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# The Experience Of Technological Collaborations By Mercosur Companies

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## I. INTRODUCTION

It is increasingly being acknowledged that firms' ability to exploit new technologies and innovate is contingent upon the interactions and relationships they build with other firms. The main purpose of these interactions and relationships is to exchange information and knowledge. These interactions or technological collaborations have grown in significance in recent years. Although not new, there has been an increase in the number of agreements, the range of industrial sectors involved and the amount and kind of international technological alliances (Chesnais, 1996; Coombs et al. 1996).

This paper aims at examining some of experiences in information and knowledge sharing involving developing country and especially MERCOSUR (Argentina, Brazil, Paraguay, Uruguay and Chile as an associated member) firms, trying to understand *their rationale, development and the benefits they bring* to the firms involved. A special concern will be the role of factors 'external' to the firm that seem to be particularly important in initiating technological collaborations in the developing country context. Much has been done in advanced countries to study technological collaboration agreements under the heading of strategic technological alliances, particularly with regard to firms' motivations in entering agreements, the evolution and learning processes involved in collaborations and the effects and outcomes of the cooperations (Contractor and Lorange, 1988; Harrigan, 1985, 1988; Hagedoorn, 1993; Hagedoorn and Schakenraad, 1994; Senker and Sharp, 1997). To our knowledge, however, there are few studies on technological collaborations involving MERCOSUR firms. The paper will also attempt to suggest some public policies aimed at enhancing technological collaboration by companies in MERCOSUR countries.

The study will be based on the analysis of eleven collaborations in nine enterprise-based case studies compiled over time by two of the authors and their colleagues at the University of Sao Paulo and existing research and available data (see Appendix). It would have been ideal to have a database on technological partnerships in the MERCOSUR region as the ones existing in some developed countries, so that proper descriptive and statistical analysis was carried out, but lack of empirical data of this kind is a known limitation in the region.[1] Therefore, it is hoped that this paper will also encourage further empirical efforts in this direction. It must be pointed out, however, that case studies, have the virtue that they provide information and insights that are normally lost in theoretical constructs and their measurements and allow to explore better patterns of causality and interaction (Hamel, 1991).

The paper will develop in five sections. After this introduction the section that follows will draw on the literature to discuss the role information and knowledge exchange in the innovation process and the development of collaboration agreements. We will then set the overall context of innovation and technical change in MERCOSUR, which tends to be very different from that in developed countries where most of

[1] Notably at the Maastricht Economic Research Institute on Innovation and Technology (MERIT) in the Netherlands, at Itsunami Inc. in the state of California in the US or at the Laboratoire de Recherche de Economie Appliquée (LAREA-CEREM) in France.

the collaborations are taking place. The fourth section of the paper will examine the experiences of technological collaborations by MERCOSUR companies through the analysis of some of the key dimensions in their evolution. The paper will end with some conclusions and policy suggestions.

## II. ANALYTICAL FRAMEWORK AND BASIC CONCEPTS.

*Why and what are technological collaborations?*

Inter-firm co-operation agreements or *technological collaborations* can be defined as understandings between corporations aimed at generating and exchanging information and knowledge for innovation. Technological collaboration involves a two-way flow of information, with each firm bringing into the relationship its resources and competencies. Thus, they do not include technology licensing agreements because they are mainly unidirectional, from licenser to licensee. They do include agreements made to address a common technological problem, as the resolution to the problem should eventually result in an organisational or process modification. Technological collaborations can be 'strategic' when they share common overall research and development objectives and approaches and is open-ended in terms of its time span or 'specific' when the objective is a predetermined product or process and the collaboration only lasts until the objective is achieved. The intensity of co-ordination, consultation and interdependence, therefore, varies accordingly. Agreements can be put into effect through a variety of mechanisms, ranging from an informal agreement, a simple memorandum of understanding to a joint-venture and can involve two or more enterprises. Hence, they do not necessarily involve alternative organisational or contractual arrangements nor equity partnership.

Technological collaborations arise from the need for an interactive exchange of information and knowledge that underlies innovation and technical change and is the result of the continuous creation of very *specific knowledge* at each stage of the process. The knowledge generated at the design stage is often similar to pure academic science while the knowledge generated at the development stage is more of a 'systems' nature in the sense that the main concern is how components interact and the 'whole' performs (Kline and Rosenberg, 1986). Indeed, knowledge specificity need not be circumscribed to different stages within an individual firm but could also come from other firms or institutions. Only through the mutual exchange and accumulation of the often dispersed information can alternative designs of new, and improvements and adaptations of existing, products and processes be achieved.

The functional importance of interaction is further highlighted by the *tacit* nature of some of the knowledge generated during the innovation process (Senker and Faulkner, 1996). Tacit knowledge implies the understanding of the ways techniques, methods, processes and designs work and of their consequences without being able to explain why. It typically arises out of the complexity of the analyses involved and the

constant resorting to practical experimentation and testing which characterises innovation.[2] Thus, tacit knowledge cannot be easily formalised nor transmitted in written form making it virtually impossible to make it subject to a contract (Yamin, 1996). It can be codified through research and replication until the underlying principles are understood, but in doing so new tacit knowledge is created. Transmission takes place mainly through demonstration and discussion (Foray, 1997).

An additional factor underlying technological collaborations emerges from the fact that innovation is a process that necessarily involves *complementary* technologies. In Rosenberg's (1982) words:"...Technologies depend upon one another and interact with one another in ways that are not apparent to the casual observer, and often not to the specialist." (pg. 57). Following Milgrom and Roberts (1990), complementarities can be said to exist if any additional knowledge of one kind increases the marginal return of any other knowledge brought into the collaboration. Complementarities arise out of the technological and economic 'interdependencies' or 'interrelatedness' that emerge during the innovation process (OECD, 1992; Rosenberg, 1982).

*Factors behind the recent upsurge in technological collaborations.*

One of the most important factors underlying the recent growth of technological collaborations is the rapid development and diffusion of *new 'generic' technologies* (Freeman, 1991).[3] Since the mid-seventies the world has been facing the emergence of technologies such as information technology, biotechnology and new materials that are deeply affecting the innovation process. These technologies are pervasive in the sense that they affect the 'conventional wisdom' and day to day practices of engineers, managers and designers in all sectors of the economy as well as in their intersectoral relationships. They also affect every function of the firm. The upshot of these new technologies is that product research and development requires a considerable backlog of knowledge in, and the integration of, 'old' disciplines including physics, chemistry, mathematics, electrical and mechanical engineering together with 'new' ones such as computer science and electronics (Mody and Wheeler, 1990). This, in turn, increases the demand for complementary knowledge and skills. It also involves the creation of 'radical' or 'never-before-seen' products that are in the technological frontier which not only require an even larger scientific input but also much more experimentation and trial (Kline and Rosenberg, 1986). These products are also technically more complex in the sense that they require more components and parts and therefore are more difficult to design and build. In addition, the life cycle of many products is said to have shortened due to intense competition, adding pressure on firms to come up with new products much more quickly (Stalk, 1991).

[2] Senker and Faulkner (1996) argue that because of the tacit nature of knowledge technology transfer agreements always involve secondment and training of personnel.

[3] Drawing on the MERIT-CATI database, which records both single and bi directional agreements, Hagendorn and Schakenraad (1990) and Narula (1996a; 1996b) point at a threefold increase in technological agreements over the last few years, from around 220 agreements in 1980 to more than 670 in 1994. Around 40%, 20% and 10% of all the agreements were in the information technology, biotechnology and new materials fields respectively.

Many firms just do not have the technical competencies nor the human, material and financial resources to engage in all of these kinds of activities.

There is yet another closely related reason for the increase in technological collaboration, namely, the *higher uncertainty* attached to present day innovation. As Kline and Rosenberg (1986) point out, because innovation implies creating novelty it is always uncertain whether a new product or process can be produced at all and at what cost, whether it can be produced with the desired technical or functional properties or whether it will be accepted by the market. It is true, of course, that the degree of uncertainty will also depend on the extent of the innovation. In the cases of minor innovations, which imply small transformations of the characteristics of existing products and processes, the risks of failure are modest. But where 'radical' innovations are involved, as those that are emerging today, the uncertainties are obviously much higher. By sharing risks with other firms, any one firm's own uncertainty and risk could be reduced, making innovations, even of the 'radical' kind, much more attractive.

*The development of technological collaborations.*

Technological collaborations are as much an agreement as a learning process, and a very draining one, between companies (Doz, 1996; Hamel, 1991; Spekman et al, 1996). Technological collaborations progresses through *formative or inception, implementation and consolidation stages or phases* (Spekman et al, 1996). During the formative stage the objectives and vision of what is to be achieved begins to be shaped by the potential partners, the technological and economic risks and benefits analysed and the decisions about the mode of governance taken. The implementation phase involves the actual operation of the collaboration. It requires the allocation of the necessary human, material and financial resources; the establishment of joint working arrangements, methods and assessment procedures; and, the management of the personal and institutional relationships, conflicts and problems that emerge during the interaction. At the consolidation stage a major review of the achievements and problems is made. The decision to continue, in which case new and perhaps longer and closer implementation and consolidation phases begin, or to terminate the collaboration is taken at this stage. Termination does not necessarily mean failure as it could well be that the expected new knowledge has already been created or a new product launched into the market and therefore it is not necessary to continue the partnership (Harrigan, 1986). There is an implicit time framework in the agreement.[4]

During these phases in the development of a collaboration learning takes place through a sequence of learning-revaluation-readjustment or learning cycle combining *a set of initial conditions and a number of learning dimensions* (Doz, 1996). The initial conditions include the definition of the tasks to be performed, the procedures to perform them, the interface or mode for performing them and the expectations on the outcome. It is crucial that they are well defined as not doing so could put the collaboration in jeopardy or

[4] Harrigan (1986) shows that most technology cooperation agreements tend to be of *limited duration*. Around 50% of agreements considered successful by partners in the US are terminated in less than four years. Narula (1996b), quoting Business Week, points at a failure rate of 70% in all international cooperative agreements.

difficult learning. Hamel (1991) adds that it is also key that partners have the same intent of learning as asymmetries in the propensity to view collaborations as opportunities for learning may result in unequal knowledge accumulation.

Over time learning is expected to occur on the environment the collaboration is facing, on the way the tasks are being performed, on the similarities and differences in procedures and organisations, on the actual skills each partner has and on the attitude of partners towards the goals of the collaboration (Doz, 1996). Through a process of cognitive and behavioural learning and revaluation, or unlearning in certain cases, partners modify or improve on their initial conditions and trigger a virtuous evolutionary path for the collaboration or frustrate it. Transparency or openness and receptivity to information and knowledge exchange by partners underlie this process and are key to ensure each and all the dimensions of learning are 'appropriated' by both sides (Hamel, 1991).

Whether the learning cycle is completed also depends on the continuous assessment and readjustment with regards to three criteria: efficiency, equity and adaptability (Doz, 1996). Efficiency refers to whether the collaboration is actually adding value to the partners, equity to whether both partners feel they are being fairly treated and adaptability to whether each partner is perceived to be adapting to the other. On the whole, the success or failure of a collaboration is conditional on fully completing the learning cycle.

To sum up, technological collaborations arise out of three interrelated dimensions of the information and knowledge that flow during the innovation process, namely, specificity, tacitness and complementarity. The outcome of the interaction of these and the codified dimension of knowledge is cumulative, in that innovation results from the often slow summation of minute pieces of information and knowledge. Available innovations, in turn, are the basis for the generation of more information and knowledge and hence a dynamic or 'snow-ball' process arises (OECD. 1992; Rosenberg, 1982). Technological collaborations vary widely in their intensity and forms but they must involve a two way flow of information. Their recent unprecedented growth is accounted for by the emergence of new generic technologies, such as information technology or biotechnology, which open immense possibilities for the generation and development of new products and processes and the growing research and development costs and uncertainty attached to these new technologies. Technological collaborations are as much an agreement as a phased learning process between firms.

## III. INNOVATION IN MERCOSUR COUNTRIES

### III.1 Main Characteristics.

One of the main characteristics of MERCOSUR countries' total innovation effort is a relatively low level of aggregate expenditure in research and development (R&D) 'inputs'. Although increasing, R&D expenditure in Brazil in 1995 amounted to US$ 6bn, around 0.9% of GDP (INOVA, 1997). Estimates for Argentina's R&D expenditure amounted to around US$ 760mn or 0.3% of GDP in 1995 while Uruguay's

R&D expenditure as percentage of GDP was 0.6% in 1991 (Alcorta and Peres, 1996 and Chudnovsky and López, 1996). Chile, spent in 1992 around US$ 269mn in R&D or 0.7% of its GDP. By contrast, the world total R&D expenditure over GDP was 1.8% in 1992 while the equivalent average ratio for Hong Kong, Malaysia, Singapore, South Korea and Taiwan amounted to 1.3% (UNESCO, 1996).

The second characteristic is the relatively 'unbalanced' distribution of the innovation effort. Take the share of public R&D expenditure first. In Argentina, around 80% of total expenditure is accounted for by the public sector, most of which is spent by universities (Chudnovsky and López, 1996). In Brazil the situation is not very different with around 78% of total expenditure in 1995 being accounted for by the state (INOVA, 1997). The equivalent ratio is 43% in OECD countries and 36% on average for Hong Kong, Singapore, South Korea and Taiwan. Consider also the sectoral distribution of R&D (Alcorta and Peres, 1996). In Brazil, only 12% of total R&D expenditure was in manufacturing sector while 55% was in natural resources and agriculture and 33% in services. In Argentina, only 4% of R&D expenditure was in manufacturing while 64% was in natural resources and 32% in services. In both cases the share of manufacturing R&D expenditure in total R&D was far lower than the share of manufacturing in total GDP and lower than the equivalent ratio in OECD countries. Take finally the expenditure in experimental development as opposed to basic and applied research (Alcorta and Peres, 1996). In Argentina in 1992 only 6% was spent in experimental development while in South Korea the equivalent figure the same year was 61%.

The third characteristic relates to the access and use of foreign technology. Since the seventies MERCOSUR countries, particularly Brazil, while welcoming foreign direct investment have been growingly restrictive of foreign technology transfer (Dahlman and Frischtak, 1993). Limitations were set on the imports of capital goods, technical co-operation agreements and licenses of goods and technologies competing with local ones. Royalty payments were also restricted. Total payments for technology transfer amounted to US$2.4 bn between 1979-1989. Annual payments have been falling consistently and nearly halved from 1979 to 1989 as restrictions on foreign outlays increased. Since the early nineties limitations have been significantly eased but technology payments abroad have not increased but remained stagnant due to financial constraints and a continuing reduced demand for foreign technology.

### III.2 The Technological Effort of MERCOSUR Companies.

The relatively modest effort at innovating is also reflected at the firm level. The small participation of the private sector in financing aggregate R&D expenditure discussed above is a first suggestion of such conduct. But there are other indications too. Perhaps the best one is Matesco's (1994a, 1994b) research on the technological effort of Brazilian firms. Being Brazil the most technologically advanced country in the region the study should provide an idea of the upper limit in innovation efforts. The research was based on the 1985 economic census and focused on 59,994 enterprises selling over US$ 40,000 per year. These enterprises employed 4.8 million people and had overall sales of US$199.1 bn that year. The main

conclusions were that only 3.5% of the firms had any R&D expenditure, a total of 2,117 firms. Within them there were 89 public enterprises of which 17 were innovators. R&D expenditure was concentrated on the largest firms and amounted to 0.4% of total sales. The average R&D expenditure over sales for the whole sample was 0.08%. For reference, that same year the average R&D expenditure over sales by US, French and German firms was 3%. South Korean manufacturing firms R&D expenditure over sales was already 0.5% in 1980 and increased to 1.9% in 1992 (OECD, 1996). Half of the firms that had any expenditure in R&D operated in mechanical engineering and chemicals. Only 413 firms made payments for technology transfer, which amounted to a total of US$30 mn. On the whole, with very few exceptions, firms were not improving their innovative capabilities and the majority of firms had no innovative capacity at all.

Dahlman and Frischtak (1993) reached similar conclusions for Brazil. They found that firms declaring R&D expenditure in their income tax returns fell from 1050 in 1976-1977 to 780 in 1981-1983, and recovered to 1095 in 1985. R&D expenditure over net revenue increased from 0.2% in 1983 to 0.4% in 1985. Expenditure was highly concentrated in state enterprises (62.6%), with eight firms accounting for more than 50%. In addition, about 25 private industrial groups were responsible for 17.4% of R&D expenditure.

There are no accurate recent estimates as to how much private firms spend on innovation. The most recent estimate was made by the National Association of Research Firms (ANPEI) based on a survey of private and public firms that had research and development activities in Brazil in 1995. Most firms that have R&D expenditure are included. The survey found that in the 573 firms surveyed total expenditure on research, development and engineering was US$2.7 bn, of which US$1.9 bn were current expenses (Table 1) and the rest was on capital expenditure. These oulays amount to 0.4% of GNP suggesting that overall private R&D expenditure may be growing but it may be concentrating in even fewer firms. Indeed, the majority of industrial firms do not seem to be concerned with acquiring new knowledge and innovating but at best improving their microeconomic efficiency. A study of industrial companies by CNI-SENAI (1996) found that 43% of firms sought information on financing, 35% on manufacturing process/quality control/organisational management, and 33% on equipment and machine suppliers.

**Table 1:Current Expenditure in Research, Development and Engineering in Brazil, 1995**

(US$ mn and number of firms)

| Items | U$ mn | Number of Firms |
|---|---|---|
| R&D | 1,095.3 | 573 |
| Technology services | 281.5 | 570 |
| Technology Acquisition | 204.5 | 572 |
| Non-Routine Engineering | 340.5 | 572 |
| Total R&D&E | 1943.2 | 573 |

Source: ANPEI's Database, 1996., p. 12.

It is worth stressing, however, that research on innovation by MERCOSUR firms has also identified a few public and private firms which on the basis of the adaptation of foreign technology and own technological efforts have been able to innovate. In Argentina, a well-known case is Aluar S.A., a locally owned aluminium making company which has made significant inroads into the international aluminium market (UNCTAD, 1993). Another case worth mentioning in Argentina is Laboratorios Beta S.A, a locally owned company that has developed its own internationally patented insulin production process and is now exporting the product to other Latin American countries and Europe (Waissbluth et al, 1992). A third case is Acindar, a steel manufacturer known for 'stretching' the productive capacity of outmoded technology to levels of state of the art plants elsewhere (Maxwell, 1987; Katz, 1987). In Brazil a good illustration of an innovative firm is Metal Leve S.A., a piston manufacturer and exporter that has developed its own R&D facilities and opened manufacturing and R&D facilities in the US (Dahlman and Frischtak, 1993; Stal, 1993). A second case is USIMINAS, a large steel manufacturer well known for 'stretching capacity' to international frontier levels on the basis of own research and development (Dahlman and Fonseca, 1987; Katz, 1987). Another often mentioned case is EMBRAER, a now privatised small aircraft manufacturer successfully competing with US, Canadian and European firms in the commuter plane market world-wide (Sbraggia and Terra, 1993). In Chile, a renowned case is that of BIOS Chile I.G. S.A., a biotechnology company dedicated to research, development and manufacturing of pharmaceutical products. With the help of genetic manipulation the company has already patented or is developing monoclonal antibodies for use in pregnancy prognosis kits, hepatitis vaccines and hormones for use in kidney dialysis. The company offers technical services in its field and is exporting its products and services to the US and other Latin American countries (Waissbluth et al, 1992). In Uruguay, Julio Berkes S.A. is a medium scale mechanical engineering company producing industrial boilers that has developed a technique for using solid fuels in its boilers. The innovation is being widely used in the sugar, rice and Soya based industrial processes in Uruguay and Paraguay (Waissbluth et al, 1992).

### III.3 The Extent of Technological Collaboration by MERCOSUR Companies.

There are no estimates of domestic or international collaborations in MERCOSUR. To have an idea of the extent of international technological collaborations it will be necessary to make use of data available internationally. According to Narula (1996b), drawing on the MERIT-CATI database, the share of developing countries' and Eastern European firms in total international technological agreements increased from 3.4% in 1980 to nearly 13% in 1989 only to fall to around 7% in 1994.[5] This suggests that despite the significant increase in later years, they still remain relatively minor partners in terms of technological collaborations world-wide. Furthermore, there are important differences within developing countries and

[5] The MERIT-CATI database include 10,000 agreements involving 3,500 different parent companies. The main sources of information are the business press and journals, company annual reports and company directories and yearbooks. The focus is agreements that involve technology and the types of agreements included are multidirectional, including joint ventures, joint research companies, joint R&D, technology sharing agreements and cross-equity investments; and unidirectional, such as second sourcing, customer supplier relations and technology licensing.

Eastern European firms, with firms from East Asian newly industrialised countries and China increasing from three agreements in 1980 to 24 agreements in 1988 and then falling to 20 agreements in 1994. Eastern European firms had no agreements in 1980, grew to 42 in 1989 and fell back to eight in 1994. Latin American countries' firms increased from two agreements in 1980 to 13 agreements in 1988 but fell to seven agreements in 1994. Altogether, 50% out of the 391 agreements in which developing countries' and Eastern European firms participated were accounted for by East Asian NICs and Chinese firms, 33% by Eastern European firms, 18% by Latin American firms and 5% by firms from other developing countries.

The relative low share of technological collaborations by Latin American countries overall, and MERCOSUR in particular, is confirmed by data on technological collaborations on information technology alone.[6] Out of 23,802 information technology agreements world-wide between 1984 and 1994, reported by Vonortas and Safioleas (1997), 2,361 involved developing countries or Eastern European firms. Agreements involving Asian firms, mainly from China, Hong Kong, Taiwan, South Korea and Singapore, accounted for 61.6% of all collaborations on information technology involving developing country firms. Eastern Europe and former USSR accounted for 21.2% of the agreements while Latin America accounted for 15.5%. Within Latin America, Brazil accounted for 3.4% of the agreements and Argentina for 1.8%.[7]

## IV. MERCOSUR FIRMS' EXPERIENCE WITH TECHNOLOGICAL COLLABORATIONS .

### IV.1 Sectoral, Firm Size and Country of Origin Considerations.

The case studies suggested that unlike most of the experiences recorded in the literature technological collaborations by MERCOSUR firms' were concentrated in *medium to low tech sectors or in relatively less advanced technologies*, such as garments, mechanical engineering or at the lower end of pharmaceuticals and biotechnology. This sectoral pattern mirrors to a significant extent the aggregate pattern of specialisation where most of the innovative effort is focuses on the mechanical engineering and chemical industries.

Three collaborations involving, Freios Varga and Metal Leve, perhaps among the most successful firms in the region in terms of technological achievement and international competitiveness, are vehicle component manufacturers.[8] Yet, it is not in the mechanical engineering industry but in biotechnology and

[6] Data based on the Information Technology Strategic Alliances (ITSA) database compiled by Itsunami Inc. Like the MERIT-CATI database, this one is also built on the basis of newspapers and trade magazines. Definitions on what a collaboration or a 'strategic alliance' is, however, vary as ITSA includes all kinds of mergers and acquisitions, joint ventures, R&D agreements, licensing, equity investments, contractual agreements, standards coordination agreements and university-industry cooperation agreements.

[7] The ITSA database divides the data into eight industrial groups: computers, telecommunications, consumer electronics, media, electronics, office automation, industrial automation and finance/banking/insurance. Computers accounted for the largest share of collaborations in the worldwide sample but was second in the developing countries sample, where telecommunications was by far the most important industrial group.

[8] Freios Varga was listed among the leading Latin American corporations in a recent survey by Business Week (Business Week, 1997).

information technology where the most significant technological advances and innovations are taking place world-wide. The mechanical engineering industry is increasingly resembling commodity producing industries such as petrochemicals, steel and edible oils, where profitability depends on maximising volume and there is with a few exceptions, little scope for innovation or for heavy premiums to brand or quality differentiation (Alcorta, 1997).[9] As far as information technology and the electronics industry are concerned, MERCOSUR's firms would seem to be passive recipients of knowledge. Where electronics industry joint ventures have been established between Brazilian firms and a foreign partner, they have been mainly aimed at obtaining market access by the foreign partner (Dahab et al, 1993). In these partnerships, local MERCOSUR firms have played little role in creating new products and processes.

Technological collaborations by MERCOSUR firms in the biotechnology and pharmaceutical areas also seem to be few and apparently not in frontier areas. Judging by the overall small number of international technological collaborations involving MERCOSUR firms, even if all of them would be in biotechnology, they would still pale in comparison with the number of collaborations by firms in advanced countries and in East Asian or East European countries. In our own sample, five of the case studies involved biotechnology related collaborations. They included some of the most capable local firms in the field. Three of them, the collaborations between Sementes Agroceres and Biótica, between Biobrás and Eli Lilly and between Vallée and Vetcorp and Vallée and International Health Corporation (IHC) were in traditional areas of biotechnology such as micropropagation and use of living organisms for insulin extraction, i.e. did not involve genetic manipulation. As to the other one, CONIFARMA, an agreement between pharmaceutical companies from all MERCOSUR countries, the collaboration was only beginning to engage in new product research which may eventually involve the use of genetic manipulation but at the moment it did not.[10]

Together with a sectoral pattern of collaboration a pattern would seem to be emerging with regard to firm size. Five of the partnerships studied involved at least one large firm from MERCOSUR. Large firms normally entered technological collaborations agreements in order to produce completely new product or process. For example, the joint venture in which Sementes Agroceres, a manufacturer of agricultural seeds and animal food, was involved aimed at researching and developing potato seeds which would later be put into large-scale production. Another collaboration, involving Biobrás and Eli Lilly, aimed at using Biobrás's production expertise internationally, developing and manufacturing insulin crystals and exporting

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[9] One of the largest cost component in the mechanical engineering industry, if not the largest, are purchases of electronic goods. Most of the new developments are also coming from the application of electronics to mechanically engineered products and processes.

[10] The relatively modest efforts in advanced biotechnology were quite surprising. Agriculture has always been a key sector for MERCOSUR countries and some 'easy' opportunities for new developments should constantly arise. There is a long-standing medical sciences tradition in Argentina, including a couple of Nobel laureates, which in principle should have some effect on innovation and technological collaborations. Indeed, a recent study on citations of scientific publications by Amsden and Mourshed (1997) pointed out at a 36% share of biology, biochemisrtry and medicine in the total publications of authors from Argentina, Brazil, Chile and Mexico. Publications in the agriculture field accounted for another 20%.

them through Eli Lilly's distribution network. Freios Varga's collaboration with Lucas from the UK eventually developed new brake technology while the collaboration between Metal Leve and Allen Bradley, a US manufacturer of electronic controls and factory automation, focused on designing and manufacturing automation adaptable to developing countries' conditions. Hence, it seems that the kinds of agreements large firms are involved in MERCOSUR are mainly of a *knowledge sharing* nature, or put it slightly different, large firms tend to be part of partnerships where there is the possibility of using complementary competencies or unique knowledge. Large firms have the finance and technological capacity to be part of these agreements.

In the case of medium and small firms the kinds of agreements entered would seem to vary much more in their nature. At one end, there is the case of Biótica, where there was a clear sharing of knowledge with the much larger Sementes Agroceres. The small firm could offer specific vegetable micropropagation and new potato seed technology that could be used in the partnership for the development of new products. At the other end, there were two collaborations involving small firms where the objective of the partnership was addressing specific problems or bottlenecks common to all. Americana, for instance, was a collaboration of 32 small and medium Brazilian textile and garment companies aimed at production process improvement, standardisation of quality, machine sharing and introduction of computerised design. These *problem solving* kinds of agreements would seem to be more important to small enterprises, as large enterprises normally have the capacity to deal with these kinds of problems by themselves.

Turning to the country of origin of the collaborations the case studies suggested an important regularity. Where firms from advanced countries participated they were multinational corporations, often leading manufacturers of the products or processes under consideration and much larger in size than their domestic partner. In addition to technical exchanges multinational corporations were nearly invariably also seeking market access.[11] A case in point was the collaboration between Biobrás and Eli Lilly, the US transnational pharmaceutical company. The collaboration did not only involve knowledge exchange but was Eli Lilly's entry point to Brazil's insulin market. Collaborations by Freios Varga with Lucas, at least initially, and by Metal Leve with Allen Bradley were as much about developing jointly manufacturing facilities and new automation and brake technology as entering the local market.[12] A similar relationship was found in one of the two case studies were Brazilian and Argentinean firms were involved together. Indeed, research by Gatto and Ferraro (1994) and Ferraro and Gatto (1994) also suggests *size and knowledge asymmetries* and *multiplicity of objectives* was characteristic of technological collaborations

[11] The importance of market entry as a key motivation for foreign firms when entering joint ventures with Brazilian firms has also been pointed out in other research. Dahab et al (1993) shows that in one-third of the joint-ventures established between 1989 and 1991by a foreign and a Brazilian partner, the main motives given by foreign firm was accessing a new market, either in Brazil or abroad. It is also consistent with data by Baranson (1993) for Mexico, who finds that 21 out 22 technological alliances also involved an access to market objective. Some of the collaborations studied here were initially only market agreements.

[12] Eventually the collaboration between Freios Varga and Lucas turned into the US market. One of Metal Leve collaborations was also aimed at the US market where the Brazilian company already had a foothold.

between Brazilian and Argentinean firms, with the former normally being the largest and interested both in technology and market access.

By contrast, where collaborations involved firms from the same country there would seem to be a more exclusive emphasis on technology and knowledge exchange. In these circumstances the assets contributed to the collaboration are equally used by all partners as they are geared to the same market. This was the case of Americana, although geographical proximity would seem to have facilitated the collaboration between partners. The collaboration between Sucralc and Acetila, two Brazilian firms involved in manufacturing of alcohol from sugar cane and alcohol based solvents, was intended to increase the quality and volume of inputs and output in the Brazilian market.

**IV.2 Motivations and Modes of Governance.**

As it could be expected, the main motivations behind engaging in technological collaboration involved exploiting technological complementarities and obtaining specific technologies or knowledge available with the possible partners or that could be bought or developed jointly. There were two distinct types of motives. The first one involved combining each partner's knowledge so that *a 'third' technology that is different from the inputs of both partners* emerges. This is sometimes referred as 'fusion' (Afriyie, 1988). This was the case in most of the collaborations. Specific product knowledge was shared in four collaborations. In the case of Agroceres and Biótica, both companies brought a well established reputation and experience in new hybrid corn and potato seeds which was then applied to the development of even newer types of potato seeds. Product and process knowledge was combined in three collaborations. This was the case of Freios Varga and Metal Leve which although having some new product design and development capabilities had even more advanced brake or piston manufacturing capacities which were joined with their foreign partners' product technology. Some of this process knowledge was later used by foreign partners outside MERCOSUR. In one case, CONIFARMA, the collaboration involved exchanges of both product and process knowledge although the emphasis so far has been on process technologies.

The second type involved each partner providing an input in which each one has a distinct advantage but without leading into another product or technology but to *improving* existing information and knowledge. This was the case of Americana and GAMDI where process technology and knowledge was exchanged. In the case of the GAMDI collaboration, for instance, the fifteen partners require a variety of scientific instruments for chemical processes such as cromatographers and electronic measuring devices. The instruments are used only occasionally and it does not pay to have all but the most crucial ones in-house. The GAMDI partnership operates as a network of information on advances and availability of scientific instrumentation and as a clearing house for allocating time in a members designated pool of instruments. Another case of collaboration aimed at improving operations was the partnership between Sucralc and Acetila. The former had an input, i.e. sugar based alcohol, facing a dwindling market while the latter had alcohol based solvent formulas and know how that it could not take into production for lack of funding and the appropriate type of alcohol. The agreement involved Sucralc providing the necessary

alcohol and technical suggestions for its more efficient use in exchange for Acetila's solvent formulas and an accord to produce jointly upgraded solvents in Acetila's facilities and distribute them through Acetila's marketing channels. There were no new products but Sucralc was able to increase alcohol output and 'match-it' to solvents while Acetila was able to survive and expand by producing better solvents.

None of the firms studied mentioned high R&D costs or uncertainty as a factor underlying technological collaboration. This was a surprising finding given the prominence of these economic reasons found in the literature in developed countries.[13] However, it is consistent with the low-tech nature of nearly all the cooperations involving MERCOSUR firms which requires less frontier and proprietary know how and uses knowledge relatively more accessible and codified, thus requiring lower financial investments and risk.

The modes of governance used to cement a collaboration varied according to the type of exchange. Where exchanges involved process and problem solving technology and knowledge the main mechanism used by firms involved where *informal agreements*. The main reason for this was that collaboration occurred as and when a need arose or was not meant to be sustained and therefore a flexible and informal approach was deemed to be the more effective. This was the case, for instance, of the agreement between Sucralc and Acetila as the partnership was sanctioned by a 'gentlemen's' agreement' backed by a 'confidential' memorandum although later it will most likely turn into a fully blown merger, as will be seen later. Where the collaboration involved the exchange of product and process knowledge the collaborations generally involved *equity investment, a joint-venture or a contractual arrangement.* In these cases the exchange of information and tacit knowledge was more intense and sustained and often it was necessary to have a clear distribution of the outcome. However, there was no apparent preference for either equity or contractual arrangements even though short and long-term agreements were involved, which contrasts with the experience in developed countries where equity and contractual arrangements are respectively linked to long and short-term knowledge exchanges (Hagedoorn, 1993). At least one collaboration, between Freios Varga and Lucas, would seem to have evolved into a strategic co-operation.

It must be noted that in the establishment of the modes of collaboration there was an important role for 'external' influences, i.e. the terms of the agreement were mainly set by outsiders to the firm. In the case of Biobrás and Eli Lilly, which eventually took the form of a joint-venture with 55% of the capital owned by the Brazilian partner and the remainder by the foreign company, Brazil's Ministry of Health had a significant role in determining the actual distribution of shares in an attempt to promote local capabilities in the field of insulin. In the case of Americana, the Brazilian Service of Support to Micro and Small Enterprises (SEBRAE) was involved in establishing and setting the terms of reference of the collaboration. Finally, the Brazilian-Argentinean Centre for Biotechnology (CABBIO), a joint government funded but privately run association of firms and individuals concerned with the development of biotechnology in

[13] Hagendoorn (1993), however, also finds that for developed countries economic motives such as high costs/risks or lack of financial resources do not seem to be an important reason behind strategic alliances, except in aviation, heavy electrical equipment and telecommunications.

Argentina and Brazil and established in the context of MERCOSUR's biotechnology industry protocol, set the guidelines for the contractual agreement between Agroceres and Biótica.

**IV.3 The Inception of Technological Collaborations.**

Most of the technological collaborations examined suggested that the decision to collaborate was taken in the *context of making important strategic decisions*. These decisions involved expanding into a foreign market or attacking the growing MERCOSUR market, a significant product diversification drive or a major attempt to recover a perceived loss of domestic or international competitiveness, all of which required strengthening own technological capability and new technology. Only two collaborations would seem to have grown out of business opportunities that emerged in the context of normal operations. One of these cases was the collaboration between Metal Leve and Allen Bradley which evolved into a fully blown collaboration following a successful installation in one of Metal Leve's plants.

Once the decision to collaborate was taken the *initial step* to cooperate came from two main sources. The first source was the firm's own undertakings to enter a partnership. In these cases beginning a technological collaboration required considerable managerial and financial search effort for determining whether and what to collaborate on, on which of the potential partners would be best suited for the partnership and on ensuring the collaboration progressed smoothly.

*Information* about the potential and possible areas for technological collaboration was not always easy to obtain nor was it free. The collaborations involving Freios Varga, Sucralc and Vallée suggested that the companies were not fully aware of the emerging trends in international technology development and partnership already evident to many firms elsewhere. In all three cases it was only after commissioning reports from international consultancy firms that management was able to access the relevant information and to decide on the usefulness of a possible technological collaboration for their firms' strategies. In Sucralc's case the partnership eventually materialised with a local firm but by then the company had researched world-wide on possible new fermentation processes from sugar cane and on new sugar deviated products.

Searching for the *right partner* was another major task. Finding an appropriate partner seemed to be an issue as the process of searching went well beyond spotting firms in the same industry or with apparently the same technologies and needs. In the partnerships involving Sucralc and Vallée information was requested to enable management to assess technically and economically several potential partners, many of them from abroad. Special efforts were made to establish the precise technical competencies of the potential partner and how to mesh them with own competencies. Evaluations were also made on potential partners' organisational culture and on whether the companies will be able to work together.

Ensuring the *collaboration eventually ran smoothly* was not free of effort either. After having had a negative experience with one of its collaborations Vallée also invested heavily in consultants and lawyers

and in own management time to prepare for other agreements and to ensure they yielded the expected results. A number of dimensions were looked into. The first dimension was the mode of co-operation, e.g. whether and what type of equity or non-equity agreement should be established. The second dimension was financial and involved making accurate valuations of the assets and human resources to be contributed and estimates of potential benefits that will accrue to the partnership. This also included defining ways of protecting and appropriating the benefits of the partnership. The third dimension was managerial and involved establishing the management procedures and practices that the partnership will have to follow. The fourth dimension was developing negotiation and communication skills of the partnership as the eventual success of the partnership was partially determined at the negotiating stage. Finally, given that sometimes foreign firms were to be involved there was the need to examine national business culture diversities, such as financial disclosure rules and styles of human resource management which, if very different, could have become a very real impediment to the partnership.

The second source for initial impetus was *'external'*. In these cases the collaboration was initiated or promoted either by the government or by a business association although it always fell in 'good ears' because there was already a prior decision to find partner. In the collaboration between Biobrás and Eli Lilly Brazil's Ministry of Health played again a key role. It first provided the information to Eli Lilly, already a major world-wide producer of insulin, about Biobrás's research on and intention to manufacture that product and its technological capabilities. It then got involved in the technical negotiations between both parties which allocated the manufacture of the main raw material or insulin crystals to a joint-venture between Biobrás and Eli Lilly and insulin to Eli Lilly. Finally it gave the joint-venture the monopoly of the production of insulin crystals in Brazil and Eli Lilly the possibility of selling directly to chemists and to the Ministry of Health diabetes programme. Brazil's official development bank BNDES, in turn, provided the financing for the venture. Another case of *government programmes* initiating technological collaborations was Americana. In this case, SEBRAE was jointly involved with researchers from the local university in bringing together partners to the collaboration.[14]

The management of a number of firms involved in collaborations also pointed out that the government could in addition contribute to technological collaboration through ensuring *overall economic and political stability*. The previous murky economic political conditions were also a major limitation to technological collaborations because of the large risks involved. Foreign partners, in particular, did not want to add another major source of risk to an already very risky undertaking. It was mentioned that the recently found stability in Brazil and Argentina since 1990 had allowed those firms that had been able to weather the adjustment process successfully the possibility of planning better their investments and to invest long term. To the extent that R&D is a long-term investment it benefits from stable conditions. Stability was also felt to draw resources into productive rather than financial activities as there was no need

[14] Brazil has a number of government programmes and institutions with the potential to initiate technological collaborations. These include the Program to Support Industrial Technological Capability (PACTI), the Brazilian Quality and Productivity Program (PBQP) and the Financiadors de Estudos e Projetos (FINEP) through financial assistance and credits. SEBRAE has also successfully backed other technological modernisation programs by micro and small enterprises across Brazil.

for quick profits to compensate for high uncertainty. Matesco (1994b) points out that this is not a factor raised in the literature as developed countries normally do not face the conditions faced elsewhere. But it is crucial for MERCOSUR countries, which have gone through a period of intense economic instability. Stable economic and political conditions when accompanied by high and sustained growth rates could increase even further the potential for innovation and technological collaborations.

Equally important in initiating technological collaboration agreements have been *business associations*. This was evident in the cases of Sementes Agroceres and Biótica and Americana. In the case of the former, CABBIO brought the partners together, supported the collaboration through organising meetings and discussions on the potential for new potato varieties consumption in the region and financed the initial contacts and work required to get the agreement of the ground. In the case of Americana, it was partially the initiative of the local small and medium enterprise association (ACIA) which made it possible for firms to collaborate. Other research by UNIDO (1997) and Tendler and Amorim (1996) has also pointed out at the positive role business associations such as those of sugar/alcohol (COPERSUCAR), shoes, leather and ceramic products manufacturers have had in initiating technological collaborations. These associations initially acted as a political lobby but then turned into the promotion of information exchange and improving the technological capabilities of their members.

Generally, our case studies suggested that government programmes and business associations had performed a unique and positive role in initiating collaborations by becoming an alternative source of information and knowledge, a forum for information exchange and discussion, promoters and funders of R&D projects and by brokering between potential partners. To an extent, they substituted for firms internal efforts. However, their effectiveness in initiating technological collaborations would seem to be related to the specificity of the associations and programmes, with the closer to the sector or the technology the greatest their effectiveness, as the needs of firms vary widely from one sector or even subsector to another, something that has also been pointed out by research on the role of government programmes and business associations in Brazil by Tendler and Amorim (1996).

**IV.4 The Implementation of Agreements.**

The collaborations studied suggested that the implementation of agreements involved significant learning for the MERCOSUR partners. The learning process was not limited to the technology itself but also required developing an understanding of the partners' methods and idiosyncrasies. During the implementation phase three key prerequisites for learning were identified including the degree of interaction and exchange of ideas, the extent of personnel movement and training and the adoption of methods of assessment and monitoring.

As far as *interaction* was concerned in most partnerships discussion teams involving all levels of management and relevant operational staff were created to implement the collaboration. In the case of collaborations organised as joint ventures personnel needed to be allocated, which in the case of Biobrás

and Eli Lilly's joint venture, involved more than 100 staff from administration, research and development, production and marketing, from both companies. Biobrás, which had been producing enzymes for a number of years had been also successfully researching the extraction of insulin crystals from pork pancreas, as the technology was not far from enzyme extraction, although its main strength lied in manufacturing. Eli Lilly, which was a world leader in the extraction of insulin from living organisms, also brought its own approach to extraction. Although there was some friction over extraction methods the discussions would seem to have always been candid and in the end Eli Lilly's formulas and Biobrás's production methods were eventually chosen. As a result there was a continuous flow of information and knowledge according to both partners, both within the joint venture as well as between Biobrás's and Eli Lilly's management and an industrial plant was built after around two years.

With one exception, communication and exchange of ideas was intense between partners in studied collaborations although it seemed to be slightly higher in situations were there was a strong personal relationship or a clear commitment to the partnership at top management level. Also, information seemed to flow better between companies were a combination of formal, i.e. called by management, informal meetings, i.e. called by any staff member, together with collegial personal relationships emerged. The more often the discussions took place the more the partners seemed to learn from each other although some managers complained of the inordinate amount of time spent in meetings and preparations.

It is perhaps the two collaborations of Vallée that best illustrate the opposite directions that interactions and the flow of information can take in a partnership. Vallée is a Brazilian manufacturer of pharmaceutical products for bovines, including vaccines, therapeutic drugs and antiparasiticides. In the early nineties the company entered collaborations with IHC, an European company world leader in poultry and pork vaccines, aimed at developing poultry vaccines for the Brazilian market and with Vetcorp, an Australian local manufacturer of bovine vaccines beginning its expansion abroad, aimed at developing new bovine vaccines and diversifying product range also initially for the Brazilian market.

Vallée's collaboration with IHC contemplated a first stage were IHC products would be registered by Vallée in the Ministry of Agriculture and if registration was obtained quickly the products would be sold in the Brazilian market. In the meantime a fully blown technological collaboration would begin to be negotiated and implemented. Registration is a long and cumbersome process which normally takes years and modifications over existing registrations are easier to process so it made sense to have a marketing agreement while 'fine-tuning' the technical side of the agreement. The agreement began in 1991 with Vallée allocating two managers and four employees to IHC activities, submitting product registration papers to the Ministry of Agriculture and launching a market study for selling poultry vaccine in Brazil. Up to this stage communications had been between Vallée's and IHC 's top management in Brazil and occasionally with manager's from IHC's headquarters and had been formal and professional. Soon after the beginning of the agreement Vallée approached IHC for discussions on exchange of technical information and the establishment of joint production facilities particularly since IHC's product prices were 50% higher than those available for similar products in Brazil. Suggestions were also made for the involvement of technical

personnel in the discussions. To Vallée's surprise, however, IHC always avoided to engage in a substantive discussion on technical exchange something that was compounded by the continuous change of IHC's management in Brazil. Also, IHC established its own subsidiary in Brazil and requested Vallée to transfer authorised products to the newly established subsidiary. Eventually, contacts broke down and the dispute had to be settled through arbitration. Vallée argued that IHC was not really wanting to collaborate with it but only wanted product registration. IHC pointed out that Vallée was using its power of registration to exact technology and money from it and was not interested in selling IHC's products.

Vallée, however, was not deterred by its experience with IHC and as was pointed out before engaged consultancy companies and lawyers offices to devise ways of being more successful with future collaborations. It is in this context that the collaboration with Vetcorp began. In this case initial negotiations were longer and protracted and although they also involved initially a local market distribution agreement as products needed to be registered at the Ministry of Agriculture the more technical issues were bought up-front and clearly specified in the initial agreement. They had been much more vaguely referred to in the agreement with IHC. Vallée also made the point of immediately raising any doubt it had about the collaboration at whatever level was necessary and went at length at discussing with Vetcorp its expectations with the agreement and at explaining to its counterpart about local accountancy and business practices. At the moment both companies are beginning joint research on new products and examining the possibility of establishing new joint production facilities first in Brazil and later in Australia. There have been several visits by Vallée's technical and production personnel to Vetcorp's laboratories and production sites in Australia.

It is complicated to make a judgement on the intent of Vallée and IHC when entering the collaboration. While clearly Vallée intended to extract as much information and knowledge as possible from its partner it is not clear that IHC was not willing to provide the necessary knowledge as it could have well been the case that it wanted to see some concrete results in registration and marketing of its products prior to moving to a more advanced stage of collaboration. Whether IHC felt it had something to learn from Vallée beyond marketing is a different matter as this was never put on the negotiating table. More than due to the lack of intent, potential learning in this partnership would seem to have been blocked by the lack of transparency and receptivity to the concerns of each other. On the one hand, IHC avoided discussing the technical aspects of the collaboration and established its own subsidiary apparently without informing its partner. On the other hand, Vallée may have not made enough efforts to identify markets that may have been willing to pay a premium price for IHC's products, and therefore was not receptive to IHC's marketing concerns. None of the partners believed that the partnership was adding any value to them, that they were being fairly treated by the partner and that the partner was accommodating for its demands. In sharp contrast, Vallée's collaboration with Vetcorp would seem to have met all the requirements for a sustained process of learning and would seem to have learnt considerably from its first failed experience. Doz's (1996) initial conditions regarding the preparation of the agreement and a clear definition of modes and procedures would seem to have been achieved. Both firms would seem to have a similar intent of learning, partially accounted for the fact that both firms are similar in size and in status in their domestic

markets. Discussions seem to be taking place slowly but frankly and at different levels within the companies, partners would seem to accommodate for each other and both companies have expressed a positive attitude to each other and a feeling of achievement.

The other prerequisite for learning was *exchange of personnel and training*. In five of the technological collaborations studied, all of them involving at least one foreign firm, study and training visits to the foreign partner's headquarters or offices elsewhere were often arranged as was the exchange of personnel between research and development centres. The Biobrás-Eli Lilly partnership, for instance, involved training of personnel in US and Argentina for up to eight months. In both of Metal Leve partnerships, with Allen-Bradley and Kolbenschmidt AG, there were regular exchanges of researchers between Metal Leve's technological centres in Sao Paulo and Ann Arbor, Michigan, and the research facilities of its counterparts in the US and Germany. Indeed, Metal Leve, not only had regular professional contacts with its foreign partners but had established research links with the universities of Standford, Batelle and Michigan in the US and the universities of Leeds, Aachen, Delft and Copenhagen in Europe. Often the same researchers involved in the partnerships had links with the universities.

Turning to *assessment and monitoring procedures* they were only present in the same five collaborations that had training schemes. Hence, none of the partnerships involving only MERCOSUR firms had established assessment procedures although some informal evaluations may be taking place. In the case of the three joint ventures studied the assessment involved analysing the usual operational and financial indicators in addition to monitoring the progress of the collaboration. The advance of the collaboration was evaluated once a particular stage in its evolution was completed or meant to be completed. At this moment the technical and economic achievements as well as the quality of the relationship was examined; i.e. the efficiency, fairness and adaptability of the collaboration in Doz's (1996) formulation, and the decision to move forward or to terminate the collaboration was taken.

It is instructive to examine the collaboration between Freios Varga and Lucas as it seems to have progressed successfully through most of the learning cycle. The partnership has its origins in the early eighties as a marketing and technology transfer agreement for Lucas to enter the Brazilian market. A few years later, Freios Varga assessed its performance and decided to expand initially into Argentina and later into the US. Freios Varga approached Lucas to join it, this time as a partner. Lucas would continue providing its brake technology while Freios Varga would contribute with some initial knowledge of the US market, considerable knowledge about the Argentinean and other Latin American markets and especially, with very strong brake manufacturing capabilities. Freios Varga had improved its process technology significantly through minor adaptations and 'capacity stretching' and became known as one of the most efficient producers in the region and was beginning to develop its own brake technology. Lucas assessed the situation and concluded that the progress made over the years in product and process technology by Freios Varga was significant and that it was worthwhile entering the partnership. As a result joint production facilities were opened both in Argentina and the US. But the collaboration did not end there.

After further working together, Freios Varga and Lucas engaged jointly in developing, manufacturing and marketing a special kind of ABS brake technology for the US, Canadian and Latin American markets.

The learning process in the collaboration between Sementes Agroceres and Biótica was much more bumpy. The former was a large company with 2,500 employees while the latter had only 28 employees and was strongly research oriented. Communications between owners and top management were cordial but vague in terms of technology. Indeed the decision to collaborate was taken by owners alone on the basis of the potential financial benefits. Technological specificities were always left to lower levels of management and operational levels and there were continuous conflicts between both firms arising from different understandings of what the aims of the collaboration were and the more rigid and structured business culture of the larger enterprise and the more relaxed and informal approach of the smaller one. There was no report of personnel exchange something that may have eased tensions and there were differences in methods to evaluation with management from the former focusing on financial results while staff from the latter was more concerned with technical advance.

The trajectory followed by Freios Varga and Lucas suggests a possible cumulative and mutually beneficial pathway of learning for firms entering and being successful with even the most basic kinds of collaborations but that quickly and accurately assess their technical and economic performance and capitalise on previous success by moving on to a next stage. Yet, collaboration approaches based on personnel exchange and training and continuous and systematic assessment and improvement were not present in all collaborations, much less so in partnerships involving local firms as the collaboration between Sementes Agroceres and Biótica suggested, which further hints at rather incomplete learning processes in the case of these firms.

**IV.5 Benefits.**

The primary objectives of technological collaborations are to create new products or production processes or to improve on existing ones. Out of the eleven collaborations examined five resulted in *new products and processes*. The collaboration between Sementes Agroceres and Biótica developed a new variety of potato seed which was then planted and scaled up to industrial production levels in Argentina four years after the initiation of the project. The first trial batch of the new potato amounted to 35,000 boxes of 30 KGs and accounted for around 2% of the Brazilian market. The new potato began competing successfully with imports from Europe which is the main source of supply of the Brazilian market. The joint-venture between Biobrás and Eli Lilly led to the development and manufacturing of insulin crystals which are sold to Eli Lilly for distribution to chemists and the Ministry of Health. The collaboration had the monopoly of insulin crystals in Brazil and has been able to export remnants via Eli Lilly. In the cases of the collaborations of Freios Varga and Metal Leve four new plants were built, two of which were in the US, and several patentable new brake and piston products developed.

In addition, in three other collaborations *process improvements were achieved*. Apart from the already mentioned case of Sucralc an Acetila there are some concrete examples arising from the GAMDI collaboration. One of these examples relates to Lord SA, one of GAMDI's member. The company often needs to make chromatographic analysis. Under normal conditions the company resorts to the University of São Carlos and State University of Campinas for the service but it is always difficult to get time allocated in the instrument as it is in great demand by university researchers and other companies. To address this issue Lord plans with some anticipation its requests for the service. Lord SA, however, often also faces urgent chromatographic analysis requests. While some of these requests can be postponed many cannot which could result in large payments to 'jump the queue'. It is in these cases that GAMDI members are approached and information obtained as to where a chromatographer is available. The company having the equipment is then contacted and normally by the next day the analysis is completed. While the individual impact on time saving may be large or small depending on the type of emergency there is no doubt to GAMDI members that having available the necessary instrument or tool in the case of an emergency repair will have a significant cumulative time saving impact on the production process. The Pablo Casará pharmaceutical company, a member of the CONIFARMA partnership, has been able, thanks to the technical exchanges with other members, to rationalise and improve the production process of anti-asthmatic devices and odontological and ophthalmologic products and as a result make available financial resources for research and development which would not have been possible prior to the collaboration. Also, marketing capabilities have improved for all CONIFARMA members.

It was difficult to obtain data on the *financial implications* for most of these technical achievements. In the case of Sementes Agroceres and Biótica, however, the cost of the initial batch of new potatoes was US$ 90,000 per hectare which was reduced to US$ 10,000 per hectare after the first year of full production. Given that there are further process improvements to make and as the company moves down the learning curve it is expected that the cost per hectare will be reduced to US$ 6,000, a figure that will make the collaboration a leading player in the Brazilian potato market. Also, since the collaboration Biobrás sales rose from US$ 2mn to US$ 10mn in the early eighties, doubled to US$ 20mn by the early nineties and increased again to US$ 40mn in the mid-nineties. Unlike before, since the partnership the company has been profitable every single year. Finally, a possible merger between Sucralc and Acetila could result in a 30% production and administration cost reduction.

As to the other collaborations two of them, Americana and Vallée-Vetcorp, they are still in progress so no tangible output can be expected yet. Nonetheless, Vallée's management has pointed at a number of advantages that are already emerging. Regarding technology, the collaboration is already providing the knowledge inputs required and is forcing Vallée to make efforts to match the knowledge received with some new knowledge of its own. Concerning human resources, the agreement has resulted in an increase in motivation of the people involved in it, thus increasing their performance. The agreement with Vetcorp had also taught Vallée how to integrate a partnership into its own organisation. Even in the collaboration with IHC the management of Vallée has found some advantages particularly in the field of poultry vaccine marketing as the firm has collected considerable information about customers and competitors. Vallée has

now started negotiations to collaborate with an Israeli manufacturer of poultry vaccine and is expecting to enter this market soon.

One important unintended benefit of collaborations was the *building of trust*. In the specialised literature trust is normally seen as a prerequisite for collaboration (Doz, 1996; Hamel, 1991; Johnson et al, 1996; Aulakh et al, 1996). Our case studies, however, suggested that trust is more an outcome of the collaboration. Humphrey and Schmitz (1996) define trust, or economic trust to be more precise, as a mode of relationship between economic agents where parties involved expose themselves to the risk of opportunistic behaviour from the other without having any reason to believe that the other party will not avail itself of this opportunity. In many economic relationships the need for trust can generally be avoided through properly written contracts or agreements and, eventually, through the courts. Technological collaboration agreements, however, face contingencies both in scope and number that cannot be completely specified at the time of entering the agreement because of incomplete information. These contingencies, if sorted out through legal means, could be very costly and even make the agreement unprofitable. Where trust exists, parties will deal with contingencies in a manner that either will be mutually beneficial or at least will not involve loss to one of the partners. Trust can ease significantly the management and implementation of a technological collaboration agreement but doesn't necessarily emerge in all cooperations nor is it meant to arise.

Three types of trust that can be built between enterprises: contractual, competence and goodwill (Humphrey and Schmitz, 1996). Contractual trust involves partners obeying what is stipulated in the agreement. Competence trust refers to the confidence in each other's ability to perform at its best. Goodwill trust is related to mutual expectations of open commitment to each other, implying that partners are dependable and can be endowed with great discretion. The three types of trust are cumulative in the sense that they build on the previous one. Developing trust is part of the learning process where partners are confronted with numerous opportunities to betray each other but do not do so.

A relationship of trustworthiness would seem to have emerged in a number of cases. Goodwill trust would seem to have appeared in the case of Freios Varga and Lucas. Not only did it allow partners to collaborate in technical developments but also to engage in even more advanced forms of co-operation. Vallée's relationship with Vetcorp would seem to have resulted in competence trust as at least the Brazilian partner was making every effort to match and improve on the Australian's partner knowledge. Contractual trust would seem to have developed in the cases of CONIFARMA and GAMDI, as partners have always complied with the terms of their co-operation even though there is no contractual or otherwise means of enforcing it. By contrast, the relationship between Vallée and IHC would seem to have been built on the basis of suspicion and distrust.

In sum, the experience with technological collaborations in MERCOSUR seems to be positive. In technology terms the advances have been significant both in number and types of innovations and process improvements. In the case of two collaborations which successfully entered the US market, it goes without

saying that this is no mean achievement for developing country firms, even if it is in a relatively backward industry. The financial impact of the innovations, in the few cases were data was available, suggested that gains were substantial also on this account. Finally, and perhaps more importantly, most domestic and international collaborations led to building trust between partners, opening the door for more and more substantive collaborations between partners in the future.

**IV.6 The Outcome and Consolidation of Collaborations.**

The outcome of the eight collaborations that had achieved intended results varied greatly. Two of them, Freios Varga-Lucas and Sucralc-Acetila had or were considering travelling towards *higher stages of 'collaboration'*. Since the mid-nineties Freios Varga and Lucas began engaging in a process of production and organisation integration involving production restructuring and relocation and co-ordination of production between factories in different countries. For Freios Varga this meant access to advanced technologies in all fields of brake manufacturing and a much higher level of output partially arising from economies of scale due to factory specialisation. It also meant access to Lucas's traditional markets in Europe and eventually in the Far East. In the case of Sucralc and Acetila, there are clear technological and economic advantages to a merger between both companies. The 30% cost reduction referred to earlier can only be achieved if alcohol and solvent production is concentrated in a single plant. Jointly, the new merged company would be able to free resources for research and development and to combine their knowledge of sugar fermentation and alcohol based solvents. The only doubt in the horizon is whether alcohol based solvents can in the long run compete with petrochemical based ones. Negotiations are at an advanced stage, the distribution of management and functions in the new company and the amount of shares to be exchanged between companies have already been agreed.

There were three collaborations that were *consolidating at the present level of activity*. Metal Leve agreement with its German partner was going well in terms of sales and there was no intention of upsetting it. The process improvement nature of GAMDI's and partially of CONIFARMA's collaborations meant that, in principle, they should be an ongoing affair and therefore no major change should take place. In the case of GAMDI there were some discussions to formalise the collaboration so that more regular use of the pool of equipment could be made but that was as far as the consolidation stage went.

But there were also three collaborations that *terminated*, some of them perhaps even prematurely. One of these collaborations that ended was between Biobrás and Eli Lilly. In the mid eighties, six years after the collaboration had started, Eli Lilly approached Biobrás to terminate the joint-venture. The reasons why Eli Lilly took such a step are not clear but are probably related to Eli Lilly's growing success in obtaining insulin through genetic engineering which would eventually reduce the cost of the product substantially and implied that insulin crystals made through traditional methods would be out-phased world-wide. Termination meant for Biobrás buying back the 45% share holding of Eli Lilly and more importantly, losing its main distribution channel. But, the termination was on friendly terms and Biobrás

obtained a two year extension of the cancellation of the distribution agreement, giving it time to build its own distribution channels and move onto the production of insulin rather than only insulin crystals. It also obtained backing of BNDES for the buy back of shares. Initially Biobrás controlled 90% of the insulin market but since liberalisation that share has fallen to 70% and is continuing to drop so the company is now considering also using genetic engineering techniques. One of its main competitor is Eli Lilly.

The two other collaborations that terminated were Metal Leve-Allen Bradley and Sementes Agroceres-Biótica. In the case of the former the reasons would seem to be financial and strategic. In the early nineties there was a sharp drop in the demand of vehicles and therefore of vehicle components prompting Metal Leve to restructure its operation. Initially Metal Leve stopped financial support for the joint-venture but it soon realised it had to divest in order to strengthen other parts of the company. Metal Leve assessed its diversification strategy and concluded that its main competencies were in manufacturing vehicle components, not in selling the equipment that produced those components, so the partnership with Allen Bradley made no longer sense. The reasons were well understood by Allen Bradley who bought Metal Leve's shares in the joint-venture and since operates as an independent company.

Similarly, the termination of Sementes Agroceres-Biotica partnership was also prompted by financial strictures although in this case there were other 'external' factors too. Like Metal Leve, at the beginning of the nineties Sementes Agroceres and Biótica faced a severe financial crunch due to an overall reduction in demand which affected consumption of corn seeds and human health diagnostic kits, the main products of both companies respectively. Two additional factors led to the termination. First, as mentioned earlier, the running of the partnership had not been easy and had been marred by conflict. Second, a number of health and import regulations were passed in Argentina and Brazil which difficulted the trans-border trade of trans-genetic seeds and the equipment used in their manipulation. The upshot was that Agroceres closed its research and development unit dedicated to plant biotechnology, which was in charge of new potato seed development, and transferred the know-how to Biótica in case it wanted to continue with the project. Agroceres does not sell new potatoes in Brazil anymore. Despite its difficulties Biótica has been able to recover financially and given that the actual production of potatoes is done in Argentina it has been able to continue production and to export to Brazil again. Indeed, part of the research team previously located in Brazil is now in Argentina. Unlike the previous two terminations, however, this one terminated in an acrimonious note as there were several misunderstandings and accusations of foul play towards the end.

On the whole, the learning cycle from inception, to implementation and then to consolidation was completed in eight collaborations while another two remained at the implementation stage. Only one collaboration, between Vallée and IHC, actually failed at the implementation stage although two of the collaborations that terminated after achieving specific results may have done so prematurely not so much due to achieving the objectives set initially, which they did, but because of financial and government policy limitations beyond the collaboration themselves. The termination of Biobrás's collaboration also suggests that despite collaborating firms in developing countries and MERCOSUR, particularly those involved with multinational corporations, must also be able to develop in-house technological capabilities for keeping

abreast of advances in the frontier of their field to avoid being 'dropped' by their more technically competent and rapidly learning foreign partners.

## V. FINAL REMARKS

*Main Conclusions.*

Technological collaboration agreements have grown in number and importance over the last few years. The normal need for sustained and interactive exchange of information and knowledge between firms has been, since the mid seventies, enhanced by the emergence and rapid development of new generic technologies and the growing costs and risks attached to them, making it even more necessary for firms to cooperate between them if they want to innovate. Technological collaboration agreements have grown everywhere, although the bulk of them concentrate in firms from developed countries. Most of the remaining agreements are accounted for by a few Eastern European, South Korean, Taiwanese and Chinese firms. Latin American and MERCOSUR firms' share of technological co-operation agreements is to date very small and concentrated in low and medium tech industries.

The small contribution of MERCOSUR's firms to the world-wide body of corporate knowledge and their technological specialisation in low to medium tech activities was the result of their modest efforts to innovate. Although there are a few world class innovative firms in the region and some talent was developed in biotechnology, by and large, firms invested little in R&D, had weak technological capabilities and were passive recipients of knowledge in high-tech industries such as electronics. Even efforts in biotechnology paled in comparison with similar efforts elsewhere in developing countries and were focusing in the less advanced areas. Furthermore, there was no clear source of potentially significant expertise in the new high-tech areas.

The motives underlying MERCOSUR firms' collaborations involved exploiting technological complementarities and obtaining technology and knowledge unavailable to them. The 'fusion' of own and partner knowledge was a chief aim in most collaborations although, unlike perhaps the experience in developed countries where the emphasis of both collaborators is product knowledge, it was found that particularly where a collaboration with a multinational corporation was involved, the local firm mainly provided marketing and process knowledge. Thus, main competencies in many local firms still remain in local market information and efficiently adapting technology to local production conditions and local customer requirements. Another major objective of MERCOSUR firms' collaborations was improving available information and knowledge and solving specific technological problems or bottlenecks, particularly in the case of small enterprises. The modes of governance would seem to be related to the type of collaboration, with those involving product and process knowledge requiring contractual or equity arrangements while those involving only process technology being based on informal agreements.

In analysing technological collaborations by MERCOSUR firms it was found that the better prepared a corporation entered an agreement the more successful the collaboration was likely to be. It was not only a matter of finding the right match technologically, which in itself was a difficult task and required screening locally and internationally the advances taking place in the field of interest, but also identifying the correct institutional match as corporations had also to coincide in their expectations and the means to achieve them and should be able to combine their national and business cultures with that of their partners. A casual approach to collaboration can very quickly turn into conflict and termination without any concrete benefits as the case of Vallée-IHC showed.

The case studies revealed that it was not only a solid preparation that guaranteed success in collaborations. It was also necessary during the implementation of the co-operation to engage in a learning process or learning cycle like the case of Freios Varga illustrated. This learning cycle required intense technical interactions and exchange of ideas with partners, exchange and training of personnel and the adoption of methods of assessment. Where technical interactions were well intended, transparent and participants were receptive to each other the collaboration would seem to have progressed smoothly and partners felt that the relationship had been fair and accommodating to their interests. The flow of information and knowledge was greatly enhanced where interactions took place at different levels of the firm and had been mediated by a combination of formal, informal and personal relationships. Exchange of personnel and training brought an even better understanding of the technical and institutional differences between partners while continuous assessment provided the partnership with a sense of achievement both in terms of the fairness and adaptability of partners and in terms of output.

Most of the collaborations studied were successful in terms of achieving product or process innovations and improvements. In technological terms the partnerships yielded new patentable and non patentable products and new factories. There were also some non-tangible benefits like in the case of Vallée-Vetcorp where the local partner was forced to improve its own knowledge in vaccine technology to keep up with the knowledge being provided by the partner. Biobrás, in contrast, was eventually 'dropped' by Eli Lilly because it was not able to move into genetically engineered insulin. Market information that otherwise would not have been obtained was another benefit in several collaborations. Some process improvement experiences were also described like in the cases of Americana and GAMDI. Yet, an important benefit not often highlighted in the literature as such was the building of trust between partners which allowed most collaborations to move forward.

As far as the termination of collaborations was concerned the case studies suggested that while financial reasons had not been a prime motive in their inception they had been a key factor in their premature termination. Termination seemed particularly premature in the case of Sementes Agroceres and Biótica, where despite poor relationships the financial benefits of the collaboration were not far from being achieved, but the short term pressures on the companies would seem to have been so acute that substantive benefits two or three years down the line were just too far. This rather premature termination would seem to further highlight the importance of a stable political and economic environment as the first activities to

be cut in a financial crisis, despite their potential, are those that are riskier and tend to yield results in the longer run .

An important finding that deviates significantly from the literature has to do with the role of 'external' factors, notably the role of government and business associations. It was clear from the case studies that both had a key role specially, although not exclusively, at the inception of collaborations. Government policies, programmes and institutions and business associations brought partners together by providing information and acting as a forum for discussion like in the cases of Americana, Biobrás-Eli Lilly and Sementes Agroceres-Biotica; provided the conditions for the successful operation of the partnerships as in the case of the Ministry of Health and Biobrás; granted financial support for the creation of and at crucial junctures in partnerships; and, established the mechanisms or modes of governance in some of the collaborations analysed. However, some more restrictive government policies would seem to have partially hampered the continuation of one of the collaborations studied.

*Policy Recommendations.*

Expanding technological collaborations will be no easy task for the majority of MERCOSUR firms. It requires major investments in capital goods, scientific instrumentation, new organisational techniques, R&D and R&D personnel. It also requires unremittingly engaging in all the phases of the innovation process. But the government could play a key facilitating role too. Indeed, there are a few areas where public policy could be quite effective in propitiating further innovation and technological collaborations.

One first area for policy intervention is increasing the *efficiency of existing government programs aimed at innovation*. At the moment there are a number of programs or institutions, such as PACTI or SEBRAE, which are promoting technological collaboration and innovation with varying degrees of success (Tendler and Amorim, 1996). The efficiency of these programs could be increased by incorporating a number of interrelated ideas arising in the field of economics of asymmetric information (Alcorta and Peres, 1996). One first idea refers to the use of incentive contracts. These are basically contracts that introduce incentives to achieve a particular objective without taking all the risk away from the beneficiary. Existing co-sharing agreements go some way in this direction but a fixed proportion of cofinancing, as most of the existing promotional mechanisms have, does not address the specificities of the risks involved in each project. A related idea is a change in the criteria for eligibility ('signaling') in government programmes. The experience of use of government programs shows that only those firms that are more advanced technologically are the ones that use those programs. Human resource requirements, such as having a number of PhDs for research, for instance, contribute to that as most firms have never seen a PhD. A switch towards criteria that better reflect the objectives or results being sought would further increase the efficiency of programmes. A third idea refers to the use of insurance contracts which would reduce the risk of failure to firms and as a result prompt them to enter high-tech sectors. All these contracts and programmes can be easily adapted to include technological partnerships.

Public policy could also have a direct impact on the growth and quality of technological collaboration agreements. Obviously there is the need for more systematic research and data on the extent and impact of technological collaborations in MERCOSUR. Meanwhile, however, there are a number of concrete policy initiatives that could be useful given the present state of knowledge. One first policy initiative refers to making *information on the potential of technological collaboration* and on possible specific cooperations more widely available. This would be of particular use to SMEs which do not have the resources to hire external consultants. More extensive awareness and publicity campaigns, as those already initiated in Chile, could be quite effective too. The second policy initiative refers to *allocating specific funds or loans for technological partnering*, particularly between firms (Baranson, 1993). Funding could go to brokering or consultancy services to identify possible partners and assist negotiations or to financing specific aspects of an agreement, especially in high-tech fields. A third policy initiative would be to introduce specific funding mechanisms for *upgrading partnerships* which involve only marketing agreements. One final, rather bold, policy initiative would be to support strictly technical *collaboration agreements with firms that have no presence in the MERCOSUR* region, particularly with regards to information technologies, biotechnology and new materials. Preferably this should be done with small and medium enterprises from developed countries or equivalent firms from developing countries to avoid possible size and knowledge asymmetries as the collaboration between Vallée and Vetcorp illustrated. This would have the advantage of bringing new knowledge into the region and should result in the emergence of new high-tech businesses.

Another area for public policy is complementing supply with *demand oriented incentives*. As was discussed, before, there are a number of advantages in the demand driven programs of SEBRAE. Although a more general justification for demand driven programs is still pending, it does seem reasonable to say that they could be a good complement to supply driven ones. The impact of government procurement policies in countries such as the US, Korea or Taiwan has been extremely positive in developing local productive and technological capabilities and technological partnerships in high tech areas. But demand oriented policies need not limit themselves to government procurement. Promoting the sale of new products to foreign markets or promoting agreements between local partners or between local and foreign partners for exports of new products, could be an effective way of linking technology and trade policies. Egan and Mody (1991) point out that these kinds of export agreements reduce barriers to entry to foreign markets and provide information about markets that otherwise would not be available. And, policies promoting export-oriented partnerships would not contravene any of the current international trading regulations.

There is also a role for public policy intervention in the *simplification and flexibilisation* of rules and institutions and in creating *homogeneity in technological collaboration regulations* across MERCOSUR countries. Given the repeated complaint by business 'clients', there does seem to be a clear-cut case now for simplifying the cumbersome and bureaucratic procedures to access innovation and technological partnership programs (Tendler and Amorim, 1996). Universities' 'liaison' offices would seem to be an appropriate model for universities and perhaps a similar approach could be used by other government agencies. Whatever institutional solution or approach is chosen it has to be vested with great

flexibility and discretion. Only if the new or modified institutions and approaches have those capacities will they be able to tailor programs, incentives and contracts to the specific needs, and perceptions, of users. Regarding homogeneity, there seems to be ample scope for the promotion of intra-MERCOSUR partnerships. Collaborations are already taking place and they are only likely to increase as integration expands. But sustaining growing partnerships will require more commonality in legislation and incentives between MERCOSUR countries in order to avoid unnecessary costs and misunderstandings. More interaction between local firms and individuals will help to address the problem of differences in business cultures. MERCOSUR exchange and mobility programs between professionals, technicians, researchers and students should also help to reduce differences.

Finally, the experience of our case studies has suggested that *involvement of other organisations* such as universities or business associations has had a positive impact on promoting technological collaborations. Public policy, therefore, should consider channelling some of their incentives or contracts through these organisations on a more sustained basis.

## VI. BIBLIOGRAPHY


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## VII. APPENDIX:METHOD AND CASE STUDY SOURCES

The case studies used for this paper have been developed by researchers at the University of Sao Paulo (USP). Attempts were made to obtain similar information from other MERCOSUR countries but nothing was available in the detailed required except for case studies from firms in Argentina, Uruguay, Paraguay and Chile that had relationships with enterprises from or were included in USP´s case study bank. The firms involved in the case studies have been studied for a number of years or have close links with different departments at the university and their experiences have been well documented in a number of thesis and papers. The case studies were built with a technological change focus and as such have considerable information on technological collaborations. Using this archival information was deemed important as it was necessary to have detailed historical data on the evolution of collaborations which was already available in the pool of case studies on record at USP. However, where necessary, additional information and extensive clarifications have been sought through interviews.

Altogether around twenty firms involved in ´collaborations´ were initially selected for analysis. Most of these firms were, however, involved only in technology transfer or marketing agreements and therefore had to be discarded. Only nine firms or group of firms had clear-cut technological collaborations. Two firms had two collaborations each increasing the amount of collaborations to eleven. No size, ownership or sectoral apriori criteria was set on the firms involved as this would have drastically reduced the number of collaborations given their reduced overall number and that in any case what was needed was qualitative information and insights about their underlying rationale. All but four names, International Health Company (IHC), Vetcorp, Sucralc and Acetila, are the real names of the companies. These names were changed due to requests for confidentiality.

The archival material and follow-up interviews have been based on contacts with main owners or presidents of companies, board members, production, research and development and sales managers and individuals responsible of the collaboration projects mainly in the local firm involved. In two cases involving foreign firms representatives of the foreign partner was also approached. Table 2 presents a summary of the firms and collaborations involved and presents sources of further infomation for each one of the collaborations involved. A firms is classed as small if having less than 100 employees, medium if over 100 but less than 500 and large when more than 500 staff are employed.

## Table 2: Technological Collaborations by MERCOSUR Companies

| Firm or Firm Grouping Name | Collaborator | Nationality of Partners | Size of Partners by Employment | Sector | Purpose of Cooperation | Brokerd by | Mode of Governance | Approximate Duration of Partnership | Benefits to MERCOSUR Partner | Outcome of Cooperation | Additional Information |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Acetila | Sucralc | Brazil /Brazil | Medium /Medium | Chemical | Improve Quality and Increase Output | Sucralc | Informal Agreement | 2 years | Improved Alcohol and Solvent Process | Possible Merger | UNIDO, 1997 |
| Americana | 32 Partners | Brazil | Small | Textiles /Garments | Process Improvement | SEBRAE, ACIA | Informal Agreement | 3 years | None yet | Continuing | Sbraggia y Barra, 1994 |
| Biobrás | Eli Lilly | Brazil /United States | Large/Large | Pharma-ceutical | Development and Prodution of Insulin Crystals | Brazilian Ministry of Health BNDES | Joint-venture | 6 years | Plant for Insulin Crystals | Terminated | UNIDO, 1997 |
| Biótica | Sementes Agroceres | Argentina /Brazil | Small/Large | Agroindustry | Development and Production of Potato Seeds | CABBIO | Contractual Arrangement | 5 years | Production of New Potato Variety | Terminated | UNIDO, 1997 |
| CONIFARMA | 21 Partners | Argentina, Brazil, Paraguay, Uruguay, Chile | Medium and Small | Pharma-ceutical | Development of New Products and Process Improvement | Both Partners | Informal Agreement | 2 years | Process Spe-cialisation, Improvement and Problem Solving | Continuing | Rimoli, 1996, 1997 |
| Freios Varga | Lucas | Brazil /United Kingdom | Large /Large | Auto Components | Development of New Product and Process | Freios Varga | Equity Investment | 15 years | New Plants and Brake Technology | Production and Regional Restruc-turing | Business Week, 1997; Rimoli, 1996, 1997 |
| GAMDI | 15 Partners | Brazil | Medium and Small | Chemical, Food and Beverages | Process Improvement | Both Partners | Informal Agreement | 5 years | Problem Solving | Continuing | Rimoli, 1996, 1997 |
| Metal Leve | Allen Bradley | Brazil /United States | Large/Large | Auto Components | Product Development | Partners | Joint-venture | 7 years | Automation on Request by Customers | Continuing | Dahlman y Frischtak, 1994; Stal, 1993 |
| Metal Leve | Kolben-schmidt | Brazil /Germany | Large/Large | Auto Components | Process Development | Both Partners | Joint-venture | 6 years | New Plants | Continuing | Dahlman y Frischtak, 1994; Stal, 1993 |
| Vallée | International Health Corporation (IHC) | Brazil /Europe | Medium /Large | Pharma-ceutical (Veterinary) | Product Development | Both Partners | Contractual Arrangement | 2-3 years | None | Terminated | UNIDO, 1997; Vas-concellos and Waack, 1995 |
| Vallée | Vetcorp | Brazil /Australia | Medium /Medium | Pharma-ceutical (Veterinary) | Product Development | Vallée | Contractual Arrangement | 1-2 years | None yet | Continuing | UNIDO, 1997; Vas-concellos and Waack, 1995 |