LATIN AMERICAN FOUNDRY R&D NETWORK

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EVALUATION

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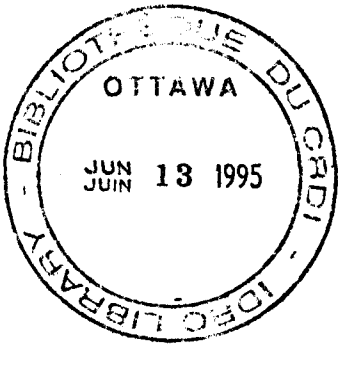

TABLE OF CONTENTS:

I.-CONCLUSIONS:

As measured by the indicators of success built into the Project Summary, the Latin American Foundry Network has been a failure.

The reasons for this failure are numerous and interrelated. Some of them are to be found in the general economic, political and cultural background of the region. Some on the nature itself of industry in general and the foundry industry in particular. Some of them changed over time and some from country to country. In general, it may be said that the background did not help.

As for the Project itself, it is based on a number of premises that do not fully apply to the world that it is designed for. The designers of the Project, maybe unwillingly, maybe not, projected their goodwill and their own motivations onto the Network's incumbents. Industry in particular, the main target of the Project, is moved by profit. The main purpose of the foundry industry is not casting, it is making money, especially in a region with short time horizons in which to operate. Know-how is just another product, a service to be bought and used if profitable.

The Project partially recognizes the self serving nature of industry when it assigned the responsibility to run the Project to the R&D side. This bias has also been to the detriment of the Network as it helped to discourage the progressive elements within the industry.

The failure to meet the standards that the Project itself has set does not invalidate the concept of the Network. Nor does it make the attempt fruitless. These standards are as demanding as the Project itself is ambitious.

The implicit purpose of the Project and the objectives listed in section II could very well be part of a government manifesto on industrial policy. Only that many governments in the area do not have such clear statements because they do not have such clear ideas. This Project attempts to do in three years, with very little money, what governments have not been able to. And to top it all, do it throughout Latin America.

The project proposal can be analyzed to exhaustion from different points of view. From a strictly professional angle it is imaginative, well structured, planned with detail and well presented. It is somewhat idealistic and too ambitious, but the former is not necessarily a flaw and the latter applies only at the level of resources and time alloted to the project.

In the end it has the aim of improving the lot of a certain segment of industry, diverse within itself, that cuts across peoples with a common language and different interests. As all projects with a higher and elusive calling it depends more on the people involved than on the level of resources committed.

Where people understood this project as an opportunity for advancing the well being of their communities, where they were responsible to the institutions they belonged, where they could see beyond the immediate interest of their industry, where the political and economic scenario gave them a chance, this project has been as successful as could be expected.

II.-PROJECT OBJECTIVES:

Objectives for this project have been considered, in the course of this evaluation, at four different levels:

i.-IDRC: "...to support research designed to adapt science and technology to the needs of developing countries."

ii.-General: "...to establish a foundry R&D Network within Latin America to provide effective liaison between foundry scientists, engineers and industries and to coordinate training, technical assistance and small R&D project grants." (P.S., paragraph 11, page 3)

iii.-Specific:

"

a) to promote scientific and technological research on key problems facing the small medium scale foundry industry in Latin America through major research projects.

b) to support small R&D projects to address priority problems in the industry (mini-projects).

c) to coordinate and organize training activities between countries.

d) to disseminate information on industry needs, technologies available, being developed, research and training activities and industrial opportunities.

e) to determine the information needs within the Network and study the existing information resources and information exchange mechanisms in order to design an information exchange Network.

f) to develop and promote methods to enhance technology transfer to industry.

g) to provide effective liaison between foundry scientists/engineers and industry both within the region and Canada.

h) to set up mechanisms by which the Network can become, over the medium term, self sustaining.

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(P.S., paragraph 12, pages 3 and 4)

iv.-Dispersed:

As found in different areas in the P.S., but not included above in the specific objectives:

-"Through the proposed project, EES will consolidate this Network, broaden its focus to look at the foundry sub-sector as a whole - not only its metallurgical aspects..." (P.S.,abstract).

-"...promoting south-south cooperation..."
(P.S., paragraph 1, page i)

-"...the Network will address all of the applied scientific and engineering and management problems..."
(P.S., paragraph 4, page i)

III.-CRITERIA FOR EVALUATION

These have been set forth in the P.S. for the evaluators use as follows:

1.- "The success of the first phase must be judged against specific performance indicators, since the Network will be engaged in particular activities, viz: a) mini-projects, b) technical training for industry personnel and for research staff, c) provision of technical advice to industry, d) publication of a newsletter, e) compilation of a list of establishments involved with R&D, f) compilation of R&D programme by country, g) compilation of list of foundry needs by country, h) degree to which one can expect self sustenance to be achieved, and i)degree to which outputs of Network have contributed to the realization of social economic regional goals.
(P.S., paragraph 39, page 11)

2.-"The success or failure of the Network will be judged on how well these activities have met the foundry industry needs of the region. Since the existence and operation of the national committee is an important part of the operation of the Network, all national committees will be evaluated in the light of the functions described earlier in this P.S."
(P.S., paragraph 40, page 11)

3.-"With respect to the evaluation of the success of the operation of the Network itself:

i.- The Network will have identified those needs which can be best tackled at a regional level, making optimum use of available Network manpower and facilities and also have made an estimate of the funds required to meet these needs.

ii.- The Network will have disbursed the IDRC mini-project funds available to it in the first phase in such a way that the benefits resulting can be clearly distinguished.

iii.- The Network will have a proposal available detailing the activities to be proposed for funding in the second phase and an estimate of their costs.

iv.- The Network will provide a preliminary proposal of the type of operation and means of funding to permit the Network to function after IDRC financial support is withdrawn.

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In addition, as with the objectives, 'dispersed' criteria can be found in the general text of the P.S. In this case, the criterion of self substainance is more forcefully stated in the "Appraisal" section of the P.S.: "The eventual self financing of the Network should provide all the measurements of success as can be wished for..."

IV.-FIELD WORK

Information regarding the Network's activities was sought in available reports to IDRC, to the Latin American Coordinator and in the issues of the Network's bulletin.

As requested by IDRC, the evaluator travelled to attend a meeting of the Executive Committee and to interview people related to the Network in different countries. A list of countries, institutions and people visited follows:

1. ARGENTINA
   -Bariloche: meeting of the Network's Executive Committee, participants: Engineer (Ing.) Biloni, Dr.Smith, Dr.Zaya.

   -Buenos Aires: meeting with Ing.Susini, Industrial Representative (I.R.) for Argentina and manager of the Argentinian Chamber of the Foundry Industry.

   -Mar del Plata: meeting with Ing.Sikora, Coordinator of the National Committee (C.N.C.), head of the Metallurgy Department of the Faculty of Engineering, National University at Mar del Plata.

   -La Plata: meeting with Ing.Biloni, the Latin American Coordinator and head of the LEMIT, National University at La Plata.

2. BOLIVIA
   -La Paz: meeting with Ing.Zegarra, head of the Department of Metallurgical Research and C.N.C. for Bolivia.

   -Oruro: meeting with Ing.Heredia from Aceros TESA, the I.R. for Bolivia.

3. BRAZIL
   Porto Alegre:
   -met Ing.Muller, head of the Foundry Laboratory, Technological Center, Federal University of Rio Grande do Sul and C.N.C. for Brazil.
   -met with Dr.Diehl staff member and expert in molding sands.
   -met with Ing.Heinen, I.R. for Brazil and superintendent of Industrial Hahn Ferrabraz S.A. (foundry and forging)
   -visit to Fundicion Becker S.R.L.

4. CHILE
Santiago:
-meeting with Dr.Mannheim of the Metallurgical Engineering Department of the University of Santiago of Chile and C.N.C. for Chile.
-meeting with all members of the Executive Committee of the Chilean Foundry Society (president: Mr.Sermini Rios Carlos).
-meeting with Mr.Caballero Gercio, from Las Rosas Foundry and I.R. for Chile.

5. COLOMBIA
Medellin:
-met Ing.Gomez, of the Department of Mechanical Engineering, Faculty of Mines of the Colombian National University, the C.N.C. for Colombia.
-meeting with Ing.Velez (trainee with INTEMA)
-meeting with Ing.Echavarria (trainee with LEMIT) and Ing.Mejia, of the Precision Casting Group.
-meeting with Ing.Rueda at the SENA (National Apprenticeship Service), graduate from the foundry course in Joinville, Brazil.
-meeting with Ing.Villa, president of Medellin's chapter of the Metallurgical Industries Association with headquarters in Bogota, informally acting as I.R.
-visited foundries:
-Furima S.R.L., met with the manager Mr.Saffon Arango.
-Fundiciones Spitia, met the owner Mr.Robino Spitia.
-Fundiciones Victoria, met with Mr.Calle.
-Fundesa Ltda., a start-up company set up by Ing. Echavarria using precision casting technology.

6. ECUADOR
Quayaquil:
-met Ing.Pacheco Mosquera, of the ESPOL Polytechnical School of the Litoral, Department of Mechanical Engineering, C.N.C. for Ecuador.
-Ing.Wiessner (the presumed I.R.) was out of town.
-visited three local foundries, met owners/managers Mr.Castano, Mr.Duque Rivera, and Mr.Manzano.

7. PERU
Lima:
-met Ing.Espinoza, C.N.C. for Peru, formerly of ITINTEC, the National Institute for Industrial Research and Technical Standards.
-meeting with Ing.Andersen, manager/owner of the foundry Fundiciones Industriales, member of the Executive Committee of the Foundry Association and I.R. for Peru.
-visited the FUMASA foundry, met the technical manager Ing.Palomino, (trainee with LEMIT) and owner Mr.Gardener. Interviewed Ms.Garcia, who attended the Tupy course in Joinville, Brazil.
-meeting with the president and secretary of the Peruvian Foundry Association, Mr.Gallardo and Mr.Cortez respectively.

-meeting with Ing.Valencia, formerly Director of Technology of ITINTEC and presently in charge of closing down the Institute.
-meeting with Ms.Vustani, Director for Affairs of International Technical Cooperation of INDECOPI, the institute stepping in after ITINTEC.
-meeting with the staff (en force) of the Department of Metallurgical and Materials Engineering of the Lima University. The Director of the Department is Ing.Ibarra Panizo.

8. URUGUAY
Montevideo:
-meeting with Dr.Fahmy, who conceived this project, at the LARO offices in Montevideo.
-meeting with Ing.Scuotegazza, of the Materials Testing Institute at the University of Montevideo and C.N.C. for Uruguay.

V.-THE STATE OF THE NETWORK:

1-Introduction:

In this section the evaluator's observations are presented on a country by country basis. For each country considered the Project's achievements and its state of development according to the evaluator's on-the-spot survey are described in a factual fashion. The list of 'Specific Objectives' (section II.iii) is used as a guide in the presentation.

2-ARGENTINA:

The Argentinian foundry industry is made up of about 400 operators employing 10,000 workers with a total annual output of 300,000 tons. Iron and steel products account for 93% of the output. In turn, 75% of these are vehicle parts or components.

The country has a solid background in metallurgical research. Work on solidification and/or casting, in particular, is conducted at least eight teaching or research institutions. Taken as a whole there is a good equipment infrastructure. A state organization (CONICET) supports a scientific career system.

A few government run institutions count the provision of technical services to industry among the main reason for their existence. Technology transfer from the laboratories to industry has been a subject of debate for years. Generally industry and academia eye each other with mutual distrust and misunderstanding.

At the onset of the Network project the foundry industry was partially represented by the Chamber of Industrial Foundries, founded in 1943. The Chamber publishes a magazine now reaching issue number 100. The publication addresses the whole spectrum of issues of concern to the industry, its suppliers and customers. It also includes technical articles, some of them of good scientific quality.

A National Committee was formed initially in which R&D and Industry were well represented. No Regional Committees were ever set up. By the end of 1989 the Committee had addressed systematically the list of 'Specific Objectives'. There was great enthusiasm for the project at all levels.

After the first meeting of the Steering Committee in Buenos Aires in November 1989, general interest in the Network waned. Network activities were promoted only by either the Latin American Coordinator (L.A.C.) or by the Coordinator of the National Committee (C.N.C.).

At the time of this evaluation research continued along lines already developed by the research establishment before the formal setup of the Network. Industry needs, only sketched by initial surveys, never resulted in a major project.

Two such major projects were ongoing in Argentina (at the LEMIT) before the start of the Network activities: Foundry Technology (3P-84-1034) and Precision Casting (3P-88-1040). From a technical standpoint both projects were extremely fruitful but industry has shown little interest in using the technologies learnt in the process.

Six mini-projects were undertaken in the period 89-93, all of them at the INTEMA, the C.N.C.'s institution was involved as the academic counterpart. No other research institutions had any effective participation.

Through the coordinating role of the L.A.C., Argentina contributed to workshops and courses in Chile and Bolivia, and hosted trainees from all of the participating countries at the LEMIT and INTEMA. Only one trainee was sent by Argentina to the Tupy foundry course in Joinville, Brasil.

In the first year of operation, with the cooperation of the Foundry Association (that is of the I.R., Ing. Susini) conferences were held to inform industry members of the Network's objectives. A workshop in preparation for late this year will gather mainly representatives from the R&D sector.

As interest in the Project on the side of industry and other research institutions faded after the first year of operation, the incipient Network ceased to operate as such.

There was no demand on the Network, on the part of industry, for additional information on technologies, research activities or industrial opportunities. Their needs, to the extent that they were at all present, were satisfied by the Foundry Association's publication, individually by each operator through contacts within the system or by access to foreign sources.

Beyond active efforts of the Association to collaborate with the Network, there were no systematic cash contributions of the industrial sector to the sustenance of the Network's activities. Industrial disbursements were only made in connection with specific mini-projects. There are no mechanisms in place to finance the Network's operations either presently or in the future.

3-BOLIVIA:

All operators in the foundry industry know each other in Bolivia. Through the efforts of the C.N.C. the links existing within the small group of foundries have been strengthened and formalized. As the C.N.C. has his laboratories at the University of San Andres (UMSA) in La Paz, network activities have been concentrated in the La Paz-Oruro region. No other Regional Committees have been formed.

Bolivia was already involved in the Molding Sand project at the onset of this Network project. The C.N.C. presented in 1990 a proposal for a mini-project to develop "Abrasion and Corrosion Resistant Cr-Al Stainless Steels" which was to be made into a major project but was finally rejected by the Executive Committee in 1992.

The Bolivian foundry industry catered almost exclusively to the needs of COMIBOL, the state owned tin mining monopoly. Since 1989, the drop in the international price of tin has caused a sharp decrease in tin production which can be measured by the fact that COMIBOL's workforce was reduced from 300,000 to 70,000 within three years. As a result, the few remaining foundries are now operating at an estimated 25% of their capacity and in search of new products and markets.

In this context the C.N.C. has been successful in enlisting the interest of a few of the largest Bolivian foundries in small projects to develop new plant practices and materials. The mini-project "Mobile Laboratory for Nodular Iron Casting", essentially designed to help foundries control the temperatures and compositions of their casts, has been successful. This is so not only because of the technical service provided but also because industry operators can see the University doing something down to earth and of immediate benefit to them.

Other small projects have been implemented between the U.M.S.A. and industry, without the Network's pecuniary support, mostly related to composition control and nodular iron casting. Of particular interest to Bolivian foundries was the course on "Nodular Iron Casting" given by Dr. Sikora, from Argentina, and sponsored by the Network. From the point of view of the Network's objectives, the course was very effective for many reasons. It brought together professionals and technicians from industry and universities, it trained personnel on the basics of casting metallurgy and introduced them to the metallurgy of nodular iron, plant practices and applications. As a result of this course and plant visits by Dr. Sikora, at least two operators are now casting nodular iron under the supervision of the U.M.S.A.

Furthermore, the fact that the C.N.C. has the implicit support of the IDRC, has implemented of the Mobile Laboratory, has solved problems on sands, general casting, nodular iron, etc. and has sponsored a successful technical course, has lent credibility to the local scientists involved.

In order to keep in touch and to disseminate information on what the Project as a whole has to offer to industry, the C.N.C. is publishing and circulating a bulletin among the industry members.

The I.R., Ing. Freddy Heredia, has been virtually inactive since the start of the project. His only involvement in the Network has been participating in the Vinas del Mar meeting in Chile, but he has not worked within Bolivia at all to further the Project's objectives.

As a result, Project activities in Bolivia have been 'supply controlled' by what the R&D system available through the L.A.C. and the U.M.S.A. has in its know-how portfolio. There has been no specific demands arising from industry's needs and there are no systematic financial contributions from industry towards the support of a local foundry network.

4-BRAZIL:

The Brazilian foundry industry is by far the largest and most developed one in South America. About 1300 foundries are nucleated in the Brazilian Industrial Foundry Association (BIFA), mostly a lobbying organization, of which 8% account for 75% of the output, mostly autoparts.

Metallurgical research, development and teaching is fairly widespread. A number of universities offer graduate and Ph.D. programs in metallurgy.

Brazil was a late starter in the Project's effort, joining in 1990. The country is suffering at the present time one of its congenital economic crises. This domestic recession coupled to an undervalued local currency has helped the industry to concentrate on the export market. This new emphasis on exporting has made casting quality a prime consideration. Industry as a whole is now more receptive to sound technical advice.

In 1991, the C.N.C. together with 20 other universities attempted to finance and form a National Network along the lines blueprinted in this Project. A proposal was submitted to the World Bank for a grant of $US 700,000. It was not approved.

The Project's C.N.C. is now active only in the region of his homestate, Rio Grande do Sul, no other Regional Committees have been formed elsewhere in Brazil.

The regional potential 'market' is made up of 64 foundries, mostly family owned and managed. These operations are represented by the local chapter of BIFA. The C.N.C. through the University

of Rio Grande (UFRGS), has applied for and had approved by the state government a subsidy for U$S 30,000 to develop a local version of the Network. BIFA participates with 20% of the total cost (U$S 60,000) of the project. It is the first cash disbursement from industry for this kind of undertaking detected in South America.

No major projects have been initiated. Two mini-projects originated in Brazil, one on the deformation of green sands (now underway) and a second on computer modelling completed by Uruguay's C.N.C.

As far as training activities are concerned, two LAFUN (Foundry Laboratory of the UFRGS) engineers visited the LEMIT, in Argentina, another attended the workshop in Chile and two industry technicians attended the course at the Tupy School in Joinville. An engineer from the Tupy School trained at the LEMIT.

Because scientific institutions need financial support and because of the personality of the C.N.C. there is a good deal of interaction with industry. Nevertheless a Network, as conceived in this Project, does not exist in Brazil nor in the state of Rio Grande.

5-CHILE:

There are about 150 operators in the foundry industry in Chile with a total output of 100,000 tons. Iron and steel products account for 90% of the output by 30% of the foundries.

Chile has been enjoying a sustained economic recovery for the last few years. The economic policies that have affected some economic indicators positively have also done a lot of harm to the local small and medium size industry. Competition of better quality, lower priced products from the Pacific Rim, has forced at least some of the Chilean foundries to recognize the need for improved practices and technologies.

There are ten universities throughout the country doing R&D in metallurgy. Of these, only five do foundry work. There is a decrease in interest for the subject amongst students. With no replacements for those few scientists active today, the future of this activity in Chile is uncertain.

The Chilean Foundries Association was founded under the auspices of this Project. It is said to have about 100 members, but there is no evidence of any significant activities sponsored by this association.

The I.R. has endeavoured to meet the formal requirements of the Project. He has contributed to forming the association, has attended Steering Committee meetings in La Plata and Vinas del Mar. The I.R. did not attend the Porto Alegre meeting and has since been inactive as far as this Project is concerned.

The C.N.C. contacted other foundry R&D centers at the beginning of the Project inviting his colleagues to join him in the proposal of mini-projects and inviting them to join the National Network. In spite of this no other Regional Committees were ever active.

Chile was involved with Argentina in one major project (Precision Casting) before this Project was started and has been responsible for three mini-projects, two of which have been satisfactorily completed and one is to be finished and reported this year.

In relation to the joint major project between Argentina and Chile, the C.N.C. organized a workshop on precision casting in Santiago in 1992. Of the 18 participants two of them were from the industrial sector and none from Chile. The I.R. from Chile did not know at the time of my visit that the workshop had taken place and had not been in touch with the C.N.C. for over one year.

As for the principal objective of this Project, the setting up of a self sustaining network between academia and industry, such a network does not exist in Chile today and no efforts are being invested by either the C.N.C. or the I.R. to make it happen in the future.

6-COLOMBIA:

Colombia's foundry industry is made up of about 400 operations, with a combined output of 70,000 tons/year. The largest operations (4% of the total) serve the food and automotive industry. Most of the industry (90%) supplies the spare parts market for machinery.

There already exists in Colombia asssociations which represent and link these foundries. Some of foundries are members of the National Industry Association which represents the interests of the whole industrial spectrum and the foundries' in particular through a special committee. The Federation of Metallurgical Industries (FEDEMETAL) has a more defined membership and has a specific interest in serving members of the foundry industry.

There are no scientifc groups doing R&D in metallurgy in Colombia. Technical know-how lies with groups and institutions dedicated to teaching. The programs offered only extend to undergraduate studies. There are no graduate or Ph.D. programs offered in metallurgy. Particularly relevant is the role of the National Apprenticeship Service (SENA) a polytechnical institution run by the state and present throughout the country.

All of the specific objectives of this Project have been met, to some degree in Colombia. The C.N.C. for Colombia has invested a good deal of well managed effort in this Project. The results obtained are realistically described in the report requested by the evaluator from the C.N.C. (5/17/93 - a copy was sent to Dr. Pierre Zaya). Its reading is recommended. An itemized summary follows:

-The "Foundry Sands" project has been completed. Two progress reports were issued, the third and last one is being written. Its results will be offered to industry in a series of seminars to be held for that purpose at the end of July.

-Nine mini-projects were submitted, two of them with the participation of the Universities del Valle and of Bucamaranga. Both of the projects were approved by the Executive Committee and are well underway. A third one was channeled into a training activity by the Executive Committee. A fourth mini-project (Mn steels) was approved by the Executive Committee but had to be cancelled due to limitations arising in Colombia.

-Two professionals from the Department of Metallurgy of the University of Antioquia received training at the INTEMA (ADI-Nodular Iron) and the LEMIT (Precision Casting). A third trainee stayed at the University of Santiago of Chile working on precision casting techniques as well. As a result of these training activities:

-A precision casting department was formed that is now lending services to industry and the art community;

-The trainees started a venture company on their own;

-A group a working in ADI-nodular iron has been nucleated at the Mechanical Engineering Department. At the present time the know-how learnt has been applied to the development of abrasion resistant motorcycle sprockets.

-Colombia sent one trainee from the SENA to the courses at the Tupy school in Joinville, Brasil. Upon returning to the SENA the apointee gave a series of weekly lectures to which 60 people have so far attended.

-Efforts were made to set up other Regional Committees in Colombia, but they did not prosper. Medellin is the only area in Colombia where the Project is active.

This has been made possible in Medellin due to the effective support of the University of Antioquia, the SENA, and FEMETAL; although there have been no financial commitments for support from the local industry.

7-ECUADOR:

Ecuador's main sources of income are bananas and shrimp exports. There is no mining or automotive industry to support a large foundry industry. Only 20 of the 40-odd operators are of any significance (in terms of their tonnage) and they produce

mostly spare parts for machinery, bodies and impellers for pumps used in shrimp nurseries, pipes and connectors for water transport, etc.

The investment of effort by Ecuadorians in this Project may be summarized as follows:

-Presence of a representative at the Lima Workshop in 1988 and at Porto Alegre in 1991.

-Preliminary work on the "Foundry Sand" project in 1990, to the extent of partially meeting specific objectives 13 and 14, none after that date.

-Initial contacts with foundries in the Guayaquil and Quito area.

-Submission of two mini-project proposals, there was no follow-up on the Executive Committee's recommendations.

-A request for Technical Assistance that was not pursued.

There has been no activity connected with this Project or the "Foundry Sand" major project since late 1991. The Network is dead in Ecuador.

8-PERU:

The description of the Project's achievements in Peru is at the present time strictly an academic matter. The responsibility for the National Coordinator role rested in Peru with the ITINTEC, an institution that appointed one of its scientists as the C.N.C. It was the recipient of major projects "Copper Base Alloys" (3-P-85-1035) and "Ductile Iron" (3-P-87-1032).

Beyond the technical results obtained, completion of these two major projects left behind at the ITINTEC a group of experienced researchers and the best equipped foundry and testing laboratory in South America. For a period of time these assets were of great service to this Project. The group provided consulting and analytical services to local industries and built a credible reputation amongst foundries in the area.

Unfortunately, the government of Peru sliced ITINTEC's personnel by half, first in 1991 and finally closed it down for good in 1992. This closure brought work on this Project to an end. The Network idea is dead in Peru.

9-URUGUAY:

There is no such thing as a Network in Uruguay. The local representative established his relationship with the Project as a spin off from the University of Rio Grande in Brazil. Nevertheless the Network has set the course for the C.N.C. There is at the present time a proposal submitted to the Uruguayan Research Council to equip a foundry laboratory and finance research in the areas already familiar to the Network.

VI.-BACKGROUND

1.-INTRODUCTION

This section provides a setting for the 'Discussion' to follow later on by framing the description of the 'State of the Network', provided in section V, in the context of the area's political, economic and cultural scenario. It then goes on to discuss the nature of motivations within industry and within the academic realm. What makes them tick?

2.-THE REGION

Throughout the period the area was in constant political and economic change. When this Project was started, countries in the southern area of the region (Chile, Argentina, Bolivia, Peru, Brasil, Uruguay) were at different stages of transition towards democracy from dictatorial governments, with Paraguay as the only military dictatorship remaining.

In the north of the sub-continent, leftist guerrilla and drug wars were a constant source of turmoil trhough the eighties. Only Ecuador and Venezuela had democratically run governments and were free of the mixed scurge of guerrilla and drug wars.

Economic change followed political renewal, the process starting with Chile early in the decade, soon followed by Bolivia, Argentina, Ecuador, Uruguay. The pattern of change has been a constant throughout the area. The long standing economic structure was initially one of strong state intervention and markets protected from foreign competition by all sorts of tariff and non-tariff barriers. Monthly inflation rates of 30% were usual.

The 'neo-liberal' wave that swept the region has changed this scenario. All of the countries, one by one, have reduced government intervention to a minimum, sold state companies to private (often times foreign) concerns thus exposing their industries to foreign competition for the first time ever.

In order to grasp the relevance of the scenario presented in the previous lines, the process underway in the Soviet Block should be kept in mind. The changes enforced in South America have received less international attention because of the different political relevance between the two regions. Nevertheless, their effect on all strata of society and levels of activity has been no less dramatic in South America than in the Soviet Block. It has also affected the results of this Project.

It is the norm to consider that people from different countries in South America are similar because they share a culture, a common or a similar languages and a common religion. This is not the case. Beyond these similarities there are deep differences in behavior, culture and expectations that can affect subtly but distinctly the outcome of any undertaking like the one under discussion here.

For the sake of example it may be said that it is not generally known that many of these countries have been at war with each other, or at the verge of it, in modern times. Paraguay against Argentina, Brasil and Uruguay; Paraguay against Bolivia; Bolivia with Peru against Chile; Chile with Argentina; Peru with Ecuador.

3.-THE INDUSTRY

As some of the figures provided in section V:'State of the Network' show, the foundry industry is heavily stratified. In all countries the largest 10 operators are responsible for about 80% of the output. A section through a different dimension shows that one key sector of industry usually controls more that 80% of the demand in each country. The vehicle industry in Argentina and Brasil, mining in Chile and Bolivia, the shrimp and subsidiary industries in Ecuador, etc.

As a result, only a few industries have access, through conveniences of scale, to serial production. There is a core of medium sized foundries which occupy the short series niche and a host of small, mostly artisanal, operations.

Large foundries in the first bracket, are usually associated with international concerns or supply to customers that are. In both cases the parent company supplies the technology and the product specifications. These specifications often include composition and microstructure, not just shape, properties or surface finishing characteristics.

Because of the stated and other reasons, the larger foundries are not part of the addressable market within the context of this Project. This discussion continues with only the medium and small size foundries in mind.

In the protected economic environment prevalent in South America at the time this Project was conceived and started, technology was not a high priority concern. As governments regulated all variables in the economy, operators formed industry associations. These associatons are lobbying organizations and represented sectorial interests regarding production, import and export quotas, wages, taxes, preferential credits, trade agreements, common markets, etc.

In contrast to this hierarchy of concerns, this Network Project's main objective is, in practice, biased towards optimizing materials, product quality and processes from a technical standpoint. The reasons for the existence of this bias are discussed further in section VI.5:'The Project Proposal'. The point is that the specific objectives of this Proposal rank, or ranked, low in the list of the industry's priorities at the onset of this Project.

On the other hand implementing technical improvements requires from the industrial sector:

a-the recognition that a problem or opportunity exists,

b-the decision that its important to do something about it,

c-capital,

d-a predictable, stable time horizon.

What these conditions imply is that two basic resources are needed for innovation: information and money. Both are necessary, neither is sufficient.

The first condition is the most limiting one. It requires, to be delivered, an informed supplier and an educated receptor. If the potential recipient does not have the level of education and training necessary (share the same techological culture) to understand or make use of the information, then information cannot be transferred in a short period of time.

In this very basic way money is different from information. If money is the problem, financial resources can be pumped into a foundry in a very short lapse of time to obtain results. On the other hand if information is what is lacking an educated audience is needed and education takes time.

The lack of formal technological education and training in most of the small foundries and in many of the medium sized ones is what makes technology transfer so difficult and frustrating. The limitation just described further constrains the size of the addressable population of foundries that can benefit from technology transfer programs in a short period of time. We add to the group of large foundries that have been discarded before, most of the smallest ones and some of the medium sized ones. We are then left as potential customers with a core of medium sized foundries with a professional staff or a technical department and some laboratory facilities.

Even if the problem is recognized in the the absence of foreign competition, the foundries had no reason to improve the quality of their products. As for competing in foreign markets, even if domestic recession favored looking abroad for customers, government regulations made exporting too complex for smaller companies to handle.

Lastly, we consider the requirements for capital and for a stable time horizon. In an inflationary economy the returns obtained from financial speculation are much higher than those obtained from investment in production. In addition, wavering government economic policies forced entrepeneurs to keep a highly liquid financial position to survive. Planning horizons in such an atmosphere is measured in days, not in years.

This scenario has changed significantly from the mid 80's to the present. The sudden turn to the neo-liberal economic policies described in section VI.2:'The Region' have improved the macroeconomic indicators used by international banking and credit institutions, but have devastated the small and medium size sectors of the foundry industry.

As a result of exposure to international competition due to the lowering of import tariffs, foundries have to make quality products at international prices. Referring to the list of conditions above, there is now a segment of the industry that is (a) aware of the need for technology and management, (b) that is being forced to act in order to survive and, (c and d) with moderate inflation, stable governments and predictable economic policies can -in principle- make planning and investment decisions.

Demand for the kind of 'products' envisioned by the Project is, belatedly, now in place. We now look at the supply side of the equation.

4.-THE R&D SIDE

In this section we examine two issues fundamental to the role assigned by the Project to the R&D establishment:

-What motivates scientists?

-What does the R&D establishment have to offer?

Motivation in the R&D community is given, directly or indirectly, by local and international peer recognition, intellectual reward and funding (personal or to the institution). The importance of the pecuniary factor cannot be exaggerated. Although salaries of scientists vary significantly from country to country they are poorly paid. In some countries take-home pay is less than $200 a month.

Almost all of the scientific establishment in South America is supported on a systematic basis by the state or occasionally through assistance of international development agencies. The degree of state-support has been generally low, although varied across the region and through time.

Government and research institutions rate scientific capability mostly on the basis on work published in (usually foreign) scientific journals. Personal prestige is also measured with the same yardstick.

The changes in the political and economic scenario in South America have also affected the traditional structure of financial support of the scientific community. Due to the diminishing role of the state as regulator and financier, scientists are being asked to look towards industry for inspiration and support of their work.

Considering now what academia can offer industry in this South American context, the fact that scientists did not traditionally depend on industry contributions for the support of their activities have tended to reinforce the cultural trend towards research for its own sake.

Research in the area of metallurgy has been an exception to this rule. The Multinational Metallurgy Program was sponsored by the Organization of American States and managed by the L.A.C. of this Project from 1967 to 1980. Mainly, as the net result of the M.M.P., the area has a long standing tradition of basic and applied research in metallurgy, resident mostly in Argentina, Chile and Brasil.

More specifically in the solidification and casting areas the trend towards applied research of interest to the foundry industry was consolidated through the funding of several projects by the EES Division of the IDRC. In these projects foundry technology already developed and being used by industry in other areas of the world was incorporated into the R&D system.

As a result of this process, at the onset of this Project the R&D system had expertise to offer in areas which could be identified right off the names of IDRC sponsored projects from 1981 to 1988:

-Precision Casting
-Foundry Technology
-Aluminum Alloys Foundry
-Copper Base Alloys
-Sand Moulding
-Ductile Iron

5.-THE PROJECT PROPOSAL

--ITS PREMISES

It can be stated somewhat crudely that this projects deals with the marketing of technical information. In the context of the proposal there are a set of assumptions that can, in the same vein, be described as follows:

a-the R&D system in South America, has an inventory of information and skills that the industry can benefit from and is ready to pay for.

b-this supply-demand scenario does not operate because the market is not clear and because the parties do not know how to deal with each other

c-the best way to 'clear the market' is to set up the proposed Network,

d-given that the R&D system has been assigned the responsibility to set up the Network, there should be sufficient rewards in the overall proposal to motivate scientists to invest their time and effort.

--DOES R&D HAVE ANYTHING TO OFFER?

Regarding the premises involved in assumption (a), the first one is supported by the discussion offered in the previous section VI.4:'The R&D Side' and was obvious to the project designer in the

preparatory stages. The R&D system controls a number of technologies applicable to the foundry industry.

--DO FOUNDRIES WANT IT?

On the other hand, the question of whether industry can benefit from the use of these technologies does not have a straightforward answer. As was discussed in connection with section VI.3:'The Industry', the issue of product quality or product innovation is not necessarily the prime concern of the local foundries, particularly in the 'closed economy' scenario.

Beyond the reasons outlined in section VI.3 in discussing the INDUSTRY scenario, it must also be recognized that foundries (and their customers) are more concerned with the issue of the constancy of quality of a given product rather than on its improvement. In addition, sometimes improved quality can lead to lower profits or require a change in specifications that require customer approval or require less procurements from a supplier that the foundry cannot afford to upset, etc.

Quite opposite is the case of scientists. Their goals are materials and products with novel or improved properties. Once these are obtained, the apparently irrational resistance of the foundries to incorporate them into their product lines or processes both baffle and infuriate researchers.

In this complex situation the criterion for success designed into the Proposal is impeccable: industry must, at some point in time, be willing to pay for it.

--IS LACK OF COMMUNICATION THE PROBLEM?

Assumption (b), that lack of information on what R&D can offer or that the foundries need is what keeps this market from operating, is only partially true. From the point of view of industry, the R&D system is just another supplier and as such it is judged by its reputation, the quality of its products, timeliness of its deliveries, its prices and, finally, local suppliers are compared with what the competition has to offer.

Because of a long standing history of detached research (see section VI.4'The R&D Side') universities do not have a good reputation among industry. Little is known about the quality of their assistance or of their research programs and in turn, scientists have not developed a sensitivity for the value of time when dealing with industrial concerns.

This insensitivity discourages the interaction between industry and science. The technical needs and problems of the foundry industry are pretty much the same throughout the world. In one way or another all of them have been addressed and solved elsewhere. The know-how needed by local foundries is available from outside the region for a fixed price, paid on delivery or on credit and can be acquired quickly without technological risk of failure. This is a kind of service that the local R&D institutions are not geared to provide.

--IS THE NETWORK IDEA THE RIGHT APPROACH?

Given the view of the problem implicit in assumptions (a) and (b) and the history of projects sponsored by IDRC in the 80's, the Network Proposal is the most effective and elegant way to pursue the objectives of this Proposal (see Section II). In terms of the marketing outlook used in this discussion, the Network idea represents a marketing campaign, managed by the supplier, where outside financing is used to advertise and distribute sample R&D products at a discount. The objective being that as demand picked up, the process would be self sustaining.

The success of the approach is limited from the very beginning by the limitations in the basic premises, which have been discussed here. In addition, the Network idea is constrained by the segment size of the industry that it can address within the time span available (see section VI.3): medium sized companies run by professionals.

There also is implied the notion that individual operators are willing to share technical know-how with each other. This was not the case in general at the time the Project was started.

Industries compete with each other and only associate to gain a common advantage. In closed economies there is no common competitor and no incentive to cooperate.

--ARE SCIENTISTS MOTIVATED TO COOPERATE?

Lastly, there is the issue of motivations. The management of the Network was entrusted by design to the R&D establishment. In effect, the L.A.C. is from such an extraction and, as stated in the P.S. (paragraph 13, page 4):

> -"The Coordinator of the National Committee will be from the academic/government sector in order to try to guarantee as much objectivity as possible when representing his/her country on the Network Steering Committee."

It is not clear what is meant by 'objectivity' in regard to researchers who are driven by personal and professional interests diverse from those operating in the industrial sector but just as strong.

Furthermore, the responsibilities of the L.N.C. are defined in the P.S. as follows (page 4, paragraph 14):

> "
> a-identify specific foundry technology needs such as:
> major research needs
> personnel training
> foundry process technology
> equipment needs and problems
> access to credit for industry and funds for research;

b-identify national research and development resources;

c-coordinate existing activity to provide solutions to amenable problems;

d-develop an action plan to meet the remaining needs in order to achieve an appropiate level of foundry technology in the country;

e-solicit funds from national and international sources to meet some of the requirements of the action plan; and

f-identify and request complementary activities from the Network to consolidate national efforts.

"

All of the appointed C.N.C.s are technical people, involved in R&D and/or teaching. This demanding list of responsibilities requires from them a significant investment of time and effort and the neglect of their regular activities. Researchers have no excess time on their hands nor excess money in their pockets. Many of the scientists in the area need second jobs in order to build up their salaries.

The list being considered, also calls for management skills, an outgoing personality, and a taste for public relations on the part of the appointee. This baggage does not quite match the stereotype of a scientist. Moreover, as suggested in the following paragraphs, the project also requires as a condition for success involvement of people with a very strong sense of mission.

--FUNDING

There are no explicit incentives designed into the P.S. In particular, it makes no provisions for personal assistance to the C.N.C.s as it does for the L.A.C. It provides funding to C.N.C.s only to begin the liaison function. That is, for expenses associated with local travel, communications, etc.

Lacking the universal driving force (money) and with the discussion in section VI.4 in mind. What other implicit motivators can be found in the proposal?

--MAJOR PROJECTS

The Network idea offers participating scientists the chance of having a major project funded by IDRC. An approved major project represents for the institution or person receiving the grant equipment, prestige, foreign travel, training, an enhanced salary, etc. This powerful motivator disappeared from the Project's horizon after 1990.

At about that time IDRC's priorities shifted away from technology programs. Local participants in this project learnt that Phase II had no chance of being pursued, regardless of the results of Phase I. For the same reason, they knew early in the process, that no major projects would be considered in the future.

--MINI-PROJECTS

What about mini-projects? The idea behind mini-projects is very sound: some seed money and an applied, technically solid project that will start the academia-industry interaction going. The project contributes money towards 'samples' of technical service, if industry likes them, it asks for more.

The funding for each mini-project, appropiately termed 'seed' money, was set at about U$4,000. Industry was to contribute with a similar amount.

It may be thought that U$4,000 is an insignificant amount for an ongoing industry to contribute. This is not necessarily the case. We concluded in section VI.3 that the most likely market for this project lies with the medium sized industry with at least one technical professional on its staff.

This medium sized industry typically has a capacity of 40 tons/month, sales during this recessive period of at most half that volume, at an average price of U$1.5/kg, 30 workers (cost of labor U$150/month) and maybe a plant manager and an engineer responsible for quality and technical matters, and a secretary. Professional's salaries can be set at about U$800 per month (cost to the company U$1300). A cash statement for a given month would for this typical foundry, would look as follows:

Sales	U$30000
R.M.,Energy, Supplies	13000
Labor	+~5000
Cost of Goods =	~18000
Gross Margin	12000
Overhead -	5000
Sales Tax -	1000
Owner withdrawal -	3000
Net Cash =	~3000

For this size foundry U$4,000 and five engineer/worker-months are a significant effort on the part of the foundry involved. On the other hand, in more absolute terms, not much can be done with an U$8,000 budget. As a result, mini-projects were both underfunded and expensive at the same time.

Because of the costs mini-projects have been an inducement to participate for countries with a healthier industry and better equipped R&D laboratories. Under these conditions, fixed costs were covered by the system and mini-project funding contributed mostly towards the variable costs.

In less fortunate environments mini-projects were more a burden than a blessing. To compound this situation, the Executive Committee thoroughly screened all mini-projects. Technically demanding proposals ended up in the hands of responsible professionals. Participants from less developed countries recoursed to extraordinary levels of imagination and effort to obtain additional resources (time, effort, money) to fulfill their commitments to the E.C. An experience not to be repeated.

--PERFORMANCE OR SUCCESS?

Lastly, a few comments on the guidelines for evaluation of success built into the P.S. In terms of the marketing campaign analogy used in this analysis, the only acceptable measure of success is the level of funding that industry is willing to commit to support the Network i.e. are they buying it or not? This notion is clearly stated in the Abstract of the P.S. (paragraph 6, page ii) but becomes diluted in the context of the P.S. itself.

The indicators of success given in the P.S., paragraph 39, page 11 and reproduced in section III only address the issue of performance not of achievement. Identifying needs, spending money on samples (mini-projects) efficiently, knowing what to do next and where funding is going to come from are only indicators of professional, systematic effort to maximize the chances of success, not of success itself.

VII.-DISCUSSION:

1. INTRODUCTION

In this section the distinction between performance and results, previously emphasized, is used in discussing the workings of the Network's organization. Next the issue of success of the Network at large is considered, followed by an evaluation of results on a regional basis.

2. THE NETWORK'S MANAGEMENT

Within the constraints discussed in the previous section, the overall performance of the Network is the result of the actions of the governing committees set up in the P.S.

The bias in the design of the project towards performance, that was pointed out earlier, has been reinforced by the fact that the supply side (R&D) of the equation actually runs the Network. There is no representative from industry in the Executive Committee, all C.N.C.s are scientists.

3. THE EXECUTIVE COMMITTEE AND THE LATIN AMERICAN COORDINATOR

Unarguably, the E.C. and the L.A.C. provided the Network with technical proficiency, effective management of the regional professionals and a flawless administration of the Project's funds. Results of this competence are clear in connection with specific activities where they count the most. Referring to section II.i: (a) major projects were identified and those mini-projects that were approved were meaningful and were completed on time and within budget; (b) workshops and courses on subjects 'in stock' were a complete success as well as training at 'centers of excellence' which were fruitful and appreciated by all participants and, lastly, (e) a compilation of the handful of establishments involved with R&D (g) and lists of foundries available on request from local industry associations.

On the other hand, where industry concerns or participation were required, accomplishments were of limited significance: (c) little technical advice was provided but then little was requested; (d) a Network bulletin was painstakingly published by the L.A.C. on a regular basis but its contents were mostly progress reports on the operation of the Network and were (with one exception, issue #6 on Precision Casting) of no interest to foundries; (e) compilations of foundry needs were put together initially in each country but were not compiled and published in the bulletin and led to no systematic actions; (h) no financial committment to the sustenance of the Network was obtained with the only exception in the Porto Alegre region.

It follows from the disquisition in the BACKGROUND section VI, that work towards the building of the Foundry Network should have been more than a disciplined and efficient pursuance of the P.S. It should have also been an exercise in human relations and communications. The customer has to be coaxed.

4. THE EXECUTIVE COMMITTEE AND THE STEERING COMMITTEE

With this concern in mind, the first thing that strikes the observer is the change in roles (from those defined in P.S.) of the Steering Committee (S.C.) and the Executive Committee (E.C.).

The P.S. called for the S.C. to: "...in large part, to discuss and *approve* the Network activities *proposed* by the Executive Committee." (author's italics) Also the E.C. "...will have the responsibility of implementing the recommendations of the Network S.C...."

As it happened, according to the unanimous report of the members of the S.C., the E.C. took over the steering of the Network as well as its running on a day to day basis starting with the very first meeting in La Plata in 1989. S.C. members from industry reported to the evaluator that the S.C. never functioned as such. The C.N.C.s submitted mini-projects, discussed the situation in their respective countries, etc. but the views of Executive Committee were always prevalent and determined the actions of the Network.

Whether real or not, in the short term this perception discouraged constructive participation of many representatives. In particular, industry representatives did not feel that investing time, effort and money in a Network run solely by academia and officials, from well meaning but extraneous institutions, was worth their while.

Over the long term the self sustenance of the Network would have required not only funds but the independent management of the system by the incumbents. Exercising their coordinating skills as a team should have been encouraged even at some expense in the short term effectiveness of the Network. Long term efforts were further discouraged by the knowledge that IDRC was not planning to pursue the second phase of this Project.

In addition, at the first coordination meeting Network participants had for the first time a chance to see the mini-project selection procedure in operation. There is general agreement that the screening process was technically fair and adhered to the ground rules prescribed in the P.S. Nevertheless it is the evaluator's opinion that they should have been less severe the first time around, even at the risk of no results. This policy, applied judiciously, would have kept proponents interested in the Network. As it was, with or without rational justification, many went back home disappointed and discouraged. Many never tried again.

The feeling of inequity became more pronounced when, shortly before the next coordinating meeting to be held in Vinas del Mar in 1990, industry representatives were informed by the E.C. that they were expected to pay for their own expenses. This step was justified by the E.C. on the grounds that the Network did not have enough funds and on the assumption that if the incumbents belonged to the industry then they surely must have sufficient funds. Results speak for themselves, industrial representatives ceased to participate in Coordinating Meetings.

5. SUCCESS

We now turn away from performance and towards achievements. It is evident from consideration of the 'State of the Network' in section V that if industry interest (as measured by their degree of financial commitment to the idea) is strictly taken as a measure of success, then the Network Project has been a failure.

The reasons for failure in this particular regard are multiple and have been addressed in one way or another in the course of the Background (section VI) above. The basic reason is that, much as it cannot and will not say so, industry as a whole is not interested in what is being offered by the local R&D system.

The foundry industry at large deals with internationally marketable products. In a protected environment technology is just another factor in the equation. In open economies efficiency is related to scale of operation. Large foundries, with knowledgeable professionals, shop abroad where these services are available as proven products with a predictable delivery time and price. Local suppliers are known or generally not trusted.

Of the medium and small size operations, as many as 60% disappeared during the transition to an open economy. Those that survived specialize in niches that are of no interest to large operators or do not compete internationally, ie. short series, parts for specific machinery, orthopedic implants, art, etc.

If the local R&D system has something to offer to these foundries, and few doubt that this is the case, then they must first be educated into the needs for and the qualities of the products that they are being offered. The path towards building a stable relationship made up of genuine self interests is through education of the customer.

The Network Proposal is a step in the right direction but its emphasis in technology, bias towards the R&D system, lack of proper motivation for participants, limited funding and a short time horizon has limited its accomplishments.

6. MEDELLIN-A CASE STUDY OF SUCCESS

The conclusion of the last section is essentially suggesting that in a project of this nature success cannot be designed into the proposal. With limited resources, as it is always the case, the designer can only minimize the probability of failure. The rest is up to the people on the field and the first choice has to be the right choice.

The performance shown and the results obtained by the C.N.C. in Medellin, Colombia is a showcase for what the Network project is meant to trigger.

Colombia's social, political and economic situation is no more propitious to R&D-industry interaction than any other country in South America. The Medellin area in the province of Antioquia is the country's industrialized region, where textiles predominate. The country as a whole is living through an acute economic recession. In addition, industry is now facing growing competition from imports. The social and public administration web in Medellin is slowly rebuilding itself after years of drug-related and guerrilla warfare (a mini-project was cancelled because the owner of the foundry that supported it was killed). There is a general undercurrent of affluence brought about by the cocaine trade that also benefits the local industry. Government red tape is a nightmare come true. SENA's engineer's application to attend the Tupy seminar had to be signed by the President!

In spite of this rather ghastly scenario Medellin is a show case for what the Network was meant to accomplish as can be seen from reviewing Colombia's part of the 'State of the Network' section V.6.

What makes Medellin different from the rest of the areas where the Network has been active is their culture in the broad sense of the word. The evaluator's perception of the foundry managers/owners and researchers interviewed is that they are energetic, enterprising,and reasonable in their expectations.

Most importantly they understand intuitively (culture at work) the nature of competition and the role that technical knowledge plays in it.

Ing.J.I.Gomez had no previous experience in research or contacts with industry, he had never managed a group of people at any level, never worked outside the confines the University of Antioquia where he is a professor with the Department of Mechanical Engineering. The Department itself was not engaged in research or development at all, only teaching. They have no graduate programs.

When appointed C.N.C, the Department allowed Ing.Gomez seven hours a week to act as such. J.I.Gomez understood the Network Project in its broader objective. He enlisted the help of dispersed resources available in the area and then proceeded to manage them efficiently towards meeting the Network's ends.

Local industry was receptive and J.I.Gomez understood the nature of their needs and demonstrated to them that scientists could be of service. He worked hard at educating his contacts. He addressed in a systematic way all of the Network's explicit objectives and has been successful to some extent in all of them but one: the Network's self sustenance. If IDRC's support is now withdrawn, the Network will disappear in its infancy stage. In absolute terms the project should be also considered a failure in Colombia. Nevertheless, given more time and additional resources J.I.Gomez could make of the Foundry Network a working reality in Colombia.

7. OTHER COUNTRIES

In the rest of the countries involved in the Network we find all levels of performance, all degrees of success and all kinds of reasons to explain one and the other.

If Colombia was an absolute failure and a relative success, Brasil comes next in line. Here there are chances of survival of the Network through government contributions and the only instance of industry committing their support. The reasons for success are very similar to Colombia's: industry's attitude and a dedicated C.N.C. with a sense of mission.

There are not large foundries catering exclusively to the automobile market in the state of Rio Grande do Sul. Most are medium sized and family owned that is, most belong to the segment that the Network appeals to. Their products compete in the national and export market mostly on price, not on the basis of quality. There is a large sector of the population in the state of German origin, the proverbial German attitude towards work and technology permeates the foundry industry which has been very receptive to the C.N.C's efforts.

The C.N.C. has made the Network idea his own. He has seen the advantages that concerted action would bring to industry and to his own department. He has made the industry share his convictions and is now looking for government support for the concept.

Peru was also way along the road of establishing an incipient Network. Mostly due to dedicated C.N.C.s and the support of the state technical system. The cause of the Network's demise has been the neo-liberal policies (see section VI.2: The Region) of President Fujimori. The responsibilities of technical research and enforcement of standards has been transferred to the private sector and the ITINTEC has been dismantled.

The C.N.C. in Bolivia has made a commendable effort and the Project has made a very significant contribution towards the '...realization of social economic goals...' (section III.1). The Network did not develop mostly because of social and economic reasons.

The Network effort should have been successful in Argentina. The background factors have been a hindrance to the Project but by themselves they do not explain the failure to nucleate even a regional working Network. Argentina has a relatively developed R&D system and a fairly large and complex foundry industry. Considerable effort was invested in getting the Network under way in the first year. A reduced but significant number of foundries and the Foundry Association contributed with enthusiasm. After the first Coordinating Meeting, effort only continued along some specific objectives but the focus on the Network was lost. In terms of the marketing analogy used in this report a possible description of what happened is that after the first sample, prospective customers liked the product but not the packaging.

In Chile very little was accomplished beyond competent work on major and mini projects. The C.N.C. participation was mostly professional. His connections with industry went only as far as were required by his commitments to projects. The industry representative played a very passive role without any conviction. Beyond the cultural and economic reasons common to the rest of the region, lack of motivation of the people responsible for the Network was the main reason for failure in Chile.

Nothing can be shown by Ecuador as a result of their participation in this Project. The people responsible for the Network never believed in the idea in the first place. If any work was done for the Foundry Sands project there was no evidence of it to be seen. All the factors discussed as probable causes of failure seem to have been at work in this country.

8. REGIONAL LEVEL

The Network has been more successful at a regional level. Through the actions of the Network a web of relationships has been established on the supply side of the R&D-industry equation. Researchers in the field from different countries have come to know and to work each other across international borders and have learnt to look to industry as an opportunity. Not less importantly some have also learnt to 'sell' their services through exercising of the tools of the trade: writing reports, making presentations and defending their views amongst peers of different nations.

These achievements have been possible because most of the within industry and between industry-R&D constraints do not apply within the R&D establishment. Professionals, more homogeneously educated, with the same noncompeting interests, whose technical activities were managed and administrated by people respected in their own fields of endeavour.

VIII.-RECOMMENDATIONS:

Knowing that there will be no second phase of this project, it is difficult to make any realistic recommendations that are Network specific.

Nevertheless, in those countries, namely Colombia and Brazil, where an incipient regional Network has been nucleated, the local C.N.C.s should be further supported. This renewed support where there has been some success is required for two reasons.

First: nothing does more to quench creativity than arbitrary changes in the rules of the game. As it happens with product quality, stable rules are better than good rules. People that worked on this Project invested their effort, and obtained results, mostly due to the prestige of the fact that IDRC was behind it. When IDRC lost interest in this Project so did those responsible for its operation. IDRC should make a show of support for the sake of its own credibility.

Second: the reasons that prompted this project are as well founded today as they were four years ago and Colombia and Brazil show promise. What the local C.N.Cs there need is the use of IDRC's name and some limited funding.