Information Technology in Latin America: Two decades of collaboration

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Abstract. There have been several collaboration experiences on Information Technology in Latin America in the last two decades, but most are little known in general and also in the region. This paper presents some of them in an analytical framework. The analysis is done with two tools: a role table and the CA/CR framework. The role table helps to identify who plays the roles of sponsor, promoter, provider and receiver for the cooperation on a geographic scale. The CA/CR framework presents the actions and the results of collaboration using graphs. The analytical approach could be used by institutions doing collaborative activities in Information Technology. The presented cases include institutions with little or no financial support for carrying out cooperation. There is also a case in which the existence of an institution playing a promoter role could perhaps have allowed a valuable collaborative initiative to continue.

1. Introduction

Latin American (LA) countries have much to share, taking into account similarities in language, some common history, geographical proximity and some similar economic development problems. One possible way to address common problems is through joint efforts and cooperation. Yet collaboration in Information Technology (IT) seems somehow difficult to achieve. Lack of funds, inadequate planning and a distorted conception of cooperation efforts and benefits seem to be the main reasons. Despite these difficulties, some experiences, both successes and failures, do exist in this respect. This paper presents some of these efforts analyzing their inception, accomplishments and lessons that can be learned from them.

The first observation to be made is that communication and joint activities in IT within the LA region in general are less intense than what one would guess from the outside. One reason for this may be geographic: the LA region is a large area spanning from the US southern border to Antarctica with 19 variously sized countries and a total population of 471 million. Then, there are different levels of economic and social development. A third cause can be the various political approaches to Government, economic policies, education, etc. Fourth, there may be practical reasons: it may be easier to ask for help or purchase a solution in a developed Northern Hemisphere nation than in another LA country. Fifth, in some cases there is excessive competition, even within a single country [14]. Finally, there is not much

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knowledge about the resources available or the accomplishments done in the region. A historical context aimed at facilitating the understanding of certain initiatives is provided in Section 2.

Why would an organization want to cooperate? In addition to the visibility provided by their activities, there are institutions finding cooperation as a way to develop themselves. Cooperation has many advantages [27], including:

- learn from others' experiences;
- receive others' points of views, ideas and relevant questions;
- receive the temporal work of other organization employees, incorporating skills not available within the organization;
- be able to achieve goals which would not be possible with their own resources.

Of course, cooperation needs multiple organizations. It requires several roles: at least two participants, a promoter and a sponsor, all with full understanding of the implications of cooperation efforts. A table identifying these roles is introduced in Section 3. Collaboration also requires a clear definition of its goals and most importantly, evaluation.

A conceptual framework is required to place these experiences to analyze them. We used the CA/CR (Cooperation Actions/Cooperation Results) Framework described by Borges and Pino [6] to this purpose. A summary of the CA/CR Framework is also given in Section 3.

We selected three groups of activities, which we believe include interesting cooperation efforts in Information Technology: Scientific Events, Education and Training, and Research and Development. Another reason to choose these three subjects was that there are several experiences in the region related to them. Other activities such as cooperation among industries, though important, were scarce or the information about them was unavailable. The activities in each of these three subjects are described respectively in Sections 4, 5 and 6 of this paper.

Section 7 analyzes with detail one particularly successful case of collaboration: CYTED. Section 8 presents a discussion of the presented approach. Finally, Section 9 concludes the paper by summarizing the lessons we can learn from the experiences. A glossary for acronyms is provided at the end of the paper.

2. Historical context

Computer Science in Latin America started in the late 60's as in many developing countries with the arrival of multinational computer companies selling their computer hardware. Banks and universities were among the first users of these products [4]. Computers were mainly used to perform scientific calculations in universities. Computer Science research was almost non-existent at that time.

Perhaps the first contacts inside the region were done by multinational hardware vendors in the early 70's. Many had regional coordination offices, moved personnel from one country to the other and developed software to be marketed within the whole region. A few had regional training centers and held occasional users' seminars. Some of these activities continue to be performed today on a regular basis [3].

The first undergraduate courses in Computer Engineering were created in the early 70's. Graduate programs in Computer Science were offered less quickly, with the exception of Brazil. In Brazil, a number of graduate engineers were sent to North American and European universities to get advanced degrees, thanks to a consistent and long-lived policy of the Brazilian Research Council (CNPq). The return of

graduates together with incentives to bring foreign visiting professors enabled the Brazilian universities to rapidly create graduate courses in Computer Science.

Radical political changes have occurred in the region in the last two decades. The end of dictatorships in Argentina, Brazil and Chile inspired other countries to follow suit and today most countries in Latin America have free elections and democratic regimes. This liberal movement has also inspired global market policies and cooperation initiatives [5].

The Mercosur – created in 1990 by Argentina, Brazil, Paraguay and Uruguay – has turned into the most successful economic block in Latin America. Encouraged by the success of the European community, the Mercosur started as a commercial agreement, but it is yet to evolve to include other areas of cooperation. Thus far, there has been little space for scientific and industrial collaboration.

3. Model description

The Cooperation Action/Result Framework [6], CA/CR for short, was developed to assess two main aspects of a cooperative environment. First, it serves to evaluate the effectiveness of programs sponsored by organizations and aimed at promoting local, regional or international cooperation among higher education institutions. The evaluation may orient the improvement of induced actions and analysis criteria. Second, the CA/CR framework can be used to ascertain the level of maturity of one institution regarding its performance towards cooperation with other institutions and to orient its efforts towards the highest levels of cooperation.

The Capability Maturity Model (CMM) developed by the Software Engineering Institute of Carnegie-Mellon University [7], was an inspiration to the CA/CR Framework. While the goal of CMM is a comprehensive adoption of qualified software processes, the goal of CA/CR is the successful and complete adoption of cooperation activities. Although the CMM was developed for the assessment of software processes adoption, its evolutionary concept can be adopted to many situations where we need to evaluate the organization's maturity towards an optimal level of adoption.

The CA/CR framework is a specialization of A/R evaluation: the study of any program or institution which performs activities (A) to generate results (R). Both A and R are described by a set of variables. For each variable, there is a scale related to the measure of progress, either in qualitative or quantitative degrees. The combination of variables and the achieved degree are depicted by a radar graph, where each axis is associated with a variable. The result of an A/R evaluation is shown in the graph as a closed area obtained by joining with lines the marks assigned for the program or institution on each axis. The complete evaluation consists of two radar graphs. The first is used to position the actions induced by sponsor programs or followed by an institution. The second is used to evaluate the results achieved by the program or institution.

If applied to a program whose goal is to sponsor projects, for example, the A would indicate its focus, i.e., the set of sponsored activities aimed at generating results by the participants. The R would indicate the set of results expected by the program. A pair of A and R graphs characterizes a sponsoring program. An example of this representation using the data from the Information Research Program of NSF [17] is illustrated in Fig. 1. An analysis of the graphs filled with data from concluded projects would denote the efficacy of the program and the adequacy of actions in relation to the expected results.

When applied to collaboration activities, the A/R evaluation is called the CA/CR framework. If applied to a higher education institution over a period of time, the CA would measure the experience or maturity the institution has on the participation in cooperation projects. This may be used to indicate whether an
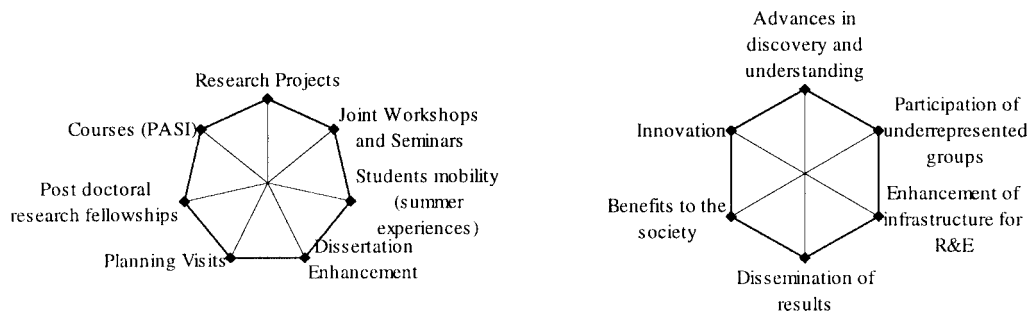
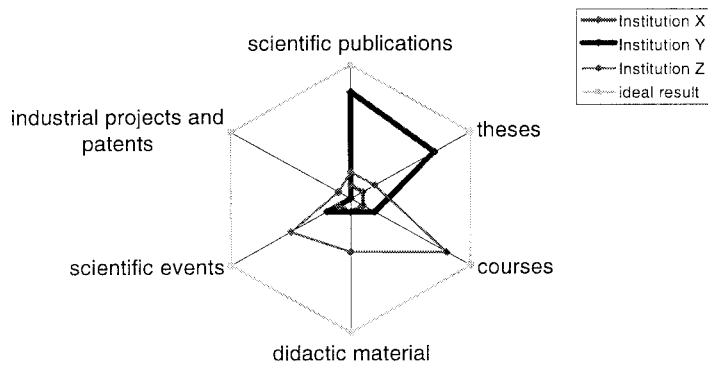Fig. 1. The A/R framework applied to the NSF/ITR Program.

Fig. 2. CR graph for three institutions.

institution is well prepared to the expected level of sponsorship it has applied to. On the other hand, the CR would provide a general view of accomplishments either related to its participation on a specific program or in general. Figure 2 depicts a CR graph comparing the results from three institutions over the same period of time using a set of variables aimed to describe academic accomplishments. It is easy to observe a weak performance in the case of institution X, and good results, though in different directions for institutions Y and Z. It can also be noticed that institution Z has relatively well-balanced results in all evaluation variables.

The key aspect of the framework is the set of variables, which represent actions and results. The purpose of the original CA/CR model was to evaluate the level of cooperation induced by sponsoring programs and produced by academic institutions. The combination of activities and results was summarized into a maturity scale similar to the CMM. Each level determines the stage in the cooperative spectrum we can position an organization when assessing its willingness towards cooperation, after evaluating its past and current experiences.

The original CA/CR framework used six variables to position the most important actions towards cooperation and other six ones to measure the results. The six CA variables were: mobility of faculty members and students, participation/organization of scientific events, interchange of students, information dissemination, organization of courses and research/industrial projects. The degrees in this case are mainly qualitative. Figure 3 shows the dimensions used in a radar graph.

The six CR variables were: scientific publications, finished thesis, taught courses, didactic material, organized events, and generated industrial projects and patents. The degrees of results are both qualitative and quantitative. Figure 4 shows these dimensions depicted in the corresponding radar graph.
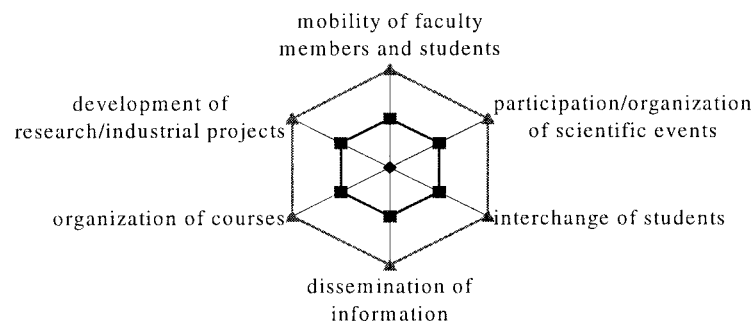
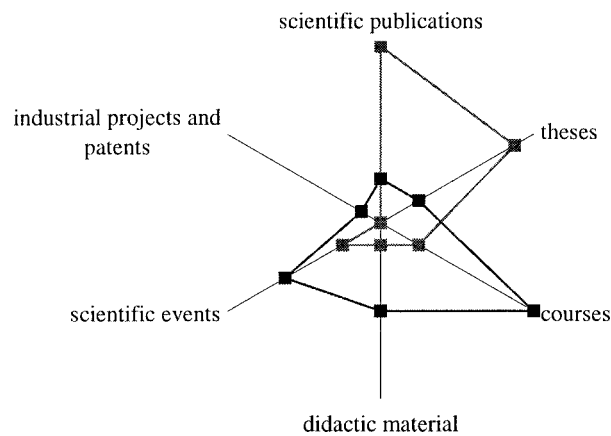Fig. 3. CA radar graph for cooperation activities dimensions.

Fig. 4. CR radar graph for cooperation results dimensions.

We use the CA/CR framework to analyze attempts during the last two decades from sponsor agencies to generate cooperation initiatives in Latin America in the context of Information Technology. We use the CA/CR to position these initiatives within the cooperation spectrum and to explain the reason for their success or failure. As we did not have access to all historical data, we focused our analyses on the actions induced by some sponsor agencies and the results achieved by selected recipients of funds from these agencies.

In some initiatives, we used the role table to categorize the main actors of a specific situation. The role in the cooperation process is an important dimension for analyzing the experiences in Latin America. The defined roles were the following ones: participant or receiver, coordinator or provider, and partner. We also defined the geographical amplitude of the initiative, as we assumed a direct relation between the amplitude and the level of cooperation. The basic role table is shown in Fig. 5a.

We first identified the promoter of the initiative. At the regional level, the promoter was typically an international organization with a regional office, such as the UNESCO Montevideo office. There was also the case of government agreements, which created programs to sponsor cooperation. This was the case of CYTED and the PABI (Argentine–Brazilian Informatics Program). Finally, there were the foundations, such as Andes-Vitae, which promote cooperation initiatives among groups in Argentina, Brazil and Chile. In most cases the promoter was also the financial sponsor of activities. There were cases however, when the promoters lend their name to the initiatives, actually working as a label.

Organization Role

	Local	Regional	World
Promoter or Sponsor			
Partner			
Coordinator or Provider			
Participant or Receiver			

Geographical Amplitude

Fig. 5a. The Basic Role Table.

At the participation level we could identify three types of predominant attitudes. An organization may be receiving the benefits of the cooperation, or may be providing the benefits or ideally, may be a partner in the cooperation process, receiving and providing benefits. In typical north-south collaboration initiatives, universities from USA and Europe play the role of providers, while South American high education institutions are the receivers. An agreement between the research councils from the involved countries provides the sponsorship.

4. Education and training

The framework can be applied to education and training in Latin America as follows. Cooperation may be understood as sharing all types of educational resources and students. The resources include physical infrastructure, library, laboratories and instructors. Sharing of students is an interesting way to make them enrich not only their thematic knowledge but also their life experiences. Nevertheless, due to practical difficulties, cooperation in resources is typically reduced to the sharing of instructors.

The cooperation role table has the receiver and provider roles. In this chapter, we interpret this as the receiver and provider of instructors, respectively. Perhaps the second organization is a stronger university in terms of teaching standards, quality, etc. than the first one and thus, it is natural that the cooperation agreement allows provision of teachers to the first one for certain periods. Note the provision of students may follow a reverse pattern: the "receiver" institution may be sending students to the "provider", e.g., to follow graduate studies.

The partnership in this case should be interpreted as the exchange of instructors (and students) among institutions in an approximately even proportion. Promoters will be institutions fostering the cooperation in education and training. Of course, the cooperation does not always need a promoter.

Universities in the LA region have always invited professors from other universities, thus being receivers in the table. The provider can be within the same country, within the region or from anywhere in the world. This activity has been very important as exemplified below.

One remarkable example of this strategy was the program giving birth to the aeronautics industry in Brazil. In the 50s the ITA (Air Force Technology Institute) hired several professors and specialists from foreign universities to teach courses there. They taught regularly at ITA for more than 15 years. This was followed by massive investment by the government in this area starting a very prosperous industry [19].

Another experience was the case of ESLAI (for Latin American School in Informatics, in Spanish). ESLAI, a specialized school in IT for LA, opened its doors in Argentina in 1987. Its mission was to provide excellence in IT education to the best students of the region. Students with two-year university studies in any scientific discipline could apply for the admission exam. All admitted students enjoyed free air tickets from their countries of origin, no tuition fees, free daily lodging, transportation and meals and a monthly allowance. Only 30 students were admitted per year. The school premises were in a beautiful mansion at La Plata (near Buenos Aires). Computer equipment was up-to-date and there was a good library. Instructors were some local teachers plus Visiting Professors from Latin America and Europe. The Argentine Government helped to finance part of ESLAI budget and the school President obtained the rest from European Governments, international organizations and companies.

The Latin American orientation of ESLAI was clear from the beginning. Both students and Visiting Professors from the region were welcome and invited to get involved. Three generations of students with 3-year concentrated studies graduated before this school had to close (the last generation had to finish their studies in a local university under agreement with ESLAI).

What went wrong with ESLAI? The economic crisis in Argentina by the late 80's associated with a change of Government caused the destruction of ESLAI. The new authorities did not have ESLAI high on their priority list. Moreover, the academic environment in Argentina was not particularly in favor of ESLAI. Why should it have a privileged status compared to other educational institutions receiving state funds? Why were ESLAI instructors paid higher salaries than teachers at other universities? The fragile arrangement supporting ESLAI was not enough to resist these pressures.

Regrettably, ESLAI was too dependent on the Argentine Government at the time it was launched and it did not have lasting positive ties with the local scientific establishment. However, its graduates are a living memory of it: many of them continued graduate studies abroad and some are now professors in the region.

In the cooperation role table, ESLAI was a receiver at the country and regional levels. It spontaneously appeared and hence there was no promoter. When things got difficult, there was no institution to keep the cooperation working. Note that this does not mean that a promoter is always needed nor that a promoter would have prevented its demise. It just means that a promoter would have helped to change the sources of financing and get good relations with the local scientific community, improving its chances of survival. Figure 5b depicts the role table applied to the case of ESLAI.

The CA/CR framework helps to analyze the ESLAI case as follows. At the local (national) level, the actions taken by ESLAI were only on the dissemination of information axis. ESLAI showed its organization, goals and achievements. These actions worked in the direction opposite to what the ESLAI executives wanted, since public exposure only increased opposition from other universities, who were worried about a special Governmental treatment given to it. At the regional and international levels, ESLAI appeared very active and its CA graph would have shown high marks in mobility of faculty members, participation/organization of scientific events, research projects, organization of courses and dissemination of information. The short ESLAI life prevents from having a significant CR graph, but at least it should have scored well in taught courses, organization of scientific events and generated didactic material.

Organization Role			
Promoter or Sponsor	Argentine Government (Sponsor)		International Organizations (Sponsor)
Partner			
Coordinator or Provider		Other LA Universities (Provider)	European Universities (Provider)
Participant or Receiver	Argentine Students (Receiver)	Other LA Students (Receiver)	
	Local	Regional	World · Geographical Amplitude

Fig. 5b. The Role Table in the case of ESLAI.

Training in Information Technology was brought about in Latin America by foreign computer companies eager to have a community of practitioners knowledgeable in using their products. For the sake of economy, most of these companies decided to create regional centers located in countries where the market had a great potential. The courses offered in these centers were intended for people from several countries in the region.

This situation perhaps encouraged international organizations such as CREI (Spanish Government Regional Center for Informatics Training), UNESCO and CYTED to sponsor other types of courses. The last two institutions sponsored courses taught by professors from the region itself. These courses created an extraordinary amplification effect. Instead of training end-users, the courses aimed at young professors from LA universities who had difficulties in accessing relevant literature and courses from North American and European universities. Besides being taught in Spanish and Portuguese, the courses have been adapted to local conditions, that is, using technology readily available in the region.

Organizers of most of these courses provide scholarships to students coming from LA countries. The main beneficiaries are young professors from the less developed countries in the region, who otherwise would not be able to attend the courses. However, the high travelling expenses are still the main obstacle to this type of cooperation in most cases. Examples of these courses are the ones supported by the UNESCO regional office: starting in 1995, there have been courses in Puno (Peru), Cochabamba (Bolivia), Quito (Ecuador), Asuncion (Paraguay) and Arica (Chile).

In addition to these courses, there are other training efforts at the national level including LA participants, for instance, the Brazilian School of Computing. This is a very successful event organized during July, every two years since 1979. Each version of the School includes courses whose careful preparation is funded. The School has traditionally allocated 10% of the places to applicants from countries in the region.

The example of the Brazilian School of Computing inspired the creation of the Brazilian–Argentine School of Computing (EBAI) under the Argentine–Brazilian Informatics Program (PABI) [18]. EBAI

has been held every two years since 1986 with similar acceptance. EBAI has recently started to register students from Chile, Paraguay and Uruguay besides those from Argentina and Brazil.

The UNESCO and EBAI efforts can easily be evaluated with good marks in the mobility of faculty members and students axis and organization of courses axis, both in the CA graph. They also get high marks in the taught courses axis and didactic material axis in the CR graph. In particular, EBAI gets an excellent mark in the preparation of didactic material.

EBAI has funded the writing of books to be used in the courses to be taught during the next version of the School. The first six editions of the School have produced over 30 textbooks covering a wide range of subjects in computer science (some of them were co-authored by Brazilians and Argentines). The monographs were published and distributed to participants and libraries of regional Computer Science Departments. Some of these books have also been commercially published and have been adopted as reference textbooks in undergraduate courses.

5. Scientific events

We have considered the organization of scientific events to be an important aspect of cooperation and thus it is incorporated into the CA/CR framework. In most countries in Latin America local conventions or conferences on IT started two or three decades ago. Eventually, these events evolved to become scientific conferences with Program Committees. They have foreign invited speakers and tutorials. A few are now international conferences with papers presented in various languages or just in English.

There have also been international events organized in the LA region, such as the VLDB conference (Rio de Janeiro, Brazil, 1979, Mexico City, 1982, and Santiago de Chile, 1994), IFORS Triennial International Conference on Operations Research (Buenos Aires, Argentina, 1987), and various IFIP meetings and working conferences.

All these events have had some degree of collaboration from people working in other countries in the region. This cooperation is shown in the participation in Program Committees, keynote speakers, referees, invited papers, etc. However, the most clear example of collaboration in scientific IT events occurs within CLEI.

CLEI is an association of LA universities and professional societies founded by researchers in 1979 [8]. From 1974 until 1979 there had been an annual conference held in Valparaiso, Chile, organized by the Catholic University of Valparaiso. The first editions of this conference were local, but recognizing the strong participation from other countries in Latin America, the delegates attending the 6th conference decided that it would be preferable to have a conference with the site changing each year. This would motivate people to organize a good conference when they had their turn and would also enhance the feeling of building a community. CLEI was initially founded to oversee the organization of this conference. All CLEI officials are voluntary persons affiliated to the institutional members.

The conference has been a sustained success. In some cases (like Paraguay in 1990), the CLEI conference was the first scientific event on IT in the country and served to put IT in the news and draw attention from local academic, professional and industry leaders. CLEI also organizes specialized workshops. It currently has 65 institutional members.

Although the CLEI conference is a Latin American event, it has always been open to participation by people from outside the region. Moreover, CLEI accepts extra-regional institutional members since 1990. CLEI is an example of a promoter organization doing work at a regional level, whereas the hosting university is the organizer of each event. CLEI can be evaluated in the CA/CR framework as follows. The cooperation actions performed by this association would be in the dimensions of participation/organization

of scientific events and dissemination of information. Its results can be measured in terms of the events held during a certain period, the taught courses and the generated scientific publications.

In recent years, especially as a result of CYTED research networks and projects (see Section 6 below), there have been several initiatives to organize international scientific events in the region. These events originated from the cooperation among research groups in the region and have become increasingly international with the participation of groups from everywhere. The most notable examples are SPIRE (String Processing and Information Retrieval – A South American Symposium), currently in its 7th edition, CRIWG (International Workshop on Groupware) in its 6th edition, and IDEAS (Software Environments Engineering) in its 5th edition, in 2000. For all these events, CYTED is the promoter. Finally, there is even an example of an international event, spontaneously created in the region: LATIN (Latin American Theoretical Informatics), a prestigious international conference.

6. Research and development

The cooperation roles in this case would be interpreted in a somewhat similar way to Education and Training. The sharable resources typically are researchers. Therefore, receivers and providers are institutions accepting researchers in their premises and organizations letting them to be away for some time, respectively. Partners would be organizations accepting and providing researchers in an even way. Usually research cooperation is considered in the context of joint projects, and the roles may also be defined in terms of which research group participates in minor tasks within the projects (receiver), which research group takes the leading activities (providers), or researchers participating in an equal-to-equal set of projects (partners).

All countries in the region have at least one Government office in charge of locally coordinating and fostering scientific research. Many have bilateral agreements with offices in other countries; mostly with developed countries from outside the region. This office then assumes the promoter role at the country, regional or international level.

An example of official endorsement to projects among countries in South America is the program to support joint research that has private foundations in three countries: Fundacion Andes (Argentina), Vitae Foundation (Brazil) and Fundacion Andes (Chile). The funds available are mostly intended to cover travel expenses for cooperation meetings among involved researchers.

The Governments of Argentina and Brazil have had a program to support IT research projects by researchers of both countries under PABI. The best-known case was the ETHOS project [25], related to the design of workstations oriented to the construction and use of software development environments.

UNESCO regional office in Montevideo, Uruguay [26] has supported IT projects presented by researchers from more than one country in LA. Again, seed funds have been provided mostly to cover travel expenses.

Both UNESCO and PABI can be evaluated using the CA/CR framework along various axes of the CA graph: organization of courses, dissemination of information and development of research projects. The CA/CR graphs for the PABI case are presented in Fig. 6.

Considering now the dissemination of information, we notice that the initial basis for any sort of cooperation is the information the potential collaborators must have about each other's activities. Conference proceedings, scientific journals and technical reports are important sources to know subject areas and achievements of research groups. This information must be complemented with face-to-face meetings, informal talks and informal data.
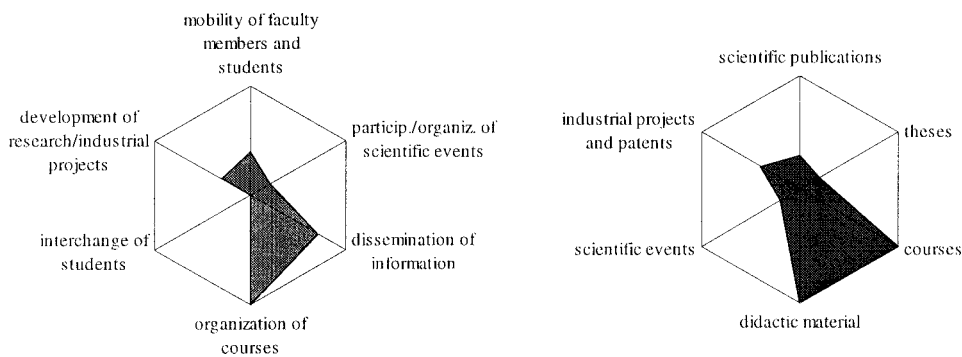
Fig. 6. The CA/CR framework applied to the PABI Program.

Recognizing this issue, CLEI was initially oriented to promote events that could disseminate information among local research groups, both in the form of gathering people and distribution of locally produced literature. Examining the proceedings of the CLEI conferences one could have a very good idea of potential collaborators for a research project in computer science. The CLEI annual conference has been for many years the only way of assessing the regional scientific production and to know who was doing what in Latin America.

Concerning journals, their regular publication usually gives a hint on the maturity of a scientific community. A good test on the stability of a journal is to check the current volume number, since a high number of journals do not survive after the first few issues. Some scientific journals have been published in the region, mainly in Portuguese and Spanish. Most editorial boards include researchers from various countries in Latin America. They also normally have Board members from North America and Europe who can read one of these languages. There is only one International Journal regularly appearing for more than five years, funded by CNPq. It is the Journal of the Brazilian Computer Society, published in English, with an international Editorial Board.

Recently, due to the facilities provided by the Internet, CLEI has started the publication of an International Electronic Journal maintaining the spirit of Latin American cooperation [8]. However, being an electronic publication, it has yet to attract strong interest from authors, who may prefer to seek recognition in conventional journals. Again, this effort strengthens CLEI marks on the CA dissemination of information axis and CR scientific publications axis.

7. CYTED: Case STUDY

The most interesting experience to promote joint applied research in LA has come from Spain. The Spanish Government decided to offer a gift to Latin American countries to commemorate five centuries of the Discovery of America. It created CYTED (Science and Technology for Development) in 1984 [9]. The idea was to provide seed money for researchers from LA, Spain and Portugal to meet each other and develop joint research projects. These projects will eventually be further developed by companies from the region to finally benefit the common citizen.

CYTED is currently an International Program created to induce Scientific and Technological Cooperation in Ibero-America (19 Latin American countries plus Portugal and Spain). Its main mission is to promote the integration of scientific and technological community in the region through the exchange of knowledge and techniques. CYTED has a minimal bureaucracy: a General Secretary and a business

office in Spain. The Council is composed of representatives from the governmental research offices of all participant countries. Its annual budget ranges between US$ 5 and 7 million.

The program is organized in thematic areas. Currently, there are six active areas: science and technology policy, environment, energy, materials, food and health, telecommunications and information technology, the last being responsible for over 20% of the activities. CYTED activity is performed by its subprograms (each coordinated by a voluntary researcher). There are 16 subprograms currently active [10]. Subprogram VII is in the area of IT and automatic control.

Each subprogram supports three types of operations:

– contact networks, aimed at facilitating contacts among research groups from different countries;
– research projects aimed at generating scientific and technological outcomes, such as publications, prototypes, etc; and
– innovation projects focused on industrial cooperation. Since the beginning of the program, CYTED has sponsored 76 networks, 95 research projects and 166 innovation projects.

The contact network is a kind of pre-cooperation activity. Assuming that many groups in the region do not know each other, the networks are aimed at gathering research groups (at least 6 groups from different countries) around a theme in order to generate joint activities, possibly producing research projects. Three contact networks on IT subjects were important in Subprogram VII: RITOS (in software technology) [22], RICOTEL (in communications technology) [21] and RIBIE (in IT applied to education) [20].

The Contact Networks have been successful in allowing people to meet and start joint activities. A few researchers attend meetings accepting the corresponding invitation, but then they realize they have to dedicate time to work with others and subsequently abandon the Network. As cooperation requires an open and participatory attitude from group members, networks also serve as a selection process. It is common for a network to have a high turnover throughout its 4 years or more of existence, due to many reasons, including the lack of cooperation posture and the expected generation of projects. However, most researchers find beneficial the opportunity to collaborate with colleagues from other countries as beneficial and are enthusiastic about it.

The CYTED Contact Networks have not only allowed people to meet but also have organized scientific events and offered free specialized courses to junior faculty members of universities in the region. For example, the RITOS network has organized the first editions of an international workshop on CSCW [13] and advanced courses in a number of places with multi-national attendance of 50–80 students in each case.

In relation to our ITLA CA/CR graph, a network sponsors four types of activities (mobility of faculty members and students, participation/organization of scientific events, information dissemination and organization of courses), but the main result expected for a network is the generation of research or innovative projects. Of course, other activities, such as courses and publications are generated, but they do not constitute the main objective at that point.

After the people participating in CYTED Networks have become acquainted, they can mature and submit applied research project proposals to CYTED itself. CYTED requires that groups participating in a research project have already financed their research activities locally, i.e., CYTED does not fund the project itself but only interaction activities. Its main induced action is the mobility of faculty members and students from participating groups. Joint scientific publications, theses, courses, scientific events and didactic material have been generated. A comparison of induced actions from each activity is shown in Fig. 7. We can easily note the different orientation of actions for contact networks and research projects.
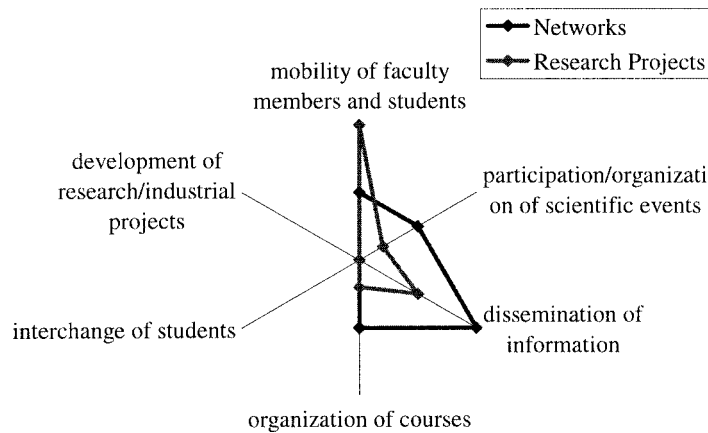
Fig. 7. Radar graph for CYTED induced actions.

Examples of research projects in the IT Subprogram are: SISCO (support for pre-meetings) [24], AMYRI (information retrieval for the WWW) [1], IDEAS (software environments) [15], and SIMHI (educational applications of multimedia) [23]. All projects generated several international publications, theses, courses, scientific events and, most importantly, long lasting relationships.

The 1998–99 CYTED report [12] shows a very large number of activities carried out within the sponsorship of the Cooperation Program. With a relatively small budget of about US$ 4.5 million, the program supported over 2,000 research and development groups in Latin America.

The innovation projects started in 1991 and over 200 projects have been created since then. CYTED provides its label IBEROEKA, a necessary condition to obtain funds from local sponsors associated to the program, and in some cases, seed money to fund coordination activities during the formulation of the project. The funding from local sponsors varies according to the research and development policy of each country. Usually, sponsorship is provided by means of loans with low interest rates and a grace period. An innovation project requires the participation of companies from at least two countries and its main goal is a product, a process or a service, carrying technological innovation and, of course, with a potential market value. Cooperation in this case has various motivations. It can be, for example, the combination of expertise to generate a new product or a participation in a joint venture in new markets.

The success of CYTED program has motivated LA Governments to commit themselves to partially finance it to keep it working. In particular, the Iberoamerican Summit of Heads of States has explicitly stated its support each year since 1992 [11]. It can be analyzed with the CA/CR framework showing that promotion can be left to a lean multi-governmental agency, which does not get involved in the details of the joint projects, letting the researchers themselves to present projects and the roles they wish to take. As it was mentioned, some researchers might even opt to assume no role, leaving this type of cooperation to others.

8. Discussion

The CA/CR framework has been used to show how the collaboration instances in IT in Latin America could be evaluated. It illustrates how multi-criteria evaluation can be used to assess the value of several initiatives both from the viewpoint of an organization doing such cooperative ventures and that of a sponsoring or promotional institution. The framework may be useful in several situations. One may

be that of a university self-analyzing itself in its competitive environment and studying how to benefit from cooperation efforts. Another is the case of a funding organization evaluating the suitability of an institution applying for a cooperation project. A third case is that of a sponsoring organization measuring the effectiveness of the cooperative projects it supported [2]. Comparative analysis is also possible, as can be seen in Fig. 3.

The examples presented in this paper do not probably cover all the IT cooperation efforts attempted in the LA region. As it was mentioned in Section 1, there is lack of knowledge concerning successes and failures. The described cases may help to fulfill this need. Furthermore, any organization claiming success in its cooperative efforts can use the framework to substantiate its achievements.

The role analysis of Fig. 4 is interesting as well. An institution always playing the receiver role may find that a provider or partner role may bring new kinds of benefits in future projects. The geographical dimension also has benefits and complexities to discover. Finally, as it was mentioned, the promoter role may be very important, as the ESLAI case shows.

9. Conclusions

Institutions doing academic work in IT can certainly benefit from collaboration with similar entities in other LA countries. There have been some instances of such joint work in various aspects in the last two decades, but there is still ample space for new cooperation ventures.

Some of the successful examples of collaboration follow the pattern of having highly motivated individuals wishing to achieve something and some small financial support from Governments or international organizations. Such are the cases of CYTED, EBAI and IBEROEKA. Other examples show that even with little or no financial support something can be done, as proved by CLEI and the Journal of the Brazilian Computer Society.

Governments and organizations in the region could learn from these experiences and from the unsuccessful ones (such as ESLAI) to assign budgets only when there are clear goals, sustained activity, motivated groups of people involved in the attempt. Some cases also show the possible need of a promoter or sponsor and insertion in the local community.

The CA/CR framework helps to understand the successes and failures in the past. However, the most important contribution is to aid the generation of cooperation programs from sponsoring agencies. It should also serve to compare the focus of different sponsors.

10. Acronyms

AMYRI	Information Retrieval for the WWW Project,
A/R	Actions/Results Evaluation,
CA/CR	Cooperation Actions/Cooperation Results,
CLEI	Association of Latin American Universities in Informatics,
CMM	Capability Maturity Model,
CNPq	Brazilian Research Council,
CREI	Spanish Government Regional Center for Informatics,
CRIWG	International Workshop on Groupware,

CSCW	Computer Supported Cooperative Work,
CYTED	Science and Technology for Development Program,
EBAI	Brazilian–Argentine School of Computing,
ESLAI	Latin American School in Informatics,
IBEROEKA	Ibero American Applied Projects (of CYTED),
IDEAS	Software Environments Engineering Project,
IFORS	International Federation of Operational Research Societies,
IT	Information Technology,
ITA	Air Force Technology Institute – Brazil,
LA	Latin America,
LATIN	Latin American Theoretical Informatics Conference,
NSF	National Science Foundation – USA,
OAS	Organization of American States,
PABI	Argentine–Brazilian Informatics Program,
RIBIE	IT applied to Education Contacts Network,
RICOTEL	Communications Technology Contacts Network,
RITOS	Software Technology Contacts Network,
SISCO	Support for Pre-Meetings Project,
SPIRE	String Processing and Information Retrieval Symposium,
UNESCO	United Nations Education, Science and Culture Organization,
VLDB	Very Large Data Bases.

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