

SARIMA

*A North-South partnership for research
in Computer Sciences and Mathematics*

Report on the implementation of the Program
2004-2008



Direction générale
de la Coopération internationale
et du Développement

DgCiD

SARIMA

Supporting Research Activities in Computer Science and Mathematics in Africa

(Soutien aux Activités de Recherche en
Informatique et Mathématiques en Afrique)

Final Evaluation

Program of the French Ministry of Foreign and European Affairs

FSP Mobilisateur N° 2002-84 (2004-2008)

Operating Institutions: CIMPA and INRIA

<http://www.sarima.org>

November 2009

Introduction

by Jean-Pierre Kahane, member of Académie des Sciences, France

In international scientific cooperation, which is an essential condition for making progress in science, the cooperation between African countries on the one hand and European and North American countries on the other is of particular importance. It is unbalanced but its dynamism aims to correct this imbalance while increasing research potential in Africa.

The originality of the SARIMA programme, supporting computing and mathematics research activities in Africa, is highlighted by this document. It was launched recently, in 2004. From the outset it has had the ongoing support of the Académie des Sciences' developing countries committee (COPED) as well as financial backing from the French Ministry of Foreign and European Affairs. It has modest resources compared with other cooperation programmes but these are still high for the usual practices of French mathematicians involved in cooperation with developing countries.

The first part of the document, written by the initiators and project managers, Claude Lobry and Bernard Philippe, gives a thorough account of the use of these resources while the last section, written by Roland Waast, summarises the work done, which is impressive, and future prospects, which are very open.

However, the document's most original aspect is to be found in the second section, the scientific report, which has been produced by a committee chaired by Bernard Helffer and based on a series of preliminary reports and surveys, prioritising, like any good scientific report should, qualified judgments on the quality of work with mechanical tabulation of statistical data. This report is remarkably laudatory on the whole, but does not hold back when it comes to offering suggestions and criticisms. It deals with African partners in the same way it would deal with French, European and American researchers. It conveys the respect we owe to the individuals who, in the difficult circumstances found in poor countries, contribute as much as they can to progress in science and progress in their countries.

This document is not an easy read but readers will be rewarded with the serious information contained within and will undoubtedly be enthusiastic about the future prospects opened up for science and humanity.

Jean-Pierre Kahane
November 5, 2009

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Context

This document includes three reports which were written in the occasion of the final evaluation of the SARIMA action (action mainly funded by the French Ministry of Foreign and European Affairs, program “FSP Mobilisateur”, # 2002-84 (2007-2008)). A special Scientific Interest Group (GIS) was set to pilote and manage the action. Two institutions (CIMPA and INRIA) were the operators implementing SARIMA.

Jean-Claude Topin, advisor of the International Co-operation and Development General Direction at the French Ministry of Foreign and European Affairs (MAEE), was in charge of the project to the Fonds de Solidarité Prioritaire and the scientific coordinators.

The global evaluation was chaired by Roland Waast (Directeur de Recherche à l'IRD) with Bernard Helffer's cooperation (Professor at the University of Parid-Sud) who was in charge of the scientific part of the evaluation. They chaired an international committee of evaluators. The two corresponding reports are published in full in Chapters 2 and 3. Chapter 1 corresponds to the activity report of the GIS which was written by its executive board.

Evaluation Committee

Chair

Roland WAAST, IRD, Bondy, France

Vice-Chair, in charge of the Scientific Evaluation

Bernard HELFFER, Paris-Sud University, France

Members

Leif ABRAHAMSSON, University of Uppsala, Sweden

Régine ANDRE-OBRECHT, University of Toulouse, France

Olivier BESSON, University of Neuchâtel, Switzerland

Andreas GRIEWANK, Humboldt University of Berlin, Germany

Mohamed JAOUA, University of Nice, France

Jean LUBUMA, University of Pretoria, South-Africa

Michel RIVEILL, University of Nice, France

Maurice TCHUENTE, University of Yaounde I, Cameroon

Scientific Interest Group(GIS) SARIMA

Executive Board

Bernard PHILIPPE, chair, **INRIA** representative, Rennes and Rocquencourt,
Claude LOBRY, secretary, **CIMPA** representative, University of Nice Sophia-
Antipolis.

Member Representatives

Jacques BLUM, **University of Nice-Sophia-Antipolis**,
Patrice QUINTON, **ENS Cachan**, Rennes,
Marie-Françoise ROY, **University of Rennes 1**,
Marc REVERSAT, **Paul-Sabatier University**, Toulouse,
Gauthier SALLET, **University of Metz**,
Annick SUZOR-WEINER, **Paris-Sud University**, Orsay.

Other members

Jean-Marc BARDET, University of Paris 1 Panthéon-Sorbonne,
Jean-Pierre BOURGUIGNON, IHES, Paris,
Fabien CAMPILLO, INRIA, Montpellier,
Didier DACUNHA-CASTELLE, Paris-Sud University, Orsay.

Administrative Coordinators

Agnès GOMEZ, CIMPA, Nice,
Marie-Claude SANCE-PLOUCHART, INRIA Headquarters, Le Chesnay.

Abstract of the Evaluation Report by R. Waast

SARIMA is a program of the Priority Solidarity Fund (Fonds de Solidarité Prioritaire) (1.6 MEuros over 4 years). Its goal is to sustainably consolidate research capabilities in computer science and applied mathematics in Africa.

The program stands out based on four innovative aspects:

- The activities concern an unusual field of cooperation: research-education in basic sciences.
- The objective is *institution building*. This means giving structure to an African research community by fostering the creation of, or supporting, high quality teams that are immediately linked in *networks*.
- It makes use of an unusual type of managers: university teachers and researchers, whose agility and personal skills have up to now been rarely used in broad-ranging projects.
- The initial recruitment is the result not of calls for proposals, but rather of a cooptation based on in-depth knowledge of the field by perspicacious French managers.

The evaluation, permanent and tight, comes to the conclusion that the SARIMA program was well-advised and seminal.

- The **quantifiable indicators** show that the initial objectives were either attained or surpassed (training, publications, structure).
- The **scientific evaluation** shows that the operation was satisfactory on this aspect.
- The **institutional evaluation** bears out a tremendous institutional prowess (networks created or consolidated; journals, scientific association; widening of the geographical and scientific extent; inclusion of new partners in France...)

- The program is well looked on in the beneficiary countries. *The prestige of French support* (for the basic sciences) **and its influence** (new networks) have been enhanced through an operation that fully complies with the current major need for "institution-building".
- One difficulty comes from that in many countries, the instruments of research exist but research role is not recognized. The system is split up through various institutions and research is seen as auxiliary. Although research is viewed as a resource for development and co-funded by the state, a long-range support is necessary for cooperation as well as the experience of a local scientific community.
- Funding limited to the launching step is not acceptable; perseverance is necessary. From the perspective of public policy, one can say that SARIMA is a forerunner to a **co-development tool that is lacking in French cooperative research programs**. It is well positioned in a neglected field but one where France has a strong hand: that of supporting basic sciences ¹.

This **assessment** is widely shared by the evaluators coming from several countries. The program responds to a concern that is gaining ground in the international arena. We have all agreed, nonetheless, to emphasize that this sort of undertaking **requires perseverance**. ² It is thus high time that the resources and means be found to **consolidate this program** and possibly even extend its reach. It provides local credibility and consistency.

¹For the sequel, it is wished that such an operation should be combined with teaching innovations; it must become even more pro-active to fit into its environment (university and society: non-academic applications). Local context of course strongly interacts with these plans.

²Successful foreign experiences bear witness to this (ISP, ICTP, etc.)

Reports

Chapter 1

Executive Report of GIS SARIMA

by Claude Lobry and Bernard Philippe
members of the Executive Board.

Introduction

In this document, intended for the SARIMA project evaluating commission, we attempt to summarize the project's operating conditions. Our report, in and of itself, takes up eight pages. The rest of the document comprises, for the reader's convenience, extracts from the program funded by the MAEE [Ministry of Foreign and European Affairs], but the entire text is available for reference.

Establishment and Operation of the GIS

G.I.S. is a french acronym for "Groupement d'Intérêts Scientifiques"

Establishment

- 2000: B. Philippe (on behalf of INRIA) and C. Lobry (on behalf of CIMPA) begin application procedures with the MAEE. A project known as "MASTIC", then changed to "SARIMA" is proposed.
- 2002: 3 October. The GIS is created (informally) and becomes the "official" interlocutor with the MAEE. CIMPA, INRIA and the universities

of Nice, Metz and Rennes I are the founding members. C. Lobry is the president and B. Philippe is the general secretary¹.

- 2002: The SARIMA program (under evaluation here) is accepted by the “Fonds de Solidarité Prioritaire” [Priority Solidarity Fund] and is due to start during the course of the year. The African teams are contacted and a program is developed to start with the 2002-2003 school year. 2003: Following the freezing of the FSP’s budget allocations, the program is delayed by a year. Start up in September 2003, but the funding arrives very late in December, which further delays start up.
- 2004: On 25 April, the GIS takes up its first duty (partially retroactive).

Postponing the program by a year, then the three-month delay in arrival of funding, substantially hindered start up. **One may say that, in reality, the program operated from December 2003 to June 2008.**

Operation

Distribution of funding

Every year, the teams being supported establish a research program and request the corresponding resources. These requests consist of solicitations for:

- Internship stays at the master’s, doctoral and senior levels in the North.
- Visits to the South for master’s courses.
- Organizing workshops and symposia in the South.

Funding is distributed between the teams and an “administration” line item. Once funding is allocated, each team is free to change its planning with the following constraint: the total cost of missions in the North, as well as that of operations in the South, must remain constant. The team manager is directly responsible for managing his allocation. Four allocations were made for the entire program.

GIS advisory board meetings

- 10/03/02 Implementation.
- 04/25/03 Allocations 2003 → end of 2004.
- 11/08/04 Submission of request for 2005.
- 12/18/04 Allocation for 2005.
- 07/08/05 Follow-up for 2005.

¹After two years in operation, the two will exchange roles. In practice, we have always worked on a fully cooperative basis, with each one keeping the other informed of his initiatives.

- 01/20/06 Allocations for 2006.
- 03/27/07 Meeting with managers of teams in the South and allocation for 2007.
- 02/21/08 Allocation of balances and of an INRIA funding of 100K-€ for 2008.

The Scientific Advisory Board

The GIS has a Scientific Advisory Board (CS) named by the association advisory board. At the outset, we had wanted the proposals for distribution of funding to undergo close review by the CS, which would in turn forward a proposal to the association's board. This procedure immediately proved to be too cumbersome and impossible to implement, to the point where strict compliance with it would have jeopardized implementation of the program. We thus settled for a "post-facto verification" and "virtual meetings" by e-mail, except for one physical meeting at the halfway point.

Allocation between the two operators

Operations in the North (administered by INRIA)

The following table shows in "number of months" the distribution of stays in the North administered by INRIA: 915 K-€ + 100 K-€ (allocated by INRIA)

Nombre de stages	Masters	Doctorants	Post-Doc.	Sci. Conf.	Total
		26	158	25	69

Nombre de mois de stages par années	2005	2006	2007	2008	Global
		133,75	248,1	195,5	38,92

Nombre de mois de stages par équipes et types	Masters	Doctorants	Post-Doc.	Sci. Conf.	Total
	Beyrouth	16,00	32,25		1,37
EDP Contrôle	4,00	96,00	4,00	12,67	116,67
Madagascar		2,00		29,70	31,70
Maghreb-Info	9,00	42,50	2,73	3,80	58,03
RAGAAD	4,00	58,00	3,00	1,00	66,00
TAMTAM	12,00	63,50	6,25	7,00	88,75
Yaoundé-Info	16,00	78,00	2,00	15,00	111,00
Yaoundé-Maths		61,50	27,00	6,00	94,50
	61,00	433,75	44,98	76,54	616,27

At the practical level, each participant contacted INRIA (M-C Sance), which took care of setting up their mission: Welcome team, establishment of the contract with EGIDE, purchase of plane ticket. This is demanding work that corresponds to at least half a full-time position. The budget for internships

in the North was 1,000K€, and it was found that one month's stay, including travel cost, came on average to €1,600.

Operations “in the South” (administered by CIMPA)

The following table shows how the 555K€ administered by the CIMPA are divided among the various teams. The “administration” line item is explained later.

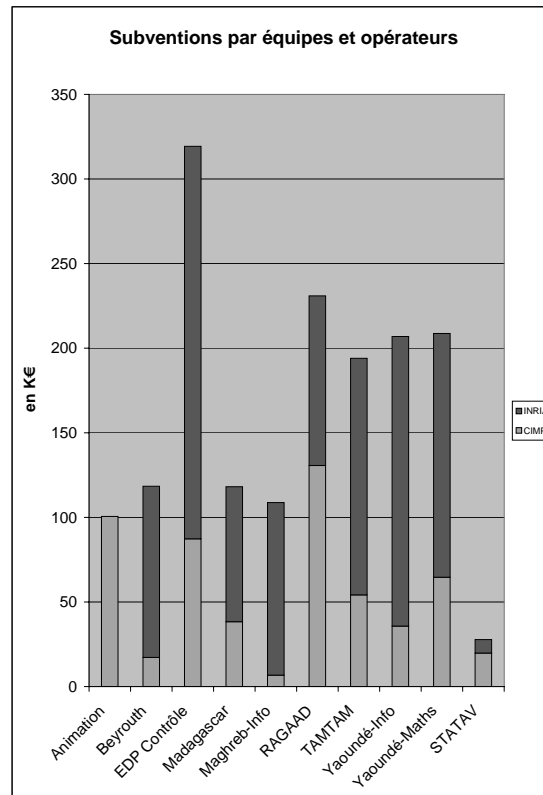
Team	Entry into the Program	Funding
Animation	2004	84 573
RAGAAD	2004	132 626
EDP Controle	2004	89 286
TAM-TAM	2004	56 671
Yaounde Info	2004	37 723
Yaounde Maths	3004	66 594
Beirut	2004	18 176
Madagascar	2004	38 326
Maghreb Info	2007	7 245
Statistiques	2008	23 777
TOTAL	.	555 000

CIMPA keeps updated accounting of the team expenditures for each team. Based on this table (Dé penseSarima230608, attached to the file), one can outline the various types of activities.

- Workshops and schools: These are events lasting approximately one week at the local level (neighboring countries) and devoted to one particular topic. For each event, the funding ranges between 5K€ (workshop) and 10K€ (school).
- Symposia: Organization of symposia², support for symposia organized independently, individual grants to participate in symposia.
- Scholarships: These are scholarships granted to doctoral candidates for relatively lengthy stays in an African country. This may turn out to be a local scholarship of around 1K€ per year.
- Courses: These are teaching trips almost always lasting two weeks and, unless otherwise noted, from the North to the South in order to provide support for teaching activities.
- South-South: These are missions carried out between African universities.

	Workshops	Symposia	Scholarships	Courses	South-South	Misc.	Total
RAGAAD	28 966	27 965	17 595	35 548	5 914	16 638	132 626
EDP	17 000	25 000	10 394	18 369	2 169	16 354	89 286
Tam-Tam	5 206	15 254	4 122	13 758	7 490	10 341	56 171
Yndé Info	0	1 419	0	29138	3 093	4 073	37 723
Yndé Maths	17 984	25 182	0	7 118	5 010	11 300	66 594
Liban	11 084	740	0	5 350	0	1002	18 176
Madagascar	0	7 573	0	19 666	2 217	8 870	38 326
Maghreb Info	0	0	990	0	4 637	1 618	7 245
SATAV	8 334	0	6 045	7 546	0	1 852	23 777
TOTAL	88 570	103 133	39 146	136 493	30 530	72 048	469 924

For each mission or event, an advance payment of 80% is made, with the balance being paid upon receipt of supporting documents and a description of the event.



Sub-Sahara	68 %
Maghreb et Middle-East	26 %
Animation	6 %

Geographic Distribution of Expenditures

Analysis of Use of Resources

Distribution among the teams

The distribution does not reflect the scientific importance of the teams. It is done based on the following principles:

- The two teams, TAM TAM and Beyrouth are considered to be teams that have reached a certain level of scientific maturity but that do not yet have sufficient “financial security”. Aid from SARIMA provides them with support for their South-South relationships, which otherwise have trouble obtaining funding.
- The project negotiated with the MAEE explicitly concerned applied mathematics and computer science. We have nevertheless had to use a very broad notion of applied mathematics. In effect, in some cases the short-fall is such that it would be absurd to deprive oneself of the skills of highly-qualified mathematicians. That is why we strongly supported the emerging RAGAAD network that was developing synergies in the fields of geometry and algebra and their applications.
- The project sought to contribute to the acquisition of greater know-how in terms of structuring teams and defining research strategies. That is why we requested activity reports and forecasts. The Yaoundé Maths team, which had tremendous difficulty in producing documents, was certainly penalized to some extent.

It should be noted that the GIS advisory board has never had any difficulty in reaching a consensus on how to allocate funding resources.

“Animation” Budget

The following table provides a breakdown of the “animation” budget.

Rubrique	Somme	Commentaire
Previous activities	11 955	Delay in allocation of funding a that required “loans” to CIMPA.
Administration	23 491	Transfert costs (> 2000) allocation to CIMPA (18 000) SARIMA Website
Board meetings	1 960	
Executive board missions	3 214	Missions to meet the MAE and with SARIMA partners.
CS meetings and March meeting 2007	15 503	
Opening	28 067	Various missions intended to “open up” to others partners.
TOTAL	84 573	

This budget was administered directly by the executive board (B. Philippe and C. Lobry). The 11,955-€ in “carry over” represent expenditures committed to by CIMPA for SARIMA teams before formal signature of the contract.

The *administration* item includes a lump sum of 6,000 € per year allocated to CIMPA to compensate it for the use of its secretariat, for overseas bank transfer costs and for costs related to setting up the Website.

We organized one meeting of the scientific advisory board and one meeting of team managers. In contrast to meetings of the management board, these “international” meetings are very expensive.

Opening. This heading includes many types of operations that were intended to open up operations to other teams. These amounts basically went to fund travel by members of the management board, although not exclusively: researchers from the South were invited to the North. These activities served to expand the RAGAAD and to create Maghreb Info.

Match up with the provisional budget

The provisional budget can be found in the attachments.

The following table matches up the predicted number of stays in the North with what actually occurred.

	DEA Internships	Ph. D. Internships	Post-doc	Seniors
Predicted	150	456	0	42
Occured	61	433	44	76

The demand for DEA (Master’s) studies was much lower than predicted and offset by a higher “post-doc” demand.

Analyzing what is called “structuring activities” and “network management” in the forecasts is harder to do given that if a person travels to give a course and takes advantage of the occasion to discuss research strategy with his colleagues, one cannot classify the mission based on both aspects. We shall limit ourselves to a few comments.

- Plans called for forty *Missions to the North* by experienced researchers. More than twice this number occurred, thanks in part to the fact that the average cost had been slightly over estimated.
- *DEA Activities* : Expenditures amounted to 136K€ for 240K€ budgeted.
- *Schools and workshops in the South* : A total of 190K€ were spent on “Workshops” and “Symposia” whereas 120K€ had been budgeted for these.
- *Start up* One may consider the 15K€ budgeted to have ended up covering the 12K€ for the “debt to CIMPA”.
- *Operation of the GIS.* 61K€ were allocated for GIS overhead costs; we are currently at 44K€ plus the “half position” made available by INRIA. The forecast was thus realistic.

- *Network management* (194K€). Meetings on network management were held during scientific events. One may deem that the 30K€ for the South-South line item, and part of the “miscellaneous” line item contribute to that.
- *Evaluation*. This is covered by a budget that is separate from the one presented here.

The Broadening of SARIMA.

The understanding with the MAEE was that the program should not be fixed, either in terms of limits on topics or geographically speaking, nor in terms of its operations.

- The perimeter of “applied mathematics and computer science” of the initial project was broadened since we supported activities in algebra and geometry, along with some of their applications (cryptography and information security). We also sought to foster thematic developments in these fields, as well.
- From the outset, we sought to extend the reach of the GIS and quickly brought on board the Cachan école Normale Supérieure and the universities of Orsay and Toulouse.
- We supported the creation of a network for modeling in epidemiology: EPIMATH. The TAM TAM network, comprising teams from Algeria, Morocco and the LAMSIN, quickly replaced the latter (which had been decided from the outset by our Tunisian partner).
- We requested the creation of the Maghreb-Info network.
- We contacted the STATAV network of statisticians and offered to include them in the program.
- In Beirut, our activities resulted in collaboration between three universities (USJ / UL / AUB) that do not often “communicate”. We tried to get the team managers in the South more actively involved in the program’s scientific supervision. That is why we organized, on 27 and 28 March 2007, a meeting of the association advisory board open to the managers of the various teams. Each team was thus able to present its research strategy and report the results of its work. We only held one of these meetings due to the travel costs for a dozen Africans, on the order of 10K€ for a meeting that was meant to be purely administrative. In hindsight, one may wonder if passing on this type of investment was really a good idea. In point of fact, if the meeting is scheduled far enough in advance, the team managers can take advantage of the opportunity to carry out some research activity (visiting a team, thesis review committee, etc.) and, most of all, the structuring effect is much stronger since every team has to regularly justify its requests for financing in front of the other teams.

- After this meeting, we set up a task force to contemplate the future of a structure such as SARIMA. This produced the idea that, given the size it had now reached, relatively independent sub-divisions would have to be created.

Comments on the Overall Result

It is not our role to assess the nature of the overall result. Nevertheless, we can go back to the “objective indicators” that the MAEE had requested that we highlight, even though we are no longer entirely convinced of the relevance of all the indicators. We have reproduced the table of objectives, accompanied by “verifiable success indicators” such as were found in the project.

We will take up these indicators one by one. The mathematics work being done in the supported teams had existed before SARIMA arrived on the scene and would have continued without it. In the balance sheet, it is hard to determine precisely what can be attributed to the program. We have attempted to do so as honestly as possible.

Main objective

A substantial increase in publications in international magazines and in participation in international symposia

We find this item especially difficult to evaluate. In point of fact, and more or less by definition, we did not have access to any statistics at the start of the project. At the end of the project, we have items available, team by team, that we were unable (for lack of time and personnel!) to properly prepare and present. Thus, the summary table that was composed for the evaluation shows 51 publications by the Madagascar team, in comparison with the EDP Contrôle team, which only shows 26. However, the former includes figures for all of the “local” publications in the proceedings of symposia and workshops, whereas the latter covers basically only publications in journals. Moreover, many publications were co-authored with people from the North, which does not always permit evaluation of the level of involvement of the author from the South. However, it is worth noting that there is a substantial number of publications signed by authors working south of the Sahara. We find some sixty such publications in the field of mathematics alone.

Formal agreements signed by teams for North-South and South-South cooperation.

We do not have an exact count for this item. In terms of North-South cooperation, we note that the LAMSIN is an INRIA partner team, two Euro-Maghreb networks were recently created on hydrogeology and wastewater treatment, and the Brittany region has funded an inter-university cooperation agreement between the University of Rennes 1 and the University of Niamey. In terms of

South-South cooperation, three projects including teams from the North and South of the Sahara received support from the Aires-Sud agency.

Objectifs et indicateurs :

<p>Objectif principal : -Donner à sept équipes répertoriées la capacité de définir leur projet scientifique, accroître leur possibilité d'encadrement de thèses, fournir à des chercheurs en mathématiques appliquées et informatique des conditions de travail convenables. -Renforcer un réseau de chercheurs en mathématiques appliquées et en informatique</p>	<p>Indicateurs vérifiables de succès - Augmentation significative des publications dans les revues internationales et de la participation aux colloques internat. - Accords formels de coopération Nord-Sud et Sud-Sud passés par les équipes. - Affichage de la politique de recherche des équipes avec perspectives à 3 ans. - Mobilisation de financements extérieurs au projet - Attribution de chaires UNESCO</p>	<p>Hypothèses sous-jacentes importantes pour la réussite du projet : -Relative stabilité politique dans les pays considérés. -Existence d'un dialogue avec les administrations universitaires hébergeant les équipes visées. -Versement en temps des subventions du MAE.</p>
<p>Composante 1 (S/Obj. 1) : Soutien aux équipes -Accélérer la formation des docteurs -Former une masse critique de chercheurs travaillant ensemble sur des sujets communs, créant ainsi des spécialités d'équipe. -Aider à la mise en place ou au renforcement de formations de 3èmes cycles</p>	<p>Indicateurs vérifiables de résultats -Par an et par équipe, démarrage de 2 thèses au moins -Chaque thèse doit être soutenue en quatre ans maximum. -Les spécialités de l'équipe sont affichées. -Des DEAs en maths applis / informatique fonctionnent à St Louis, Yaoundé, Tunis, Beyrouth.</p>	<p>Hypothèses sous-jacentes importantes pour l'atteinte de ce sous objectif : -Autorisation de mission en France des doctorants et chercheurs (obtention de visa, autorisation FSD d'accueil, attribution de contrats EGIDE) -Pour les DEAs, participation des autorités universitaires</p>
<p>Composante 2 (S/Obj. 2) : Action structurante -Organiser entre-elles un réseau de compétences qui anime les activités habituelles de la recherche (visites scientifiques, colloques, revues, écoles) -Réaliser les activités décidées par le réseau. -Etablir des conventions entre universités du Nord et du Sud.</p>	<p>Indicateurs vérifiables de résultats -Création d'un Comité Africain de la Recherche en Math. Applis (CARMA) et pérennisation du CARI. -Consolidation du programme Post-doc lancé par CARI et création d'une revue en informatique -Existence de conventions</p>	<p>Hypothèse sous-jacente importante pour l'atteinte de ce sous objectif : Mobilisation de financements extérieurs au projet pour le programme Post-Doc et pour la revue électronique</p>
<p>Composante 3 (S/Obj. 3) : Gestion du réseau -Faire fonctionner le réseau . Aider les équipes dans leur projet scientifique et leurs coopérations</p>	<p>Indicateurs vérifiables de résultats -Rapports d'exécution du projet. -Existence de rapports d'activités par équipes</p>	<p>15</p>
<p>Composante 4 (S/Obj. 3) : Evaluation -Evaluation du fonctionnement du projet -Evaluation de l'activité scientifique -Evaluation des résultats par rapport à la politique publique</p>	<p>Indicateurs vérifiables de résultats -Existence de contacts, déclarations communes et contrats entre les équipes et les administrations du pays -Les nouvelles formations doctorales intègrent des thèmes applicatifs</p>	<p>Hypothèse sous-jacente importante Volonté du pays concerné de valoriser la R&D dans les politiques de développement.</p>

Presentation of team research strategies with three-year projections.

The teams from South of the Sahara did not provide such documents.

Mobilization of funding from outside the project

There are many of these cases.

- ICTP: nearly all of the mathematics events receive assistance from ICTP.

In particular, EDP Contrôle's "WATS"² is supported in large part by ICTP.

- In consultation with SARIMA, the I.S.P. (International Science Program - University of Uppsala) provides support to several teams.
- The AUF: The AUF has long supported exchanges of professors between African universities. SARIMA brought no basic changes to these programs. However, a certain complementarity was established in the doctoral thesis programs under "co-tutelles" [co-advice PhD with usually a dual degree diploma].
- Support provided by teams from the North using their own allocations is undeniable but not subject to quantification at present (assistance for co-tutelles, travel to the South by their staff, one-month invitations for researcher-educators from the South, etc.).
- Awarding of UNESCO chairs: UNESCO does not provide financial support for its chairs but does grant a "seal of quality". The "Mathematics and Development" chair in Tunis, created at the start of the program, is clearly a success. It offers 12-week "semesters" of advanced courses for many auditors, especially from south of the Sahara. A number of SARIMA team members (Yaoundé, EDP Contrôle) have benefited from this assistance.

Support for the teams

Per year and per team, at least 2 theses started.

We asked the teams to report only theses that would certainly not have been started were it not for SARIMA. We seem to have reached approximately fifty, which is compliant with the objective ($3 \times 14 = 42$).

Each thesis must be completed (successfully defended) in a maximum of four years.

This objective has been met for theses started at the beginning of the program, since more than twenty theses clearly resulting from SARIMA were defended.

Team specializations are presented

This is the case.

²Initiated by "EDP Contrôle" for analysis and continued by RAGAAD for algebra, the WATS (Western African Training Schools) are schools lasting one or two months intended for West African doctoral candidates and including English-speaking countries (Nigeria and Ghana).

DEA (Master's programs) in Applied Math/Computer Science are in operation in St. Louis, Yaoundé , Tunis and Beirut.

This is the case.

Structure-building Activities

The creation of an African Committee on Research in Applied Mathematics (CARMA) and maintenance of the CARI.

The constitutional symposium for CARMA was held. An exclusively African advisory board was set up and an initial symposium was held at the end of 2007. It is too early to assess the effect of this action. The CARI has enhanced its influence, especially in applied mathematics.

Consolidation of the post-doc program initiated by CARI and the creation of a computer science journal.

The journal ARIMA was created in the wake of CARI activities. The sizeable number of visits by confirmed researchers may be deemed to be in line with the post-doc program that CARI took responsibility for over three years.

The existence of agreements

This is probably the weakest point. We did not make the investment required to make SARIMA visible to local university authorities with whom, save a few notable exceptions, few formal agreements were signed. For example, we could have based SARIMA's support on the signature of partnership agreements with universities by explicitly calling for research assistance in the form of write-offs for teaching work. One can, however, point to the existence of nearly a dozen co-tutelle doctoral program agreements.

Network management

Project implementation report

Thr present report

The existence of activities reports by teams

This is the case

Evaluation

Not applicable for the present report.

Conclusion

We seem to have noticed, over these four years, an evolution in administration to a level comparable with that of a (very) large research centre.

- Each team managed to do sensible planning and properly use the funding made available to it. Just as in a real research centre, the management (the GIS office) was able to “fill in the gaps” (thanks to the budget for “administration”).
- The activity reports submitted by the teams have improved considerably, even if there is still significant room for improvement in this respect.
- The team managers from the South have gradually taken on greater roles in the scientific supervision of the program.
- For many teams, if not for all, SARIMA funds were far from being the only funding available to the team. However, and from our point of view this is where the pioneering nature of the program is key, SARIMA funding was totally unrestricted in how it was used, just as recurrent allocations are in research centers in the North.

Without wanting to suggest that it is the only way of effectively cooperating with Africa, especially with Sub-Saharan Africa, we believe that the French government should support the creation of “research centre-networks” without walls, that would be similar in size to a research centre in the North - between 50 and 100 full-time positions - with a research production capacity comparable in nature to that of a research centre in the North and should make aid available on a recurrent basis until the countries involved realize the need to do so themselves.

Appendix 1: Reminder of the Objectives Set by the “SARIMA Program”

The “Fonds de Solidarité Prioritaire” (FSP - *Priority Solidarity Fund*) provided funding for a program entitled:

Soutien aux Activités de Recherche Informatique et Mathématique en Afrique
(SARIMA)
Aid to Mathematics and Computer Science Research Activities in Africa

The document explaining the program adopted is huge, comprising 63 pages, from which we have extracted the most meaningful parts.

Executive Summary of the Program

We reproduce below the “executive summary” of the program as it appears at the start of said document.

Baseline situation and justification for the project

In Africa, *research in basic sciences* (also known as the exact sciences) is still often the poor step-sister in development programs, despite the fact that it contributes to countries that engage in it:

La recherche en sciences de base (aussi appelées sciences exactes) en Afrique reste souvent le parent pauvre des programmes de développement alors qu’elle apporte au pays qui la pratique :

- *scientific know-how* required for a country to become a player in the international community of knowledge
- *technological know-how* required for managing a country’s development
- *improvement in the standard of university-level training* thus enhancing a country’s class of potential leaders.

Moreover, the project contributes, *de facto*, to improving the working conditions for researchers and thereby reduces the *brain drain of researchers moving to developed countries*. The project aims to *strengthen the research potential* of university teams in the ZSP (Priority Solidarity Zone) in Africa and around the Mediterranean in the field of *Applied Mathematics and Information and Communication Science and Technology* (ICST). The approach adopted consists of creating or strengthening *centers of excellence collaborating in a network structure*. Seven teams³ from the ZSP were selected at the start of the project as network nodes (five French-speaking Sub-Saharan teams, one Tunisian team and one Lebanese team).

³These teams are described in the document. At the end of the present document, we have included the presentation given by these teams.

Main activities

Project activity is focused on two areas :

- assistance specific to each team: the aim is, after four years, to end up creating a critical mass of researchers in the areas of research presented by the team's research plan. Direct assistance will concern the funding of internships in specialized teams, in the North as well as in the South, for graduate students, doctoral candidates or new post-docs.
- actions structuring the teams and their cooperation: based on the research plans of the project teams, institutions in the North will propose cooperative efforts with their own research centers. These will provide an opportunity for joint research and the creation or strengthening of post-graduate programs. The project will administer a network of teams that collaborate to establish a structure in a continental framework for the African research community in computer science (which now exists in the form of the CARI) and in applied mathematics (still to be created). These specialized networks will host regional gatherings (theme-based schools or workshops) and facilitate links with the international research community.

Implementation of the partnership and expected results

The project is to be run by two institutions, INRIA and CIMPA, that will work jointly based on each one's specific experience. INRIA will contribute its experience in administering the CARI network and in cooperation between North and South research teams. The CIMPA will contribute its mathematics network and know-how in organizing post-graduate programs and specialized schools. The two institutions will draw on three universities: Metz, Nice and Rennes. All five establishments will set up a Groupement d'Intérêt Scientifique (GIS - Scientific Interest Group) that will enable them to coordinate their plans for North/South cooperation. Upon completion of the project, there is expected to be a significant improvement in conditions for research in applied mathematics and computer science in Africa, improvement to be borne out by:

- growth in the number of better established researcher-educators and team specializations
- new skills in applications critical to a country's development
- new technological know-how in the field of ICST.
- an on-going organization on the African continent for North/South research cooperation.

All of these objectives were outlined in detail in the body of the project, from which we have extracted the following part that seems to capture the gist.

One of the key objectives of the project will be to strengthen the potential of research teams by producing 30 to 40 Ph.D.'s (in particular, by giving them the opportunity to do one or more internships in a research centre in the North) on a team's subjects, to be defined by means of North/South collaborations supported by the network. Upon completion of the project, the teams should all have a clear plan for their research activity. Some of them will attain a level of research competence such that outside researchers, from both North and South, will want to spend time there in order to advance their research.

Funding

In order to attain these objectives, the following budget was proposed, which we reproduce here without a number of items related to the MAEE allocations involved.

Support for the teams: 750 K€

This involves the funding of internships for graduate students at research centers in the North. Estimates are based on €1,000/month for a doctoral student, €800/month for a DEA (Master's) student, and North/South travel costs varying between 1,200 and €1,500 depending on the length of stay. The project calls for 76 doctoral student internships with a total duration of 456 months and 50 DEA student internships with a total duration of 150 months.

Structure-building activities: 511.2 K€

Missions to the North: 151.2K€.

These are missions for experienced researchers. 6 one-month missions per team at approximately €3,600 each (travel = €1,200, per diem = €2,400).

DEA Support Visits: 240K€.

This represents strengthening a DEA teaching program through a 2-week visit by a specialist from the North or South. Average cost per visit: fees: 32 hrs x €50 = €1,600; per diem: 15 x €80 = €1,200; transportation: €1,200. Meaning an average cost of €4,000 per visit. The amount of 240K€ will thus cover 60 visits. Since it is local institutions will be expected to contribute, based on their ability to do so, the number of visits will be higher.

Schools and workshops in the South: 120K€.

A "school" may last for two to three weeks, bringing together 30 - 50 participants. The cost for a school is approximately 60K€, 20K€ of which will go for speakers. A "workshop" will last one week and include between 10 and 20 participants. The cost for a seminar is approximately 20K€, including 5K€ for the speakers. The project would pay for the speakers for one school and two workshops per year.

Network management: 208.8K€

Set up: 15K€.

This involves the signing of seven start-up contracts and thus at least seven short-stay North-South or South-North trips.

Network management: 193.8K€.

Meeting of team managers. Six meetings of team managers and their corresponding peers in the North, meaning 42 North-South trips and 42 South-South trips at an average cost of €1,200, for a total of: 100.8K€.

Travel for the two administrators. Two trips to the South for each administrator per year: $16 \times 2K€ = 32K€$.

Operation of the SARIMA GIS.

Two trips to France per year: $40 \times €325 = 13K€$.

Overhead (CIMPA) 18K€.

Unforeseen expenses 30K€.

Evaluation: 90 K€

Evaluation shall be organized based on three sources of input:

- The steering committee shall provide continuing evaluation and submit recommendations to the GIS advisory board.
- A research and network operations evaluation at the halfway point.
- A final evaluation with a scientific appraisal by an international committee and evaluation of government strategies.

Appendix 2: Teams selected at the outset

Seven teams or networks were selected. We have re-written the synopsis for each one here, deleting certain parts⁴ that did not seem to be critical to us.

EDP Contrôle Network

Description of the network

This network was established two years ago by bringing together a dozen researchers from the universities of Nouakchott, Ouagadougou and Saint Louis in Senegal under the direction of three researchers. Its research topic is the theory of partial differential equations and their application (É). The three directors of this group were trained in the best French teams and returned to their native countries some ten years ago. Their relative proximity to their universities enabled them to set up an effective network that meets three times a year. The main node of the network is the numerical analysis research centre at Saint Louis, in Senegal.

North-South and “trans-Saharan” cooperation

- Université de Nice-INRIA Sophia Antipolis / INRA Montpellier (EPI MERE)
- Université de Besançon.
- Université de Neuchatel.
- International Center for Theoretical Physics (Trieste Italy) and CIMPA.(...).
- ENIT’s LAMSIN Research centre in Tunis and collaboration with Morocco.

South-South cooperation

Since it is one of the most advanced teams in the region, the EDP Contrôle network is in high demand, especially by English-speaking countries. Members of the network often have an opportunity to give high-level courses in various universities. **Research program**

The chosen scientific object is modelling of “everything which has concern with water”, which is a scarce resource in countries from Sahel. As examples on mention : Problems with wastewater treatment, eutrophization of lakes, conflict between sated and unsalted water, control of hydraulic systems (deams, canals, ...)

Objectives

- To create a research centre dealing with water problems - water being essential to all life forms - in order to become a world leader in everything related to modeling.

⁴Outlined by (...).

- To create a DEA and co-tutelle doctoral programs for researchers that will effectively contribute to various international programs dealing with key development issues (agronomy, public health) for those regions.

Network leaders

- ISSELKOU Ould Ahmed Izid Bih, Faculté des Sciences et Techniques, Nouakchott, Mauritanie.
- NIANE Mary Teuw , Laboratoire d'Analyse Numérique et d'Informatique (LANI), Université Gaston Berger de Saint-Louis, Sénégal
- TOURE Hamidou, Université de Ouagadougou, Burkina-Faso.

Three young people who have just defended their theses will soon join the administrative team.

Department in Niamey and Algebra network.

Mathematics Department at the University of Niamey.

This small department has some fifteen permanent members, half of whom are establishing a research team in geometry, algebra and computer science. This team is administered by new appointed educators who are enterprising and well qualified. The research topics are nevertheless broad-ranging, as is often the case in Sub-Saharan Africa. A plan for master's and doctoral programs focused on reflectivity in algebra and geometry is in the design stage, following the CIMPA School devoted to this topic, held in January 2002 in Niamey and of interest to other countries (Burkina, Senegal). At present, the University of Niamey has no DEA program (counting all disciplines as one). In the absence of a high-level research director in Niamey, substantial outside involvement at the international level will be critical to the creation of this program. It should be noted that the Mission Française de Coopération [French Cooperation Mission] and the Institut de Recherche pour le Développement [French Institute for Development Research] are providing support.

Creation of a network.

A research network on algebra, geometry and their applications in Africa, complete with an international research committee, is being started with Akry Koulibaly (Burkina) as director and with Issoufou Katambe (Niger), Gérard Kentaga (Burkina) and Jounaidi Ab-deljaoued (Tunisia) as secretaries. This field of research deserves to be developed because there is a substantial number of algebraists and geometers in Africa but they are not fully up to date on possible applications for their fields of study.

Research topics

- Differential geometry (Mahaman Bazanfare).
- Analytic geometry (Djibrilla Garba Belko).
- Formal calculus (Warou Harouna Maimouna Salou).

- Genetic algebra (Issoufou Katambe).
- Algebraic and geometric methods in development modeling (Ousmane Moussa).

North-South Coopération University of Rennes I, of Besançon, of Strasbourg and Santander.

Yaoundé Maths. team

The research situation in Mathematics.

The Mathematics Department at UY1 has a number of highly qualified mathematicians (with more than ten publications in first-rate international magazines) also working in partnership with mathematicians from other universities. This level of excellence is the surviving remnant of the noteworthy support the university received between 1975 and 1985 and of a well designed cooperation program. Regrettably, starting in the mid 1980's and up until recently, the Cameroon government abandoned its university to the point where even the most basic operations were not reliable. Banking on this wealth of human potential, it is possible to quickly reassemble a productive team, especially given that the Cameroonian ministers of research and higher education have expressed interest in supporting mathematics.

Together with Benin, Cameroonian mathematicians have set up the GIRAGA. Two CIMPA schools (Mathematical and Computer Science Software for the Study of Dynamic Systems: 5-19 April 1999, and Mathematics and Malaria: 4-15 September 2000) have opened the Mathematics Department to deal with applied problems.

South-South Cooperations. Strong connections with the Cameroonian universities in Douala, N'Gaoundé ré and Tchang. Foreign countries: Bénin, Congo (Brazzaville), Central African Republic, Gabon and Nigeria.

North-South Coopération. The universities of Lille, Nice, Orléans, Metz, Paris-Sud.

Research topics.

- Differential geometry.
- Complex and standard analysis.
- Mathematical physics.

Objectives.

- Structuring of the Cameroonian mathematics community.
- Two or three doctoral thesis start ups per year under co-tutelle status.
- Initiation of joint activities with the Computer Science Department in digital calculus (joint Research topics and creation of a common DEA program).

- Creation of a mathematicians' network for Central Africa.

Parties involved.

We are aware of at least a half-dozen senior mathematicians who could become involved, but it is too early to cite them by name as long as the organizational foundations have not taken shape.

Computer Science teams in Yaoundé and Douala..

The research situation in Computer Science in Yaoundé and Douala..

The Computer Science department at the University of Yaoundé I (UYI), started in 1992 with a bachelor's degree program, and comprises a large number of researcher-educators in computer science. In 1996, with approval from the UNU/INRIA/UYI tripartite cooperation agreement, the graduate program was started and students graduated from the program have already defended their doctoral theses in Cameroon or in the North. The post-graduate program has always benefited from the contributions of outside visitors coming from France or other African countries. This program has a significant regional role since nearly every year students from Chad or the Central African Republic take part in it. (...).

The Computer Science Engineering department at the University of Yaoundé 's Ecole Nationale Supérieure Polytechnique (ENSP) also has researcher-educators in computer science in its LABORIMA research centre.

The Mathematics Department at the University of Douala and the one at its IUT are beginning to invest in the field of computer science.

These various departments and research centers thus house the greatest know-how in computer science in Central Africa(...).

External cooperation programs

South-South: in the area of education, course exchanges with the countries of Central Africa and the hosting of doctoral candidates from Chad.

North-South: numerous joint projects, especially with several teams from INRIA (e.g., through the CAMEREAU project and CORUS project, currently underway).

Research topics Networks, Internet navigation, Parallel Calculus Multimedia, Systolic calculus, Theoretical/Algorithmic/Numerical computer science with applications to environmental science, Computer systems applied to environmental and socioeconomic data bases.

Objectives

- Three new doctoral candidacies per year.
- At least two promotions to the rank of Associate Professor (Level A).
- Initiation of joint activities with the Mathematics Department in digital calculus (joint research topics and creation of a common DEA program).
- Participation in the INRIA research center in Yaoundé in order to develop activities there in software (Internet navigation, multimedia, data bases, etc.) and digital modeling (jointly with the Mathematics Department).

Parties involved.(...)

- Emmanuel Kamgnia, Instructor, Chairman of the Computer Science Department (É).
- Laure Fotso, Instructor.
- Marcel Fouda, Instructor.
- Basile Louka, Instructor.
- René Ndoundam, Instructor.
- Gilbert Tindo, Instructor.
- *In Yaoundé , at the Ecole Polytechnique:*
- Lot Tcheeko, Lecturer, Director of the School's LABORIMA research centre;
- Abdou Njifenjou, Instructor.
- Claude Tangha, Instructor, in charge of the AUF digital campus in Yaoundé .
- *In Douala:*
- Maurice Tchunte, Professor of Computer Science, Rector of the University of Douala.
- Awono Onana, Instructor, Chairman of the IUT Computer Science Department.
- Robert Nzengwa, Instructor.

Antananarivo and Fianarantsoa Computer Science teams**Description of the situation**

Research in computer science has yet to be extensively developed in Madagascar. The project draws on a team of people brought together by Lala Andriamampianina. He was the person who organized the CARI symposium in 2000, held in Antananarivo. In addition, activities to train teachers are currently under way between the IFSIC (University of Rennes 1) and the universities of Antananarivo and Fianarantsoa.

External cooperation programs.

Team members contribute to research topics of European research centers or institutes, most of them French. They become part of these research programs following thesis work they did at those research centers or by means of agreements signed by their university. In the context of this project, plans call for setting up links with African research groups or networks to establish a South-South relationship in areas to be determined.

Research topics.

- Image processing and its applications, including remote sensing;
- Applied mathematics.

Objectives

- Define research areas and a training plan.
- Establish links with research groups or networks in the South, especially African ones.
- Creation of a post-graduate program in computer science or strengthening of the current DEA program by adding one or more options.
- Doctoral candidacies starting in Year 2.

Parties involved.

- Lala Andriamampianina, Associate Professor at the Ecole Supérieure Polytechnique of the University of Antananarivo (ESPA); Executive Director of the Fades-CRESED II project.
- Nicolas Raft Razafindrakoto, Associate Professor, in charge of the New Computer Science Technologies DESS graduate program at the ESPA.
- Tefy Raelivololona (Mrs.), Associate Professor, in charge of courses of study in the Telecommunications and Networks Engineering section at the Antsirana Institut Supérieur de Technologie.
- Pascal Ramanantsizehena, Professor, in charge of the Environmental Impact DESS degree program at the ESPA.
- Josvah Razafimandimby, Associate Professor, Director of the National School of Computer Science at the University of Fianarantsoa.
- Victor Harrison, Professor, Director of the Institut Supérieur des Sciences Comptable de l'Administration d'Entreprises, Antananarivo.

LAMSIN Research centre in Tunis

Description of the research centre.

This is a large numerical analysis research centre (the biggest in French-speaking Africa?) (É) It has four professors, 16 certified researchers and fifteen doctoral candidates. The research work described in its activity report shows that the research centre possesses all the activities of a research research centre in the North. This research centre will serve as an intermediary between North and South within the project. It will also be the point of entry into the network for the Annaba (Algeria) applied mathematics research centre. A DEA (now, Master's) degree program in applied mathematics has been in operation for several years. (...)

External cooperation programs. By means of agreements, the research centre takes part in a significant number of Franco-Tunisian assistance programs. This has resulted in close relationships with many French university research centers or with those of INRIA. In particular, there is a strong link between the LAMSIN and INRIA's ESTIME project. The other relationships involve teams from Mediterranean or North American countries. In advancing this project, we now envision establishing collaboration with a team from Annaba and with Sub-Saharan teams.

C'est un laboratoire important en analyse numérique (le plus important d'Afrique francophone?) (...). Il compte quatre professeurs, 16 chercheurs confirmés et une quinzaine de doctorants. La vie scientifique décrite dans son rapport d'activités montre que le laboratoire possède toutes les activités d'un laboratoire de recherche du Nord. Ce laboratoire aura un rôle de médiateur entre le Nord et le Sud dans le projet. Il sera aussi le point d'entrée du laboratoire de mathématiques appliquées d'Annaba (Algérie) dans le réseau. Un DEA (maintenant Mastère) de mathématiques appliquées fonctionne depuis plusieurs années.(...).

Coopérations extérieures. A travers des conventions, le laboratoire émerge à bon nombre de programmes de la coopération Franco-Tunisienne. Il en découle des relations étroites avec beaucoup de laboratoires universitaires français ou de l'INRIA. En particulier un lien fort relie le LAMSIN au projet ESTIME de l'INRIA. Les autres relations concernent des équipes de pays méditerranéens ou d'Amérique du Nord. Il est envisagé maintenant, à la faveur de ce projet, une collaboration avec une équipe d'Annaba et avec des équipes sub-sahariennes.

Project research areas.

- Project research areas.
- Identification and inverse problems.
- Shapes management and optimization.
- Flow modeling.
- Water management problems (collaboration with the Sahel network within EDP)
- Coastal erosion.

Objectives

- To become a resource center for applied mathematics teams in the South.
- To assist the Annaba research centre in creating a research structure by providing it with an opening to the outside.
- To open the Master's program to students from Sub-Saharan Africa.

Parties involved.

- *Tunis*
- Mohamed Jaoua, Professor.
- Amel Ben Abda, Professor.
- Ali Saada, Assistant Professor.
- Nejla Hariga-Tlatli, Assistant Professor.
- *Annaba, Mathematics Department.*
- Fatma-Zohra Nouri, Professor.
- Ahmed Salah Chibi, Professor.
- Lahcène Chorfi, Professor.
- Hocine Sissaoui, Professor.
- Nasserline Kechkar, Professor.

Beirut Research Team.

Creation of a research team in computer science and applied mathematics in Beirut.

Since 1996, a DEA program in Modeling and Scientific Calculus Engineering has been in existence in Beirut. The Lebanese University (LU) and St. Joseph's University (SJU) started it jointly, with contributions from the Universities of Reims and Rennes 1, the Ecole Polytechnique Fédérale de Lausanne (EPFL) and support from the AUF. There is an agreement linking all of these institutions (from which SJU subsequently withdrew, however).

2002 will thus see the sixth class receive their diplomas. Statistics for the first four classes show an enrollment of 70 students that resulted in 52 graduates, including 18 doctorates. These doctoral studies are done in Lebanon, overseas (mainly in France) or under co-tutelles between both countries. Several of them have already been defended or are about to be by the end of 2002.

Given the difficulty of organizing doctoral thesis co-tutelles due to the lack of a favorable environment in Lebanon, the DEA program sponsors decided to create a hosting facility that would be located on the premises of the Lebanese CNRS (National Science Research Center). At this location, doctoral candidates and their Lebanese supervisors would find proper conditions for carrying on their research in connection with their French correspondents. INRIA could fund this center under development.

External cooperation programs.

The joint programs correspond to those of the DEA, since for each class interns go to the various partners and their thesis work is often done there as well.

Fields of research.

- Numerical analysis.

- Image processing.
- Signal processing.
- Neuron networks.
- Data analysis.
- Parallelism.

Objectives.

- Continuation of the DEA with the offering of courses to other DEA's or schools.
- Two doctoral thesis start ups per year.
- Installation of the research center to be managed by CNRS-L.
- Collaboration with the Tunis team.

Resource persons.

- Bilal CHEBARO, College of Science, Lebanese University.
- Chawki DIAB, ISAE, Lebanese University.
- Dolly FAYAD, College of Science, Lebanese University.
- Charbel KLAIANY, College of Science, Saint Joseph's University.
- Chafic MOKBEL, School of Engineering, University of Balamand.
- Nabil NASSIF, ISAE, Lebanese University and Université de Reims.
- Jihad TOUMA, Faculty of Arts and Sciences, American University of Beirut.

Chapter 2

Scientific Report

Authors :

Bernard Helffer, Professor at the Paris-Sud University (chair),

Régine André-Obrecht, Professor at the University of Toulouse,

Olivier Besson, Professor at the University of Neuchâtel,

Michel Riveill, Professor at the University of Nice,

Maurice Tchuente, Professor at the University of Yaounde I.

Preamble

This report was done at the request of the Ministry of Foreign and European Affairs (MAEE). It is in addition to a report done at the halfway point less than two years ago, and to a new report prepared under the coordination of Roland Waast (IRD).

The following achievement report focuses on three points:

- the quality of the research,
- the quality of the doctoral training,
- the quality of the network structure-building.

This achievement report is a synthesis of contributions by R. André-Obrecht (University of Toulouse), O. Besson (University of Neuchâtel), B. Helffer (University Paris-Sud), M. Riveill (University of Nice - Sophia Antipolis) and M. Tchuente (University of Yaoundé 1 and IRD joint chair).

It is based in part on the participation of certain members of the committee:

- in field evaluations, especially the Tunis meeting in June 2008 and the Yaoundé meeting in November 2008 (which also included the participation of M. Jaoua from the University of Nice-Sophia Antipolis and UNESCO chair),
- in the so-called final evaluation meeting at Rocquencourt,

and in part on reports supplied by each of the networks involved, the synthesis prepared by F. Campillo and M-F. Roy, and the details provided by the two main project managers, C. Lobry and B. Philippe.

Our role is not to report on all of the research in Math-Computer Science in Africa, but rather to analyze the degree to which the SARIMA program has attained its objectives in terms of the three points mentioned previously.

In the interest of greater clarity, we have used throughout the text the current French titles for researcher-educator positions, while nevertheless keeping that of Lecturer¹.

Analysis of the various networks

EDP Control Team

Team Manager: Hamidou Touré

GIS Contact: Claude Lobry

Team Name: Réseau de recherche en Equations aux Dérivées Partielles, Modélisation et Contrôle [Network for Research on Partial Differential Equations, Modeling and Control]

This network is comprised of researchers from Sub-Saharan Africa, drawing on the universities of St-Louis (Senegal), Nouakchott (Mauritania), Cocody (Ivory Coast) and Ouagadougou (Burkina Faso). This team's creation in a reduced form dates from 1999.

It comprises 7 Professors, 17 Associate Professors, 5 Lecturers and some thirty Ph.D. students.

In terms of the Ph. D. students, there are 27 Ph. D. enrolled at the University of St-Louis (UGB) and 7 candidates enrolled at the University of Ouagadougou (UO). The topics of these doctoral dissertations nearly all have to do

¹For example, Cameroon uses the following hierarchy: Lecturer, Instructor, Associate Professor, Professor, which we will translate as Lecturer, Assistant Professor, Associate Professor and Full Professor.

with modeling. It is hard to imagine this doctoral supervision being possible without external joint administration. As can be seen in the list of theses defended or in the list of support funding granted by Sarima, this is indeed nearly always the case.

At the level of DEA (Master's) programs, the report mentions the contribution of C. Lobry and G. Sallet to a DEA program in Saint-Louis.

The central topic is the theory of ordinary differential equations or of partial differential equations with a noticeable concentration on applications. The team also has a computer science component.

The LANI at St-Louis now seems to be in a position to make use of its skills in the local context. We cite, for example, the agreement signed between the LANI and the Senegal River Basin Development Company.

The team engages in collaborative activities with high-quality researchers in the North and includes accomplished researcher-educators in the South who are engaged in on-going supervision of doctoral candidacies (13 PhDs defended).

The list of publications comprises 26 items and does not seem to cover all of the articles derived from dissertations since it is limited to publications from 2005 to 2007. This represents roughly 15 publications in the field of mathematics, 5 in applied journals and 5 in computer science. For mathematics, one finds 6 articles in recognized journals, 4 entries in annual reports to an Academy, and one entry in the proceedings of a presentation.

The Sarima program (sometimes jointly with AUF and ISP) has clearly promoted several South-South operations, whether they be within the network, as in the case of co-supervision of the doctorate of Bayili by H. Touré and M.T. Niane, or across networks, as in the case of co-supervision of Zabsonre Issa (by H. Touré and K. Ezzimbi (Morocco)), or that of Nyanquini Ismael (by H. Touré and Hedia Chaker (Tunisia)).

It is clear that the program is highly focused. This is a good basis for attaining a critical mass in one field of research, especially given that, in its applications, this field deals with questions stemming from local problems. It is important to note that all of the students obtaining their Ph.D. were able, if they so desired, to obtain a position in the region. One must nevertheless be careful in the mid-term (assuming that the students will not be working elsewhere) not to train PhDs who all have the same skill. The titles of the dissertations defended give cause for some concern in this respect. It might be necessary to broaden the group of specialists from the North who contribute to the degree program.

The network took an active role in organizing two international conferences: one deals with control theory and the other corresponds to the first² African Symposium on Research in Applied Mathematics. It also organized workshops on the following topics: Mathematical Models in Oceanography and Asymptotic Methods for Common Differential Equations (2005), Mathematical and

²It is not clear whether or not this separate CARI symposium will be continued. The most recent one, CARI 08, has a part devoted to Applied Mathematics.

Computational Models of Water and Sand (Momies) (2006) and (2007).

The program in figures

The figures for the operations in the North show 4 months of Master's internships, 96 months of Ph. D. students internships, 4 months of post-doc internships and 13 months for Senior Researchers. The figure of 90K-€ for operations in the South breaks down to 17K-€ for organizing workshops, 25K-€ for symposia, 10K-€ for fellowships, 18K-€ for funding courses in the South, 2K-€ for South-South activities and 16K-€ for miscellaneous (South-North travel).

Conclusion

This network presents a very positive overall result in the area of training and at the level of local integration. Ceasing to support it would be extremely prejudicial. We nevertheless recommend that attention be given to gradually broadening the field of topics covered.

RAGAAD Team

Team Manager: Marcel Tonga
GIS Contact: Marie-Françoise Roy.

Team Name: RAGAAD (African Network on Geometry and Algebra Applied to Development).

RAGAAD was founded in 2003 and has representatives in the following countries: Algeria, Benin, Burkina Faso, Cameroon, Congo, Ivory Coast, Guinea, Mali, Mauritania, Morocco, Niger, Senegal and Tunisia. It has approximately 175 members. On a nicely organized Web page, one finds all of its objectives and accomplishments since its founding.

An analysis of publications shows productive research activity in journals listed in MATHSCINET. In terms of publications in African journals, the journal *Afrika Mathematica* (published by the African Mathematics Union) seems to be the one most used. There are other journals, such as *IMHOTEP* (African Journal of Pure and Applied Mathematics, whose chief editor is D. Bekollé - but which seems to be distributed rather sporadically), and the "African Diaspora Journal of Mathematics".

The report is still, however, fairly incomplete. Out of fourteen teams participating in the network, only the teams from Benin, Cameroon, Morocco, Tunisia and Senegal show a list of publications suggesting that a certain critical mass has been attained. Niger appears to be active but activity at the local level is doubtless still weak (the list of dissertations done under co-tutelle often fails to include the research director from the South). Benin has, largely due to the publications of J.P. Ezin and Tadjihoude, a reasonable list of publications in the field of Riemann geometry and its applications to physics (general relativity)

but does not seem to be heavily involved in operations of the network³. In fact, despite a number of reminders from coordinators, the teams from Algeria, Burkina Faso, Congo, Ivory Coast, Guinea, Mali and Mauritania have not provided information.

A closer analysis of publications turns up around 70 publications in journals listed by Mathematical Reviews. These publications are often brief (short articles, comments in Academy proceedings, or a “local” journal for Senegalese researchers). This would seem to indicate that there are about forty people publishing, which is quite low in relation to the number of members shown.

Congo, Guinea and Chad appear as part of organized events (symposia, workshops), but do not seem to supply any activity reports.

The evaluating committee was able to very briefly meet with M. Tonga, the “South” coordinator for RAGAAD. Activity in Cameroon is found under the aegis of the ERAL (Research Team on Algebra and Logic), which organizes a one-week workshop every year. The last workshop (May 2008) focused on the topic of cryptography (the possible creation of an Algebra and Cryptography track in the Master’s program at Yaoundé 1 was discussed there). A CIMPA school will be held in August 2009 on “Effective Software and Logic for Algebraic Geometry and Cryptography.”

RAGAAD reports four avenues of research:

- A) Differential geometry and applications,
- B) Algebraic theories and applications (biology, data processing),
- C) Algebraic geometry, real algebraic geometry and formal computation,
- D) Discrete mathematics and computer science.

Productive research work seems to correspond mostly to points A and C. The “Applications” aspect still appears infrequently in their publications and it is thus mostly in the topic areas adopted for the schools that one finds any observance of the concern expressed in the network’s name for moving into applications. In a field such as cryptography, the network has surely had some influence in having this subject become part of the course offerings.

24 doctoral fellowships were awarded by the SARIMA program. These generally operate in conjunction with other sources of funding (ICTP, AUF, etc.). Even if many dissertation topics still fall within the confines of the classic disciplines of Algebra and Geometry, some effort is made to suggest research or dissertation topics on subjects such as formal computation and cryptography (5

³Benin nevertheless appears as part of the organization of the GIRAGA network, created in 1986 with Cameroon, but that network is not a SARIMA operation.

dissertations on the latter subject).

In terms of funding, SARIMA's share comes to 33%.

This network showed a huge amount of activity in terms of organizing workshops, schools or conferences. These events in fact did have a structuring effect given that the participants hailed from many African countries.

In terms of degree courses, it is very important to mention that in 2004-2005, RAGAAD started a DEA program in Mathematics and Applications in Niamey and took part in the creation of the Master's program on "data transmission and information security" in Dakar. The Ministerial decree creating this Master's program explicitly states that it should be directed toward applications (25 registered in 2004-2005). Other projects are under way at the University of Yaoundé 1 (Cameroon). At the level of research, it is harder to determine whether or not the program has effectively resulted in progress toward certain teams or researchers adopting more modern topics.

Conclusion

The overall result, at least as it emerges from the data provided, is mixed. The DEA and Master's programs created are a success, but the level of the research teams, their ability to work on applied subjects and their ability to forward information for the purpose of evaluating them may be a problem. A redirection of efforts to applications will naturally take time, but it is still hard to perceive who in the South will be the parties involved in such a redirection. The membership of the RAGAAD research advisory board should also include more applications specialists. It would seem that, in their desire for structure building, those in charge freely included a large number of researchers and teams, but the obstacles one subsequently encounters in obtaining data or reports on them demonstrate that the structuring is not up to standard. Thought should probably be given in the long term to composing a more efficient network. We have included, below, the response of M-F. Coste-Roy to some of our enquiries: *One insight into the situation is that the RAGAAD network was set up in order to "federate the know-how of African teams in algebra and geometry together with the international community", it thus did not start with a nucleus of people actively publishing but rather with the goal of providing stimulus and direction to the entire African community working in algebra and geometry without in principle excluding anyone but still devoting the resources to key topics.*

TAMTAM Team

Team Manager: Amel Ben Abda

GIS Contact: Bernard Philippe

For obvious reasons, Professor M. Jaoua did not contribute to composition of the report on achievements of the TAM-TAM team.

The TAM-TAM team (Trends in applied Mathematics - Tunisia, Algeria and Morocco) was built up in 2003 around an informal network of mathematicians in the three Maghreb countries.

Network

- The main research center is the LAMSIN (Research center for Mathematical and Numerical Modeling in Engineering Sciences) at the El Manar University of Tunis,
- the other partners are the LERMA (at the EMI-Rabat), the EIMA (at the Kenitra College of Science) in Morocco,
- and to a lesser degree, the Numerical Analysis team at the University of Annaba in Algeria.

This network works well and has an international reputation, the latter thanks in particular to the LAMSIN and, to a lesser extent, to the LERMA and to EIMA.

Staffing

- The Numerical Analysis team has 10 researchers and 7 Ph. D. students,
- LERMA has 56 researchers, including 29 Ph. D. students,
- EIMA has 16 researchers, including 8 Ph. D. students,
- LAMSIN has 97 researchers, of which 46 are Ph. D. students and 11 are visiting fellows.

Description of the team

All of the teams involved share a common and enduring concern for research-based training motivated by a strong surge in the student population. The founders of these teams firmly believe that scientific research is a key development tool for closing the gap with the North.

Research topics

The research topics are all based on numerical and mathematical analysis of partial differential equations. Applications deal with the environment, image processing, mathematics of the living and financial mathematics.

Methods are related to, among other things, scientific computation (numerical methods for processing EDPs), optimization (topological, shapes, etc.), and optimal control.

Research structure

- LAMSIN has hosted the UNESCO "Mathematics and Development" chair since 2003.
- Since 2005, LAMSIN has been a member of the consortium administered by the Lebanese University and AUF based on the "Modeling and Simulation in Computer Science" DEA program in Beirut.
- LERMA has maintained a number of collaborative activities and bilateral projects with LAMSIN since 1998. It works closely with the Mathematical Engineering team from Kenitra that is involved in the TAM-TAM team.

Organization of conferences

- In 2005, LAMSIN organized the second session of the bi-annual TAM-TAM symposium in the Maghreb.
- The third TAM-TAM symposium was held in Algiers in April 2007.
- In Morocco, JANO Days on Numerical Analysis and Optimization are held every other year at various universities. the 8th JANO Days took place in Rabat from 14 to 16 December 2006. During these sessions, the Moroccan Society of Applied Mathematics (SM2A) held its constitutional assembly and was founded with support from several institutions and several projects, in large part including SARIMA.
- 2nd Days on Differential Equations and Their Applications, JEDAIL, University of Annaba, 13 - 15 November 2006.
- In February 2008, the SM2A held its first conference. Two and half days of the conference were devoted to research work.

Training

The team has approximately 90 Ph. D. students, 12 of whom are financed by SARIMA. Under the aegis of SARIMA, 2 PhDs and 3 Master's degrees were completed. There are 10 students enrolled in DEA programs.

SARIMA financial assistance for stays in France went:

- in 2005, to 7 Ph. D. students, 5 researchers and 1 post-doc,
- in 2006, to 9 Ph. D. students, 5 researchers 3 DEA fellows and 1 post-doc,
- in 2007, to 6 Ph. D. students, 2 researchers and 1 MA2 fellow,
- in 2008, to 3 Ph. D. students and 3 researchers.

Hirings and promotions: 5 Professors, 1 Assistant Professor, 10 Lecturers.

SARIMA's impact

a) Stimulation of research and renewal of topics: This objective was greatly advanced by thematic semesters organized by the UNESCO chair. These semesters were attended by researchers from the TAM-TAM network, which allowed them to get to know one another better. These semesters also provided an opportunity to create ties with the other SARIMA teams. Structuring of the TAM-TAM network through SARIMA assistance is also evidenced by the establishment of doctoral co-tutelle projects between Maghreb countries.

b) Improvement in programs and the creation of new tracks: SARIMA contributed to the development of a design for a new engineering track at ENIT. This new course of study was thought up by the researchers at LAMSIN. The new MINDS track (Modeling for INDustry and Services) will recruit its engineering students during the 2009 entrance examinations for Tunisian engineering schools.

Conclusion

The TAM-TAM network is a structure that is working well. SARIMA has basically contributed:

- to reinforcing contacts between members of the network and researchers in the North,
- to visits to France by Ph. D. students and researchers from the Maghreb.

As for the University of Annaba, these visits more closely resemble bilateral collaboration and the level of research on the Algerian side appears to show a moderate level of research; they may not be fully in line with SARIMA's focus of activity.

The TAM-TAM network played a driving role in the SARIMA program but the Algerian center will doubtless need strengthening in order to ensure that the network develops properly in Algeria.

Yaoundé Maths Team

Team Manager: David Bekollé.

GIS Contact: Gauthier Sallet.

The team's base of operations is in Cameroon, where there are five universities represented. It has ramifications in the Central African Republic and in Congo-Brazzaville. It was subject to an evaluation mission⁴ in November 2008. Several topics are worth highlighting.

1. The first has to do with traditional Analysis, working under the direction of D. Bekollé.
2. The second is related to the EDP in conjunction with the general theory of relativity (M. Dossa, N. Noutchequemé).
3. The third corresponds to Differential Geometry and Algebraic Topology (Bitjong Ndombol).
4. The fourth is related to Mathematical and Computer Science Modeling⁵ for Epidemiology.
5. The fifth relates to Statistics but is located at the Ecole Nationale Supérieure Polytechnique (which is part of the University of Yaoundé 1) and forms part of the Proba-Stat. network, which became part of SARIMA in 2007.

Most of the members belonging to other universities were educated at Yaoundé 1 (for the South portion).

⁴Composed of O. Besson, B. Helffer, M. Jaoua and M. Riveill. ⁵ Also present in Yaoundé Info.

⁵Also appears in "Yaounde Info".

Network structure-building has made great progress during this period. The EPIMATH network (Central African Network on Computer Science and Mathematical Modeling for Epidemiology and Immunology) was created in 2004 (in Brazzaville). It was in this context that a workshop was held in Brazzaville in March 2007 that brought together researchers from Germany, France, Cameroon and Congo to discuss topics such as malaria and AIDS.

The RAGTAAC network (Central African Network for Analysis, Geometry, Topology and Applications) was founded in Brazzaville in 2008, bringing to fruition what had been conceived in a meeting held in Dshang in 2006 with 35 participants, including 15 students (mostly from Cameroon (2 from Congo) and two educators from the North (from Louvain and Montpellier) that was comprised of five “fundamental” courses.

This meeting brought together some thirty participants (educators or Ph. D. students), a dozen of who were from outside Congo-Brazzaville (France - 1, Cameroon - 6, DR of Congo - 5). Contacts with France are in the field of geometry with teams at Montpellier and Angers. The RAGTAAC network intends to be responsible for 2 Master’s in Mathematics: one Master’s in Analysis, Geometry and Topology with a joint Brazzaville-Dschang-Ngaoundéré campus, and a Master’s in Mathematical Epidemiology with a joint campus between Ngaoundéré and Brazzaville. A second meeting is planned for 2009. The Yaoundé Maths center also takes part in the GIRAGA network (Inter-African Association for Research in Analysis, Geometry and Applications). The main activity of this network, created in 1986, is organizing a meeting every other year and it is administered jointly by Benin⁶ and Cameroon⁷ but has a regional focus.

The Yaoundé Maths center organizes scientific events on a regular basis. We may cite, for example, a workshop (containing two mini-courses) on traditional analysis that brought together in September 2007 some fifteen researchers, mainly from Cameroon but also from Rwanda (1), the Central African Republic (1), Japan (1) and Scotland (1) on the theme “Homogeneous Complex Domains with several variables”.

Supervision of doctoral work takes various forms depending on the sub-groups. In analysis on manifolds, administration is effectively carried out on a co-tutelle basis with a senior Cameroonian director and a very highly qualified “North” director. The situation is similar for algebraic topology (Bitjong Ndombol) or for traditional analysis (D. Bekollé). In contrast, one finds an entirely different situation concerning epidemiology that merits closer examination.

Gauthier Sallet would seem to be playing a very important role here for the North. He has an IRD. joint chair shared with M. Tchuenta. On a co-tutelle basis, he supervises four Ph. D. students working on the subject. One may stop to wonder if this doesn’t result in over concentration, given that he is also

⁶Jean-Pierre Ezin .

⁷D. Bekollé.

very active in the EDP Contrôle network. Our analysis in the field revealed that, even though one must be careful in the mid-term not to fall into a one-track research trajectory, the predominant impression is that there is a certain number of new graduates in Instructor positions who seem to be capable of succeeding on their own. These young people have, moreover, been taken over by the IRD Research center project (which is Math-CS in nature) and one of whose research topics is mathematical epidemiology. We also refer the reader to a Master 2 project in Mathematical Engineering (with two tracks: Hydrology and Mathematical Epidemiology).

Analysis of publications.

The list of publications with international visibility⁸ comprises about 20 (including 4 citations in the CRAS and a smaller half corresponding to highly-specialized journals of good quality, such as SIAM, J. Appl. Math., Math. Biosciences, Discrete Continuous Dynamical Systems). In terms of pure mathematics, the level is very good.

Overall impression.

The network draws on local know-how. D. Bekollé and Bitjong Ndongbol have played a key role. Although D. Bekollé's field of research is analysis, he has also supported development of the EPIMATH network, especially in Ngaoundéré. Given the base of faculty and their specializations, it is not clear that all of these Master's programs will be able to thrive in proper conditions. There will need to be at least some strong financial support to enable visits (or stays) by some faculty from the outside, but these do not always seem to be included in budgets.

The overall result for the network shows 16 Ph. D. students in 2005, 25 in 2006 and 21 in 2007.

Among the dissertations defended, 5 received assistance from SARIMA, 4 are in SARIMA's sphere of influence, and two defenses are planned for 2008. Many of the doctoral students gave high-quality presentations at Rocquencourt or during the evaluation sessions in Yaoundé in November 2008.

What is probably most impressive is the growth in the number of Master's students: they have gone from 20 in 2005 to 80 in 2007.

Four post-docs have also been supported by SARIMA. In the presentations given by some of them, we perceived that they may soon be ready to take over the reins from their elders in order to supervise new students. This is the case, for example, of certain members of the EPIMATH team trained by Gauthier Sallet.

⁸I.e., listed in Mathscinet.

Conclusion

SARIMA's role in doctoral training (which is predominantly focused on the University of Yaoundé 1) has been very effective at a time when teaching positions are being created at a number of Cameroonian universities. Yaoundé Maths has played a key role in network building in Central Africa and its redirection toward applied topics seems to be well in hand.

Probas-Stats Team

Team Name: STAFV (Statistics for French-speaking Africa and Applications to the Living).

The Probas-Stats team became part of SARIMA in 2007. It includes teams from Sub-Saharan French-speaking Africa (Benin, Cameroon, Congo, Ivory Coast, Gabon, Guinea, Madagascar, Mali, Senegal and Togo). It has a dozen African researchers and a dozen in France (Toulouse 1, Versailles, Paris 1, 5, 11) and 6 doctoral students graduated from the Master 2 program at Yaoundé 1. Every doctorate supported by SARIMA is done under the administration of a supervisor who works in Yaoundé ((Ecole Nationale Supérieure Polytechnique, IRAD, OCEAC, Institut Pasteur) and a supervisor working in France (Univ Paris 5, Télécom, Univ de Versailles, Univ Paris 11, INRA). Its concentration on applications and the analysis of real public health issues in Africa is very positive.

The goal is to create, in addition to the one at Yaoundé 1, two Master 2 programs in Applied Statistics at St-Louis (Senegal) and in Cotonou (Benin). The team on the African side has some ten publications in international journals. The researcher-educators from the North are recognized experts in statistics who occasionally have dual training in probabilities, statistics and medicine. It is, of course, too soon to make a final assessment as for the other teams. On the Yaoundé 1 side, one may nevertheless note that students accepted in the Master's 2 program last year are now starting doctoral work (two at Paris-Sud). There are, however, a number of minor organizational friction points concerning the creation of professional Master's programs at Yaoundé 1 that we hope can be resolved in everyone's best interest⁹.

In conclusion, let us simply say that the inclusion of this team in the project is a good step since its objectives fit well with those of the SARIMA project.

Lebanon Team

Team Manager: Nabil Nassif
GIS Contact: Bernard Philippe

⁹Cf. Our comment in the section on Yaoundé Info.

Team Name: Modeling-Simulation and Computer Science Group

Network:

College of Arts and Science, American University of Beirut (AUB),
College of Science, Université de Balamand,
College of Science, Lebanese University (LU),
College of Science and Engineering, Saint-Joseph's University (SJU).

Staffing: The AUB has (in terms of this report) 1 Professor, 1 Associate Professor and 3 Ph. D. students,
The University of Balamand has 2 Associate professors and 4 Ph. D. students,
The LU has 3 Assistant Professors, 3 other researcher-educators and 3 Ph. D. students,
SJU has 1 Associate Professor, 3 Assistant Professors, 1 Instructor and 4 Ph. D. students.

Description of the team

This team is a recent, locally-based group of researcher-educators belonging to three private and one public institutions of higher learning in Lebanon.

Its purpose is to consolidate and improve the levels of research and technology in the following fields:

- Modeling and Numerical Simulation for EDPs and their applications,
- Parallel Computational Algorithms in problems of integration over time,
- Inverse Problems and their applications in geoscience,
- Analysis of protocols and weighting parameters in data searches,
- Design of applications for data display,
- Imposter-based output methods,
- Software architecture,
- Web services security strategies.

The team is making tremendous efforts to revive research in Lebanon following recent political events there. Fifteen publications have been submitted to or accepted by renowned international journals over the 2005-2008 period, most of which pertain to the field of computer science.

Training

The team currently has 12 Ph. D. students, 4 of which are funded by SARIMA and 2 doctorates were defended in 2007. Six Master's or DEAs were completed between 2005 and 2007 (two each year).

SARIMA financial assistance for stays in France went:

- in 2005, to 4 Ph. D. students,
- in 2006, to 6 Ph. D. students, 1 researcher and 6 DEA fellows,
- in 2007, to 5 Ph. D. students and 2 researchers,

- in 2008, to 3 Ph. D. students and 1 DEA fellow.

In addition, two Ph. D. students began work on a dissertation in France during this period. Lastly, we should also mention SARIMA's impact on the following projects.

- DEA program support: EDP Numerical Analysis at the College of Science (SJU), for the Computer Science Master's program at the College of Science (LU), the latter in collaboration with the Paul Sabatier University and North-South teaching missions.

- In 2006, creation at the AUB of the MODSIM (Modeling and Simulation Research Group), and in 2007, of the "Computational Science" Master's program.

- Strengthening of cooperation within the SARIMA Lebanon network through bilateral cooperation activities and joint seminars among the components.

- LAMSIN-MODSIM cooperation: Research stays for Amel Ben Abda (Beirut), Nabil Nassif (Tunis).

Organization of research events: ÓGrid and Parallel ComputingÓ Symposium, 4-7 January 2006, and workshop on ÓMathematical and Numerical Modeling in the Medical SciencesÓ, 7 June 2008 in Beirut.

Conclusion

The SARIMA network enabled strengthening of:

- doctoral programs in Lebanon.
- collaboration with French universities,
- links between members of the Lebanon team,
- links with the TAM-TAM team.

Research within the Lebanon team seems to have undergone a resurgence since the recent war there, especially at Balamand and LU in computer science, and to a lesser degree at AUB and SJU in mathematics.

There may be a way to find reinforcements in mathematics at the Lebanese University. There is, in fact, strong potential for Lebanese Ph. D. students in mathematics who could return to Lebanon if the political situation stabilizes and if researcher-educator positions are created (as is the case in Computer Science at ULB).

Madagascar Team

Team Manager: Lala Andriamampianina

GIS Contact: Fabien Campillo (Montpellier)

The team is comprised of 7 Professors, 11 Assistant Professors and 6 Lecturers. This is a very low number of researcher-educators relative to the number of institutions involved, which are the three universities of Antananarivo and Fianarantsoa, the Ecole Supérieure Polytechnique of Antananarivo (ESPA), National Institute of Computational Science (ENI), Ecole Supérieure Polytechnique

of Antsiranana (ESPD), Institut et Observatoire de Géophysique of Antananarivo (IOGA) et l'Institut Supérieur de Technologie of Antananarivo (ISTT), geographically located at the three sites of Antananarivo, Fianarantsoa and Antsiranana.

Each geographic site of the SARIMA Madagascar group corresponds to one research area:

- Antananarivo: image processing and remote sensing
- Antsiranana: data mining
- Fianarantsoa: modeling and probability and statistics.

Research and Doctoral training

Local resources devoted to research are few and far between. The SARIMA program (combined with assistance from other institutions such as the IRD, AUF, etc.) thus plays a critical role in structuring research in Applied Mathematics and in Computer Science. This contribution is mainly evident at the level of doctoral training: seven Malagasy students have benefited from it in the context of doctoral co-tutelles. They are supervised by Malagasy researcher-educators and partners with the aim of working on topics selected jointly. The students spend periods of time at the partners' research centers on a regular basis. Two have defended their thesis and the five other defenses are planned for the second semesters of 2008 and 2009. These studies are regularly accompanied by publications. The number of "Habilités à Diriger des Recherches" (H.D.R.) in the group has also increased by two. Publications (46 articles) are predominantly in French. Several international publications appeared in 2007. It would seem that the level attained in research should allow for an increase in the number of publications in conference proceedings or international journals. This comment applies primarily to new researchers, meaning Ph. D. students.

Local involvement of the SARIMA Madagascar group

A major effort has been devoted to setting up workshops and schools intended for students and researcher-educators all over the island. These training courses are potentially open to students from the entire region (Africa and the Indian Ocean). In more precise terms, the regular holding of workshops with participation by both researchers from the North and partners from the South is one of the mainstays of SARIMA Madagascar's growth.

These workshops are organized every year in order to be able to establish research teams in the fields covered. The events held were as follows:

- Seminar at the University of Antananarivo on the topic: Introduction to Bayesian Inference: the Monte Carlo Model via Markov Chains - 23 November 2007,

- Seminar on Data Mining and the WEB at the University of Fianarantsoa, 19 December 2006 and at the University of Antananarivo, 21 December 2006,
- Seminar at the University of Antsiranana on Extracting Knowledge Using Complex Data, 20 February 2008,
- Scilab Training Workshop - In partnership with the University of Antananarivo, the University of Fianarantsoa, the CNTEMAD (Madagascar National Distance Learning Center), AUF, NIC-MIG (Network Information Center-Madagascar) and AMUL (Malagasy Association of Free Software Users) in Antananarivo, 8-12 January 2007.
- Thematic workshop: Probability, statistics, Scilab - Several applications to the environment, University of Fianarantsoa, 21-25 May 2007, preceded by a refresher course, 14-18 May 2007,
- Workshop on R Software Training - In partnership with the University of Antananarivo, University of Fianarantsoa, University of Antsiranana, CNTEMAD (Madagascar National Distance Learning Center), NIC-MIG (Network Information Center Madagascar) and RTD (RTDistribution) and AMUL (Malagasy Association of Free Software Users), - Antananarivo, 11-15 February,
- Thematic workshops: Spatial strategies - In partnership with the IRD and INRA - University of Fianarantsoa, 8-16 April 2008,
- Thematic workshop: Regional Workshop on Introduction to Digital Processing of Radar Remote Sensing Images - In partnership with AUF, Antananarivo, November 2008.

The SARIMA Madagascar group also organized a CIMPA-UNESCO-MADAGASCAR school - Mathematical and Computational Methods for Landscape Modeling (MIMOPA), 15-30 September 2008, at the University of Fianarantsoa (National Institute of Computer Science).

Yaoundé Info Team

Team Manager: Emmanuel Kamgnia.
GIS Contact: Bernard Philippe (Rennes).

This team was subject to an evaluation mission¹⁰ in November 2008.

For obvious reasons, Professor M. Tchunte did not contribute to composition of the report on research achievements of Yaoundé 1.

The Yaoundé team is comprised of the researcher-educators from the Computer Science Department at the College of Science at the University of Yaoundé 1 and from the Computational Engineering Department at the Ecole Nationale Supérieure Polytechnique (ENSP). It has 12 members, including 1 Full Professor, 2 Associate Professors, 6 Assistant Professors and 3 Lecturers.

Research structure-building

In the early 1990's, when the two departments were created, each member worked alone and in some cases in collaboration with teams from the North. The SARIMA program served to identify a list of topics likely to bring several researchers together. At the outset of the SARIMA program, the following topics were selected:

1. Public key cryptography based on cellular automata,
2. Design of integrated circuits for multimedia on-board applications,
3. Deployment of distributed applications and Web technologies,
4. Design of open and adaptable software programs (compilation and programming by aspects),
5. Parallel numerical algorithms, linear algebra procedures,
6. Adaptive techniques for combinatorial and numerical problems,
7. Data assimilation and image processing in climatology,
8. Numerical simulation of underground flows.

If one examines today the results obtained for these predefined thematic areas, the list may seem to be too broad when compared to the available resources and results presented. That presentation is, in reality, much more dependent on the fields in which the various members of the Yaoundé Info team did or are

¹⁰Composed of O. Besson, B. Helffer, M. Jaoua and M. Riveill.

doing their doctoral work than on a presentation strategy chosen jointly. The research activity and the overall impact are, moreover, very unequal: the main publications mentioned are only those of the members who were supported by SARIMA and were generally done as doctoral students. They were co-authored with members of research centers in the North, with a non-negligible part being in CARI (6 presentations out of 20), but also with 2 publications in international reviews and 9 presentations in other international conferences and 1 national conference.

At present, little work is done independently. From this perspective, the team is not yet fully mature and free of the ties created when each of these members was doing their doctoral work (i.e., relatively few publications to our knowledge outside of those done with researchers from the North).

The team manager (E. Kamgnia) is now convinced that the team needs to be re-focused on two or three broad fields and to work with a research director so as to aggregate the various works. Two topics were mentioned during the visit by the evaluating commission: numerical analysis done under Emmanuel Kamgnia and distributed systems under Maurice Tchunte. South-North partnerships have already been built around both of these nuclei.

Thanks to the SARIMA program, several researcher-educators were able to work in research centers in the North and set up research collaborations during the hardest period, now over, when Cameroon stopped funding their research. It follows naturally that the SARIMA program served to strengthen existing cooperative exchanges and to create new ones with certain institutions in the North: in addition to existing cooperative exchanges with INRIA and the University of Rennes I, new cooperative arrangements were set up with the IRD and with the Joseph Fourier University in Grenoble.

New projects are currently being developed with the University of Bordeaux Mathematics Department and with the Institut National Polytechnique in Toulouse.

Doctoral training

The number of students enrolled in Master's programs has noticeably increased, reaching more than 40 per specialization, with the best among them having an opportunity to go on to doctoral work.

A number of Master's programs are currently being designed at the various universities throughout the country. In our view, it is critical that these creations be coordinated in order to make the best use of the know-how of the various faculty members.

Regarding the Yaoundé 1 Master's programs (Computer Science Dept., Mathematics Dept. and Polytechnic Computer Science Dept.), our meeting with the persons in charge in combination with a meeting with representatives of industry linked to those degree programs, showed that it would be possible, for reasons of visibility and coordination, to have a single Master's program in mathematical engineering with the 3 options initially envisioned: the work of approaching corporations for internships, monitoring students and a non-negligible portion

of teaching loads must be shared among the various sectors.

The SARIMA program funded several DEA/Master's teaching missions. These missions facilitated the establishment of cooperation and research relationships, resulting in doctoral studies under co-tutelle. The SARIMA program partially funded a dozen doctorates under co-tutelle (IRISA/Rennes, UJF/Grenoble, LORIA/Nancy) for periods of several months a year. Six of these doctorates were defended and four are scheduled to be defended in 2008. All of the dissertations defended have resulted in a number of publications in conference proceedings or journals.

University hiring and research funding

At the start of the SARIMA program, few positions were opened for competitive entry and four of the students who had received SARIMA funding have either stayed overseas after receiving their doctorates or returned home to work in the private sector.

As of two years ago, many positions have been created and put up for competitive entry. The situation has now gone to the other extreme and, given the lack of doctorates, most recent hires involve starting researchers still without PhDs. We should emphasize that some positions have gone unfilled due to a lack of candidates.

At the end of the 2005/2006 academic year, five teaching positions were created, as were ten more positions at the end of the first semester in 2007/2008. An extremely positive aspect of the SARIMA program is that, among the Ph. D. students who received SARIMA support, eight obtained positions as Lecturers¹¹ in government universities: two at the University of Dschang (Guy Atenekeng and Tchoupé), two at the University of Douala (Noumsi and Djeumen) and four at the Université of Yaoundé 1 (Chana, Ngoko, Souopgui and Tsobze).

Changes.

One of the consequences of these hirings at the country's various universities is that the Yaoundé Info team will have to change status from being a team to being a network internal to Cameroon, at least initially. In fact, most of the young faculty named to positions at the various universities in Cameroon are also members of the Yaoundé 1 research team and this engenders specific requirements.

Substantial funding assistance is needed so that, while ensuring the large workloads they have in the pedagogical sector (setting up Bachelor's and Master's programs), they can pursue research work under reasonable conditions, thus complete their doctorates and then guarantee their continued research.

The Yaoundé Computer Science team (Yaoundé Info), the nucleus of this network of universities, is today facing two major challenges:

¹¹The position of Lecturer only requires having a doctorate in progress.

- coordinating computer science courses at the Master's level in the country's universities - the emergence of an independent Master's program within each university seems to us unfeasible in the short term given the available teaching staff and despite a high level of student demand;
- coordinating computer science research since most of the new faculty hired are not yet PhDs and are doing their doctoral research while being co-supervised by a researcher from Yaoundé 1 and a researcher from the North.

The needs in terms of training for administrators are significant at all levels: training for new doctorates along with constituting a corps of administrators capable of gradually taking over for traditional leaders.

Beyond the need for aid to train PhDs and promote faculty currently in positions, we believe that other instances of funding, not necessarily expensive but certainly essential, could be arranged by means of partnerships with industry. In fact, our meeting with various industrialists leads us to think that there is an industrial base ready to collaborate on projects for training or R & D.

As part of this assistance, broadband Internet connections and access at the various universities to research collections would be not only a plus, but also a necessity. The presence of these connections would enable: distance learning, including with the North, and thus a more efficient distribution of coursework, the construction of Master's programs that are delinked in time and place from concurrent programs, and access to documentation for the country's researchers.

Impact of the SARIMA program

Among the main fallout from the SARIMA program, one may cite:

- strengthening of cooperation with the IRD that has resulted in the creation of the IRD joint chair involving professors Maurice Tchunte and Gauthier Sallet. This joint chair enabled preparation of the plan for a Master's in Professional Mathematical Engineering, jointly supervised by the Computer Science and Mathematics departments at Yaoundé.
- The writing and submittal of a proposal involving several sub-regional universities in a response to the European EDULINK request for proposals (which, unfortunately, was not accepted). A meeting in Yaoundé brought the regional partners together.
- Contacts established through the SARIMA program and the experience gained in writing the research proposals served to put together a research

proposal in response to the CORUS 2 RFP that was accepted. Two six-month doctoral work stays under co-tutelle for Innocent Souopgui, along with three one-month research stays for faculty, will also be funded.

Difficulties at various levels:

- Access to research documents: the computer science group has a reasonably well-stocked library, but lacks funding for subscriptions to scientific bulletins and journals.
- The research proposals seem to be closely tied to doctorates under co-tutelle with institutions in the North. Special mention should, moreover, be given to the strong contributions by Bernard Philippe, Patrice Quinton and Eric Badouel in supervising these cases.
- The difficulty in composing genuine research teams given the multiplicity of tasks, the poor research conditions and fluctuations in research funding. After a problematic period, the universities are once again in a position to support the research teams. The presence of a stable external program is critical to assisting in the training of research administrators. In this respect, SARIMA proved to be effective.

Conclusion

The Yaoundé-Info team has demonstrated its ability to train a number of researcher-educators in a field where the local needs are substantial since Cameroon has decided to create universities in the various regions of the country. Since there are many more positions open than PhDs trained, we believe that the assistance undertaken should be continued. This funding cannot be limited to the aggregate of diverse grants; coordination between the various grant programs is necessary to ensure: the acquisition of research autonomy by the teams in the South through their ability to mobilize a substantial portion of the resources available around one topic or another.

The Yaoundé Info team began its spade work by identifying the various relevant fields of know-how. We encourage them to consolidate these to produce 2 or 3 research proposals capable of unifying research at the national level.

In addition to funding to promote intra-Cameroon or inter-team mobility, IT links and access to research documents should clearly be improved in order to offer everyone solid conditions for self-training.

Maghreb Info Team

Team Manager:

GIS Contact:

Research structure-building

The Maghreb-Info team was created in 2006, thanks to SARIMA. It comprises 90 faculty and 89 Ph. D. students divided among 8 teams (3 in Algeria, 2 in Tunisia and 3 in Morocco), having risen to the call made by its founder, M. Sellami (Professor at Annaba) during a meeting of the Maghreb Computer Science Conference, held every other year since 1989. The range of collaborative processes set up thanks to this network has today resulted in a convergence toward three unifying topics:

- Shapes, images and documents,
- Collaborative platforms and distributed computation,
- E-learning.

These research topics are often developed with clear intentions of being of service to society, such as the recognition of handwritten words in Arabic and data mining applied to the data from the Institut Pasteur. This social need is very evident in Algeria but is inhibited by the lack of a legal framework for signing contracts with the universities.

Publications

Limiting ourselves to the list supplied and to publications for the years 2006 and 2007, we find:

- some twenty publications in scientific journals, presentations in proceedings of international conferences with peer review,
- 36 participation in a broad number of regional conferences: Algiers 2006, Rabat 2006, Rabat 2007, Marrakech 2007, Tunis 2007, Ham-mamet 2007.

Taking the period of 2004-2007 that is covered by the list of publications, one notes that in 2006-2007 there was a surge, very likely due to SARIMA. Moreover, most of the publications in the 2006-2007 period were derived from dissertations supported by SARIMA. In a breakdown by teams, those of M. Sellami (Algeria) and Y. Slimani 26

(Tunisia) are clearly in the forefront, followed by those under A. Alim (Algeria) and D. Mammass (Morocco). The others seem to be clearly falling behind, and the team of B. Mohamed (Algeria) may even be said to be sinking out of sight following the expatriation of its team leader.

Collaborations

North-South collaborations are focused mainly on support for Ph. D. students. Within the Maghreb region, exchanges for Ph. D. students were organized, and collaboration between teams has already produced publications (Sellami-Lalam, Sellami-Slimani, etc.). In addition, the hosting of Sub-Saharan researchers (Senegal, Niger, Mali) is beginning to intensify and broaden in scope.

Conclusion

A very active network has been set up based on a broad invitation proffered to a community established prior to SARIMA. SARIMA's support led to an evident strengthening of the research community: North-South co-tutelles, ranges of regional collaborations and outreach to Sub-Saharan Africa. SARIMA's support has come to be part of a much broader mechanism: local funding, INRIA projects and FSP programs. Current difficulties are of several magnitudes:

- the frustration of teams that applied for membership after the deadline,
- the absence of a legal framework for the network, such as the GIS set up on the French side,
- the difficulties of setting up projects that benefit society: very low demand in Tunisia, non-existent legal framework in Algeria.

The establishment of a second SARIMA program would provide for consolidation of the gains of the first SARIMA program and an even greater impact by, for example:

- a UNESCO chair type mechanism for training trainers and support for renewing the research topics of senior researchers,
- movement toward greater access to publication platforms indexed in the Web of Science that would promote the network's visibility outside the Maghreb region,
- greater participation by Moroccan teams and the strengthening of other building blocks such as networks,
- an extension of thematic sub-networks to the teams of Sub-Saharan Africa.

Conclusion

The SARIMA program decided it would undergo a series of evaluations. We made a point of attending the closing symposium. Most of the research presentations given at the symposium were of high quality. The meeting demonstrated that the PhDs trained are not second rate.

The presentations by team managers, taking into account the short time allotted to them, did not, in contrast, supply a wealth of information.

We did not take up all of the aspects of the analysis made in the report by the two main administrators, C. Lobry and B. Philippe. That report is clear and shows the full extent of the work done by that team. We have occasionally taken a page from their analysis by drawing on their examination of the research work.

We deem that it would be highly unproductive to halt the work begun. It would even be catastrophic in some countries that provide no support whatsoever for research.

From meetings we held with various members of SARIMA in France, we came away with the impression that there are volunteers prepared to set up a new administrative team possessing both the required research skills and a knowledge of the problems in Africa.

We find it pertinent to add a few thoughts on what could be improved.

The scientific advisory board does not seem to have fulfilled its role: no report on scientific aspects seems to have been produced by this board. It clearly would not have been realistic to request (as it appears was initially imagined) that it manage approvals for internships and missions on a case-by-case basis, but it seems

desirable that the program managers be able to look for backing, in their consideration of the networks' research directions, to a scientific committee that is also likely to propose initiatives. In this sense, one should also inevitably consider expanding the administrative team: the administrative and training tasks involved require more hands on deck. It is difficult to determine from their report (and conversations with C. Lobry did little to counteract this impression) whether or not, beyond the GIS managers who did yeoman's work largely on a pro bono basis and with occasional funding by other sources, there are many other researchers from the North who are heavily involved in an activity in the South besides co-tutelle supervisions or sporadic missions. Regarding a subject such as epidemiology, it might be worthwhile if the various networks (EPIMATH or STAFAV or Yaoundé Info) working on this topic with members from the same universities could manage to pool their know-how¹². This is especially important in relation to the objective of creating internationally recognized centers.

As the halfway point report so amply demonstrated, the SARIMA program has developed an innovative approach focused on the South taking charge of its own training, thus setting it apart from traditional

¹²The EPIMATH network uses techniques of dynamical systems.

bilateral collaborative mechanisms between universities in the North and the South. Without a doubt, this is a long-term undertaking that has more or less progressed depending on the various networks that make up SARIMA.

It is critical that there be a continuation. As noted in most of the reports produced concerning SARIMA, the effectiveness of this type of activity assumes that there will be support over a period of a decade.

Chapter 3

Global Report

by Roland Waast
Emeritus Director of Research at I.R.D.¹

SARIMA

SARIMA is a program of the Priority Solidarity Fund [Fonds de Solidarité Prioritaire] (FSP). Its goal is to consolidate sustainable research capabilities in computer science and applied mathematics in Africa². Although modest in size (1.6 M euros over 4 years), it has been strongly supervised:

- as a GIS [French model of an Association for the Advancement of Science], submitting accounts and activity reports to its General Advisory Board every year, and endowed with a Research Advisory Board
- and through external evaluation, implemented independently throughout the entire program.

The program is mostly remarkable for several innovations :

- The activities concern an unusual field foreign aid: research-education in *basic sciences*.
- The objective is *institution building*. This means giving rise to an African research community by supporting or fostering the creation of high quality teams that are immediately linked in *networks*³.
- It appeals to an unusual type of managers: academics, whose agility and personal skills have up to now been rarely tapped by French aid to pilot broad-ranging aid projects.

¹Institut de Recherche pour le Développement

²Initially: in French-speaking Africa on both sides of the Sahara.

³Attention is first given *not* to obtaining new mathematical results *but* to improving the conditions for producing them.

- The initial recruitment is not the result of a call for tenders, but rather of a cooptation based on in-depth knowledge of the field by perspicacious French managers.

These special features (and their challenges, to which we will return) certainly justify the evaluation scheme specially created from the outset. I will discuss below its approach and outcomes.

The evaluation: approach and process

The evaluation was designed to have two phases:

- a follow up of the activities by independent specialists as of the second year of the project (known as the “halfway evaluation”),⁴
- a final evaluation condensed over time, involving many specialists.

The first phase (halfway evaluation) consisted of three one-week missions *in situ*, occurring throughout the duration of the project, each one involving three specialists and timed to take place in conjunction with events where numerous SARIMA participants were present⁵. For this phase, the research assessment was minimal⁶. The focus was primarily on institutional aspects and those of public policies. The intermediate report closing out this phase provides an already fairly precise picture of the program’s impetus and progress, and its conclusions will be taken up here.

The assessment is based on observations made on site, on focus groups and on many interviews done on location (with SARIMA members and non-members), as well as on meetings with local administrators of research and cooperation⁷.

The “final” evaluation was devoted to the assessment of research and to providing supplementary information on public policies. This phase focused on the final stages of the program and comprised:

- a research symposium held in Tunis in early June 2008 to evaluate the accomplishments of SARIMA networks in the Maghreb region.
- a research symposium held in Paris in mid-June 2008 to present a selection of the best work done in each country involved.
- a mission to Yaoundé (July 2008)⁸ in order to evaluate the activity of Sub-Saharan regional networks.

⁴This system, inspired by evaluations of small projects in Finland, has a monitoring role that includes flagging problems and giving advice.

⁵The three main missions were: Cotonou (CARI, Nov. 2006); St Louis, Senegal (applied math symposium, Sept. 2007); Niamey (RAGAAD network meeting, Dec. 2007). Each mission was comprised of 1 specialist in public policy and 2 researchers with substantial experience in cooperation and research administration.

⁶There was a need to leave time for producing significant work (dissertations, theses, etc.). Intermediate-level productions (symposia presentations, articles submitted, etc.) were nevertheless examined by the relevant evaluators (German and Swedish). Their conclusions at this stage were that the work presented was “acceptable or good” at the international level.

⁷The assessment also took into account the teams’ annual activity reports.

⁸Finally rescheduled for September November 2008 in order to ensure that enough specialists were available.

The specialists from the earlier phase were retained, and were supplemented by 6 (six) more strictly research-based specialists under the direction of B. Helffer (Paris XI).

The research assessment was based on teams' final results, on lists of publications, on articles supplied and on presentations attended. It resulted in a separate report.

The overall assessment (below) is based on the results of the halfway evaluation, supplemented by new investigations in Tunis and Paris, on the research report and on all of the final results documents produced by the teams and by the GIS.

A few closing words concerning the approach:

The evaluators were selected to draw international attention to the program and to take advantage of the breadth of experience of a wide range of specialists. A major part was made up of Europeans and Africans, including English-speaking ones⁹ (cf. attached list). As far as possible, we organized on-site meetings between the experts, involved researchers and relevant stakeholders (authorities, users). The "desk studies" was kept to a bare minimum. Our goal was not to merely perform an audit (verifying compliance with the indicators of success defined at the outset of the project). The novelty and challenges of this program justified also using descriptive terms (that are more qualitative, even if they are standardized) and narratives (extracts of written work or interviews that depict the aspirations, obstacles, tensions and initiatives) in order to provide material for an insightful evaluation.

Indicators of Results

From the time of its submission, the project included a certain number of **performance indicators** for measuring its ultimate success. Even if some of those may today seem a bit remote from realities, inappropriate to the challenges or as providing little insight into the program's progress, it is important to refer to them.

The page from the project containing these "markers" is attached to the present report, along with a table providing results that were quantifiable¹⁰.

⁹It goes without saying that all were fully competent, with no ties to the program, often conversant with cooperative activities and well-versed in public policy and research administration. In Phase 1, they included 1 French, 1 African and 2 other Europeans (Swedish, German)⁸; Phase 2 also included 2 French, 1 Belgian, 1 Swiss and 2 Africans (1 from South Africa). Other specialists (equally diverse) were mobilized on an occasional basis.

¹⁰The project called results for seven teams. SARIMA today has some twenty teams: this is a sign of tremendous efforts and progress, but a burden for evaluators. In order to deal with the "table of forecast", we arranged these teams into **nine groups** (proposed by the GIS, which now treats them as budgetary units: 5 Networks (EDP ContrTMle, RAGAAD, TAM-TAM, Maghreb-Info, SATAV) and 4 local "Research centers": Yaoundé Info, Yaoundé Maths, Lebanon and Madagascar.

We should note that half of them already constitute networks and are no longer simply centers. The rest are national centers, often comprising several institutions.

In **general terms**, the program has **reached or surpassed its objectives**.

This is true for the traditionally quantifiable fields:

- *Training*: the number of doctorates started (two per year and per team) and completed (time to completion: not more than four years);
- *Publication*: articles in journals, presentations at symposia, etc.

The program can also bank on positive results in the more qualitative field of *institution building*:

- Full development of post-graduate programs (DEAs offered at: Saint Louis, Yaoundé, Tunis, Beirut);
- The creation or strengthening of regional associations (CARMA, CARI); the creation of a Journal (“ARIMA Computer Science”)¹¹.

One may consider the objectives to have been surpassed with the launching of **new networks** (Maghreb Info), the expansion of others (RAGAAD), national coordination established for geographically dispersed teams (Madagascar) and with extensions beyond the scope initially called for (Lebanon, along with, on occasion, Congo, Burundi, South Africa, etc.).

However, **at the level of the teams**, progress was uneven. This is evident in the details of the previous indicators and even simply in the varying quality of the activity reports submitted to GIS, as well as their involvement in mid-term plans. Some elements obviously know how to “present a research plan” supported by “clear specializations” and with “three-year horizons” (an overall initial objective). Others merely list individual projects, without ranking their publications and show that they are mostly bogged down with local problems.

The difficulty of presenting one’s own situation and of projecting where one will be in the future - all things considered as research to reach - is largely due (and that is the lesson, here) to teams operating in “highly unfavorable environments”¹². Rather than reflecting instances of failure of the program, this should be seen as a measure of (un)propitious working conditions. There thus arise institutional and public policy questions to which we shall return (e.g., can one count, as predicted, on the more vulnerable being buoyed by those with more highly developed structures? Or do they require different sorts of programs? Should one give preference to regional programs?, etc.).

¹¹The CARMA (Association of Applied Mathematics, which holds a symposium every other year) is an innovation. Both the journal and the associations aim to have a continental role (yet to be proved).

¹²A “really weak environment” in the words of the Swedish evaluator, Leif Abrahamson: in the Sahel more than in the rest of West Africa, and in Sub-Saharan Africa more than in the Maghreb. Abrahamson believes that they should be given some sort of priority (of at least special consideration).

The teams invested their energies in developing an abundant amount of **research activity**¹³.

In order to achieve their goals, they have also generally managed to arrange *additional funding* and, on occasion, *cooperative agreements*¹⁴.

But very few have concerned themselves with making those accomplishments official by establishing a *contractual* basis for their relationships with oversight authorities, with partner foreign institutions or even within their own networks (between teams). One should nevertheless lend credence to the idea that (as several evaluators would have it) keeping the authorities regularly informed, pursuing trust-building relationships with them and involving them in contractual agreements will lead to the sustainability of the activities.

Defining formal agreements as “criteria” of success may have been premature. But it still makes a certain amount of sense in the long term (SARIMA after-effects) to move beyond windfall funding sources and to provide a firm foundation for a “research center”.

One other “criterion of success” has turned out to be exceedingly “optimistic”. This refers to integrating activity into local social concerns. This is stipulated as being at least in the form of “including applied aspects in new doctoral programs.” This criterion has been met to *the letter*¹⁵. But analysis of it should be more rigorous. Is the inclusion merely a formality? Or does it actually involve applied research (and not just “applicable”), linked to a source of demand (local or international) and promising employment opportunities for the doctoral candidates? These are all poignant issues of public policy to which we shall return later.

One cannot rightly close out this section without discussing the performance indicators themselves.

We have seen that, on their own, the quantifiable indicators provide little help in terms of understanding the activity. They are also ambiguous.

In regard to publications, it is useful to measure quantities (evidence of activity), but one must also consider their quality. Despite various schemes - ranking of publications, degree of impact, h-index, etc., the best means of evaluation still falls to impartial peer review. This is the role given in the present evaluation to the research advisory board, chaired by B. Helffer and

¹³Even in a less than propitious environment: to wit, Madagascar, which lists all of its publications, provides a yardstick: 1 item per member every 2 years (doctoral candidates included).

¹⁴South-South cooperative activities within the context of SARIMA networks have increased. But they are, in fact, quite sporadic (accepting a student for advising, giving a course, etc.), informal and occur less frequently than the promoters had imagined. The more “advanced” teams prove to be more “pro-active” - which brings us back to the institutional and public policy issues already raised. .

¹⁵The research evaluators, attentive to this aspect, identified only one group (RAGAAD) that could make more sustained efforts to include such themes in their program. to one party or the other. This is the case for publications. It is also the case for dissertations started, certifications supported, doctoral level schools or associations launched. We clearly requested that in their final results the teams identify, if possible, which doctorates were specifically supported by SARIMA, as well as what portion of their budget program funding represented. These indications remain approximate.

constituted on an ad hoc basis. Moreover, since publications are sometimes co-authored, various means of counting are possible (in bibliometric terms: integral, fractional, etc.). Lastly, a publication that appeared in year N often reports on work done in year N-2, making it hard to distinguish and attribute which works are directly related to a particular grant that is ending.

Likewise (and this is, furthermore, evidence of their success), teams or research centers do not depend on a single source of funding: but rather on several ones, which provide various types of resources that, when placed end-to-end, serve to produce a coherent project. When all is said and done, it is thus difficult to untangle just what portion of the results are attributable to one party or the other. This is the case for publications. It is also the case for dissertations started, certifications supported, doctoral level schools or associations launched. We clearly requested that in their final results the teams identify, if possible, which doctorates were specifically supported by SARIMA, as well as what portion of their budget program funding represented. These indications remain approximate¹⁶.

It would be pointless to strive for excessively refined accounting in this sense. SARIMA's inherent purpose (and its advantage, as is recognized by the teams) is, in fact, to offer "unrestricted" funding (rather than "earmarked" as is so often the case with minor amounts of aid). The objective is to push forward research activity and to make it part and parcel of a plausible and programmable "vision" (how to give strength to the life of a center). It is thus relevant to reckon an "additional activity" (even if we find ourselves without a true baseline and thus the means to calculate an increment), and to supplement this acknowledgement with other criteria: descriptive terms and narratives, which we will draw on to a great extent in the following sections.

Conclusion on Performance Indicators

Considering the quantified indicators (essential, but not sufficient alone) is enough to demonstrate the overall success of the program. This is true as much in terms of research activity as it is for institution building (especially networks). Stipulated objectives have been attained, and often surpassed. A thorough examination of the indicators also calls attention to the difficulties inherent to this type of initiative (uneven development of teams depending on contextual difficulties, slow starts for South-South cooperative activities that are more often informal and sporadic than sustained and organized, low impetus for making activities contractual and official, obstacles to integration of the Project with social concerns - not only with academic ones -). This serves to demonstrate the **long-term efforts** needed by this kind of program, whatever its immediate success and the worth relevance of its objectives.

¹⁶SARIMA's share of the total budget comes to approximately 30% for RAGAAD and for LAMSIN.

Research Evaluation

This section should be considered in relation to the scientific report **established by the *research evaluation* commission chaired by B. Helffer**. That document examines the results produced by SARIMA with no holds barred and in excruciating detail (by network and even by component teams). To provide proper grounding for the present document, we have summarized the aforementioned report, linking it with institutional and public policy issues that it helps identify. In either footnotes or small type, we will also append the observations of other research specialists who were called in along the way.

The final research evaluation was done by 4 professors (2 French, 1 Swiss and 1 Cameroonian)¹⁷. It focuses on three main points:

- The quality of the research,
- The quality of the doctoral training,
- The quality of the network structure-building.

The document draws on:

- final evaluation sessions (symposia in Tunis and Paris: presentations of selected works, synthesis communications by teams and networks),
- team reports,
- the GIS report (including lists of publications, dissertation topics, events held and budgets),
- and on answers to specific points contributed on request by the Program's managers and the network managers.

In overall terms,

the scientific evaluation gives full credit to SARIMA for the aspects it considers:

- Most of the research presentations given were of "high quality".
- The doctoral candidates trained are "not second rate".
- There was a tremendous activity in terms of organizing workshops, schools or conferences. These events indeed have a structure-building effect.
- The operation reinforced contacts between members of the network and researchers in the North.

¹⁷B. Helffer (Paris-Sud), R. André-Obrecht (Toulouse), O. Besson (Neufchâteau) and M. Tchente (Yaounde). At relevant points, we will insert brief comments drawn from the mission reports of other researchers invited to take part in the halfway point evaluation: especially those of L. Abrahamson (Sweden) and A. Griewank (Germany).

Through practical examples,

the report brings to light the difficulties of this undertaking. These are demonstrated by the divergences or dilemmas of this or that team.

1. Among the main strains, those ranking higher are:

- *heterogeneity* in levels between units that make up SARIMA: ranging from research centers still being built up (Madagascar and Lebanon, where one finds a dozen faculty and an equal number of doctoral candidates working under difficult circumstances) to extremely active networks supported by a few research centers that come close to international renown hosting a hundred or so researchers and just as many doctoral students (TAM-TAM and Maghreb in applied mathematics). The difference can immediately be seen in the intensity (and visibility) of their publications, as well as in the level of training of the doctoral candidates¹⁸.

What is surprising is that this diversity is tolerated all round and does not lead, for example, to squabbling over budgets. This is due to a consensus over the project (bringing research in Africa up to standard) and on the thresholds to be crossed. It is also due in practical terms to the smooth operation of the GIS Advisory Board, and to the efforts and charisma of the two SARIMA managers, to whom the Program owes an unspeakable debt.

- *heterogeneity in levels between teams* within the same network. This fact is mentioned several times, in the case of a loosely-structured network as well as in that of a tightly-knit, well-renowned one. The evaluators wonder how this mish-mash came about (while other teams with high recognition in the same country are not part of the project) and how to resolve it.

This situation arises in part from the basic heterogeneity mentioned previously. It may create greater resentment than the former. But it is still the result of a choice made by the interested parties since networks are formed by cooptation. Moreover, participants in SARIMA embraced the initial principle: those more “advanced” should help to raise the level of those who are less so. Setting up groups by levels is out of the question. The basic principle at work here would seem to be viable, which each one shouldering its share of the load (on condition that there are no “free-loaders”).

Over time, a question of strategy may need to be asked. It may be desirable to enlarge the circle of participants based on a standard of excellence (or via calls for proposals). One may have to depend on teams with better footing to ensure that a network thrives in a

¹⁸In the words of A. Griewank, concerning the talks given at CARI at the halfway point: “Overall the standard of the activities supported by SARIMA was at least acceptable. A consistently high level is hard to achieve due to the uneven preparation of graduate students.”

particular country¹⁹. But one must concede that the effectiveness of a network does not only depend on its level of ambition, but also on congeniality, shared interests, on investment and on active participation by its members in its vital tasks, including operational ones. And there is nothing to prevent each center from participating in several networks or from having relationships (as is always the case) with teams “of its caliber” outside the network.

2. **Other tensions** are apparent and have an effect on the research:

- There is the problem of *updating and converting* the capabilities that necessarily affects training as the laboratory raises its standards. The report examines, in this respect, the doctoral research topics proposed. Just as it recommends a narrowed focus on a limited number of topics while the research center is being built up (“this is a good point for reaching *critical mass* in a research field”), it also calls for (once this threshold is crossed) “care...[to be taken] in not training PhDs who all have the same skill.”

One of the recommended solutions is to call in more specialists from the North (and in greater variety) to participate in training. This tricky question will appear again in the institutional part of this report.

- Problems related to **structure-building**. There are a number of all too easy pitfalls:
 - *Over-diversification* (possibly due to haste) in the building phase. The example given is that of a “national” research center where the component teams all multiply their relationships on diverse themes in a variety of distinct geographic areas with partners more or less regular within and outside of SARIMA.

The result is, despite a high level of activity, a loose-knit or disordered structure-building process. In our example the strongest link was a sub-network focusing on epidemiological applications that, despite there being avatars, continues to re-surface. Thanks to SARIMA, it was strengthened and “structure-building has made great progress during the term of the project.”

- *The very loose structure* of a quickly growing network. This is the case of a very broad-based network (14 teams and nearly 200 members) set up in a very problematic environment (13 countries, most of them very underdeveloped). This type of network is a particular target of SARIMA support. According to the scientific report, “in their desire to make the large number benefit from the program, it seems that the administrators have cast their net widely, but the difficulties suggest that the quality of the institution building turns out to be poor.” The evaluator

¹⁹The scientific report notes this in one case (that of a network in the Maghreb that is otherwise very effective).

suggests that thought be given “in the long term to composing a more efficient network”

Based on the publications listed, there are likely not more than 30 or 40 people publishing, with few making noticeable contributions to indexed journals (“which results in a rather poor performance given the number of members reported”). Only two research areas out of the four reported seem to be active. Four country-teams “show up in the (many) activities held - symposia and workshops - but do not seem to supply any activity reports.” Several others were at a loss to establish for the organizers a well-documented balance sheet to be presented for the final evaluation. Four countries are highly active, but “the local level remains weak - the dissertations prepared under joint-supervision often fail to include the name of the research supervisor in the South.” This case highlights the sensitive issue of the *right moment* for inclusion in a network, as well as that of who constitutes the initial group: this brings up again the question of the “required” level and the risk of leaving out those most lacking in resources. This also falls into the case (rather uncommon within SARIMA) of those *environments* characterized by Leif Abrahamson as “very poor” and that in his view deserve special attention²⁰. Should one postpone inclusion in the network? Should it only be done with partners already well advanced? Should special resources be used, as suggested by Leif Abrahamson?²¹ These are kee-questions of public policy.

- Another pitfall is tough to overcome in the beginnings: the marked *individualization* of network administration in which (at SARIMA’s level) a very small number of *charismatic people* play an overbearing role.

In the future, the scientific report notes, there must be “a broadening of this administrative team: the heavy tasks taken on require more hands on deck.” There is no magic prescription for resolving this institutional issue of how networks should progress from infancy to adolescence and on to independence. The dynamics are necessarily dependent on strong motivations and personal commitments that cannot be planned out, but for which one can provide backing (which is the role of a public policy).

- Lastly, one must include mention of the *reversion to bilateralism* that the scientific report uncovers in the behavior of a few teams. While still under construction, they turn, solely in France, to var-

²⁰It seems also as if there is no really weak environment at any of the SARIMA nodes. By “really weak” I mean a department where there are very few (if any) PhD-holders, no PhD-programme and no on-going research worth mentioning. There are such departments to be found in especially sub-Saharan Africa, and these departments are needless to say in great need of support from the outside.

²¹One way of starting activities at such departments would be via regional cooperation, exchange of lecturers and MSc-training in the region. Such enterprises also demand a long-term perspective (more than 10 years), and from my point of view it would be very good if this was to become part of SARIMA’s activities in the future.

ious partners with “a rather modest level of research.” SARIMA, which seeks to operate on different principles, should see to meet their needs within its own framework, including via recourse to research centers in the South that are well advanced and particularly good leaders.

3. **The scientific report devotes particular attention to the implementation of applied topics, in both the research and teaching programs.**

- This assumes, in a certain number of cases, that changes in the syllabus will occur. This will take time, but partners in the South have to prepare to it. The report suggests a number of avenues: workshops, schools or events that introduce applied topics, more specialists from applied fields on the research boards of the network, opening of the network to local researchers working in applied sciences (who can contribute real data and housing laboratories to candidates for Master’s or doctoral programs), involvement in the design and implementation of training in engineering and other practical subjects within local institutions, etc. We wish to note that these practices have been proven to be successful by other SARIMA teams.
- This assumes a certain amount of good will and preliminary negotiation with stakeholders and potential users outside the faculty. This may be harder to come by in “weak” environments. But it is not beyond the realm of possibility: there is no lack of subjects that may lead to contractual agreements (the environment, epidemiology, halieutics, etc.). The report highlights a number of examples within SARIMA.
- The challenge, and a big one, is that of “local integration” which, along with the quality of the training and publications, serves as a yardstick to measure the success of the project. As the report sees it, “it would be extremely harmful to halt support...for a network that shows very positive results in this field.”
- In this respect, the report looks forward to the recent entry of a new network, small but well-structured. It is specialized in probability and statistics (a dimension missing from SARIMA at the outset) and “its focus on applications and the practical analysis of health problems in Africa is very promising.” Its work is carried out in close collaboration with local practitioners (IRAD, OCEAC, Institut Pasteur, etc.). We heartily agree with the report that “the entry of this team into the project is a good decision since its objectives fit in well with those of SARIMA.”

By means of this example, one should also note that **SARIMA offers a unifying framework** for a number of French initiatives well targeted but small and isolated, heretofore maintained precariously

and highly dependent on the dedication and efforts of a person often working alone.

Conclusion on scientific aspects

Following a very detailed assessment, the report concludes in no uncertain terms that the program has produced satisfactory results in terms of research. It also lauds “the scope of the work done in terms of training and institution building.” It supports the principles and design of this program and deems that “it is critical that there be continuation.”

This is also the opinion of other specialists who participated as of the halfway evaluation, such as A. Griewank, who writes: “Generally speaking, the program is quite successful and should definitely be extended beyond the first funding period”; or Leif Abrahamson: “There is no doubt that the SARIMA has had a positive impact on Mathematics and Computer Science in the countries where the activities have taken place. If the support were to terminate, then the future for the different teams involved would most likely vary a lot. In some cases, like in the Maghreb, it seems that the teams are strong enough to continue more or less as before. In other places, where the funding for research and PhD-training is almost non-existing (at least for sandwich training and cooperation with other countries) the activities would suffer a lot”.

Evaluation of the institutional aspect.

This section deals with the management of the project (process, dynamics, tensions). It is based on observations and interviews done on site by the evaluators²². The interviews done with researchers (and research authorities) encountered on site contain three major issues: motivation for research, the comparative advantages and disadvantages of the SARIMA aid program, and the current research situation in the country visited. We will limit ourselves here to the key features.

Management

1. **The Management** of SARIMA has proved to be **efficient**. It is well documented, clearly and in detailed way. The accounts are rigorously kept, up to date and always at the disposal of the parties involved. Operations were carried out in scrupulous compliance with the rules of public accounting. Budget allocations have been adhered to up to the present. Their breakdown seems to satisfy the stakeholders, and to correspond to their “capacities for absorption”.²³
2. Nearly all of the resources go to research activities.

²²Mainly R. Waast, L. Abrahamson and A. Griewank. Interested readers will find a comparable but much more detailed version in the “halfway evaluation report”.

²³The Swedish specialist nevertheless expresses doubt on this point in relation to certain “over endowed” Sub-Saharan research centers.

3. The Program resorts to **traditional means** of cooperative assistance: missions and fellowships. These constitute tools for training and networking.
4. There is *no allocation for logistics. This is a disputed point.*

Certain teams complain, and a number of specialists stress, that the working conditions (especially in countries where the environment is the “least propitious”) will require support for equipping a research center in order to provide for post-graduate supervision²⁴. This suggestion is in line with a sense of consistency for the program.

The Program managers maintain, however, that equipment and facilities (just as acquiring building space - whether for courses or for symposia, as well as for housing junior participants, etc.) are the contribution requested from the local teams: it is up to them to provide for this aspect by other means and sources (from their host institutions or other sponsors). This is, in short, a litmus test of their commitment to the program and their degree of involvement in the local environment.

There is doubtless another underlying reason: facilities can be costly and always require recurrent funding. Documentation, for example (which is key to mathematical research) can only be made available contingent on group - and most likely, national - subscriptions to journals and electronic data bases - which inevitably raises the related problem of a broadband connection and general access to the Internet²⁵. Hardware type equipment poses the problem of maintenance (including software and license renewals). The costs and complications involved in shipping and customs (for items purchased in France, or those related to maintenance (if purchasing is done locally) are hard to foresee and subject to considerable bureaucratic red tape. In addition, negotiated agreements between teams may end up being further complicated by disproportional development of their stock of equipment.

From an administrative point of view, there is no doubt that the absence of funding for logistics simplifies the task. This does not, however, bring the debate to a close.

Management practices deserve to be described and commented on.

The initial phase obviously has to do with the allocation of funding. According to the reports of the GIS, every year, “the teams being supported establish a research program and request the corresponding resources”. These requests consist of solicitations for:

- Missions by senior researchers or internship stays in Master’s and doctoral programs, going from the South to the North.

²⁴To cite L. Abrahamson: “It is also important to provide the infrastructure at the collaborating departments in the South, in order to minimize brain drain, to provide for possibilities to do research, to lay the groundwork for MSc-and PhD-programmes. Therefore, it would be good if the SARIMA could include support for this, too”

²⁵The AUF has also provided timely assistance in this respect in many African countries.

- Visits to contribute to Master's or doctoral programs, going from the North to the South.
- The organization of workshops and symposia and participation in conferences in the South.

Requests are examined and ruled on by the GIS general advisory board. Funding is allocated to the teams and a (small) line item for "administration". Once its funding is assigned, each team is free to change its planning with the following constraint: the total cost of missions in the North, as well as that of operations in the South, must remain constant. "The team manager is directly responsible for managing his allocation."

In practice, this manager places orders with one of the two administrators, both of whom are in France: one in charge of visits to the North (travel and expenses) and the other in charge of operations in the South (travel and expenses). These administrators are located at two small facilities²⁶, where they are responsible for the program. They have full knowledge of the operations and understanding of their challenges. They do not limit themselves to responsive actions. They establish in advance well-informed, individual relationships with the managers and parties in the field. They are aware of their constraints. Orders are placed (or allocations paid out) and are made available in a very timely fashion, where and when they are needed. Aid may potentially also be provided for practical aspects that are critical to operations (costs for visas, for hosting at French research centers, assistance in finding housing, etc.).

This *personalized and considerate* management is a relief to managers in the field, who said they are extremely satisfied in comparison with the normal hassles involved in other projects. The secret behind this is clearly having the reins held by only a few people, who are dedicated and specialized, working within small structures where the program is given proper recognition.

This way of organizing procedures recommends itself for future such long-term programs. Responsive and operational, this style of administration guarantees not only dependability but also smooth-running efficiency. It satisfies the users of the system and greatly enhances the program's "reputation" overseas²⁷.

Activities

SARIMA combines **traditional means** of cooperation (trips, stays) to fit together the pieces of a coherent program. This means simultaneously consolidat-

²⁶Respectively: at CIMPA, an association for the advancement of Mathematics, and at the department of international relations of INRIA (a French research institute).

²⁷This is the lesson learned by all foreign operators involved in institution-building: the only alternative is to delegate operations and administration to very small structures that have a stake in the outcome, as is done by the Swedish cooperation agency with IFS and other organizations. Cf. also ICTP's "Italian" experience and that of the "Netherlands Program" for the social sciences in India. All long-term initiatives that are undertaken in this manner are highly appreciated and showcased as "models" by their users and by authorities in the South.

ing in each country at least one good-size research center, and supporting the significant activity of regional networks which feed them.

Each of these tasks requires a roadmap, which is defined for the entire term (multi-annual). These roadmaps have to be made up together.

Starting points and contexts may be very different. In the case of research centers, the first task is often to fill out the supervisory staff. One must provide a number of faculty members able to support doctoral programs and certifications. Beyond that, the target should be to develop a critical mass in a few research specialties. This involves recruiting doctoral candidates who will carry out their work on a joint supervision basis, but who will also need support for overseas fellowships. The "research center" will gain stability by serving as the locus for hosting a DEA (Master's) program or even a Ph.D. program.

At that stage, things become more complex. First of all, implementing a post-graduate program involves a huge amount of energy, time and worries unrelated to research. Secondly, it requires offering various types of course that often seem contradictory to the need for specialization to make breakthroughs in research. This dilemma can be partially resolved by mobilizing colleagues from the North to be associated with the course offerings (and the life of the research center). It will re-emerge, however, when the time comes to hire new faculty. Should priority be given to the DEA program (to cover the spectrum of specialties), or to the needs of the research center (to enable it to reach a critical mass in at least one specialization)? This is a tricky transition.

Subsequently, a mature research center will confront the problem of not "cloning" its members²⁸, and of keeping up to date on new developments in related or new promising areas. This transition cannot be made simply through new recruitments (too many positions would be needed). But the center can make headway by attracting back colleagues who had moved away from research or by promoting reconversions. This heavy reinvestment will, however, require support. The LAMSIN in Tunis has been through the mill. It owes its success to a UNESCO chair, to the funding it enabled to be mobilized and to the thoughtful use to which it was put. The point was to organize four full semesters of research and coursework for advanced students in four novel (and related) specializations. Noteworthy speakers were imported and fellowships were found for a significant number of lecturers hailing from a broad range of African countries (and from Lebanon). The research center made substantial gains in terms of its influence, its network and its reputation. And it brought about its own renewal.

Even though SARIMA supported the operation from the sidelines, one must nevertheless recognize that its accomplishments outstripped the resources available from the program. The latter wisely divides its efforts among all of its research centers "under construction" and monitors the activity of its networks. LAMSIN's great leap forward marks its passage to a stage of full autonomy, something not easy to do because of the resources required²⁹. But this leap

²⁸For example, the LAMSIN in Tunis.

²⁹Other components of SARIMA (Saint Louis, for example) are doubtless nearing this stage. The research evaluating committee prods them onward, reproaching them for sticking too much to the same subjects. The sticking point remains the problem of resources, and the

does not rule out a continued presence for SARIMA. The Tunisian center multiplied its training capacity, which is a plus for the program. It has also, as part of its strategy for growth, an interest in the vast pool of African students that it might attract for specially crafted training programs should the crop of Tunisian students be no longer sufficient. It has taken a number of initiatives in this respect. From this perspective, the GIS has good reason to keep it as a pro-active part of the system and consider it as “a research center of the North”.

At the level of **institution building**, the course of action has been to create or consolidate **post-graduate programs**: whether at the DEA/Master’s or doctoral levels. This is an objective easily understood in the university framework. It is also the best way to provide a long-lasting goal for a reference research center that will serve as a landing pad for doctoral candidates.

The latter are thus able to find subjects and on-going supervision, while the research center can bank on their productive efforts. There is, however, a risk that the educational aspect will become an end in itself. Or that it gets trapped in in-breeding, shuttered within a logic of academic reproduction: making the training of future faculty its goal above all else, and placing it ahead even of the research center in terms of the research done. We have already touched on this dilemma.

In addition, SARIMA has determinedly supported the activities of *networks*. This track met keen interest. It engendered regroupings and stimulated resurgences (because networks, nimble and independent beings, may go into hibernation but also have great durability underground³⁰). This avenue attracted teams not initially in the cards and resulted in the reactivation of old networks, the creation of new ones or the rallying of groups already constituted (RAGAAD and STATAV).

A greater goal began to take shape with the assistance provided to broad regional institution building: the expansion of CARI (the meeting point every two years for African computer scientists, now on a firm footing), the founding along the same lines of an association of applied mathematicians (CARMA, which is now flying its own wings and holding regular symposia), along with the creation of a computer science journal and joint issue with another one (English-speaking). These are powerful tools for structure-building in the research community on a scale that intends to be continental.

One should note that in every one of these cases, SARIMA’s support is strictly limited to organizing events (symposia, summer schools, publications, etc.) The program looks after the operational side of the groupings created. It sees to it that participation in these events include young up and coming members: special activities are held for them (schools associated with CARI, etc.). For many of them, this is their first opportunity to give presentations before their peers and to make contacts outside their normal spheres. The associations that receive support are never “academic institutions”, but rather coalitions focusing on organizational tasks. They constitute an “ordinary” community of common researchers at work.

expenditure in terms of the energy and imagination that have to be mobilized.

³⁰Maghreb Info is a prime example of this.

The institution building of a regional research base has proceeded faster and farther than expected. Here, as well, however, we should note that haste is not the rule of thumb. The intermediate steps are never out of sight. Priority is again given to the smooth going of basic networks (sub-regional and specialized in branches of a discipline³¹. Events with large numbers in attendance are supported as a healthy bonus that should strengthen the foundation work.

We would be remiss to not recognize here the catalyst role played by a number of people in these undertakings. Each research center can count on the assistance and advice of a designated member of the GIS advisory board³². Each network is given impetus by one (or more) manager(s) (usually from the South). The task of organizing each major event is given to a local committee of volunteers. The fact that there has never been a shortage of helping hands shows that the formula is tailor made for the objectives and for the arrangements and researchers involved.

When all is said and done, it should be remembered that the activities, which one could profanely reduce to merely training (doctoral candidacies, fellowships, schools, etc.) and livening up tasks (symposia, associations) come to form part of a **constructive design** that produces powerful effects for institution building. This design confers upon the traditional means used a **net added value** compared to their roles outside such a master plan. SARIMA is not the be all and end all. The program cannot always go all the way to the end of the line (cf. mature research centers fending for themselves). But it has the advantage of keeping on course sustainable groups of specialists who are better equipped to persevere than mere individuals and to provide a future community with a stable framework of shared interests.

The process

1. SARIMA *very quickly gained momentum* due, certainly, to the initial decision to use cooptation. The program benefited from the store of trust previously built up between academics (the French managers and their selected partners in the South). It linked up projects in progress and gave life blood to others already on the drawing board, now unified in an ambitious set up. The decision to keep the initial teams as part of the program and their subsequent effectiveness demonstrates that there were nearly no errors in recruitment³³.

³¹They are the ones who laid out the progress of their structure-building for the final scientific evaluation committee. In contrast, the “halfway point” evaluation took advantage of the heavily attended events - such as CARI - to increase the number of encounters (including those outside the perimeter of SARIMA).

³²This principle, in a more official form, is also the one adopted by well-known international programs: ISP, FIS, etc. They use it to set up a reliable web of external, allied “advisors” who adhere to the program and create its reputation.

³³The French managers are old hands in cooperative assistance in Africa (via the schools organized by CIMPA or INRIA’s cooperative activities). Obtaining the participation of the teams from the South was discussed with them at great length. The delay in the MAE’s funding (unexpected) provided an additional opportunity to put these callings to the test.

2. The program generated a *plethora of initiatives and saw unanticipated come-backs*.

Such was the case, in less than three years, of the creation of a Maghreb Computer Science network (Maghreb Info), the inclusion of new partners in Lebanon, the integration of a Moroccan “competence center”, the expansion of the RAGAAD network in the Sahel and South-South collaborations (even on a casual basis) with countries not initially partners (hosting doctoral students and course exchanges: Rwanda, Burundi, Congo), etc. All of these breakthroughs bear witness to the impetuosity of the more advanced members (who often took the initiative) but do not prevent each team from following its own chosen course³⁴. The GIS takes responsibility for maintaining the pace and funding (set aside) for those who have yet to build a viable team (see the final report of the GIS office on program implementation).

3. SARIMA has served as a *catalyst*.

- The program stimulated its participants to seek out *sources of additional funding*. In this respect, its “*quality label*” helped in approaches to SCACs (French government aid programs), as well as to international programs such as ICTP or the Swedish ISP.
- The program also led to *ambitious regional institution building*, with the creation of an African association of mathematical research (CARMA: a committee charged with organizing a bi-annual symposium and whose advisory board is entirely African), the strengthening of the CARI (enhanced influence in applied math, creation of a journal, closer contact with South Africa), the rapid constitution of networks among committed teams (the affiliation of Maghreb Info and TAM-TAM, expansion of the RAGAAD).
- And lastly, the program contributed to *broadening the interest in France* for cooperative activities in its fields of operation (adhesion of new members to the GIS: ENS Cachan, the Universities of Orsay and Toulouse, IRD). It broadened its scope of action to new sectors: especially into statistics, with the inclusion of the STATAV network.

4. These accomplishments require input from the participants. As a matter of fact, the researchers involved are *highly motivated*.

Those in the North often have a long-standing and endearing attachment to the countries with which they are working. One should also not overlook the fact that the community of French mathematicians has a long tradition of international outreach (including to developing countries)³⁵.

³⁴Verified at the time of the annual report and of the new budget request to the GIS.

³⁵This is also true for many physicists. And, of course, new good wills are emerging on all sides spontaneously. Such a mood is, nevertheless, more closely associated with a particular generation.

Researchers in the South also make themselves clear on their commitment³⁶. In broad terms, it stems from their attachment to their discipline, their career and their country. They take seriously the survival of their academic field (where faculty hiring had dried up in recent decades in the name of administrative reform programs) and protecting institutions often fallen into decay (especially in Sub-Saharan Africa)³⁷. Above and beyond that, one perceives an ambition to emphasize the quality of the faculty and their students. They are particularly grateful to SARIMA for helping to **set up the post-graduate programs**, the one missing link in the curriculum.

5. The program enjoys a *highly positive reputation in the South*. It is given credit in particular for noteworthy characteristics.
 - The first one is that it gives its beneficiaries the feeling of “*ownership*” of their project. The local manager, who has to defend his budget, is subsequently at liberty to allocate it to activities that he deems most in line with the goals set. Management and strategy are handled through on-going exchanges with a member of the GIS office, but this always involves a peer to peer approach where the interests of research take priority. Initiatives are processed expediently. Nearly all of the funding goes to research activities with carefully crafted transparency.
 - The second comparative advantage of SARIMA is that it *allows one to make plans*. In contrast to usual aid schemes (where funding is earmarked: a few plane fares, a fellowship, a one-time study - never enough on their own to execute an entire project), SARIMA offers a type of “baseline funding”: an “open” and recurrent budget that allows and entitles to draw up a coherent development plan. SARIMA thus makes it possible to look to the future, to let one’s imagination roam, and even if it is not sufficient alone, it provides encouragement despite the habitual pitfalls.

In the view of local managers, this is precisely the key impediment that needed to be removed. Above and beyond the daily miseries besetting institutions (especially in Sub-Saharan Africa), obvious at a glance, there exists a wealth of enthusiasm and a secret force resisting the decay of the academic disciplines. This is currently embodied by a few figures more so than by the institutions themselves, and by grasping at the straws of meager aid programs they manage to provide a shadow existence for research activity. It is this potential that SARIMA was able to identify, tap and bring to fruition in a very short time.

³⁶The full halfway point evaluation contains a large section that elucidates these motivations.

³⁷Where research is becoming de-institutionalized for the benefit of a worldwide market for research work. Cf. R. Waast, “The status of science in Africa”, *Science, Technology and Society*, 8/2, Dec 2003.

- A third feature is also greatly praised. This concerns the program’s immediate insistence on *establishing networks*: both North-South and *South-South*. This approach responds to the concern for “raising the standard”, which admittedly can only be done by way of reliable alliances with advanced partners from the North. It also echoes a “pan-African” vision that is self-generated and more widespread among the researchers involved than one would have thought. A network allows one to break out of isolation, to keep up to date, to lock horns with colleagues and to feel he is a member of a research community³⁸. These networks are active on the ground (organizing summer schools, workshops and major symposia on a regular basis). For newcomers, it is an opportunity to measure up to stringent standards, and for everyone, a chance to exchange ideas, make contacts, trade invitations and set up new projects, all within the context of a critical mass of colleagues working on the same specialization.

One of SARIMA’s success stories is to have dictated that there be this regional, and even continental dimension, instead of the customary bilateral one-on-one (where governments and their bureaucracies are often too quick to crash the party, and the North/South imbalance can have too great an impact).

The correlated difficulty is that the researchers involved remain those from a single country, that their projects for consolidation are by rights first those of a local research center, and that sooner or later they have to depend on funding and nods of approval from their national oversight bodies³⁹.

Tensions and Risks

As the program unfolds, *tensions* crop up, sometimes unexpectedly:

- the tension between *research and teaching duties*, each with their own development requirements (forming a coalition to support a handful of narrowly-defined subjects versus more diversified hiring to cover the entire spectrum of the discipline).

SARIMA managed to come up with a variety of ways to resolve this predicament (inter-institutional centers, regional networks based on a variety of themes, etc.).

- the tension between countries who have made “*greater or lesser*” strides in institution-building. The former are more (often to the exclusion of all

³⁸We should add that if networks are sometimes here-today-gone-tomorrow in nature (this not being currently the case for SARIMA’s), they nevertheless maintain a lengthy life span *sub rosa*. And hibernating networks can be re-awakened (Maghreb Info, for example, once again became the torch bearer for a regular Maghreb symposium among computer scientists that had been interrupted by political troubles in the 1990s).

³⁹There is no fundamental contradiction here. Organizing CARI, for example, a research event that is continental in scope, is generally considered by the host country to be an honor whereby, despite a paucity of resources, it will never fail to make a contribution.

else?) preoccupied with training concerns, while the latter are more bent on pursuing an advanced research goal.

An ear for mutual concerns seems present, however, and a range of initiatives emerges to support (on a South-South basis) each party's projects.

These constructive tensions notwithstanding, one must be wary in the future of two potential risks:

- the risk associated with decentralizing the program and the free rein given to its local managers (selecting who benefits from fellowships, missions, new initiatives, etc.) This is the secret of the "ownership" principle so dear to SARIMA, but it requires a clear statement of decision-making criteria and oversight through the provision of regular and transparent assessment reports.
- the risk involved in wholesale, direct management by "peers". This is the best way to ensure an optimal matching of resources with needs, but at some point it is necessary to *officialize the activity* with oversight bodies, to amplify gaining support from local cooperative assistance entities and to give evidence of proactive measures showing *involvement outside the academic community*.

Up to this point in time, this requirement (which falls entirely to the local project directors) has been met with greater or lesser degrees of diligence except for informal procedures. This is not a case of a contradiction (most researchers say they are ready to "serve" their country and are predisposed to engage in applicable research), but rather a source of tension based on a common concern to maintain academic freedom and on a defiance in regard to any operation managed by authorities with little research competence. It will be necessary to formulate a code of good practices in these respects, and maybe more systematic involvement by key managers with authorities and potential users during their visits in the field. The kinds of experience gained in a number of countries vary from this double perspective⁴⁰.

Conclusion...on the institutional aspect

At the institutional level, the program has shown a rapid gain of momentum and a highly imaginative creative force. It doubtless owes this to its principles of cooptation. (These could subsequently be tempered in part by calls for proposals, even if the initiatives and spontaneous resurgences⁴¹ seem to have greatly modified the initial make up). The program seems to correspond fully to the motivations and aspirations of its beneficiaries. It demanded that they invest heavily. It is given credit for substantially positive accomplishments (researchers' "ownership", the guarantee of a future, efficient and responsive administration). SARIMA has served as a catalyst and generated many resurgences and initiatives. The decisions to support the establishment of local post-

⁴⁰Lastly, one should note that South-South activities are slow getting started. And our foreign evaluator colleagues insist on the advantage to be gained, soon to come, of entering into relationships with English-speaking aid agencies such as AIMS or AMMSI, as well as of providing support to one or two groups in English-speaking Africa. Such developments will nevertheless be dependent on ensuring a sustainable future for SARIMA itself.

⁴¹A number of evaluators have commented that certain teams of repute, especially in the Maghreb, are not "on-board" in this respect and that their participation should be solicited.

graduate programs and to set up networks were especially well received. Institution building activity has taken on a key momentum. Without interfering with efforts to consolidate research centers and basic networks, it is marked by a regional, even continent-wide vision.

The injection of resources implemented through an overall strategy endowed them with net added value.

Public policies

SARIMA's greatest innovation is to focus on institutional reconstruction in the area of basic sciences. The program is well targeted since it responds, according to the latest surveys, to a crying need in developing countries (African countries, in particular). In effect, one finds there⁴², at the level of higher education and leaders' training, an alarming decay of the institutions and weakening of the skills base in fundamental sciences. It is important to start this policy section with an examination of the "aid available" in this area. We limit ourselves to that related to the basic sciences, both French and international.

French aid programs

1. African researchers and the teams we met with are *very attached to French aid* (one might even say: tied, dependent, restricted to - if only due to the language barrier; but that is not all: there is also a basic level of *trust and expectations*);
2. Unfortunately, this *type of aid is rare*. What is done, in terms of basic science, is contingent on the voluntary action of a multitude of entities, each with their own doctrine and means of operation. Universities have taken many initiatives, but they are all piecemeal and not listed anywhere. The EPST's [*Public Science and Technology Establishments*] are easier to identify, especially when they have representation in the field (IRD, CIRAD, even CNRS, etc.). The Ministry of Research seems to take only a passing interest in the least developed countries. The Ministry of Foreign Affairs, more pro-active and professional, has seen its funding reduced.
3. The system *does little to promote institution building*. Most aid grants are personal⁴³. The constantly renewed focus on producing "skills and capacities" predominates over the concern for replicating them locally (but will they endure?). The system is ill-prepared to implement a sustained policy of institution building. No aid agency is tasked with this

⁴²Cf. especially: (op. cit.): Les Sciences en Afrique, Le Maroc scientifique, Commission européenne: ESTIME Project; UNESCO: Higher education forum - special initiative.

⁴³The doctoral fellowships are the fruit and the best example of this, as are the internships, missions, and funding for travel or for one-time activities. The exception to the rule is the MAE's. "Integrated actions": calls for proposals involving at least two teams, one from the North, one from the South.

and no one is set up to do so. There is a patent lack of ability to see the bigger picture and little willingness to get involved. It is thus hard to come up with a mid-term strategy.

4. One must, however, qualify this picture:
 - The abovementioned considerations are especially true in the “least advanced” countries. Sub-Saharan Africa suffers more from it than does the Maghreb⁴⁴.
 - Certain French aid mechanisms are well known and highly respected. Among those most often mentioned, we include:
 - AUF (Association of French-speaking Universities), which provided the African research community with access to the Internet and which supports “partner” research centers based on a standard of excellence.
 - Aire Suds (which has offered long lasting support to teams but rarely in the basic sciences).
 - Certain mechanisms set up by EPSTs, such as the PICS or the CNRS⁴⁵
 - The assistance offered by inter-university cooperative bilateral programs (*integrated actions* of the MAE). Admittedly, the projects are only funded for 2 or 3 years and involved only teams working in twos. But they make a useful contribution to training “skills” and provide funding for the operation of local research centers.
 - Many forms of aid are valued but *not listed*. This is true of training (free of charge) within French universities, hosted positions in the EPSTs, free access to equipment and supervision of “interns” at French research centers, residence fellowships and travel expenses granted on a “personal” basis (invisible to the home research center).
5. The mechanism is thus well-oiled and well-developed, but *hard to decipher*. It is a mystery to foreign parties, from who *cannot be provided with global view of any evaluation*. No document provides a panorama of all the assistance granted in Africa: no institution is in charge to do it, and no ministerial requirement exists in this respect. The *operators are too dispersed* for one to have access to even an order of magnitude of their expenditures. The *piecemeal nature of aid* results in a multitude of doctrines and practices, muddying any clear picture of their intentions, strategy or tenacity. The same uncertainty can be perceived in the South regarding the perseverance and mechanisms of the aid given. There are

⁴⁴There are some exceptions: the solid institutions in Burkina Faso and those long neglected for long in Algeria. Cf. *Etat des sciences en Afrique*, op.cit.

⁴⁵INRIA’s 3 + 3 programs, cooperation with the Geodes unit of the IRD (applied math), the logistical support offered by the CIRAD or the IRD.

numerous “windfalls”, but it is hard to plan a local group strategy based on them.

6. This lack of visibility is harmful, both to *the prestige of French aid and to its influence*. For our foreign evaluator colleagues, French aid to the basic sciences in Africa was initially incomprehensible, in terms of both quality and quantity. They are surprised by the scope and transparency of SARIMA, and its strategy inspired them to make felicitous comparisons with other, well-renowned international programs.

International aid programs.

International aid programs designed to support the basic sciences in Africa are limited, but steady and well-documented.

1. Over the last two decades, most of the providers of public aid have advocated a withdrawal from “social” expenditures, educational ones in particular. Higher education was deemed to be particularly unproductive, and research even more so unless it was linked to “*problem solving*” for urgent problems akin to engineering.

Going against the grain, a certain number of countries persist, openly, in providing aid for the basic sciences. This is the case for countries *from Northern Europe*⁴⁶, as well as for several American foundations.

2. For four or five years now, the need has been felt to “reconstitute leadership classes”, to “rehabilitate” university institutions in ruins and to prepare for the coming of “knowledge-based societies”.

The stated positions of major funding providers have done an about-face. The World Bank has joined up with the Ford, Carnegie, Kellogg and Rockefeller foundations and the northern Europeans in order to redirect “a reasonable portion” of support to the basic sciences.⁴⁷

3. The steadiest type of assistance, also reputed to be the sharpest one, nevertheless still goes through small programs (or institutions). Viewed as venerable since they were often founded on the initiative of a Nobel prize winner, these are regularly nourished by aid providers (the Scandinavian countries, Italy, etc.) within whose walls these institutions are set up. They have an independent legal status and their administration is often entrusted to university units that see to the tricky steering.

Administration is used here in the broad sense - not only in terms of logistics but also research (in selecting the beneficiaries and organizing activities) and

⁴⁶Sweden, Norway, Finland, Denmark and the Netherlands. One might also add to this list France (in dispersed order, as noted above), the United Kingdom (through the Association of Commonwealth Universities), Germany (by various foundations), the European Commission’s Directorate General for Research, and others that have thus gone against the grain of the official doxa.

⁴⁷The norm (without any indication of what it is based on) is set at around 10% of S&T funding.

in the sense of promoting the activity (tapping new funding sources, organizing forums on research policies and their implementation).

4. *Among the programs that are best known, most highly respected and most influential, we wish to mention:*

the Swedish ISP. This is managed by a specialized division of the University of Uppsala. This program has existed for forty years, has an unwavering objective (supporting the basic sciences) and documented strategy (institution-building), along with a geopolitical focus (the "least developed" countries) and stable targets (twenty-one years of support being a standard model). It should come as no surprise that this program is recognized worldwide. Its record of results is impressive and it is careful to recommend, evaluate and propagate its experiences. It has constituted a doctrine that has become influential on the world stage of development aid and assistance. It has unfettered access to the ministries in the countries where it works, and can pull enough weight to get them to contribute to the projects it sets up there - even on the part of skeptical governments.

the ICTP, founded by the Pakistani Nobel Prize winner, Abdusalam. The ICTP is based in Trieste and largely funded by the Italian government. This institute organizes mainly within its own walls high-level seminars in physics, chemistry and mathematics. It invites to them researchers from the "Third World" (confirmed and active, or young and promising). Invitations are made on a personal basis (individual support, given to "big names"). The ICTP also provides aid (through a smaller program, funded by the Swedish aid agency) to research events and meetings organized in their own region by researchers from the South.

the TWAS (Third World Academy of Sciences) was also founded by Abdusalam. It has outgrowths (including an African Academy) and indefatigably promotes the development of basic sciences, especially through international conferences. It also supports a few research centers "of excellence" and regional research projects.

the TWOWS, IFS and certain *Dutch and Danish programs*, intervene in fields other than mathematics (in basic **biology**, mainly).

one must not overlook the **UNESCO chairs**, which - while not themselves endowed with substantial funding - provide an enduring label that serves to obtain significant amounts of funding.

Except for ISP (which supports teams and networks), all of these programs target individuals. They provide long-term support for eminent research personalities. All of them bear "excellence" as their standard and seek to maintain and promote it. This is the source of their renown and of the

prestige they bring. Their field of action has little focus on the French-speaking region (although there are more and more cases of outreach there as they expand)⁴⁸

France has lost touch with this type of aid systems

It nevertheless has strengths, *albeit maybe not sufficiently used*.⁴⁹

1. It has *prestigious research communities* in the basic sciences. This is the case in *mathematics*, where the French school is a benchmark. Although its Noble prizes are becoming few and far between, Field medals continue to flood in. This is also true in particular fields, such as physics, chemistry and biology. These communities are prepared to mobilize for aid to the developing world (at least significant portions are) and are sometimes organized for that purpose (as one can see, in mathematics, by the existence of CIMPA)⁵⁰. We have maybe not made the most of these skills and this willingness.
2. France has *an exceptional network of former students*, now in university chairmanships or managerial positions. Care should be taken not to let it fade away. But it can be put to good use by setting up *complete post-graduate programs on site*. This new breeding ground can be given support for creating lasting structures *across* a region. It can be given support so that it creates alliances and its influence spreads around it.

There are good reasons for supporting the basic sciences in Africa today

1. Modern R&D (“development-research”) draws on the ideas and methods of a knowledge base that has radically changed. In order to have access to it, the South must *update the foundations of its skills* in basic sciences. These are the ones that are most useful and widely distributed. It is no longer possible to seek out solutions for agricultural development (knowledge and modifications of plants, etc.) without going through molecular biology. To put it to use (and to know its limitations), it has to be taught by researchers who have experience with it. It is also clear that modeling (including some mathematical approaches) will be ever more indispensable for “managing” a substantial range of problems in the environment, epidemiology, fisheries, water resources management, etc.

⁴⁸E.g., “Institut Béninois de Physique et Mathématiques” (supported by ICTP and TWAS), the LAMSIN in Tunis (UNESCO chair), the ISP in Cameroon (networking of research centers in agricultural and medical biology, etc.).

⁴⁹We are nevertheless indebted to it for major successes and extreme generosity in the 1960s and 1970s when African universities and research facilities were being built up.

⁵⁰We should not forget that in the period of the 1960s to 1980s, a society of physicists also organized summer schools in countries in the South, working through cheer enthusiasm.

2. If higher education has fallen on hard times in the South⁵¹, national research facilities there are surely in a dizzying tailspin. They were, however, built up at great expense in the years from the 1960s to 1980s. Their *institutional “reconstruction”* seems to be necessary and should draw lessons from that history⁵².

There is an open debate on what constitute sustainable means of “rehabilitating” research in “less developed” countries: *Centers of excellence, regional centers, and international centers?* Institution building based on **recognized research centers and network creation** is one of the possible ways. It is well looked upon by a number of aid providers (WHO, etc.) and has the advantage of not circumventing national authorities.

3. One must not neglect, from a political perspective, that the basic disciplines maintain their *prestige*. Their renowned “scholars” are the pride of many governments and of even very poor nations: the proof is that they readily become media figures.

In more prosaic terms, the aging of former students trained in the Metropolis and the establishment of complete course curricula in their countries will weaken France’s traditional *influence*. It is time to rebuild a pool of allies, by contributing not only to programs of study (at the Master’s and doctoral levels), but also by consolidating the best local research centers (in the hands of the next generation) and promoting their regional inter-connection.

4. If one takes a slightly more removed perspective, it is easy to also see the *advantages for our own research*. As was emphasized by people in the Maghreb and in Africa, many youth in their countries have maintained a marked interest in scientific research, more so than in Europe. Therein lies a font of hearts and minds that one should elevate to the highest level of quality in order to subsequently establish with them consortia that reinforce our own abilities to compete internationally⁵³. In order to keep the well from running dry, the best elements need to be able to blossom at home, be gainfully employed in their fields and produce offspring.
5. Lastly, in terms of *development*, and even if this stance is a bit premature, there is no doubt that globalization will impose a “leveling up” of local economies, restructuring them and bringing them up to standard. Besides the basic needs to be met (and one cannot do without, in this undertaking, reference to the latest methods and skills), one must bank on

⁵¹Fortunately, this seems to be less true in French-speaking Africa. On this point (and on the condition of research facilities), see: Waast, R. *L’état des sciences en Afrique*, op. cit.

⁵²In the end, it is the “big names” and groups of specialists that “soldier on” the best in situations of adversity: the establishments are handicapped by their academic setting or their authoritarian bureaucracies; the administrative superstructures give in quickly. Cf. Waast, R. *Re-building science in Africa*, IRD, 2004.

⁵³This is one of the lessons of the European programs: having been given support, the new members (smaller research countries: Spain, Greece, Portugal, etc.) have made considerable progress in record time. They have held their own in the projects of the 6th PCRD.

the creation of highly skilled jobs, offered by multinational corporations in search of a wellspring of scientists and engineers that they can no longer find at home⁵⁴. As for government authorities facing the complexity of issues to be managed (climate change, pollution, halieutics, etc.), they, too, have to ensure that technical capabilities are enhanced (through recourse to modeling, for example).

6. The objective, for aid programs, is to lay the groundwork for these changes, to conceive of them in terms of *co-development*, and to aim at the *sustainable* re-building of universities preparing new leaders. **SARIMA** is a novel type of means and, after all, not very costly, that adds to the range of possible approaches. It *is a harbinger of the instrument that was missing* and that complies with foreign experiences currently held up as models: those of *institution building*.

There will clearly be risks and objections.

In particular:

1. Shouldn't we stick to the time-tested formulas in a foreseeable period of *austerity*?

We should note, nevertheless, that a program such as SARIMA simply recombines a number of traditional means in a different way, and that it provides them with a key added value in terms of transparency and visibility. France knows how to “build capacity” and support projects. It has no set of guidelines for providing support over the long term. It is this institutional framework that must be invented so that in the future SARIMA can be folded into it.

2. Should we be helping create *post-graduate programs in Africa*? Will the knowledge thus dispensed be gainfully *employed*?

This is a substantial objection. It must be examined through the double lens of the term “employment”:

- in terms of *know-how*, it is clear that solving current problems and meeting basic needs will more and more require recourse to up to date methods and concepts. As we have already said: to gain access to it, the South must *update the foundations of its skills in basic sciences*⁵⁵.
- as for the *employment market*, there is good reason to be attentive. We wish to note that, to date, the demand for university faculty

⁵⁴A good example of this is Morocco, which surprised itself in becoming the seat of significant relocations (including R and D centers), especially in the fields of telecommunications, electronics and auto design. Pertinently, it is well known that local degree programs are excellent in these subjects and the pool of students, nearly inexhaustible.

⁵⁵And that are doubtless also applied and evolve at the same rapid pace. Cf. *Le Maroc scientifique*, Paris, 2008.

remains strong in Africa⁵⁶. But new ideas are needed.

The leveling up of economies and the relocation of international companies (along with their R&D) are introducing new job sectors and will require new skills. For the moment, this phenomenon is resulting in a “devaluation” of local degrees in comparison to those earned overseas⁵⁷. Renovating course offerings can provide them with a critical boost. This must, however, be combined with not only an updating of skills, but also a certain renewal of pedagogical practices valued in the job market⁵⁸.

It is thus strongly recommended that future programs of “institution building” be pushed to include a dimension of pedagogical innovation (with the approval of university authorities) and to be pro-active in their relationships with end-users.

The lesson of SARIMA is that success in this field is not a sure thing, and may not be immediate. In accordance with the findings, it may depend strongly on the context:

- on policies and legislation governing higher education.
- on the demand for research (public and private sector) and on the nature of local corporations:

In some countries, the demand is high, but university regulations forbid academics to enter into contracts (Algeria). In contrast, in places without such constraints, demand is low (Tunisia). The results in terms of applications are more frequently found in relatively industrialized countries (Maghreb). Elsewhere, it may depend on the legal role of the negotiator (Rector, etc.) and contractual employment does not occur frequently (one rather sees cases of corporate patronage).

Conclusion...on the public policy aspect

SARIMA: the forerunner of a missing tool.

The discussion above in no way calls into question SARIMA’s results. It is instead a reflection on how to implement a possible (and desirable) continuation of the program (and of several others for “institution building”).

From the perspective of public policy, one can say that SARIMA is a forerunner to a co-development tool that is lacking in French cooperative research programs. It is well positioned in a neglected field but one where France holds a strong hand: that of supporting basic sciences. It is also well focused, with institution (re-)building being clearly the principal area of need in Africa today. Lastly, it has just provided convincing proof of its capability.

⁵⁶Most of the PhDs trained by SARIMA have obtained a university position in their home region.

⁵⁷Cf. for example, the recent study by E. Gérard, *Mobilités étudiantes Sud Nord*, Paris: Publisud, 2008.

⁵⁸Language study, professional internships, (end of course) work projects, done in partnership with corporations, etc.

It thus seems reasonable to *sketch out a future* for this undertaking. This requires a *long-term perspective* and follow-through on the concepts. The *credibility* is at stake. The SARIMA program raised high hopes among its participants and a surrounding level of interest. It was universally perceived to be a new undertaking intended to establish an on-site research capability that is viable and independent. But one cannot commit to such an undertaking lightly. Halting it in the first round would be to show vacillation at the risk of not being understood and of placing one's reputation for constancy in jeopardy.

It thus becomes a question, for *French aid programs*, of making room, somewhere, for a long-term activity carried on with perseverance.

Conclusion

This evaluation comes to the conclusion that the SARIMA program is welcome and seminal. By combining in a novel fashion resources that were both traditional in nature and, in the end, modest in scope, it managed to give them a net *added value*.

- The quantifiable indicators show that the initial objectives were either attained or surpassed.
- The qualitative evaluation bears out the fact that the operation was satisfactory from the research perspective and that it demonstrated tremendous institutional prowess.
- The program is well looked on in the beneficiary countries. The *prestige* of French support (for the basic sciences) *and its influence* (new networks) have been enhanced through an operation that fully complies with the current major need for “institution building”.
- From the perspective of public policy, one can say that SARIMA is a forerunner to a *co-development tool that is lacking in French cooperative research programs*. It is well positioned in a neglected field but one where France has a strong hand: that of supporting basic sciences.

This assessment is largely shared by the evaluators from various countries. The program responds to a concern that is gaining ground in the international arena (but where the supply of cooperative assistance remains limited).

We have all agreed, nonetheless, to emphasize that this sort of undertaking *requires perseverance*. Successful foreign experiences bear witness to this (ISP, ICTP, etc.). It is thus high time that the resources and means be found to consolidate this program, and possibly even extend its reach.