http://www.nation.co.ke/news/education/Cash-crisis-University-of-Nairobi/2643604-3814880-8g0do3/
[9] The sources for all un-referenced statements in this paragraph are the self-evaluation documents, whose templates are attached in Appendix G, as well as the interviews.
[10] According to a recent survey by the Pew Center, a Washington, DC think tank, sub-Saharan Africans rate education as one of their most important concerns, second only to health care and well ahead of government efficiency or access to food, roads or energy. See http://www.pewglobal.org/2015/09/16/health-care-education-are-top-priorities-in-sub-saharan-africa/
[11] https://www.daily-mail.co.zm/?p=58164
[12] http://www.newvision.co.ug/new_vision/news/1439133/museveni-closure-makerere-university

allocation of funds (or rather the perceived lack thereof). The very damaging effect University closures have on research and teaching activities hardly needs to be emphasized.

3.4 Organizational structure

The EAUMP network consists of five nodes located at UoN, UDSM, MAK, UR and UNZA respectively, all having the same status within the network.

The activity of each node is coordinated by a *Node Coordinator*, a member of staff of the node institution. The Node Coordinators meet twice a year, usually at one of the nodes or at an activity run by the network, to decide on the budget for the upcoming year and to discuss matters related to the network (reports from coordinators, schools and conferences planned and concluded, ISP concerns, writing applications for the next funding cycle when relevant). The minutes of the meetings are shared with ISP.

The network activities are coordinated by the *Overall Network Coordinator,* a position that rotates among the nodes, whose role is to chair the Node Coordinators meetings and to overview the activities at the different nodes. The Node Coordinator at the same institution as the Overall Network Coordinator acts as a secretary for the coordinator meetings. The Network Coordinator role rotates between the nodes on a three-year basis, following the cycle of network funding described in Section 3.1.

There is an additional role within the network, that of the *Inter-Network Coordinator.* This role was added to the ones described above at a later stage. The Inter-Network Coordinator has the task of linking EAUMP to other networks within and outside Mathematics (such as SEAMaN, SAMSA, NAPRECA), and to explore avenues for resource mobilization and experience transfer. In addition, the Inter-Network Coordinator is engaged in fundraising from external sources (IMU, LMS, CIMPA, DAAD, Sida, CDC, etc).

Current holders of these positions are listed in the following list.

- Prof Patrick Weke, Overall Network Coordinator, UoN
- Prof John Mango, Inter-Network coordinator, MAK
- Dr Jared Ongaro, Coordinator, UoN
- Prof Juma Kasozi, Coordiator, MAK
- Dr Eunice Mureithi, Coordinator, UDSM
- Mr Michael Gahirima, Coordinator, UR
- Dr Mubanga Lombe, Coordinator, UNZA

The network is supported by an *Advisory Committee*. The current list of members is as follows.

- Prof Wandera Ogana, UoN
- Prof Patrick Weke, UoN
- Dr Jamen Hudson Were, UoN
- Dr V. A. Ssembatya, MAK

- Prof Allen Mushi, UDSM
- Dr Eunice Mureithi, UDSM
- Dr Isidore Mahara, UR
- Dr Banzi Wellars, UR
- Dr Desire Karangwa UR
- Dr Minani Froduald, UR
- Dr Alasford M. Ngwengwe, UNZA
- Prof Leif Abrahamson, University of Uppsala

The Committee gives general advice on the running of the network, both at the global level and at the individual nodes, and intervenes whenever there are conflicts. Its members can participate at Node Coordinators meetings. The Overall Network Coordinator is automatically a member of the Advisory Committee with the role of secretary.

ISP support for EAUMP is currently provided by the Programme Director of IPMS, Prof Leif Abrahamsson. Administrative support is provided by Ms Pravina Gajjar, ISP Administrator. IPMS also has a *Reference Group*, whose role is to evaluate the tri-annual application, and to provide general advice (for its list of members see Appendix A.1).

EAUMP coordinators and collaborators, and ISP staff during
the EAUMP biannual network meeting in Dar es Salaam, Tanzania, January 2017

3.5 Resource allocation

Between 2002 and 2013, EAUMP has been awarded funds under the following headings by ISP.

1. *Training*. This heading includes expenses incurred by PhD and MSc students, both local and sandwich.
2. *Regional activities and cooperation*. This heading covers the costs of regional training of MSc students and other regional activities, as well as coordinator meetings.
3. *Development expenses*. This covers three sub-headings:
    a. Exchange - joint research and travels staff and advisors
    b. Equipment - laptops, books and journals
    c. Workshops (including summer school) and conferences (merged with b. from 2009)

It has to be said that the Evaluation Team has found it difficult to get information on some aspects of these headings and the resource allocation in the early days of the network in general.

The following two tables give details of the resource allocation in absolute and relative terms.

Table 3.1 EAUMP expenditure (SEK)

Year	Training	Regional activities	Development expenses			Total
			Exchange	Equipment	Workshops	
2002	261,900	0	104,900	98,600	194,200	659,600
2003	497,000	144,000	78,000	59,000	133,000	911,000
2004	103,700	0	6,300	907,600	7,700	1,025,300
2005	684,000	302,000	129,000	272,000	121,000	1,508,000
2006	612,000	115,000	107,000	127,000	150,000	1,111,000
2007	1,151,000	345,000	19,000	130,000	318,000	1,963,000
2008	782,000	98,000	108,000	117,000	380,000	1,485,000
2009	677,000	899,000	69,000	87,000		1,732,000
2010	1,074,000	264,000	158,000	264,000		1,760,000
2011	1,122,000	914,000	130,000	195,000		2,361,000
2012	1,703,000	1,031,000	196,000	316,000		3,246,000
2013	1,963,000	422,000	32,000	229,000		2,646,000
2014						2,626,000
2015						3,022,000
Totals 2002-2013	**10,630,600**	**4,534,000**	**1,137,200**	**4,106,100**		**20,407,900**
GRAND TOTAL						**26,055,900**

Table 3.2 EAUMP expenditure (as percentage of the yearly total)

Year	Training	Regional activities	Development expenses			Total (SEK)
			Exchange	Equipment	Workshops	
2002	39.7%	0.0%	15.9%	14.9%	29.4%	659,600
2003	54.6%	15.8%	8.6%	6.5%	14.6%	911,000
2004	10.1%	0.0%	0.6%	88.5%	0.8%	1,025,300
2005	45.4%	20.0%	8.6%	18.0%	8.0%	1,508,000
2006	55.1%	10.4%	9.6%	11.4%	13.5%	1,111,000
2007	58.6%	17.6%	1.0%	6.6%	16.2%	1,963,000
2008	52.7%	6.6%	7.3%	7.9%	25.6%	1,485,000
2009	39.1%	51.9%	4.0%	5.0%		1,732,000
2010	61.0%	15.0%	9.0%	15.0%		1,760,000
2011	47.5%	38.7%	5.5%	8.3%		2,361,000
2012	52.5%	31.8%	6.0%	9.7%		3,246,000
2013	74.2%	15.9%	1.2%	8.7%		2,646,000
2014						2,626,000
2015						3,022,000
Totals 2002-2013	**52.1%**	**22.2%**	**5.6%**	**20.1%**		**20,407,900**
GRAND TOTAL						**26,055,900**

By 2016, the allocation headings have been changed. The following is the most recent, 2016 allocation, which gives a much clearer picture of the destination of ISP resources.

Table 3.3 EAUMP expenditure 2016 (summary)

Purpose	**SEK**	**%**
Support for PhD students	1,590,000	50%
Support for research projects of PhD students	57,750	2%
Support for M.Sc. Students	410,410	13%
Summer School	130,000	4%
Conference	318,000	10%
Research visits from Africa to Sweden	104,100	3%
Visits of Swedish researchers to Africa	67,600	2%
Postdoc research visits	175000	5%
Staff exchange in the region	26120	1%
Inter-Network Cooperation	24039	1%
Equipment, books and publication fees	115500	4%
Coordinators / Advisory meetings	116,363	4%
Honoraria for coordinators	69,120	2%
Total	**3,204,002**	**100%**

Based on these different sets of numbers, recent rough allocations appear to be the following:

- PhD training 50%
- MSc training 13-15%
- Scientific meetings (Conference, Summer School) 15%
- Research visits incl. postdocs 10%
- Equipment etc 5%
- Admin expenses (coordinators' meetings, honoraria etc) 5-6%

3.6 PhD training

One of the main aims of the EAUMP network is to build capacity by postgraduate training, with special emphasis on PhD training. PhD training can be carried out in various ways, the traditional way being for a PhD student to join a research group at a mathematics department for the entire duration of the programme, with a fixed assigned advisor (or advisors). A PhD programme can be based purely on research, or it can also include a course-based component at an advanced postgraduate level. Both types of programmes need highly qualified local staff members as advisors. If the PhD program includes also a taught course part, it will need highly qualified university teaching staff as well.

Sandwich PhD programme

At the time of the establishment of the EAUMP network in 2002, none of the participating institutions housed a taught PhD programme or had courses at the appropriate level, and supervision capacity at the right level was also mostly lacking. At the same time, presumably for reasons of cost as well as to avoid possible problems with retention, it was decided that a large-scale recruitment of PhD students to standard PhD programmes in Sweden was not appropriate. A Sandwich (SWC) PhD programme was established instead in collaboration with ISP. The first students were enrolled in the SWC PhD programme in 2003.

In the SWC programme, the prospective PhD student is enrolled in a PhD course at the home University, but spends a considerable amount of research and course time in Sweden, perhaps 50% of the entire duration. This is organized as follows: after enrolment, the student is invited for a one-month visit to Sweden. The host of the first visit is either contacted by the network, or by IPMS, keeping in mind the field of interest of the student. The aim of the first visit is to see whether this choice is appropriate, and also to give the student literature to prepare for the next, longer visit. Based on the first visit, a Swedish advisor is selected, as well as one or more co-advisors at the home University. Thereafter the student spends periods of self-study at his home institution, returning to Sweden for several visits that usually last for 4-6 months. During these visits, the student works on the research topic with their advisor, while also attending postgraduate courses at the allocated Swedish University, as well as participating at international conferences. After a number of years, the candidate obtains a Licentiate degree (see Section 2.3) in Sweden, upon submission and approval of a research thesis. Thereafter, a longer and more complete version of the Licentiate thesis is submitted for approval for a PhD degree, usually at the home University.

As SWC students are usually not registered PhD students of the Swedish host institution, they are sometimes not given information available to regular PhD students. Some also report feeling outside the community of young researchers at their Swedish host.

In the SWC programme, the average cost for a stay of one month in Sweden is 21 500 SEK. Up to the present time, 11 PhD students have graduated, with a total 60 visits to Sweden (also involving return air fares of approx. 10000 SEK per visit), lasting a total of 248 months. For the 11 students, the average cost to graduation comes to approximately 560k SEK per student.

Not all students who embarked on a SWC PhD programme have succeeded in finishing their degree; there has been a total of 3 dropouts, for personal reasons. Two of these students have however completed their Licentiate degrees in Sweden.

The SWC PhD programme fundamentally depends on PhD advisors who are willing to advise PhD students through this unusual route. The majority of advisors have come from Swedish universities, with some collaborators also getting involved from other European institutions. It is to the great credit of the Swedish mathematics community that advisors have come forward in sufficient numbers.

EAUMP sandwich student (current coordinator of the Nairobi node) Dr Jared Ongaro in discussion with Prof Rikard Bögvad, Stockholm University

Bilateral programmes in the region

Alongside the network support in the form of EAUMP, some Universities in the region have also benefitted from Sida *Bilateral Programmes*. The bilateral programmes are agreements directly between the universities and the Swedish partners, directly funded by Sida. NUR (later UR) was the first node in 2007 to have been awarded a bilateral programme in mathematics, a collaborative research programme to provide research support in five-year cycles (currently July 2013–June 2018). The value of this funding is approximately 29M SEK for the current cycle. In the second half of 2015, UDSM and MAK have also been awarded bilateral programmes in mathematics similar to the one in Rwanda, funded to a total of approximately 10M SEK and 39M SEK, respectively, for a five year period.

The main component of a bilateral programme is also PhD training. Since 2007, four students have graduated from Linköping University and four students are ongoing in Sweden, giving a total of eight SWC students. For MAK and UDSM, the plan is to have some SWC students, 5 and 3 respectively, but also to build up new local PhD programmes with support from the Swedish partners.

Local PhD programmes

All nodes in the network, except for UR, are able to offer research-only local PhD programmes. This has made it possible for the SWC students supported by ISP, who have already graduated with a Licentiate degree in Sweden, to submit a PhD thesis at their home Universities. This opportunity however has not been available for the UR students, since UR did not have a local PhD programme.

Within the Bilateral programmes, new local PhD programmes are being developed at UDSM, MAK and UR based on research and courses. The programmes have been developed together to harmonize the course component and to make it easier to mobilize both students and lecturers / advisors, across the region. The programmes at MAK and UDSM are ready to start with 15 and 3 students respectively, and the programme at UR plans to start in Fall 2017 with approximately 10 students.

PhD outcomes and development

The following table gives the number of PhD graduates from each node since 2002.

Table 3.4 PhD graduates

University	Number of PhD graduates since 2002	Number of PhD graduates with EAUMP support 2002-2015	Number of current PhD students	Number of current EAUMP supported SWC PhD students	Number of current EAUMP supported LOC PhD students
UoN	6	3	15	2[13]	0[14]
UDSM	10	5	11	3	0
MAK	10	3	5	3	0
UR	6	0	8	2	0
UNZA	4	0	5	3[15]	1[16]
Total	36	11	42	13	1

The numbers in the table above are worth considering in relation to the number of members of staff and PhD holders at each Department when they joined the network and now.

Table 3.5 Staff numbers and PhD holders [out of these, female mathematicians]

University	At the time of joining network (2002/2008/2009 respectively)		2016	
	Staff	PhD holders	Staff	PhD holders
UoN	15 [2]	13 [0]	45 [7]	30 [2]
UDSM	12 [1]	9 [1]	37 [4]	23 [3]
MAK	14 [1]	1 [0]	26 [3]	13 [1]
UR	N/A	5 [N/A]	38 [N/A]	13 [N/A]
UNZA	16 [2]	5 [1]	22 [3]	7 [1]

The quality of the PhD training is addressed in Section 5.2 below.

[13] One UoN PhD student finished very recently, see Footnote in Appendix C.1.
[14] Some local PhD students have received EAUMP support towards publication fees.
[15] One UNZA PhD student finished very recently, see Footnote in Appendix C.1.
[16] PhD student Wallace Haziyu, registered at the University of South Africa.

3.7 Masters training

Within EAUMP, ISP sponsorship is also used to partially support MSc students, sometimes giving them also travel support for conference and school participation, a computer, and access to other facilities.

At UoN there are currently 108 MSc students across many programmes in the Mathematical Sciences, 3 of whom are supported by ISP. A total of 280 MSc students have graduated since the start of the network, 18 with ISP support. Over 70% of these 18 students still works or teaches in Kenya.

MAK has a total of 23 enrolled MSc students, where two are supported by ISP. 14 MSc students have graduated in the programme with ISP support, 85% of whom still work or teach in East Africa. With the Government's liberalization of University education, there are now several private universities and these rely on MAK to train staff for them. This has led to an increased number of Master's students.

UNZA has 3 MSc students, none supported by ISP. Some MSc students tended to take a long time to complete their degree or left the program. This seems to be due to lack of funding, and the students taking on employment outside their MSc programme.

23 students are currently enrolled in the MSc programme at UDSM and one student is being supported by ISP. EAUMP supported 2 MSc students on average in the past, but due to the increase of educational fees in 2014, the node had to reduce the number of supported students. Fortunately, the University has decided to reduce fees again for the Natural and Applied Science schools (hence also for Mathematics). A total of 142 MSc students have graduated since the start of the network, 12 with ISP support. All still work or teach in Tanzania.

At UR, at the moment there are 3 MSc students supported by ISP. In total, 20 students have graduated from the MSc programme; of these, ISP supported four.

In the context of the bilateral programmes, the nodes MAK, UDSM and UR have started a process to review their master programmes in January 2016, in order to harmonize the curriculum. This process is ongoing. The Master programmes at these nodes derive substantial benefit from the involvement of the Swedish partners, through help with the design of programmes and with more direct help such as teachers and supervisors.

The Master programmes delivered at the nodes of the network appear to have relevant and up to date content, but teaching often appears more knowledge oriented than focusing on understanding. Master graduates are reasonably well prepared for PhD studies.

3.8 Postdoctoral opportunities

EAUMP has been able to offer a number of postdoctoral opportunities, for visits of 3 to 6 months. Node Departments released EAUMP-supported postdocs from teaching, allowing these mathematicians to fully focus on research during this time. The full list of visits is as follows.

- Damian Maingi, 2012, visiting the University of Barcelona
- Wilson Charles Mahera, 2012, visiting the University of Oslo
- Nyimvua Shaban, 2012, visiting Uppsala University
- Nelson Owuor Onyango, 2012, visiting the Swedish University of Agricultural Sciences
- Makungu Mwanzalima, 2016, visiting Linköping University
- Jared Ongaro, 2016, visiting the Universities of Oxford and Sheffield
- Ivivi Mwaniki, 2016, visiting the University of Cape Town

Postdoctoral opportunities are also available under the bilateral programmes. In their current cycles, the nodes UDSM, MAK and UR will offer 3, 10 and 3 postdoc positions, respectively.

3.9 Building up departmental facilities

Departmental library build up

Most of the nodes have used support from ISP to build up Departmental Libraries with graduate/advanced reference books (in addition to those donated by individuals) and get access to international journals. Journal access remains expensive and some of the nodes (for example, MAK) do not have basic access to sites like MathSciNet and ScienceDirect.
The nodes have also used library funds to support publication fees.

Equipment, computing facilities and Internet

Most of the nodes report reasonable internet connection, though this can often be affected by unreliable power supply. However, there appears ample room for improvement.

ISP supported PhD students are all given their laptops. Most MSc students also appear to have access to personal laptops.

3.10 Network conferences

The EAUMP network has held three major Conferences in the region.

- Third Conference, Makerere University, Uganda, 26-28 October 2016.
- Second Conference (10th Anniversary meeting), Arusha, Tanzania, 22-26 August 2012.
- First Conference, Nairobi, Kenya, 2003.

The conferences have attracted additional funding from ICTP, CIMPA, LMS, TWAS, and other organizations.

The conferences were attended by well over 100 mathematicians, and have involved a mixture of plenary and parallel sessions, with invited speakers from the region, elsewhere in Africa, Sweden, Europe, and the rest of the world. They also provided opportunities for major meetings of all stakeholders to discuss the future direction of the network.

3.11 Summer schools

One important component of the EAUMP network has been a series of regular (recently annual) MSc-level Summer Schools, which was started in 2008. The aims of the School have been to introduce participants to current trends in some area of pure mathematics, to provide possible research topics for masters and PhD students, to provide a forum for young African mathematicians to interact, to exchange ideas and initiate collaborations, to identify talented students for PhD programmes, and to produce digital lecture material for dissemination.

The audience at the EAUMP School on
Applicable Algebraic Geometry, Mombasa, Kenya, 8-26 July 2013

The most recent Schools were the following (for the full list of Schools, see Appendix B.1):

- 2017 (planned): EAUMP-ICTP School on Modern Functional Analysis, University of Nairobi, Kenya, 19 June to 7 July 2017.
- 2016: ICTP-EAUMP School on Number Theory, University of Rwanda, Kigali, 4-22 July 2016.

- 2015: EAUMP School on Experimental Pure Mathematics, Makerere, Kampala, Uganda, 6-17 July 2015.

A summary of feedback collected at recent schools can be found in Appendix B.2.

The Schools have attracted additional funding from LMS, CIMPA, ICTP and other organizations. ICTP has recently become a major partner in the running of the Schools, contributing very substantially to the 2016 edition (EUR 30K) and also for the 2017 school, currently being planned (EUR 15K, support reduced on account of limited funds available at ICTP).

Before 2016, the audience at the Schools consisted of 30-40 Masters students studying at the EAUMP network nodes. At the 2016 school, ICTP funding has allowed students from EAUMP countries but outside nodes, as well as non-EAUMP students, to be invited. The 47 participants consisted of 8 Rwandans, 28 non-Rwandans from EAUMP nodes, and 11 students from outside EAUMP nodes, including universities in Zambia and Tanzania that are not EAUMP nodes, as well as Botswana, Benin, Cameroon and Sudan.

Complete financial information was only available to the evaluators about the last School, held in Rwanda.

Table 3.6 Income and expenditure, 2016 ICTP-EAUMP School

Income		**Expenditure**	
ISP	24%	Flights (39 non-Rwandan students and lecturers)	29%
ICTP	52%	Accommodation (47 students and lecturers)	38%
CIMPA	13%	Food (47 students and lecturers)	25%
Elsevier Math Sciences Fund	8%	Local transport, expenses of support staff, stationery, etc	8%
LMS-AMSSI	2%		
University of Rwanda	2%		
Total income	**$62,883**	**Total expenditure**	**$62,883**

3.12 Research output

There were main two sources of information about publications written at the network nodes available to the evaluators. One source was an extensive search[17] performed on the MathSciNet database[18], one of the most complete and well-respected Mathematics review sites run by the American Mathematical Society. The other source was the network self-evaluation document, which asked all the nodes to list all publications by staff members since 2010. The latter was, on the one hand, incomplete, and on the other hand contained items not recorded on MathSciNet either because the subject matter, or the journal, lies outside MathSciNet coverage.

The following table gives a summary of the research outputs of the five nodes from the two sources.

Table 3.7 Research outputs on MathSciNet

University	Total number of publications on MathSciNet	Number of publications on MathSciNet 1994-2004	Number of publications on MathScinet 2005-2015	Growth between the two periods	Number of publications since 2005 reported in the network self-evaluation document
UoN	90	13	29	123%	22
MAK	54	0	49	∞	28
UDSM	88	19	48	152%	19
UNZA	24	6	4	-33%	3
UR (NUR and KIST)	15	0	15	∞	9
MathSciNet totals		711,110	1,109,048	55%	

Regarding MathSciNet data, it can be seen that the period 2005-2015 has been a much more productive period in most of these departments than the preceding period of the same length. Of course the total number of papers on MathSciNet has also grown in this period, but UoN and

[17] The MathSciNet data below refers to the period 2005-2015, chosen since the first publications that can be considered to have arisen from network activities started appearing around 2005. The time period 1994-2004 of the same length was chosen to make comparisons. Choosing different cut-off years does substantially change the reported conclusions.

[18] The following MathSciNet Institution Codes were included in the search. UoN: KEN-NRB-SM, KEN-NRB, KEN-NRB-AFN, KEN-NRB-NDM, KEN-NRB-IC, KEN-NRB-SMB. MAK: UG-MAK-M, UG-MAK, UG-MAK-CIS, UG-MAK-ODL. UDSM: TZ-DAR, TZ-DAR-MNA, TZ-DARS, TZ-DARS-NDM. UNZA: Z-ZAMB-MS, Z-ZAMB, Z-ZAMB-NDM. UR: RW-KIE, RW-KIST-AM, RW-KIST-M, RW-NUR, RW-NUR-AM, RW-NUR-M, RW-RWAN-M, RW-RWAN-MST.

UDSM have growth rates well in excess of the overall rate, whereas MAK and UR have started producing output when there was none before. UNZA is an outlier in this list.

The research outputs are analyzed further in Sections 4.3 and 5.5 below.

3.13 Impact beyond teaching and academic research

Some of the nodes have reported impact of their research beyond teaching and academia. This includes MAK studies on disease modeling (Malaria, HIV/AIDS, TB) that have been utilized by health officials. UoN reports that their research has been been used in industry and have influenced policy in the following areas:

- fighting spread of malaria in Kenya and the East African region;
- vaccination of livestock and small animals;
- evaluating claims in the insurance industry.

4 Tracer study

4.1 Composition of the Tracer Group

The 11 PhD graduates of the EAUMP network (for a list of names, see Appendix C.1) form a group of mathematicians who most directly benefitted from ISP support, and form the core of the Tracer Group. From the interviews, two further mathematicians have been identified, who are not PhD graduates of the network, but have benefited very substantially from EAUMP support, including attendance at EAUMP schools and postdoctoral opportunities. They are Dr David Ssevviiri (MAK, PhD Nelson Mandela Metropolitan University, South Africa, 2013) and Dr Damian Maingi (UoN, PhD Nice, France, 2010). They are thus also included in the Tracer Group.

The Tracer Group consists of 12 male mathematicians (92%) and one female (8%). Gender issues are discussed further in Section 5.2 below.

It should also be noted that two female mathematicians, Idah Orowe (UoN) and Mervis Kikonko (UNZA), have very recently completed their PhD studies, just outside the timeframe to be added to the Tracer Group.

All members of the Tracer Group, with the exception of Dr Cyrus Ssebugenyi, who was not available at the time of the site visit, have given detailed interviews to the evaluators.

EAUMP graduate and Tracer Group member Dr Betty K. Nannyonga, organizer of “2nd workshop on gender equality activities in basic sciences” held 25 October, 2016 at Makerere University, Uganda

4.2 Employment status

All 11 members (100%) of the Tracer Group are employed in East Africa, one in a government role and the others in higher education, at Mathematics Departments at the nodes. Among the Tracer Group members, one finds the following:

- One Higher Education Officer
- One Deputy Principal of College
- One Head of Department
- Five Senior Lecturers
- Six Lecturers

Some members of the Group have built research groups and advised a number of MSc students, leading to international PhD scholarships for their students. Members of the Tracer Group have also taken on substantial other roles, with one being a leader in gender-related discussions within the field (see Section 5.2), and another leading the first team from his country to the International Mathematical Olympiad.

4.3 Research output

The total number of publications by members of the Tracer Group is 57, including 36 publications recorded on MathSciNet and 54 journal publications. The full list of research outputs by members of the Tracer Group can be found in Appendix D. This list was built up from the individual self-evaluation documents supplied by the nodes, supplemented by MathSciNet search.

The following table extends the MathSciNet publication data from Section 3.12 with an indication of how much Tracer Group members have contributed to the growth of the number of MathSciNet hits at the three departments having such members. It can be seen that the contribution in all cases is substantial.

Table 4.1 Research outputs on MathSciNet and the Tracer Group

University	Number of publications on MathSciNet 1994-2004	Number of publications on MathScinet 2005-2015	Number of publications by members of the Tracer group on MathSciNet 2005-2015	Contribution to growth of number of publications of the Tracer group
UoN	13	29	5	31%
MAK	0	49	14	28%
UDSM	19	48	5	17%

The number of MathSciNet publications of Tracer Group members here is lower than reported above, since several of the publications in the List of Appendix D were recorded on MathSciNet when their authors were members of departments outside East Africa.

The quality of publications of members of the Tracer Group is analyzed further in Section 5.5 below, as part of the general evaluation.

4.4 General concerns of members of the Tracer Group

This section summarizes some observations made by Tracer Group members during the interviews.

Tracer Group members had an almost uniformly positive experience with the SWC programme. This was especially true for students who already had families. All have reported of very productive visits to Sweden and elsewhere in Europe, to welcoming and inspiring research environments. Time back in Africa during the SWC programme was more difficult, with some carrying substantial teaching loads, especially if they were specialists in areas in which no other member of staff had any expertise. Some reported lack of research funds while at the home institution as negative.

All Tracer Group members had Lecturer contracts with their departments before they embarked on their PhD, ensuring a relatively smooth transition back to East Africa when they finished their studies. As seen above, many have since been promoted, with some taking on senior roles within their Departments and Universities.

As far as their current roles are concerned, high teaching loads often make Tracer Group members' jobs very difficult. Many find allocating time for research very tricky, especially when they have agreed to take on a major administrative role. Some have returned to relatively well functioning research groups; others report feeling alone within their field and find their current environment a particularly difficult one for research. Some respond by adapting research interests, for example by moving into interdisciplinary research. Return visits to Sweden and elsewhere are much appreciated. Conference funding, especially for trips to Europe or the US, is in general hard to obtain, with local departments usually unable to help; some have reported positive experiences in this regard with certain outside funders.

5 Evaluation and recommendations

5.1 Introduction: objectives

The objectives of the EAUMP network stated in Section 3.2 are in good agreement with the ISP current reason for supporting regional scientific networks as stated in the ISP Strategy Plan 2013-2017: *"Regional cooperation generates scientific cooperation and complementary activities, gives access to advanced equipment, and contributes the human capital needed for good postgraduate education."*

Below we will discuss in more detail aspects of the different objectives, with a Summary in Section 5.12.

5.2 Capacity building via postgraduate training

Objective 1: Enhancement of postgraduate training with special emphasis to PhD training.

The goal of postgraduate training has been to raise the competence level of academic staff at the network nodes, which is absolutely essential in building research and teaching capacity. As discussed above, the main way of training has been the sandwich (SWC) model, in which the students are already employed as academic staff and teach at their departments while back in Africa. Upon graduation, they return to these teaching positions and are usually promoted, ensuring that they remain in the system.

In the period 2002-2015, the EAUMP network has directly supported 27 PhD students and indirectly supported 2 PhD students, the latter for a very short time[19] (see Appendices C.1-2). By late 2016, 11 out of the 27 students had graduated, 13 PhD's were in progress, some of them very close to graduation, while 3 students had aborted their studies (11%). It appears from available evidence that all 13 current students are on course to complete successfully, giving an overall 89% success rate. Of the three students who did not complete the program, two have obtained Licentiate degrees, but had to abort the PhD degree for personal reasons.

There is a 100% return rate to the region among ISP-supported SWC PhD students.

To be able to address the quality of the PhD training provided, the Evaluation Team reviewed two PhD theses in detail in areas close to their mathematical interests. While neither of these theses was outstanding by international standards, they both contained original and interesting contributions to the relevant field, and would in particular have stood a good chance of being accepted as doctoral dissertations at the evaluators' home institutions. As a minor comment, in the case of a thesis on modelling, the provided data was of good quality and of interest, but the

[19] One further student, Wallace Haziyu from the University of Zambia, receives financial support from EAUMP for return visits to the University of South Africa, where he is completing a PhD. His case is very different from the others discussed here, so is not included in the numbers.

strength of the statistical analysis could have been improved. The quality of the PhD training is also evidenced by the improving publication trends to be analysed further in Section 5.5 below.

Recommendation 1: Maintain the sandwich PhD studies model as a good way to grow teaching and research capacity, with a high completion rate and rate of return to the region. Work with University administrators at African departments to maintain a development programme for young members of staff that includes a contract before embarking on a PhD.

Figures on the number of female scientific staff at the nodes at the time of joining EAUMP and 2016 are shown in Table 3.5 above. The table shows that the number of female scientific staff has grown proportionally to the total staff increase. The proportion of female scientific staff at the EAUMP nodes in 2016 ranges between 10.5% and 15.5%, a figure that is comparable to the ratios observed in many European countries.[20] One point to recognize is that two of the five current EAUMP node coordinators are women.

Typically, however, the proportion of female PhD students in mathematics is higher than that of female staff. Figures vary from country to country. Norway reports a 44% ratio of female PhD candidates in mathematics and natural sciences (2015).[21] The AMS reports that 32% of all PhD students in mathematics in the U.S. was female in 2013.[22] The following table summarizes the number of PhD students supported by ISP at the different nodes in the period 2002-2015 from the point of view of gender.

Table 5.1 EAUMP PhD students by gender

PhD students 2002-2016	UDSM		UoN		MAK		UR		UNZA	
	M	F	M	F	M	F	M	F	M	F
Graduated	5	0	3	0	2	1	0	0	0	0
Ongoing	3	0	0	2	3	0	2	0	3	1
Aborted studies	0	0	0	1	1	1	0	0	0	0

Among the 27 students, 6 are female (22%), among students who aborted their studies, 2 out of 3 (66%) are female. Thus the figures for female PhD students' enrolment/completion are somewhat at the lower end of the scale. The Evaluation Committee's meetings with students during the field visits indicate that at the Master level there is a good gender balance that is not reflected at the PhD level. In line with international examples, a target of 30% female ratio among PhD students should be achievable within the framework of the project, without recourse to specific gender preference in selection (that might be illegal in some countries).

[20] Statistics on Women in Mathematics. Report by C. Hobbs and E. Koomen, EMS/EWM, 2006, https://womenandmath.wordpress.com/past-activities/statistics-on-women-in-mathematics/
[21] http://www.uniforum.uio.no/nyheter/2015/09/flere-kvinner-enn-menn-tar-doktorgrad-i-norge.html
[22] http://www.ams.org/profession/data/annual-survey/2014Survey-NewDoctorates-Report.pdf

In addition, although numbers are too small to do any significant statistics, it appears evident that completing a PhD is more challenging for female students than it is for male students. The interviews indicate that several types of reasons play a role in drop-out decisions, including social, cultural and religious factors. A mentoring program could help detecting problems at an early stage.

Recommendation 2a: Increase the number of female PhD candidates within the EAUMP network, aiming for a minimum of 30%. Establish mechanisms to help on-course female students.

It is noteworthy also in this context that a workshop *"Gender Equality Activities in Basic Sciences – Bridging the Gap"* was held at Makerere University in October 2016 with more than 300 participants. The workshop was organized by ISP Gender Equality Grant winner, Dr Betty Nannyonga, who is an EAUMP PhD graduate and a member of the Tracer Group.

Poster for the 2nd workshop on *Gender Equality Activities in Basic Sciences* held on 25 October 2016 at Makerere University, Uganda

Recommendation 2b: Explore ways EAUMP can help in working towards better gender balance within mathematics and in creating career pathways for female scientific staff leading to promotion to senior level.

Possible ideas in this respect include a mentoring programme, targeted buy-out from teaching, courses in scientific leadership, support for travel to conferences, and help with child care[23].

[23] For an example of a possible scheme, see https://www.lms.ac.uk/grants/caring-supplementary-grants

In terms of timing, the average number of years to the completion of the PhD in the sandwich programme was about 5.5 years. The students spend about 20.5 months in Sweden on average. During their visits in Sweden, they are released from their teaching duties. When back at their home institution, some resume their teaching duties, sometimes having to teach more hours than normal, to recover the load covered by others while staying abroad or because they have special expertise. The teaching load varies a lot from institution to institution, the worst being at present UoN, as it is carrying a double intake of students (which is expected to terminate in 2017).

Recommendation 3: Encourage node Departments to give as much teaching relief as possible to on-course SWC PhD students; a total or almost total release from teaching should always be considered, when local teaching capacity allows this. Think of time spent at the home institution also as research time; make small research funds available during this time also (e.g. for data collection).

Advisors play a key role in the SWC programme. Upon their first visit to Sweden, prospective students are interviewed and put in contact with a suitable Swedish advisor. In addition, the PhD students are assigned one or more local advisors from their home institution. From the interviews it has emerged that often there is little or no communication between the external and the local advisors. An improved communication between the external and local advisors can double the effect of the investment in the PhD position, as it establishes a stronger scientific link with the external institution and also helps local advisors develop their skills.

Recommendation 4a: Maintain good communications with participating Swedish mathematics departments that provide PhD advisors, rewarding them appropriately. Improve communications between Swedish and local advisors, for example by making funds available for short visits of local advisors to Sweden. Work towards increasing the role of local advisors in PhD training.

As mentioned earlier, all EAUMP PhD students are enrolled for a PhD at their home University, but also registered in Sweden for the Licentiate degree. The degree generates a financial reward for the Swedish institution where the Licentiate degree is completed[24]. From the interviews it emerges that the different Swedish institutions have different requirements on the formal requirements (ETC points, length and extent of the thesis) that creates a sense of disparity among the students.

Recommendation 4b: Harmonize to the extent possible the requirements for the Licentiate degree for EAUMP students. Encourage Swedish host departments to integrate SWC students into the local academic community.

[24] At Uppsala, the reward for the Licentiate is paid out when the student actually passes the PhD examination at the home University.

5.3 Research collaboration

Objective 2: Establishing and strengthening collaborative research in Mathematics areas of interest in the region.

At the planning stages of the EAUMP network, it was agreed that the main aim of the network would be to build research and teaching capacity at the individual nodes, to establish and strengthen collaborative research across the region, and to increase staff mobility. Before the establishment of the network, the nodes appear to have operated completely independently and had few links with each other, with other research groups in Mathematics in Africa or outside. In this context, the following collaborative achievements of the network are worth mentioning:

- Shared student supervision across the nodes (though mostly on the basis of giving feedback to written submissions)
- Node Coordinator meetings and joint EAUMP renewal proposal writing
- Joint organization and coordination of EAUMP schools and conferences
- Student mobility
- Links between research groups at different nodes

Several of the interviewees have stated that *getting to know each other in the region* has been a major added value of the network.

However, despite the achievements described above, collaborative research across the nodes is still weak. Although student mobility is fair (especially via the Summer Schools), staff mobility has been very limited indeed. There appears to have been very few inter-node research visits, collaborations, or inter-node visiting lecturing (with some notable exceptions, for example in Financial Mathematics). This is of course partly due to heavy teaching duties at home institutions, understaffed universities, failure in getting Government investment at Higher Education level and the belief that mathematicians work on smaller, more personal projects. But the situation is not helped by the fact that only a very small part of the yearly budget is allocated to research visits/staff exchange - and from the interviews it also emerges that these funds often remain unused.

Recommendation 5: Work towards increasing inter-node collaboration and visits for teaching and research purposes.

Turning to the issue of different areas of mathematics, what areas should be considered *“of interest in the region”* appears very difficult to decide once and forever. Areas such as Applied Mathematics (e.g. epidemics modelling) and Financial Mathematics have clear relations to Development Goals, and have rightly emerged as strong focal points also in the network. However, while it has been more difficult to make a case for Pure Mathematics, and applications and benefits of these research areas might come in a less immediate future, these areas have very close links to more applied areas (for example, the theory of PDEs or Graph theory, also known as Network Science) and can also have unexpected benefits (such as Number Theory,

once considered one the most theoretical of topics, now playing a vital part in computer-based encryption systems). Indeed, one of the secondary objectives of the network has been *"to strengthen pure mathematics"* that was practically non-existent at several of the nodes before the establishment of the network. One of the mechanisms has been a series of EAUMP summer schools on topics in pure mathematics (for further discussion, see Section 5.5 as well as Appendix B).

The table below shows a rough classification of the research topics of the EAUMP PhD students, using the thesis title, including theses both completed and in progress.

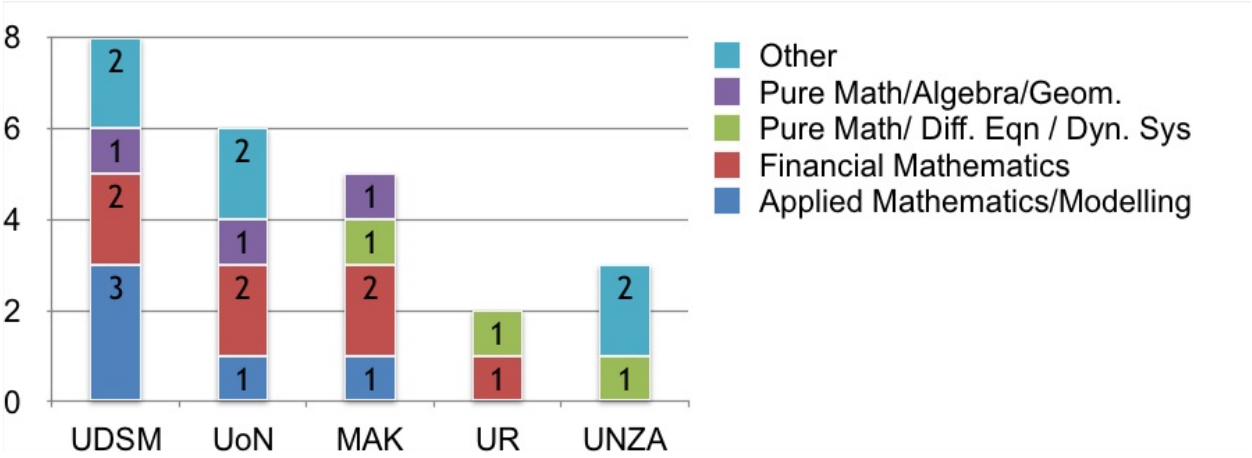
Table 5.2 EAUMP PhD topics

Topic	Number of theses
Applied Mathematics/Modelling	5 (21%)
Financial Mathematics	7 (29%)
Pure Mathematics: Differential Equations/Dynamical Systems	3 (12.5%)
Pure Mathematics: Algebra/Geometry	3 (12.5%)
Other	6 (25%)

A further distribution of the topics per institution is presented in the table below.

Table 5.3 EAUMP PhD topics by node

Topic	UDSM	UoN	MAK	UR	UNZA
Applied Mathematics/Modelling	3	1	1	0	0
Financial Mathematics	2	2	2	1	0
Pure Mathematics: Differential Eqn / Dyn. Sys	0	0	1	1	1
Pure Math: Algebra/Geom.	1	1	1	0	1
Other	2	2	0	0	2



The topic of Applied Mathematics/Modelling indeed comprises mostly epidemiological models, and cuts across the UDSM, UoN and MAK nodes. The Financial Mathematics stream cuts across UDSM, UoN, MAK and UR. These two topics appear well consolidated at some of these nodes, with a critical mass of research active staff.

Pure Mathematics: Algebra/Geometry is present at UDSM, UoN and MAK. At the latter two nodes, there are emerging research groups in this area that include researchers not trained through EAUMP, with synergies with each other also. The other topics in Pure Mathematics (Differential Equations and Dynamical systems) appear more isolated at all the nodes where they are present.

UNZA is the latest to join the network, and correspondingly at a much earlier stage of development. There are signs of an emerging cluster of pure mathematicians there, but most members are at an MSc stage only.

It is notable that, even if Financial Mathematics does include some mathematical statistics, the core subjects in mathematical statistics: probability theory and statistical inference, are missing at most nodes. It proved beyond the time available for the Evaluation Team to make detailed recommendations, but clearly this issue must be addressed at some point.

The choice of PhD topics appears to have been based mostly on individual students' interest. As the table above indicates, this has often lead to a spread of isolated competences. Although this might be justifiable in a build-up phase, it is clear that in the long term, it will lead to a fragmentation of the research environment. Ideally, research groups should emerge consisting of at least 3 people working in related areas, a regular seminar, and students.

It should finally be noted that stronger regional activity in specific research areas will be a necessary foundation for project-based grant applications, regionally and internationally (e.g. Simons Foundation).

Recommendation 6: Build capacity strategically at the different nodes, leading to viable research groups. Strategic planning should identify gaps in teaching/research provision, and drive recruitment to PhD positions in these selected areas (e.g. by advertising in specific areas).

5.4 Research environment

Objective 3: Strengthening the collaborating Mathematics Departments in terms of equipment and literature.

Individually most of the departments have upgraded their equipment and literature, as already discussed in Section 3.9, and now report on reasonable provision in this regard. Electronic journal access is still low, compared to a typical well-developed academic environment.

Some nodes use the library funds to support publication fees. Although this can help to increase the number of publications of the nodes, this is a short-term benefit to the author and the Department. Such practice also risks distorting the market by encouraging the emergence of more predatory journals that accept articles more quickly and with little or no peer review, provide neither adequate editorial nor publishing services but charge relatively high publication fees. (See more on publishing in predatory journals below in Section 5.5.)

Using library funds towards open access publication fees appears acceptable in some cases, but often is not really necessary. Typically open source publication is rather expensive, so the costs should be weighted against the benefits. Open source can also be achieved through other means, like upload to arXiv.org. Several legitimate scientific journals allow authors to keep a copy of their paper for publication on personal web pages, researchgate.net, or other non-profit scientific sites.

Recommendation 7: Maintain the allocation for library, computer equipment and electronic journal subscriptions. Monitor closely the usage of library funds towards open access publication fees, and always check against lists of predatory journals.

Objective 4: Development of resources for the collaborating Mathematics Departments

Two types of resources can be considered: on the one hand, teaching and learning materials, research databases, websites; on the other hand, financial resources.

Insofar as the first type of resources is concerned, there is no evidence of much progress in any of these from the self-evaluations and the interviews. An exception is the EAUMP site maintained by ISP[25], which describes the activity of the network and has a collection of Licentiate theses by EAUMP students. From a Google search with the keyword “EAUMP”, we found the website www.eaump.net for the network, which however is largely out of date. There were many hits to the EAUMP Summer Schools.

[25] http://www.isp.uu.se/what-we-do/mathematics/networks/eaump/

Recommendation 8: Develop an active EAUMP site as an information portal and research database, that includes a list (with links) of the papers produced by the those who have been supported by the program, teaching materials from Summer Schools, etc, creating a teaching and research resource for the network and beyond.

The development of financial resources for collaborating Mathematical Departments can play an important role when the ISP support reaches the exit-stage. Though the network does not really have a realistic exit plan at the moment (see also Section 5.10), there has been some notable activity towards creating connections and collaborations in Africa and abroad, and towards fundraising. As evidenced by the interviews, these include

- Cooperation with East-West Africa on PDEs (ground water flows) and control theory
- Cooperation with NAPRECA on biological sciences (weak)
- Cooperation with SEAMaN, mostly EAUMP sharing experience about challenges, modus operanding, etc.
- Cooperation with SAMSA by sharing research findings and teaching/supervision exchange
- Cooperation with Sida, leading to the establishment of bilateral programs with UR, MAK and UDSM
- Funding of scholarships through CIMO (Finland) and DAAD (Germany)
- Collaboration with ICTP on the Summer Schools
- Funding support for conference and workshops from CDC, LMS, World Bank, Simons, CIMPA, TWAS, etc.

These links, if strategically developed, can contribute to broadening the competence and competitivity of the network and can provide stronger scientific platforms for future grant applications.

One notable exception from the above list of partners is AIMS-NEI, a very successful network of Mathematical Sciences teaching and research Centres. Initially founded in South Africa in 2003, there are now six AIMS Centres in operation. Two of these are in the Eastern African region, one located in Kigali, Rwanda and another one in Bagamoyo near Dar es Salaam in Tanzania. There are many synergies between the objectives of EAUMP and of AIMS. While some members of the EAUMP node departments have participated in AIMS activities, there is ample scope for enriching the interaction.

Recommendation 9: Maintain networking and fundraising activity with an exit-plan in mind. Explore opportunities to work more closely with AIMS-NEI.

Objective 5: Postdoctoral training of academic staff.

The ISP-supported postdoctoral programme has been a recent addition to the network's activities (2011). As capacity-building is progressing, it has become necessary to support a

continued research activity of the PhD graduates on their return to their home university and lecturing position. The postdoctoral trainees enjoy the benefit of “buy-outs”, giving them extra hours to devote to research, and the possibility of full focus on research while on a research visits.

Recommendation 10: Maintain and possibly increase the postdoctoral programme as more PhD students graduate from the network.

5.5 Scientific output

One overall objective of the network was to improve mathematics research throughout the region. The improvements in the *quantity of the scientific output* have already been discussed in Section 3.12. This is consistent with results elsewhere; indeed, some of the Universities in the network have seen an increase in their university ranking[26]. Publication volume however remains low when compared to other universities worldwide. While mathematicians do publish fewer papers than other scientists, about 1-2 scientific papers a year[27] appears reasonable as a target. This rate of publishing should be an achievable target within the EAUMP project as well.

From the interviews, several possible reasons why publication rate is low have emerged. One obvious cause is the high teaching load and limited time to conduct research, especially after the completion of the PhD. Teaching buy-outs and targeted postdoctoral positions could be effective means to focus on research. Another reason is the fact that publications have little value for the individual and they do not generate any type of reward, except when promotion is discussed.

Recommendation 11: Aim for 1-2 publications/person per year for each research-active member of the node departments. Use targeted postdoctoral positions and teaching buy-outs strategically for this purpose. Consider small financial rewards for publications in legitimate journals (such as support towards participation to an international conference, money for books etc).

Turning to an assessment of the *quality of the publications from the network*, the table below analyses the publication list submitted by the nodes from the network self-evaluation document. This publication list refers to the time frame 2010-2014, is incomplete and not completely up to date, but it has been taken to be indicative of general trends.

The journals have all been checked against Beall’s list of predatory journals[28], and a register for scientific journal series and publishers that is used to evaluate performance at Nordic

[26] UoN and MAK now regularly feature among the top 10 institutions on the African continent, in rankings by the Times Higher Education Supplement, Webometrics, etc.
[27] http://www.ams.org/profession/leaders/culture/RatesofPublicationfinal.pdf This is a study on winners of prestigious mathematical awards, strongly supporting the view that when judging the work of mathematicians, the key measure of value is the quality of publications rather than the rate.
[28] This list was accessed from https://scholarlyoa.com/publishers/ in 2016, but is not currently available.

universities[29]. The register forms the basis for research publications that have an impact on the weighted funding model. Each Nordic country uses a slightly different database, but they are all cooperating on a common registry of research publication channels.

The papers are evaluated on a point-based system with 0/1/2 points awarded based on the journal, level 2 being the best (2 points). The journal classification is reviewed every year by a national scientific committee[30] and journals can change in level according to the quality of the papers, of the refereeing and of the editorial board. Some of the journals have changed level in the period 2002-2015, for changes 0-1 we count 0.5 points, for changes 1-2 we count 1.5 points. The percentages reported will not add up to 100, as level 0 journals do not appear explicitly in the statistics. It is not clear whether the level 0 journals are predatory or not, but they are listed with an unknown refereeing process. The publication points percentage score is calculated on an expectation of one publication point per published paper.

Table 5.4 Publications of EAUMP node staff

Network staff	UoN	UDSM	MAK	UR	UNZA	Total
Listed publications (Network self-evaluation)	22	19	28	9	3	81
Publications in likely predatory journals	13 (59%)	8 (42%)	11 (40%)	3 (33%)	0 (0%)	35 (43%)
Level 1	5 (23%)	2 (10%)	9 (32%)	3 (33%)	3 (100%)	22 (27%)
Level 2	1 (4%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1%)
Publication points	7 (31%)	2 (11%)	9 (32%)	3.5 (39%)	3 (100%)	24 (29%)

A similar exercise can be done for the publications by PhD graduates and ongoing PhD students of the program with direct and indirect ISP support. Books, book chapters and conference proceedings are not handled by the publication channels database, so there is missing information for this type of publications. The same scoring system described above is also applied to this latter list, contained in Appendix D.

[29] https://dbh.nsd.uib.no/publiseringskanaler/Forside.action?request_locale=en
[30] Universitetets- og høyskolerådet (UHR)

Table 5.5 Publications of tracer group members

EAUMP graduates	UoN	UDSM	MAK	UR	UNZA	Total
Retrieved list of publications	9	17	33	1[31]	3	63
Publications in likely predatory journals	0 (0%)	3 (18%)	7 (21%)	N/A	0 (0%)	10 (16%)
Level 1	3 (33%)	6 (35%)	18 (55%)	N/A	2 (66%)	29 (46%)
Level 2	0 (0%)	1 (6%)	0 (0%)	N/A	1 (33%)	2 (3%)
Publication points	5.5 (61%)	8.5 (50%)	19 (58%)	N/A	4 (133%)	37 (58%)

From this table, it is evident that EAUMP graduates have significantly fewer publications in likely predatory journals (16% against 43% from the network self-evaluation) and more publications in level 1 and level 2 journals (46% and 3% against 27% and 1% respectively). This is a strong indication that the quality of the research has improved with ISP training and there is a positive trend in research. However, in terms of the overall quality of publications, there appears to be ample room for improvement.

Recommendation 12a: Work on improving the quality of publications. Avoid predatory journals. Opt for open source publications through legitimate mathematical journals, preferably those covered by MathSciNet.

Individual researchers have a responsibility towards disseminating their own research. The visibility of individuals' research often remains very low, with very few complete and up-to-date personal web pages containing preprints of downloadable papers. Personal pages can now be easily hosted on free sites such as Google pages, no longer having to rely on local web servers. The use of the free and accessible electronic depository arXiv.org remains particularly and unexplainably low, as is use of the Mathematics Genealogy Project, a free online index of Mathematics PhD's.

Recommendation 12b: Improve dissemination of research through the arXiv, personal webpages and the Mathematics Genealogy Project. Work with ISP to arrange for all SWC students to be given training in these matters.

[31] Published in a Conference Series/Proceedings.

5.6 Conferences and Summer Schools

The EAUMP Conferences and Summer Schools play a very important role in the mathematical life of the region. We refer to Sections 3.10 and 3.11 for some more details about their organization and figures about participation and budget.

There have however been very few specialized, research-based meetings organized within the EAUMP network. As some of the research groups within the network gain strength, it will be important to start organizing more such meetings, inviting international experts in a specific area, as well as all specialists and students of this area within the network.

Recommendation 13: Maintain the Conference series. Work towards a regular series of smaller, research-based meetings organized by different research groups within the network.

From the interviews, it emerges that the Summer Schools in particular have been an eye opener for many students, especially for those interested in Pure Mathematics. Lecturers are very good on a scientific level and friendly on a social level. (For more detailed feedback, see Appendix A.4.) Students interested in Applied Mathematics have however reported that the schools are less relevant to their topics and that they are "obliged" to attend because of the quota system among the network nodes.

Overall, the feedback for the Schools is very good, but there is still room for improvement in some aspects. Some of the comments from the students concern the organization. Topics are occasionally announced too close to the school start and students with weaker backgrounds do not have the time to read up on the subject. Further, some of the schools have intensive teaching which covers regular taught Masters courses, but there is no course credit for the school which could be used at the home institution. Finally, there have been disparities in the treatment of local students and external students (accommodation, food, pocket money), resulting in different school experience among the participants.

One notable outcome of the Summer Schools has been the emergence of research groups of young algebraists and algebraic geometers at the MAK and UoN nodes[32], and the germ of a similar group at UNZA.

Recommendation 14: Maintain Summer Schools, but work towards improvements in the following areas: early announcement of topic, with supporting materials and school plan; course credit transfer; uniform standard and management of the Schools.

5.7 Organizational matters

The organizational structure of the network appears largely satisfactory, with reported disagreements and conflicts sorted out amicably. However, one aspect in which some difficulty

[32] An exciting new development was the awarding of the first "home-grown" PhD to a student at UoN in algebraic geometry in December 2016, who is at the same time a Lecturer at another local university.

was reported was the speed of response to new initiatives. More of the coordinators' business could be done via email and virtual meetings. Six-monthly face-to-face meetings appear to be reasonable, but ways could be explored to conduct business also between meetings.

Recommendation 15: Explore ways to conduct coordinators' business also via virtual meetings.

Reporting on network activities does not appear to be done very consistently. It has been difficult to get information during the evaluation process about some aspects of financial arrangements, such as details of summer school and conference support. A yearly layman's report with photos would also be desirable that can be circulated among senior management of nodes, government ministries, etc.

Recommendation 16: Improve reporting to ISP by providing a yearly report that includes financial details of in-year spending, short stories about activities, successes, papers written, etc. Produce also a shorter version that can be circulated more widely to stakeholders.

5.8 Cost, efficiency and resource allocation

As discussed in Section 3.5, about 50% of the financial resources provided to the network have supported PhD training. As reported above in Section 3.6, the average cost up to graduation (computed from 11 completed students) is around 560K SEK ($65.5K). By comparison, a fully registered PhD student in Sweden is entitled to a average salary of about 30K SEK per month; with social security and indirect costs, this gives a *yearly* cost of 700K SEK or more. The figure of $65.5K also compares very favourably with the costs of international PhD programmes elsewhere, again only covering perhaps one to two years at full fees[33].

The average number of years to graduation is around 5.5 years. This appears reasonable under the circumstances, but it would be preferable to shorten this; the best students are able to finish their doctorates in considerably less time.

Overall, the sandwich model to train PhD students appears reasonably cost effective.

Consistently across the interviews, the students have expressed a wish to have longer stays (6-9 months) in Sweden, as this would give them more time to focus on research and the possibility of attending advanced courses in Sweden from the beginning to the end. The Evaluation Team does not have a strong opinion on the extension of the stays, as longer periods abroad would add considerably more to the cost of the projects and possibly result in fewer students admitted. On the other hand, a coordination of the visits with Swedish semester dates appears very reasonable.

[33] For example, the standard estimate for the cost of a PhD in Norway is about 1M NOK or $120k. In the UK, yearly PhD fees for international students are likely to be $20K or more, with another $10-15K for living expenses; costs at PhD programmes in the USA can be higher still.

Recommendation 17a: Coordinate the research visits of SWC PhD students to Sweden with semester dates. Should funds allow, consider the possibility of longer stays.

At the nodes where bilateral programmes have been established (UR, MAK and UDSM), this programme also funds PhD training, creating an overlap with EAUMP Objective 1. PhD training at these nodes should be thought through strategically, both in terms of numbers and subject balance (pure and applied math, statistics). It has also been pointed out to the Evaluation team that the EAUMP and bilateral programmes create different financial incentives to the departments hosting students. This may lead to unnecessary prioritising between different programmes that is probably best avoided. Finally, parallel funding also means that at these nodes EAUMP has an opportunity to focus on supporting different types of activity.

Recommendation 17b: Cooperate with the bilateral programmes, especially in PhD training, considering carefully subject balance and financial incentives in particular. Re-think EAUMP resource allocation at the nodes with bilateral programmes, perhaps focusing on activities that benefit the entire Department.

As discussed in Section 3.5, in recent years the rough division of resources appears to have been the following.

- PhD training 50%
- MSc training 13-15%
- Scientific meetings (Conference, Summer School) 15%
- Research visits incl. postdocs 10%
- Equipment etc 5%
- Admin expenses (coordinators' meetings, honoraria etc) 5-6%

About half the budget is spent on PhD training, in line with this being the focus of activity. With other sources available for PhD training, in particular the bilateral programmes, it seems reasonable to decrease this spending at least at some of the nodes in the future. As discussed before, it would be advantageous to spend these resources to increase research activities, in particular intra-network collaboration, postdoc positions and focused workshops. The yearly allocation for library, computer equipment and journal subscription, at about 5%, seems a reasonable amount. Administration costs at 5-6%, if anything, are a little on the low side; money should be set aside in particular for website development.

Recommendation 18: Continue to improve on the reporting of the allocation of resources. Think strategically about resource allocation, considering in particular allocating more resources to research activities and website development.

5.9 Impact

While the EAUMP network comprises five node Universities, these in turn have clear responsibilities as leading institutions in their home countries. Instances have already been

noted elsewhere in the document where EAUMP has made positive contributions to nearby universities, such as training MSc and (in very small numbers) PhD students, and participation at Summer Schools. Other engagement however, in particular involving research, appears essentially non-existent.

Recommendation 19: Explore more extensive ways to spread EAUMP impact to Universities in the five countries beyond the nodes, with special emphasis on research activities.

It has been discussed several times that staff at all nodes suffer from heavy teaching duties at their home institutions, the ultimate reason being lack of sufficient investment in staff at expanding Universities. The EAUMP network has not particularly been successful in getting Government involvement and promoting investments in Higher Education.

Recommendation 20: Find ways to lobby members of University Administration and eventually Government to provide better teaching and research resources at participating Universities and beyond.

In order for Mathematics to be relevant to other stakeholders, collaboration with industry, public institutions and civil society must be a strong part of the research activity. Section 3.13 has listed some instances where this has been successfully achieved, but compared to developed research environments, the level of such activity is very low. Another aspect that is worth considering is the use of expertise developed in the context of the network to improve mathematics teaching to younger age groups. It has not been possible to make detailed recommendations in the given time frame; these points deserve another, more detailed look.

Recommendation 21: Improve mathematics research engagement with industry, public institutions and civil society. Find ways to spread the impact of the network to the teaching of mathematics at elementary and intermediate (high school) level.

5.10 Sustainability

From the self-evaluation documents and interviews, it appears that none of the institutions have a particularly well-formed exit plan at the moment, while is it clear that the research and teaching capacity already built up by during the lifetime of the network so far will have lasting effects.

In terms of the financial health of the network, it must be noted that despite some successes in external fundraising, many of the activities rely solely or to a very high degree on ISP support. In the long term, this will not be sustainable. There are very successful models that could be studied and possibly followed, such as AIMS-NEI that has been immensely successful in raising funds for mathematics in Africa from a large variety of public, industrial and philanthropic sources. On a more local level, EAUMP could develop guidelines under which any activity could require some minimum level of external support (say 50%) alongside any ISP contribution.

Recommendation 22: Explore ways to obtain further financial support, leading to a weaning away from sole IPS support to a more balanced financial base and shared projects with other funders.

5.11 Benchmarking against other ISP-supported research

In a recent review of ISP, one finds the following summary statement.

"Over the 2003 to 2010 period covered by this evaluation, ISP support has contributed to the awarding of 195 PhDs [...] and 1,539 published papers, for a total expenditure of SEK 157 million[34]."

While the Evaluation Team had no access to the criteria by which ISP support was deemed to have "contributed to" a PhD or paper, it seemed worthwhile to compare these numbers with those achieved by EAUMP in the time-frame 2002-2015.

EAUMP spending in the period 2002-2015 was SEK 26M, about a sixth of the SEK 153M figure quoted in the sentence above. Thus, using the above quote as a reference, one would expect EAUMP to have contributed to about 32 PhDs and 256 published papers.

As mentioned earlier, up to 2015 the EAUMP project had seen the graduation of 11 PhDs, 6 PhD students close to completion and 8 in progress, as well as two Licentiates that did not lead to a PhD. Attaching somewhat arbitrary weights of 1/0.8/0.4/0.75 of accomplishment respectively to these categories, this adds up to about 19.5 PhDs for the given spending. The total number of publications by ISP-supported researchers (including on-course students) came to about 60 papers.

When comparing these numbers, the following factors should be kept in mind.

- The number of EAUMP PhDs and publications above uses a very narrow definition of "ISP support". Local PhD students have also benefitted from EAUMP support; wider criteria will lead to substantially higher numbers. However, it seemed difficult to establish good criteria or obtain a comprehensive list of publications.
- Mathematics always has lower publication rates than other hard sciences - it just has a different publishing culture. It would not be unusual for a sciences PhD to contain material from 4-6 papers, while in mathematics one or two publications might well be appropriate within a PhD.
- The early period of the EAUMP project took place against an especially challenging research environment.

[34] *Report on the Evaluation of the International Science Programme*, Sida, 2011.

In summary, while the numbers of PhDs and publications are below the averages reported elsewhere by ISP, there are reasonable explanations to account for the difference, and thus the output considered adequate.

5.12 Final conclusions

Appendix E contains a summary of the Evaluation Team's view of how the different Objectives have been met in detail, based on the discussions in this chapter. While many of the targets have been adequately met, substantial work remains on several other targets.

The main bottlenecks for the further development of research and postgraduate education capacity within the network appear to be the following.

- Heavy teaching and administrative loads carried by junior staff at the node institutions and the associated difficulties of concentrating on research and research leadership for substantial periods of time.
- The difficulty of accessing resources to participate in international activities including workshops and conferences.
- Scarcity of links to local and international industrial partners including banks, insurance companies, manufacturing and engineering firms and others.
- Lack of government buy-in at many of the nodes.

In overall summary, it is the view of the Evaluation Team that the EAUMP network has played an absolutely essential and transformative role in building mathematics research and teaching capacity throughout the Eastern African region, introducing new areas of mathematics and strengthening existing ones. The SWC PhD model in particular has given the students a much better chance than local programmes to get good training to the doctoral level, as well as international experience and access to contemporary facilities. There are signs of consolidating and emerging research groups, regular activities becoming embedded and finding additional support, as well as new types of activity. At a total cost of 29.3M SEK over 15 years (1.95M SEK or EUR 200K per annum), these are very considerable achievements.

It has been the strong impression of the Evaluation Team that after an initial *capacity-building phase*, the network is ready to move into a *consolidation phase,* with the possibility of making detailed strategic decisions, extending the financial base, and generally building on the achievements of the period 2002-2016. It is hoped that this evaluation will help the network continue to achieve its initial objectives, and to find further ways to improve mathematics teaching and research, in the widest possible sense, in East Africa.

6 EAUMP SWOT table

Strengths ● Dedication to mathematics and enthusiasm for research across the network ● Name recognition ● Network connectivity for staff and students ● Well-functioning management structure ● Emerging research groups	Weaknesses ● Gender balance ● Lack of fully functioning, collaborative research groups ● Lack of intra-network research collaboration ● Quality of research outputs ● Strategic allocation of resources
Opportunities ● Learning of current trends in mathematics ● Transfer of best practices and opportunities across the network ● Joint PhD and Masters programmes across the region ● Spreading impact beyond nodes in each country ● Funding applications to external sponsors	Threats ● Lack of government buy-in ● Lack of time for research ● Sustainability

Appendix A Interviews

A.1 List of interviewees

The Evaluation Team conducted interviews with the following interviewees during the fieldwork phase of the evaluation.

(1) University of Rwanda
   (a) Dr Banzi Wellars, Head of Department, Department of Mathematics
   (b) Michael Gahirima, EAUMP coordinator
   (c) Dr Isidore Mahara, EAUMP coordinator, National University of Rwanda
   (d) Celestine Kurujyimbwami, current EAUMP-supported PhD student
   (e) Jean-Paul Murara, current ISP-supported PhD student
   (f) Vincent Umutabazi, recent ISP-supported MSc graduate
   (g) Ignace Ntezimana, current ISP-supported MSc student

(2) University of Zambia
   (a) Dr Mubanga Lombe, Node coordinator
   (b) Dr Isaac Tembo, Head of Department, Department of Mathematics and Statistics
   (c) Dr Habatwa V. Mweene, Dean, School of Natural Sciences
   (d) Dr A. M. Ngwengwe, EAUMP advisor
   (e) Adson Banda, current ISP-supported PhD student

(3) University of Dar es Salaam
   (a) Dr Eunice Mureith, Head of Department and EAUMP node coordinator
   (b) Dr Sylvester Rugeihyamu, Previous node coordinator
   (c) Dr Egbert Mujuni, EAUMP PhD graduate and Deputy Principal, College of Natural Sciences
   (d) Dr Nyimvua Shaban, EAUMP PhD graduate
   (e) Dr Makungu Mwanzalima, EAUMP PhD graduate
   (f) Dr Rashid Mohamed, EAUMP PhD graduate
   (g) Dr Mashaka Mkandawile, EAUMP PhD graduate
   (h) Emmanuel Evarest, current ISP-supported PhD student
   (i) Billy Dellvine Koka, current ISP-supported MSc student

(4) Makerere University
   (a) Prof John Mango, Deputy Principal, College of Natural Sciences, and EAUMP Inter-network coordinator
   (b) Prof Juma Kasozi, Dean, School of Physical Sciences and EAUMP node coordinator
   (c) Dr David Ssevviiri, Head of Department and Tracer Group member
   (d) Dr Betty K. Nannyonga, EAUMP PhD graduate
   (e) Dr G. Ismail Mirumbe, EAUMP PhD graduate

(5) University of Nairobi
   (a) Prof Patrick Weke, Head of Department and Network coordinator

(b) Dr Damian Maingi, EAUMP postdoc grant holder and Tracer Group member
(c) Dr Nelson O. Ongargo, EAUMP postdoc grant holder
(d) Dr Jared Ongaro, EAUMP PhD graduate
(e) Dr Ivivi Mwaniki, EAUMP PhD graduate
(f) Dr Wycliff Rao, EAUMP PhD graduate
(g) Idah A. Orowe, current ISP-supported PhD student

A group discussion and private conversations with

- Prof Peter Sundin, Head of ISP,
- Prof Leif Abrahamsson, Programme Director, IPMS,
- Rebecca Andersson, Project Coordinator, ISP, and
- Prof Bengt Ove Turesson, Bilateral Programme coordinator;

as well as the following members of the ISP Mathematics Reference Group:

- Professor Christer Kiselman, Guest Professor at Department of Information Technology, Uppsala University, Sweden
- Professor Tom Britton, Department of Mathematics, Stockholm University, Sweden
- Dr Fanja Rakotondrajao, Department of Mathematics, University of Antananarivo, Madagascar
- Professor Mohamed El Amin El Tom, Garden City College for Science and Technology, Khartoum, Sudan

at and around the 2016 EAUMP Conference were also instrumental in arriving at the conclusions of this report.

A.2 Standardized interview questions

A.2.1 Interview questions: Head of Department, Node Coordinator

1. What is, in your opinion, the most important contribution of EAUMP to your institution that you couldn't have achieved without the EAUMP support?
2. Some of the students have used several years to complete their degree. What could your institution do to reduce the delay and how can the institution reduce fall-out?
3. What are the strengths and weaknesses (a.k.a. mathematical topics) of your institution? What would you see strengthened? How could EAUMP help in accomplishing this?
4. How is the, if any, bilateral program funded by Sida affecting your activity at department level and within EAUMP?
5. Is the sandwich model, as it is planned, a proper way for your department to use?
6. Can you see that the PhD-students from the sandwich program can benefit from their studies after graduation at department level? In what way?
7. Within the list of publications attached to the report, one can see that the journals published in are not top international journals. Why is this so? What can be done to improve this and increase impact to a more international level?
8. How effectively does the organizational structure of the network operate from your point of view? What organizational changes would you welcome?
9. Does your institution you have an exit plan?

A.2.2 Interview questions: Junior recipient of scholarship (MSc, PhD)

1. Describe your career so far and positions held
2. Describe the state of your current research
3. Give your opinion about the sandwich model (if appropriate) or course attended with EAUMP support
4. What are your aims in your future career?
5. (If returning to home institution) Will you be able to join a research group, or will you have colleagues in related fields of research, at your home institution?

Appendix B Summer schools

B.1 List of all EAUMP Summer Schools 2002-2017

- 2017 (planned): EAUMP-ICTP School on Modern Functional Analysis, University of Nairobi, Kenya, June/July 2017.
- 2016: ICTP-EAUMP School on Number Theory, University of Rwanda, Kigali, 4-22 July 2016.
- 2015: EAUMP School on Experimental Pure Mathematics, Makerere, Kampala, Uganda, 6-17 July 2015.
- 2014: EAUMP School on Representation theory, Arusha Technical College, Arusha, Tanzania, 7-26 July 2014.
- 2013: East African School on Applicable Algebraic Geometry, Bandari College, Mombasa, Kenya, 6-28 July 2013.
- 2012: School on Combinatorial Commutative Algebra, Arusha Technical College, Arusha, Tanzania, 13-21 August 2012.
- 2011: Introduction to Riemannian Geometry, Kigali Institute of Science and Technology, Kigali, Rwanda, 21 November - 3 December 2011.
- 2010: The 5th school, Linear Algebra and the Fast Fourier Transformation, Makerere University, 6-17 December 2010.
- 2009: The 4th school, Linear Algebra, University of Dar es Salaam, Tanzania, 16-30 August 2009.
- 2009: The 3rd school, Set Theory and Logic, University of Nairobi, Kenya, from 6-19 April 2009.
- 2008: The 2nd school, Linear Algebra, Mombasa, Kenya 2-14 December 2008.
- 2008: First East African School, Linear Algebra: The Google Algorithm, Makerere University, Kampala, 17-29 March 2008.

B.2 Feedback from recent EAUMP Summer Schools

The following feedback was collected at the end of each Summer School by the organizers, initially on paper-based feedback forms and more recently using an online feedback form.

In Arusha in 2014, 33 completed feedback forms were returned.

- *Programme content met my needs*: average 4.28 out of 5.
- *The material covered was relevant for me*: average 4.27 out of 5.
- Overall rating of the course: Excellent 10, Very good 19, Good 3, Average 1, Poor 0.

Comments: “I liked the organization of the school and the lecturers as well, they motivate me to work harder.” “The exercises made me broaden my thinking.” “I liked the organization of the school and the contributions of the students during the exercises.”

At Makerere in 2015, 23 completed feedback forms were returned.

- *Overall, the school was of the expected quality*: average 4.3 out of 5.
- *The topics were useful for me*: average 4.7 out of 5.

Comments: “I liked the use of softwares like Sage and Maple for solving mathematical problems.” “…the facilitators helped a lot how to understand material when we were stuck…” “I was introduced to many courses which are not taught at my university…” ‘The topics on combinatorics, number theory and graph theory were thought provoking, I was learning these for the first time.”

In 2016, following the end of the school in Kigali, 30 responses were recorded on the online feedback form.

- *The mathematical content of the lecture courses taught was useful for my work*: average 4.6 out of 5.
- *The lecture courses were of high quality*: average 4.4 out of 5.
- *I was able to socialise with the other participants and make connection*s: average 4.75 out of 5.
- *The school was well organized*: average 3.93 out of 5.

Comments: “The course content was well varied and interesting, there was a good balance between computational and theoretical aspects of number theory. The lecturers were superb too!!” “I learned a lot in 3 weeks thanks to EAUMP. If possible EAUMP should have more schools yearly.” “We thank you very much for your initiative to inspire African mathematicians!”

Appendix C The EAUMP doctoral programme

C.1. List of beneficiaries

The following mathematicians have graduated with PhD degrees with ISP support in the EAUMP network.

1. University of Dar es Salaam
    a. Dr Egbert Mujuni, PhD 2008, *Fixed Parameter Tractability of Graph Colouring and Related Problems*
    b. Dr Nyimvua Shaban, PhD 2008, *Epidemic Models for Socially Structured Communities: Effects of Early Stage Vaccinations*
    c. Dr Makungu Mwanzalima, PhD 2014, *Betti Numbers of Graded Modules with Support On a Reduced Set of Points in Projective Space*
    d. Dr Rashid Mohamed, PhD 2015, *Modelling Dynamics of HIV/AIDS: The effects of Awareness Campaigns on Complacency and the Role Geographic locations in Tanzania*
    e. Dr Mashaka Mkandawile, PhD 2015, *Development of Near Optimal Algorithms for List Colouring Problems Using Random Graphs*
2. Makerere University
    a. Dr Cyrus Ssebugenyi, PhD 2009, *Construction of minimal entropy martingale measures in discrete time / finite probability market models*
    b. Dr Betty K. Nannyonga, PhD 2011, *Modelling the severity and co-infection with malaria in populations with persistent and re-emerging infections*
    c. Dr G. Ismail Mirumbe, PhD 2012, *Distribution solutions to ordinary differential equations with polynomial coefficients on the real line*
3. University of Nairobi
    a. Dr Ivivi Mwaniki, PhD 2010, *On APARCH Levy Filter Option Pricing Formula for Developed and Emerging Markets*
    b. Dr Jared Ongaro, PhD 2014, *Towards Plane Hurwitz Numbers*
    c. Dr Wycliff Rao, PhD 2016, *Quantum Graphs and Equi-transmitting Scattering Matrices*

The following students have abandoned their PhD courses.

1. Makerere University
    a. Michael Nganda (obtained a Licentiate, Gothenburg University)
    b. Rebecca Nalule
2. University of Nairobi
    a. Anne Wanhombe (obtained a Licentiate, Stockholm University)

The following students are currently involved in PhD programmes with ISP support.

1. University of Dar es Salaam
    a. Emmanuel Evarest, ongoing, *Regime-Switching Models on Weather Derivatives Pricing* (tentative title)
    b. John Andongwisye, ongoing, *Asset and liability management for Tanzania pension funds by stochastic programming* (tentative title)
    c. Isdory Augustino, ongoing, *Quantifying the impact of human mobility on HIV transmission* (tentative title)
2. Makerere University
    a. Fred Mayambala, will defend in 2017, Licentiate 2105, Linköping University, *Mean-Variance Portfolio Optimization: Eigendecomposition-Based Methods* (tentative title)
    b. Alex Tumwesigye, will defend in 2017, Licentiate 2016, Mälardalen University, *On one-dimensional dynamical systems and commuting elements in non-commutative algebras* (tentative title)
    c. Dennis Wokiyi, ongoing, *Cauchy problem for nonlinear stationary heat equation,* (tentative title)
3. University of Nairobi
    a. Idah Orowe, defended[35] in November 2016, Multi-State Transition Models with Censoring in Vertical Transmission of HIV.
    b. Carolyne Ogutu, ongoing, Licentiate 2014 (?), Swedish University of Agricultural Sciences, Asian options, jump-diffusion processes on a lattice, and Vandermonde matrices (tentative title)
4. University of Rwanda
    a. Celestin Kurujyimbwami, ongoing, Licentiate 2016, Linköping University, Group classification of linear Schrödinger equations by the algebraic method (tentative title)
    b. Jean-Paul Murara, planned to defend in 2017, Licentiate 2016, Mälardalen University, Asset Pricing Models with Stochastic Volatility (tentative title)
5. University of Zambia
    a. Adson Banda, ongoing, Licentiate 2016, Linköping University, Half–Exact Coherent Functors over PIDs and Dedekind Domains (tentative title)
    b. Mervis Kikonko, will defend[36] in December 2016, Licentiate 2014, Luleå University of Technology, Qualitative and Spectral theory of some regular non-definite Sturm-Liouville problems (tentative title)
    c. John Musonda, ongoing, Three Systems of Orthogonal Polynomials and Associated Operators (tentative title)

[35] Idah Orowe successfully defended her PhD thesis on 12 November 2016, around the time when the first draft of this report was being written. She is treated as "ongoing" in this evaluation.
[36] Mervis Kikonko successfully defended her PhD thesis on 13 December 2016, around the time when this report was being finalized. She is treated as "ongoing" in this evaluation.

C.2 Details of PhD student support 2002-2015

Orange=ongoing
Red=lost
Green=graduated
Yellow=other grants

No of months in Sweden, by student

			2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	No months	No years to grad	
EAUMP 29	Gender	Student																
UDSM 8																		
	M	S Mbare	4	0	5	4	6	2								21	6	
	M	E Mujuni	4	0	6	3	8									21	5	
	M	M Mwanzalima					1	0	0	5	3	12	4.5			25.5	7	
	M	M Rashid					1	4	4	3	7	5	3			27	7	
	M	M Mkandawile					1	4	5	4	4.5	3				21.5	6	
	M	E Evarest										1	5	5.5	6.5	18		
	M	I Augustino										1	5	6	4	16		
	M	J Andongwisye										1	5	5	6	17		
UoN 7																		
	M	I Mwanike	4	0	5	4	12	4								29	6	
	F	A Wanhombe	4			4			4							12	7	
	M	N Owour					1									1		
	F	I Orowe					1	4	4	4	3	5	6	2	0	29		
	F	C Oguto								1			7	3	4	15		
	M	W Rao									5	7.5	9	2	3	26.5		
	M	J Ongaro										8.5	10	6		24.5	3	
Makerere 9																		
	M	M Nganda	4	0	5	4	6.5	1	2							22.5	7	
	M	C Ssebugenyi		6	5	4	12	4								31	5	
	F	R Nalule				1	4	5	0.5							10.5	4	
	M	I Mirumbe			1	0	4	4	4	1	5.5					19.5	7	
	F	B Nannyonga							4	4	1					9	3	
	M	A Tumwesigye								1	0	6	5.5	6	9	27.5		
	F	B Kirenga										1				1		
	M	F Mayambala									1	5	7	4	2	19	5	
	M	D Wokiyi											1	4	5	5		
UR/KIST 2																		
	M	C Kurujyimbwami										4.5	10	9	10	33.5		
	M	J-P Murara										1	5	3	11.5	20.5		
UNZA 3																		
	M	A Banda										1	5	4	5	15		
	F	M Kikonko										4	3	4	4	15		
	M	J Musonda												4	12	16		
TOTAL EAUMP			20	6	27	24	57.5	32	27.5	23	30	66.5	91	67.5	82	554	5.5	*Average to grad*

Appendix D List of publications of EAUMP PhD students and Tracer Group members

Node	Authors (author with EAUMP link in bold)	Title	Journal	Year
Papers of PhD graduates with direct ISP support, after graduation				
UDSM				
	N. Shaban	Modelling the effects of public health education in the spread of hepatitis B disease	Applied Mathematical Sciences	2014
	N. Shaban and H. Mofi	Modeling the Impacts of Vaccination and Screening on the Dynamics of Human Papillomavirus Infection	International Journal of Mathematical Analysis	2014
	T. Sagamiko, **N. Shaban**, C. Nahonyo and O. D. Makinde	Optimal Control of Threatened Wildebest-Lion prey predator system incorporating constant prey refuge in the Serengeti Ecosystem	Submitted to Africa Journal of Ecology	2014
	N. Shaban and A. Hassan	Modelling the Effects of Nutrition on the Transmission Dynamics of HIV/AIDS	ICASTOR Journal of Mathematical Sciences	2013
	J. William Kira, **N. Shaban**, and J. Y. T. Mugisha	The Optimal Clean Renewable Energy Revenues under the Climate Problem Scenario	ICASTOR Journal of Mathematical Sciences	2013
	N. Shaban, T. Britton, M. Andersson and Å. Svensson	Networks, epidemics and early stage vaccination: the effects of infectious and vaccination delay periods and their randomness	Pioneer Journal of Mathematics and Mathematical Sciences	2011
	N. Shaban,T. Britton, M. Andersson and Å. Svensson	Household epidemics,: Modelling the effects of early stage vaccination	Biometrical Journal	2009
	N. Shaban, T. Britton, M. Andersson and Å. Svensson	Networks, epidemics and vaccination through contact tracing	Mathematical Biosciences	2008
	D. Manumbu, **E Mujuni** and D Kuznetsov	A Simulated Annealing Algorithm for Solving the School Bus Routing Problem: A Case Study of Dar es Salaam	Computer Engineering and Intelligent Systems	2014
	E. Mujuni	Connected Dominating Set Problem for Hypercubes and Grid Graphs	iCASTOR Journal of Mathematical Sciences	2013

	E. Mujuni, M. Seleman and A. Mushi	An Examination Scheduling Algorithm Using Graph Colouring–The Case of Sokoine University Of Agriculture	International Journal of Computer Engineering & Applications,	2013
	M. Kahebo, **E. Mujuni** and A. Mushi	Optimization of Municipal Solid Waste Management Problem with Composting Plants: The case of Ilala Municipality	Int. Jour. Adv. in Comp. Sci. & Tech.	2013
	H. Lyeme, **E. Mujuni**, A. Mushi	Optimization model for Solid Waste Management at Ilala Municipal, Tanzania	Journal of Informatics and Virtual Education	2011
	E. Mujuni, H. Fleischner, D. Paulusma and S. Szeider	Covering graphs with few complete bipartite subgraphs	Theor. Comput. Sci.	2009
	E. Mujuni, H. Fleischner, D. Paulusma and S. Szeider	Covering graphs with few complete bipartite subgraphs	FSTTCS 2007: Foundations of software technology and theoretical computer science,Lecture Notes in Comput. Sci., 4855	2007
	E. Mujuni	Parameter algorithms in smooth 4-regular hamiltonian graphs	Mathematics in Computer Science	2008
	E. Mujuni and F. Rosamond	Parameterized complexity of the clique partition problem	In James Harland and Prabhu Manyem, editors, Fourteenth Computing: CATS, volume 77 of CRPIT,pages 75–78, Wollongong, NSW, Australia, 2008. ACS.	2008
MAK				
	G. I. Mirumbe, V. A. Ssembatya and J. M. Mango	On the existence of fundamental solutions for ordinary differential equations with polynomial coefficients.	Far East Journal of Mathematical Sciences	2014
	G.I. Mirumbe, V.A Ssembatya, Rikard Bogvad and Jan Erik Bjork	On the distribution solutions to ordinary differential equations with polynomial coefficients on the real line	Journal of pure and applied mathemtaics: Advances and Applications	2011
	G.I. Mirumbe and V.A Ssembatya	ON THE COEXISTENCE OF DISTRIBUTIONAL AND RATIONAL FUNCTION SOLUTIONS TO ORDINARY DIFFERENTIAL EQUATIONS WITH POLYNOMIAL COEFFICIENTS,	Journal of Pure and Applied Mathematics: Advances and Applications	2012
	J. Switkes, **B. Nannyonga**, J.Y.T. Mugisha and J. Nakakawa	A Mathematical Model for Crimean-Congo Hemorrhagic Fever: Tick-Borne Dynamics with Conferred Host Immunity.	Journal of Biological Dynamics	2016

	B. Nannyonga and L.S. Luboobi	Optimal control of Human African Trypanosomiasis in a population with endemic malaria.	Journal of Progressive Research in Mathematics	2015
	B. Nannyonga, G.G. Mwanga, L.S. Luboobi	An optimal control problem for ovine brucellosis with culling.	Journal of Biological Dynamics	2015
	B. Nannyonga, L.S. Luboobi, M. Jablonska-Sabuka, and P. Tushemerirwe	Using contaminated tools fuels outbreaks of Banana Xanthomonas wilt: An optimal control study within plantations using Runge-Kutta fourth-order algorithms	International Journal of Biomathematics	2015
	B. Nannyonga, G.G. Mwanga and L.S. Luboobi	An optimal control problem for ovine brucellosis with culling	Journal of Biological Dynamics	2015
	T. Kinene, L.S. Luboobi, **B. Nannyonga** and G.G. Mwanga	A mathematical model for the dynamics and cost effectiveness of the current control of cassava brown streak disease in Uganda	J. Math. Comput. Sci.	2015
	B. Nannyonga, G.G. Mwanga, H. Haario, I.S. Mbalawata and M. Heilio	Determining parameter distribution in within-host severe P. falciparum malaria	Biosystems	2014
	G.G. Mwanga, H. Haario, **B. Nannyonga**	Optimal Control of Malaria Model with Drug Resistance in Presence of Parameter Uncertainty	Applied Mathematical Sciences	2014
	J. Otieno, J. Y. T. Mugisha, **B. Nannyonga**, P. Oleche	Parameter Driven Dynamics of Trypanosomiasis in a Cattle Population	Applied Mathematical Sciences	2014
	B. Nannyonga, J.Y.T. Mugisha, L.S.Luboobi	Evaluating the effectiveness of DDT house spraying in persistent and re-emerging malaria.	Afrika Matematika	2013
	B. Nannyonga, D.J.T. Sumpter, S. Nicolis	A dynamical systems approach to social and economic development	In: A Treatise of Biological Models. Eds: F. Nyabdza, M. Kgosimore, E.M. Lungs. Nova Science Publishers, Inc. ISBN: 978-1-62257-390-5, (8):145-164.	2013
	B. Nannyonga, D.J.T. Sumpter, J.Y.T. Mugisha, L.S.Luboobi	The dynamics, causes and possible prevention of Hepatitis E outbreaks	PLoS ONE	2012
	B. Nannyonga, J.Y.T. Mugisha, L.S.Luboobi	Does Co-infection with Malaria Boost Persistence of Trypanosomiasis?	Nonlinear Analysis: Real World Applications	2012
	G.G. Mwanga, H. Haario, **B. Nannyonga**	Spread of Antimalarial drug resistance in a Population with Superinfection	Applied Mathematical Sciences	2012

	Ssebugenyi, C. S.	Option pricing: lattice models revisited	J. Math. Stat. Allied Fields	2007
	Ssebugenyi, C. S.	Valuation of real options using the minimal entropy martingale measure	Applied Mathematical Sciences	2008
	Ssebugenyi, C. S., **Mwaniki, I. J.**; Konlack, V. S.	On the Minimal Entropy Martingale Measure and Multinomial Lattices with Cumulants	Applied Mathematical Finance	2013
	Ssebugenyi, C. S.	Using the minimal entropy martingale measure to valuate real options in multinomial lattice	Applied Mathematical Sciences	2011
UoN				
	Ssebugenyi, C. S., **Mwaniki, I. J.**; Konlack, V. S.	On the Minimal Entropy Martingale Measure and Multinomial Lattices with Cumulants	Applied Mathematical Finance	2013
	I.Mwaniki	Modeling Returns and Unconditional Variance in Risk Neutral World for Liquid and Illiquid Market	Journal of Mathematical Finance	2015
	J. **Ongaro** and B. Shapiro	A note on planarity stratification of Hurwitz spaces	Can. Math. Bulletin	2015
Papers of PhD graduates with other type of ISP support				
UoN				
	D. Maingi	Vector bundles of low rank on a multiprojective space	Matematiche (Catania)	2014
	L. Siro, I. Kamuti, **D. Maingi**	On the actions of the symmetric group, Sn, n≤7 on unordered quadruples	Int. J. Algebra	2013
	D. Maingi	Monads on a multiprojective space	Int. Math. Forum	2012
	D. Maingi	Maximal rank for Omega(P^n)	Int. Math. Forum	2011
	D. Maingi	The application of the method of Horace to get number of generators for an ideal of s general points in P^4	Int. J. Algebra	2010
	D. Maingi	On the minimal resolution conjecture for P^3	Int. J. Contemp. Math. Sci.	2008

MAK				
	Ssevviiri, David	On completely prime submodules	Int. Electron. J. Algebra	2016
	Ssevviiri, David	A relationship between 2-primal modules and modules that satisfy the radical formula	Int. Electron. J. Algebra	2015
	Groenewald, Nico J.; **Ssevviiri, David**	Properties of different prime radicals of rings and modules	Comm. Algebra	2015
	Groenewald, Nico J.; **Ssevviiri, David**	Generalization of nilpotency of ring elements to module elements	Comm. Algebra	2014
	Groenewald, Nico J.; **Ssevviiri, David**	On the Levitzki radical of modules	Int. Electron. J. Algebra	2014
	Ssevviiri, David	Characterization of non-nilpotent elements of the ℤ-module...	Int. J. Algebra	2013
	Groenewald, Nico J.; **Ssevviiri, David**	2-primal modules	J. Algebra Appl.	2013
	Groenewald, Nico J.; **Ssevviiri, David**	Completely prime submodules	Int. Electron. J. Algebra	2013
	Groenewald, Nico J.; **Ssevviiri, David**	Köthe's upper nil radical for modules	Acta Math. Hungar.	2013
	Ssevviiri, David	Structure of non-nilpotent elements of some ℤ-modules.	Int. J. Algebra	2012
Papers of PhD students (ongoing) with direct ISP support				
MAK				
	Mayambala, Fred; Rönnberg, Elina; Larsson, Torbjörn.	Eigendecomposition of the mean-variance portfolio optimization model	Optimization, control, and applications in the information age, Springer Proc.	2015
	Nansubuga, Martha; **Mayambala, Fred**; Mahera, Charles Wilson; Kasozi, Juma	Maximisation of dividend payouts under infinite ruin probability constraints	Int. J. Math. Comput.	2016
UNZA				
	Kikonko, Mervis; Mingarelli, Angelo B.	On non-definite Sturm-Liouville problems with two turning points.	Appl. Math. Comput.	2013
	Kikonko, Mervis; Mingarelli, Angelo B.	Estimates on the lower bound of the eigenvalue of the smallest modulus associated with a general weighted Sturm-Liouville problem	Int. J. Differ. Equ.	2016
	Kikonko, Mervis; Mingarelli, Angelo B.	Bounds on real and imaginary parts of non-real eigenvalues of a non-definite Sturm-Liouville problem	J. Differential Equations	2016

UR				
	Célestin Kurujyibwami	Equivalence groupoid for (1+2)-dimensional linear Schrödinger equations with complex potentials	Journal of Physics: Conference Series	2015

Appendix E EAUMP Logframe matrix evaluation

The following detailed evaluation is based on the Logframe Matrix accompanying the 2014-2016 EAUMP application to ISP.

Outputs	***Outcomes***	***Performance Indicator***	***Evaluation***
Specific Objective 1: To increase the production, quality and relevance of Mathematical Research in the Network Countries			
	Improved Research activities and training	Numbers of master's and doctoral theses defended	Adequate
		Number of publications	Adequate
Staff exchange	Collaboration with scientists regionally and in the North	Number and duration of exchange visits	Limited (regional), adequate (North-South)
Joint Supervision		Number of students trained with partners	Adequate
Joint Publications			
Schools / Conferences / Workshops	Dissemination of Research Findings	Number of Schools/Conferences/Workshops proceedings	Adequate
Scientific meetings	Effective Coordination of Activities	Number of implemented positive decisions	Adequate
	Use of research results from supported activities	Number of recorded instances of use (including in teaching)	Limited
		Number of external assignments	Sporadic
		Number of patents	None
	Production of research results relevant to development	Use of results by industry, public and private sector	Limited
		Number of Collaborations with industry, public and private sectors	Sporadic
	Funding is well managed, used and reported, scientifically and economically	Level of budget performance	Adequate
		Transparency and correctness of local account; Number of Audit Queries	Not enough evidence presented to judge
		Quality of Reports	Limited

Specific Objective 2: To Introduce new mathematics areas in the curriculum of participating countries			
Schools	Introduction of new areas of mathematics	Number of areas introduced in various curricular	Adequate
Staff exchange (North-South, South-South)	Utilisation of existing but scarce HR in the region	Number of courses delivered in that mode.	Adequate
Specific Objective 3: Gender Inclusive Capacity building at graduate level			
MScs trained (Within the network)		Number of MScs trained and retained	Adequate
PhDs trained (Sandwich)		Number of PhDs trained and retained	Adequate
Female MSc and PhDs		Number of female trained and hired/retained as staff	Limited
Post-Doc trained	Competence building in research	Number of publications after PhD award	Adequate
Specific Objective 4: To improve teaching and research facilities for graduate training			
Equipment and ICT	Improved research and training environment	Number of ICTs acquired and utilised	Adequate
Books		Number of books procured and referenced	Adequate
Journals		Number of journals subscribed to and referenced	Adequate
		Number of research databases subscribed to and utilised	Limited
Specific Objective 5: To attract sufficient financial support, other than from ISP, to supplement network activities			
	Funding from sources other than ISP	Amount of funding received from specified sources, and duration of funding	Limited

Appendix F Terms of Reference of the evaluation[37]

1. BACKGROUND

1.1 Information about ISP

International Science Programme (ISP) at Uppsala University assists low income countries to build and strengthen their domestic research capacity and postgraduate education in the basic sciences – chemistry, mathematics and physics. ISP provides support to research groups and regional scientific networks at universities and institutes in Africa, Asia and Latin America. ISP consists of three subprograms:

- International Programme in the Physical Sciences (IPPS), from 1961,
- International Programme in the Chemical Sciences (IPICS), from 1970,
- International Programme in the Mathematical Sciences (IPMS), from 2002.

ISP has supported scientific regional networks since the early 1980's. The current reason for supporting regional scientific networks, given in the ISP Strategy Plan 2013-2017, is that "*Regional cooperation generates scientific cooperation and complementary activities, gives access to advanced equipment, and contributes the human capital needed for good postgraduate education*". For more information visit: www.isp.uu.se.

1.2 Information about EAUMP

ISP has funded the East African Universities Mathematics Program (EAUMP) since it was constituted in 2002 by Departments of Mathematics at University of Nairobi, Kenya, University of Dar es Salaam, Tanzania, and Makerere University, Uganda. After a few years, the Departments of Mathematics at University of Zambia, National University of Rwanda, and the Kigali Institute of Science and Technology, Rwanda were included in the network.1 Each university functions as a node in the network and has a coordinator (the Head of Department, or someone appointed by her/him). There is also an Overall Coordinator of the EAUMP network, which is an appointment that rotates between the nodes on a three-year basis. Apart from this, the network also has an Inter-network Coordinator whose responsibilities includes cooperation with other groups and networks (not necessarily only in mathematics) and fund raising. The main objective of EAUMP is, as stated in the 2013 application to ISP, is "*to increase the contribution of mathematical research and training to sectors important for local and global development".*

The Specific objectives 2014 - 2016 are:

1. "*To increase the production, quality and relevance of Mathematical research in the network countries (or nodes).*
2. *To introduce new mathematics in the curriculum of participating institutions.*
3. *Gender inclusive capacity building at graduate level.*
4. *To improve teaching and research facilities for graduate training.*
5. *To attract sufficient financial support, other than from ISP, to supplement network activities".*

[37] Provided to the evaluations by ISP in January 2016

2. EVALUATION PURPOSE AND SCOPE

2.1 Purpose

EAUMP has existed and been supported by ISP since 2002. The purpose of the evaluation is to analyze and assess the EAUMP network and its node institutions in order to provide EAUMP and ISP with indications of the progress and development of the network, and to provide input and recommendations on future directions and improvements.

2.2 Scope

The evaluation should cover the period **2002-2015** and include both the EAUMP network and its activities as a whole and as well as the node institutions (Departments of Mathematics at University of Nairobi, Kenya; University of Dar es Salaam, Tanzania; Makerere University, Uganda; University of Zambia; and National University of Rwanda).

The scope of the evaluation is to analyze and assess the relevance, efficiency, effectiveness, impact, and sustainability of the EAUMP network and its nodes in relation to EAUMP's stated main and specific objectives (listed under 1. Background) and Logical Framework (attached) and in relation to ISP's stated reason for supporting scientific regional networks as given in the ISP Strategy Plan 2013- 2017 (given under 1. Background).

3. THE EVALUATION ASSIGNMENT

The evaluation should ultimately result in:

1) **An overview of how EAUMP functions, its activities and progress** based on relevance, efficiency, effectiveness, impact and sustainability, where strengths and weaknesses are clearly outlined (3.1)
2) **Recommendations and improvements** (long and short term) to EAUMP and to ISP, respectively, on future directions of the network and its activities, including outputs, outcomes and impact (3.2)
3) In addition, the evaluation should include a brief **tracer study of the (ISP supported) PhD graduates** from the network (3.3)

3.1 Overview of EAUMP, its activities and progress

The evaluation should result in an overview of how the EAUMP network functions, and its activities and progress from 2002 until today. In general, it should provide a brief history and organizational overview of the network and account for how far EAUMP has come in achieving its stated specific goals and objectives. It should result in an assessment of the overall relevance and scientific quality of the research and postgraduate education, as well as the effects, efficiency and impact of EAUMP, and the prospects of sustainability. Strengths and weaknesses of each part should be clearly outlined. More specifically it should provide answers to the following:

History and organizational structure

1) Provide a brief history of the EAUMP network
2) Provide an overview of the organizational structure and governance of the network, including communication, decision making processes, and planning and implementation

of activities. In addition, the main strengths and weaknesses of the organizational structure should be outlined.

Relevance and scientific quality

3) Are the EAUMP network objectives and activities consistent with the needs and priorities of the network countries and node institutions? Describe.
4) Are the EAUMP network objectives and activities consistent with ISP's reason for supporting regional scientific networks? Describe.
5) To what extent and how has the EAUMP network contributed to increase the relevance of mathematical research in the network countries and node institutions?
6) What are the quantity and scientific quality of the research conducted within the EAUMP network, in terms of publications in scientific journals and contributions to scientific conferences? Have there been any improvements in quantity and quality since the start of the collaboration?
7) Assess and describe the quality of the MSc and PhD education (teaching and training) provided within the network, including organization, planning, content, development and outcomes.

Cost and Efficiency

8) Describe and analyze the efficiency of the EAUMP network and the development since the start of the network (i.e. what has come out of the network given what has been put in).

Effectiveness

9) Has the program been successful in delivering outputs such as the number of students enrolled and the number of graduated PhD and MSc students? Is there a difference between node institutions, and if so, why?
10) What is the time needed for completion of MSc and PhD studies and what are the reasons if students have difficulties to finalize studies or are leaving the program?
11) Has the sandwich model been an effective way of achieving results?
12) Does each node have the requirements (e.g. adequate number of advisors, researchers, infrastructure etc.) for meeting the national demand for high qualifications (MSc, PhD) in mathematics through in-house programs? If no, what is lacking?
13) Are the major areas of mathematics adequately represented within each node? If not, to what extent is this compensated for through the cooperation?
14) Does each node adopt and implement a process of curriculum reform? Do the structure and content of current programs reflect modern trends in mathematics adequately?
15) Has EAUMP effectively and sustainably supported strengthening of the research environment at the node institutions? Regarding the adequacy, functionality and impact of the research- and teaching facilities (ICT infrastructure and management, library and services, etc.).
16) Describe the network's and nodes' efforts and ability to attract sufficient financial support, other than from ISP, to finance network and node activities. How has it developed over time?

17) Has the ISP collaboration contributed to improved gender representation on the graduate level?
18) What are the main bottlenecks for increased research and postgraduate education capacity?

Impact

19) Describe and analyze how the nodes cooperate and influence each other and others in the region.
20) To what extent has the EAUMP network impacted on academic quality and research culture in the context of undergraduate, MSc and PhD training at the node departments?
21) Has EAUMP contributed to increased research capacity at the node institutions?
22) Has EAUMP and its nodes had any impact on policies and practices in the node countries and/or region in any way?
23) Describe any collaboration with universities outside the network, and with public institutions, industry or civil society.
24) What are the positive and negative unintended effects, i.e. “spin-offs” resulting from the EAUMP network and its activities?
25) In general, what has the ISP support contributed to?

Sustainability

26) Describe the current planning for sustainability regarding research capacity building and postgraduate education in the network and at the node institutions.
27) What will happen with EAUMP in the case of withdrawn from ISP? Describe the exit strategies on a network and node level. (*Do the institutions have sufficient institutional capacity and mechanisms to maintain and sustain the built research infrastructure capacity? What is the sustainability of the local MSc and PhD programs without donor support?)*

3.2 Recommendations and improvements

The evaluation should also result in (long and short term) recommendations on the future direction of the network and on improvements of its activities including outputs, outcomes and impact. The recommendations should be based on the findings and headings in 3.1 Overview of EAUMP, its activities and progress. The recommendations should be directed both to EAUMP and to ISP.

3.3 Brief tracer study

In addition to 3.1 and 3.2, the evaluation should include a brief tracer study of the (ISP supported) PhD graduates from the network. The tracer study should answer questions of where graduates are employed today as well as the quantity, quality and impact of their research, if any.

4. METHODOLOGY

The evaluation team should provide ISP with an overview of methodology and proposed time schedule for the evaluation. ISP will assist if requested.

The evaluation should include both preparatory desk studies and field visits to the node institutions. Preferably each node institutions should be visited by at least one member of the evaluation team. Interviews should be held with the following stakeholders involved in the network activities:

- The overall EAUMP Network Coordinator
- The Node Coordinators
- The Inter-network Coordinator
- Staff members at the node institutions involved in the network
- Relevant people in university management at node intuitions
- PhD and MSc students
- PhD graduates
- Director of the Mathematics Program (IPMS) at ISP
- The IPMS reference group members Interviews should be at least semi-structured, but templates might be adapted to the interviewed category.

5. TIMEFRAME, REPORTING & COST COVERAGE

5.1 Timeframe and reporting

The assignment of the evaluation team will start **1 February 2016** and be completed **1 December 2016.** The evaluation will include a desk study performed during spring/summer 2016 and 2-3 weeks of field visits during autumn 2016. The field visit should be in connection to, and end with participation in the EAUMP conference held in Uganda 26-28 October 2016.

- A **Draft report** including the desk study and preliminary findings should be presented and distributed at the conference held in Kampala, Uganda **26-28 October 2016.** An electronic copy should also be sent to ISP.
- The **Final Report,** including the stated scope of the evaluation, should be sent electronically to ISP no later than **1 December 2016**.
- A **Briefing Seminar** should be held at ISP mid December 2016.

Both the draft and final report should be written in English, and be in word format for Windows.

5.2 Cost coverage

ISP will provide full cost-cover for the evaluation team for the field visits to the network nodes as well as for participation in the conference in Kampala, Uganda. In addition, members of the evaluation team will each receive net honorarium of 1,500 USD plus travel allowance, according to Swedish rules and regulations.
NOTE: Only flights in economy class are reimbursed. The field visit and the conference should be covered in one connected trip.

6. AVAILABLE DOCUMENTS

ISP will provide the evaluation team with the necessary documents to carry out the evaluation. In addition, the evaluation team will be provided with recent filled out self-evaluation forms both on the node and network level.

Appendix G Network self-evaluation templates

The following pages contain the self-evaluation templates sent to the overall network coordinator, as well as to the coordinators at individual nodes.

UPPSALA UNIVERSITET

Deadline 30 January 2016

EAUMP Self-evaluation

For the NETWORK coordinator

The EAUMP Network will during 2016 be evaluated by external evaluators. The main purpose of this self-evaluation is to provide the evaluators with a basic understanding of the network. This report should reflect the experiences and visions of the network as a whole and includes questions about the history and development of the network, the ISP collaboration, funding, activities and outreach activities. Please develop your answers to give the evaluators the best possible understanding of the network. Node coordinators fill out a separate form with more detailed departmental data. This evaluation should be sent in word format no later than 30 January, 2016.

1. Organization

a) Contact information

Name of Network Coordinator
Location Department/unit: University/institute:
Contact Email: Phone office: Phone mobile:

b) Network Structure: list all coordinators, with university belonging.

Gender (F/M)	**Given name, family name**	**Function held**	**University, Country**

c) Briefly describe the organization of the network and working order among network and node coordinators.

2. Historical overview and current situation

Description of EAUMP

a) **Provide a brief history of the network.** *(Including how the network started, how it has developed and the current situation).*

b) **What has been the main challenges/difficulties facing EAUMP since the start up to date?** *(Internal and external bottlenecks or hindrances for increased capacity, collaboration and development).*

c) **What are your approaches to solve current challenges/difficulties?**

Objectives and Vision

d) **What is the overall vision of EAUMP?**

e) **Describe the overall and specific objectives of EAUMP.**

f) **Give an estimate of how far EAUMP has come in the fulfillment of the stated objectives.**

g) **Where should your future emphasis be put to be able to realize the objectives and the vision?** *(Which are the areas of improvements and what are the general future plans?).*

3. The EAUMP Network and the ISP collaboration

a) **What would you say that the ISP support to the network has contributed with?** *(Both in material and immaterial terms).*

b) **What has been the impact of ISP support to the region?** *(If possible, give examples on how activities and outcomes have strengthened and benefitted researchers and stakeholders nationally and regionally).*

c) **What are your experiences of the network collaboration? What has worked well and what can be improved?**

d) **How can the ISP support be improved to benefit you more?**

4. Funding

a) What funding for postgraduate activities does EAUMP currently have besides ISP? Please list the funding received for year 2015 in USD below.

Source of grant (Besides from ISP)	Amount/Currency

b) What activities is ISP support mainly used and needed for and what can be done without ISP support/with other sources of funding?

c) Does EAUMP have an "exit" strategy if and when ISP phases out the support? Please describe.

5. Network activities and outreach

a) What has been the nature of ISP support? What has it mainly been used for?

b) Provide a brief summary of the main network activities carried out since the start.

c) Please list the conferences and summer schools organized by the network since the start.

Name of event, Location, Dates and Year (no of participants)

d) Please list all publications from staff members at each department from 2010 until today. Please provide information for each department clearly separate, and indicate Impact Factor of journal when available. *(All publications reported to ISP by EAUMP is listed in the ISP annual reports, available through: http://www.isp.uu.se/eaump2016)*

e) Outreach activities: Describe any interaction (meetings, participation in committees, etc.) with government/society/industry/NGOs in the country, in the region or in global conventions, etc., including unpublished reports to authorities, media exposure and public lectures etc. *(Were the outreach activities on your initiative or by invitation? Give account for any tangible or expected effects of outreach activities, including possibilities for policy influence.).*

f) Application and use of research results: are there research results that have come to use in practice or have influenced policy? (*Describe any documented use of research results, including in teaching, and any impact or possible influence on policy/practices, any results used in patents and/or in practical/industrial use, etc.).*

6. Additional information and comments

a) Is there anything else you would like to add about the ISP collaboration or EAUMP in general?

UPPSALA UNIVERSITET

Deadline 15 January 2016

EAUMP Self-evaluation

For all departmental members of the network

The EAUMP Network will during 2016 be evaluated by external evaluators. The main purpose of this self-evaluation is to provide the evaluators with a basic understanding of the network. It includes questions about the former and current situation at your department, your vision, view and experiences of the EAUMP network and ISP collaboration, funding, outcomes of the collaboration and challenges faced. Please develop your answers to give the evaluators the best possible understanding of the situation at the departments involved in EAUMP. The self-evaluation should be sent as a ***word document*** *no later than* ***15 January 2016****. Please don't hesitate to contact ISP if you have any questions.*

1. Organization

a) Contact information

Name of Node Coordinator
Location Department/unit: University/institute: Part of the network since year:
Contact Email: Phone office: Phone mobile:

b) List all staff at the department involved in the EAUMP network activities.

Gender (F/M)	**Given name, family name**	**Position held/ Function**	**Staff qualifications** PhD	Other Ac.	Supp.

c) List all PhD students currently enrolled at your department. Clearly indicate if they are supported by ISP or not.

Gender (F/M)	**Given name, family name, area of specialization and email address**	**Start. year**	**Exp. Grad. year**	**Staff** (Yes/No)	**ISP-support** (Yes/No)	**SWC/ LOC***

*SWC = Sandwich, LOC= Local

d) List the ISP supported MSc students currently enrolled at your department.

Gender (F/M)	**Given name, family name**	**Start. Year**	**Grad. year**	**Staff** (Yes/No)	**SWC/ LOC***

*SWC = Sandwich, LOC= Local

2. Historical overview and current situation

Historical description of your department

a) **Baseline. Briefly describe the situation at your department before you joined the EAUMP network.** *(Including postgraduate training, research activity, available facilities, book and journal access, internet connection, funding, staff capacity, conference attendance and available networks for scientific collaboration).*

b) **With the help of your librarian, provide a brief historical account of the development of the Departmental library since you joined the network.**

c) **What were the main challenges/difficulties facing your department since you joined the network?** *(Internal and external bottlenecks or hindrances for increased capacity and development).*

Current situation& development

d) **Briefly describe the situation today compared to when your department joined the network.** *(Including postgraduate training, research activity, available facilities, book and journal access, internet connection, funding, staff capacity, conference attendance and available networks for scientific collaboration).*

e) **How well does the library meet the needs of your Department in terms of periodicals and reference texts?** *(Highly satisfactory, fairly satisfactory, satisfactory, lacking some mainstream periodicals, lacking some reference texts, inadequate Internet access? Briefly describe).*

f) **What are the main challenges/difficulties facing your department today?** *(Internal and external bottlenecks or hindrances for increased capacity and development).*

Vision

g) What is the overall vision of your department? *(What does your department want to achieve in term of research and higher education?).*

h) Where should your future emphasis be put to be able to realize the vision? *(Which are the areas of improvements and what are your general future plans?).*

3. Postgraduate training

MSc Program

a) **Does your department have an in-house MSc program? If no, what is the reason? If yes, what specializations are available?**

b) **How many MSc students are currently enrolled?** *(Indicate both the total number and number with ISP support).*
Total:
ISP supported:
Comment:

c) **How has the MSc program(s) developed at the department over the past 10 years?**

d) **What improvements can be made in regards to the MSc program(s)?**

PhD Program

e) **Do you have an in-house PhD program at the department? If no, what is the reason?**

f) **How many PhD students from your department are currently enrolled at your department?** *(Indicate both the total number and number with ISP support).*
Total:
ISP supported:
Comment:

g) **How has the PhD program developed at the department over the past 10 years?**

h) **What improvements can be made in regards to the PhD program?**

i) **Is there any course work available for local PhD students? If yes, please list the courses available for PhD students.**

j) What is your opinion on the sandwich model PhD training, compared to other models (full time local and full time abroad)?

Postdoc

k) Are there any Postdoc positions for incoming Postdocs available at your department?

l) Besides ISP/EAUMP, are there any other sources of funding available for Postdoc from your department? If yes, from where?

4. Research and Collaboration

a) How is the research activities organized at your department? Do you have research teams? If yes, in what fields? If not, what is the reason why?

b) Approximately how many hours/week does staff and sandwich PhD students spend on research, on average?
Staff:
Sandwich PhD students:
Comment:

c) Approximately how many hours/week does staff and sandwich PhD students spend on teaching, on average?
Staff:
Sandwich PhD students:
Comment:

d) Describe the staff exchange within the network. *(To and from where, and frequency and purpose of travel).*

e) Besides the EAUMP network, what scientific collaboration and networks does you department have with researchers inside and outside the university? If not, what is the reason? *(Indicate both national and international and type of collaboration).*

f) Please list the seminar series conducted at the department since you became a member of the EAUMP network.

Topic seminar series, and name of responsible staff member	Year	Frequency	No. of participants

5. The EAUMP Network and the ISP collaboration

a) **How and when did your department get involved with the EAUMP network? Briefly describe.**

b) **What has been the nature of the ISP/EAUMP support? What does it include for your department?**

c) **What would you say that the ISP support to the network has contributed with to your department?** *(Both in material and immaterial terms).*

d) **What are your experiences of the network collaboration? What has worked well and what can be improved?**

e) **How can the ISP support be improved to benefit you more?**

6. Funding

a) What funding for postgraduate activities does your department currently have besides ISP? Please list the funding received for year 2015 in USD below. *(Including university funding, and national, regional and international funding).*

Source of grant (Besides from ISP)	Amount/Currency

b) What activities is ISP support mainly used and needed for and what can be done without ISP support/with other sources of funding?

c) Does your department have an "exit" strategy if and when ISP phases out the support? Please describe.

d) How would you describe the government's attitude towards mathematics?
(Highly supportive, supportive, weakly supportive, or unsupportive? Briefly describe).

e) How would you describe the university administration's attitude towards mathematics?
(Highly supportive, supportive, weakly supportive, or unsupportive? Briefly describe).

7. Outcomes

Graduations

a) **How many PhD graduates have graduated from your department since you joined the network until today?** *(Indicate total number and number with ISP support).*

Total:

With ISP support:

Comments:

b) **List all PhD graduates from your department supported by ISP, since you joined the network until today. Please also provide the additional information requested.**

Gender (F/M)	**Academic title, Full name and email**	**Start. year**	**Grad. Year**	**Univ. of grad.**	**SWH/ LOC***	**IF SWH: Country, host institution and name of host supervisor**	**No of SWH visits**	**Total no of months in host country**	**Present position, affiliation and country**

*SWC = Sandwich, LOC= Local

c) For the PhD graduates supported by ISP please also list publications in international peer-reviewed journals, since graduation.

Gender (F/M)	**Full name**	**Grad. year**	**No of pub. in int. journals**	**List publications**

d) How many MSc graduates have graduated from your department since the start of your membership in the network until today? *(Indicate total number and number with ISP support).*

Total:

With ISP support:

Comments:

e) List all MSc graduates from your department supported by ISP, from the start of your membership in the network until today.

Gender (F/M)	**Academic title, Full name and email**	**Grad. year**	**Univ. of Grad.**	**If possible, present position, affiliation and country**

f) In your opinion, is the number of Master's and Doctoral graduations since your joined the EAUMP network over or under the expected number of graduations? Please comment and explain.

g) Approximately how many students have left the MSc or PhD program since you joined the network?*(Indicate both total and ISP supported students).*

Total:

With ISP support:

h) What were reasons for students leaving the program? And where did they go?

Postdocs

i) If applicable, please list all EAUMP postdocs from your department.

Gender (F/M)	**Full name**	**No of months**	**Year**	**Country, host institution and name of host supervisor**

8. Outreach activities, application of results, assignments and awards

a) Outreachactivities: Describe any interaction (meetings, participation in committees, etc.) with government/society/industry/NGOs in the country, in the region or in global conventions, etc., including unpublished reports to authorities, media exposure and public lectures etc. *(Were the outreach activities on your initiative or by invitation? Give account for any tangible or expected effects of outreach activities, including possibilities for policy influence.).*

b) Application and use of research results: are there research results that have come to use in practice or have influenced policy? (*Describe any documented use of research results, including in teaching, and any impact or possible influence on policy/practices, any results used in patents and/or in practical/industrial use, etc.).*

c) Give examples on how activities and outcomes have strengthened and benefitted researchers and stakeholders nationally and regionally. *(including new assignments. E.g. List staff members who took new positions in 2014, received awards, were given other honors, or were appointed to boards, government committees, etc. For staff members, who took new positions, please give new affiliation and email address. How have stakeholders benefitted, for example the public, collaborators, and any group affected or concerned by the research activities?).*

9. Additional information and comments

a) Is there anything else you would like to add about the ISP collaboration or EAUMP in general?