Shaping the Demand Side for Environmentally Sound Technologies: Inter-Firm Cooperation, International Partnering and Technical Assistance

Jörg Meyer-Stamer

Contribution to ATAS Bulletin No. XII,
The transfer and diffusion of environmentally sound technologies: From Research to Commercialization

August 1999

Table of Contents

A Introduction

Making environmentally sound technologies available to firms, especially in developing countries, is a necessary but not sufficient precondition to reduce the ecological burden caused by industrial production. A key challenge is to stimulate a demand for environmentally sound technologies. This is what this chapter is about.

There is little dispute today that it is not adequate to describe technology as just another merchandise that can be purchased off-the-shelf. Apart from tangible technology, like a machine tool, there is also intangible technology, like management and organization, and there is tacit knowledge, i.e. non-codifyable knowledge on how to fine-tune a machine or how to make an organization actually work efficiently. In other words, it is important to conceptualize technology in a broad sense, i.e. not just as technical hardware but also organization and knowledge.

It is quite obvious that technology in the broad sense is not easily transferable – not within an economy and even less between countries. At the same time, it is quite obvious that international technology transfer has worked marvelously in many occasions. Such occasions were those where the competence of the donor and the recipient of a technology fit, not only in terms of mastering a given technology but also in terms of mastering the transfer process as such. In many other cases, international technology transfer has failed – often due to insufficient capacity of the donor and / or the recipient.

The purpose of this chapter is to look more closely at the recipient side. In particular, two issues will be addressed. First, there is the question why firms should try to acquire environmentally sound technologies in the first place. There seems to be a typical trajectory in the way firms deal with environmental issues and technology. Initially, firms tend to see environmental protection only as a burden, adding cost without measurable benefit. It is only later on that firms start to acknowledge that environmental measures may also have a positive economic impact, and that more than just a few businesspeople start to articulate an environmental consciousness. In some cases, firms are forced to reduce their environmental impact by government agencies, but it would be exaggerated to claim that in the developing world environmental agencies are consistently in a position to strictly enforce environmental legislation. Therefore, it is essential to consider further means to stimulate firms to implement environmental measures.

Second, there is the question how international transfer of environmentally sound technologies can be stimulated and supported. Creating a demand and leaving the rest to the market would be one option. However, given the peculiarities of the economic good "technology", mentioned before, it makes sense to consider specific support measures to create the preconditions so that the market mechanism can work.

The structure of the chapter is as follows. Section B presents six case studies where firms in Brazil for one reason or another started to articulate demand for environmentally-sound

technologies, often within the context of an overall effort to reduce the environmental burden; this is why the term “environmental management” occurs more often than “environmentally sound technology”. It focuses specifically on cases where inter-firm cooperation played an important role. The case studies are then evaluated in a comparative perspective, and a number of policy conclusions are drawn. Section C discusses instruments to stimulate international partnering as a precondition for successful international transfer of environmentally sound technologies.

The evidence presented in this paper is based on research and policy advisory work conducted on behalf of two pilot projects of the German Agency for Technical Cooperation, GTZ, namely the “Pilot Programme for the Promotion of Environmental Management (P3U)” (http://www.gtz.de/p3u) and the “Pilot Project Strengthening Environmental Competence in Developing Countries (ETC)” (http://www.gtz.de/utk).

B Stimulating the Demand for Environmentally-Sound Technology (with Special Reference to Inter-Firm Cooperation): Experiences from Brazil

Brazil has been implementing an environmental policy since the 1970s, mainly as a response to growing environmental damage caused by dynamic industrial development. Brazil has created a federal environmental agency, IBAMA, states have created their own environmental agencies, and even some municipalities have active environmental agencies of their own. The division of responsibilities between these agencies is often not clearly defined, and their mode of action is extremely diverse. A large firm in an urban agglomeration is likely to be controlled strictly, whereas small firms in small towns may not have suffered any control so far even if they are highly polluting. In any case, there is not only legislation but also implementation so that firms are under pressure to reduce their environmental impact. An important instrument in this context is the certification formal sector firms have to obtain from the environmental agency. The need to get a license first arises when building a new plant (licença prévia / provisional license at the initiation of a project, licença de construção / construction license before start of construction); afterwards the license for operation (licença de operação) usually has to be renewed on a fixed-term basis (with differences in the actual practise; firms in Joinville complain that they have to renew the license annually, at a substantial cost).

I Case studies

The following six case studies describe experiences in inter-firm cooperation in environmental technology and management in Brazil. They cover a wide spectrum regarding types of cooperation, of firms involved, and of the role of business associations and government. They are all from the industrially more advanced South and Southeast of the country (although no case from the state of São Paulo, the most important state in terms of

industrial production, is included). They cover different types of business structures: mostly domestic firms in the cases of Santa Catarina and Rio de Janeiro, and production systems that include domestic suppliers and foreign-owned final producers in Paraná.

Núcleo do Meio Ambiente, Joinville

The *Núcleo do Meio Ambiente* (NMA) of the *Associação Comercial Industrial de Joinville* (Association of Commerce and Industry, ACIJ) was created in March 1993. It is essential to know three factors to understand its creation.

First, firms in Joinville were under pressure to improve their environmental performance. Joinville is the largest city and the most important industrial town in Santa Catarina; it locates a number of large, well-known firms, mainly from four branches: electromechanical industry (Embraco, Multibrás, Schulz, Wayne-Wetzel), metal-engineering industry (Fundição Tupy, Carrocerias Nielson, Fundição Wetzel, Embraco Fundição, Docol), plastics industry (Tigre, Akros), and textiles industry (Döhler, Lepper). The state environmental agency, FATMA, at that time followed the principle that large firms are the main polluters and thus the main targets of controls. In the specific case of the Joinville firms, this particularly meant intense controls of their wastewater effluents and pressure to build wastewater treatment stations. This was motivated by the high level of pollution of local rivers and the high water-intensity of many firms (particularly in sectors like textiles).

Second, a number of medium-sized and large firms had an – albeit brief – history of cooperation on a concrete environmental problem. In 1989, they had created the "Group of 19", consisting of the owners or CEOs of 19 leading local firms, to find a solution for the problem of disposing solid waste; the municipal landfill site did not offer adequate installations for the disposal of industrial waste.[1]

Third, ACIJ was a partner in a German technical cooperation project that had started in 1991. It involved several ACIs from the northeastern part of Santa Catarina and the Chamber of Arts and Crafts of Munich and Upper Bavaria. A key contribution of this project was to induce the creation of working groups within ACIs ("núcleos"), not just by suggesting the possibility and referring to successful experiences in Germany but also by organizing the process of starting and sustaining them. Thus, even though the notion that it might be possible to set up a working group ran against the predominant local business paradigm,[2] there were already a few cases which proved that there was an alternative.

1 It took no less than eight years until the industrial landfill site finally went into operation. The delay was mainly due to problems of acquiring a piece of real estate, although all actors involved had in 1991 agreed to use a certain area.

2 The local proverb to describe this paradigm is "cada um por si e deus por todos", i.e. everybody for himself and God for everybody.

The working modus of the Núcleo do Meio Ambiente

The format of the NMA is as follows. It had 31 member firms at the end of 1997. Each member firm is represented by an employee (i.e. not the owner or CEO), typically the manager / engineer in charge of wastewater treatment, environmental management, or utility issues. It meets every fortnight. The work is facilitated by a consultant employed by the ACIJ[3] who has a long experience in the environmental field, both in the public and the private sector, something that gives him a high standing with the firms' representatives. He sees to the administrative work, convenes the participants, prepares material for the meetings, moderates the meetings, and takes care of the follow-up. A typical meeting lasts about three hours and is attended by 15 firm representatives (although deviation is very high, from as few as six participants to as many as 34, i.e. including representatives from firms which are not member of the núcleo).

Results of the work of the NMA

Initially the NMA addressed mostly the issue of wastewater treatment. Over time, there has been both a broadening and a deepening of the focus of the work. The NMA has started to address new issues, like environmental management or the Local Agenda 21. And the NMA has produced a manual for wastewater treatment in industrial firms, 5,000 copies of which are now distributed among local firms, particularly SMEs.

Participants point out that, apart from the issues raised in the meetings, the NMA has played a crucial role in creating a culture of easy information exchange between firms' professionals. This is an important aspect as this runs contrary to the local business culture. Firms just did not have informal exchange of information and experiences (Meyer-Stamer et al 1996, Meyer-Stamer 1998), particularly not among employees. Owners and CEOs met at the ACI and socially (but they did not discuss firm issues there), but employees hardly met at all (there are also no professional associations which might stimulate information exchange). In this context, participants point out that it is an important feature of the NMA that it consists exclusively of employees. The presence of owners / CEOs would make frank communication much more complicated.

A further contribution of the NMA's work has been a profound change in the firms' relationship with FATMA, the state environmental agency, which used to be highly conflictive in the past. The NMA has repeatedly invited FATMA officials to its meetings. This gave rise to a mutual learning process where firm representatives started to understand

3 This, at least, is the prevailing notion and the usual pattern regarding persons who accompany the work of núcleos. In fact, the consultant in charge of NMA is technically not an employee of ACIJ but of a cooperative that has been founded by the "Club of 19". However, he has his office at the ACIJ like everybody else, and he acts as if he were an employee of ACIJ.

the logic, necessities, and pressures behind FATMAs acting, and vice versa. A result was that a certain level of trust evolved between FATMA and the NMA member firms.

The change in the relationship can be illustrated with two examples. First, it sometimes happens that a technical defect disables a firm's wastewater treatment station. The firm will then get in contact with FATMA to inform it about the problem and the schedule to solve it. FATMA normally accepts this and refrains from fining the firm. Second, firms and FATMA are in the process of setting up a system of self-monitoring where firms will constantly control the composition of their effluents to assure that they comply with legally established standards. At the time of the field research for this paper firms and FATMA were stuck in a conflict on the number of substances to be controlled. FATMA proposed a comprehensive list to be applied to all firms that included various substances that were not used at all by some of the firms, whereas firms suggested to check only a limited number of substances, thus reducing the monthly cost of the tests from about R$ 6000 to about R$ 2000. Local actors were optimistic regarding the resolution of this conflict and the possibility of creating an arrangement that counts on the responsible behavior of firms.

Another impact of the NMA's work is increased awareness for environmental issues both in member firms and in the business community as a whole. The NMA is locally well-known, inter alia because it received the environmental prize established by a business magazine.[4]

The future work of the NMA will probably focus on two issues. First, there is environmental management. So far, the technical discussions have mostly been focused at end-of-pipe-technologies, particularly in wastewater treatment. Firms have only recently started to move beyond this towards environmental management systems. This is the obvious next step on the typical trajectory of firms' dealings with environmental issues. At the same time, some firms are suffering a pressure from their customers to get active in this field and to seek a certification according to QS-9000[5] or ISO-14000. There is a general agreement among participants that the NMA will be a highly useful forum to organize information exchange on environmental management, thus accelerating and leveraging the learning process in each firm.

Second, the NMA will become more involved with the community **(***comunidade*). In the perspective of participants, community involvement has already been one of the foci of the NMA, especially regarding the production and dissemination of the wastewater treatment manual and the involvement of NMA members in discussions on a Local Agenda 21. In the future the NMA participants are keen to support local micro and small firms. They are also

4 This magazine, Expressão, thus each year highlights the environmental effort of several individual firms. The NMA's activities gave rise to a special prize for collective action.n

5 QS-9000 is a quality standard used by U.S. car manufacturers. It builds on ISO 9000 but goes beyond it; among other features it includes certain environmental features. European car manufacturers are using a similar system.

interested in stimulating a broader dialogue on environmental issues; as a first step they invited a number of local environmentalist groups for a joint discussion.

In explaining the success of the NMA it is important not to forget the emotional side. Being the person in charge of environmental affairs so far meant mostly to be responsible for wastewater treatment and solid waste, and to make sure that the firm was fined as little as possible by the environmental authorities. In their respective firm, the NMA participants were often in a marginal position, tolerated but associated with one of the unpleasant sides of the firm, a side that mostly causes costs and conflicts with authorities. Thus, the emotional stress was quite high. Sharing their problems and experiences with colleagues suffering from the same problem help professionals in dealing with this stress.

Grupo de Aterro Industrial, Blumenau

In 1995, the local administration in Blumenau noticed that it was running out of space in the municipal landfill site. In order to delay the closure of the landfill site, it notified firms that it planned to reserve the landfill site for domestic waste. Thus arose the question how dispose of industrial sludge which with 3,000 tons per month made up the largest part of the solid waste generated by firms. The massive generation of sludge is the result of high investment in wastewater treatment stations; essentially all large firms in Blumenau, most of them from the textiles industry, have their own stations. They were mostly built in the second half of the 1980s in response to pressures from FATMA and foreign customers.

Within the local Chamber of Industry and Commerce (ACIB), a working group of ten industrial firms was formed to deal with the problem.[6] Among the options pursued by the group was the installation of a sludge incinerator. This idea was not feasible, mostly for financial reasons (it would have involved an investment of some R$ 60 million) but also for the toxic content of its emissions. The most realistic option, it turned out, was a two-track-approach: reduce the generation of sludge and initiate the construction of an industrial landfill site.

In order to reduce sludge, the firms contracted a small local engineering firm specialized in wastewater treatment, Resíduo Zero (RZ). It suggested a different biological treatment process which reduced the generation of sludge by 80 % at 20 % less cost (compared to the established process). However, the process itself is tricky as it requires a roughly stable consistency of the effluent entering the station. Currently, the firm is refining the process to make it more stable, for example resilient against vast oscillations in the pH value of the

6 ACIB is taking part in the same technical assistance project as ACIJ, but the working group preferred not to employ the núcleo methodology, apparently because nobody at ACIB had the idea that this might have been a good idea.

effluent (which are due, for instance, to the practice of some textiles firms to conduct certain types of finishing activities, like mercerizing, only once per week).

Regarding the industrial landfill site, the group identified a local firm in the waste business which was willing to invest in the construction. The firm visited installations elsewhere in Brazil and abroad in order to make sure that its installation would reflect the current best practice in this field. The new landfill site has been completed recently.

During the process, ACIB professionals repeatedly pointed out to the firms that the disposal of waste in the new installation was bound to be much more expensive than the R$ 6 per ton firms had to pay at the municipal landfill site. In fact, the waste firm is going to charge according to the water content of the waste. Whereas waste with a water content of less than 20 % per ton will cost R$ 20, waste with a water content of more than 80 % will cost R$ 75 per ton; depositing humid waste involves high costs since it has to be mixed with concrete and lime. This has created a further incentive for firms to generate less sludge.

Reducing the generation of sludge by firm is ecologically desirable, but it may compromise the economic viability of the landfill site. To counter this, the Chamber has informally encouraged the waste firm to identify, within a circle of 100 km around Blumenau, firms which do not dispose their sludge adequately and to notify the authorities. As the firm is in charge of disposing of industrial waste in the region, it is easily in the position to observe irregular behavior by firms.

Cooperation among the firms so far has been restricted to the issues mentioned before, i.e. reducing the generation of sludge and discussing the sludge issue with the waste firm. A culture of intense communication, like in the NMA in Joinville, did not emerge so far. Possible explanations are a local business culture that is maybe even more hostile to cooperation, and the fact that the group did not establish a clear distinction between the participation of owners and employees. However, being confronted with the Joinville experience firms' representatives liked the idea of continuing to work in the group, but with a broader focus, like environmental management. It is probable that it will depend largely on ACIB whether this materializes: If it invites firms and facilitates the work of the group, an experience similar to the one in Joinville may occur.

Small Printing Shops, Blumenau

In 1996, the local environmental protection agency in Blumenau, FAEMA, started to control more intensively local micro-firms in the textiles printing industry. The existing several dozens of firms were estimated to generate 1,200 cubic meters of effluent with high dye-contents and high pH-values without any attempt to clean this. Being threatened to be shut down, the micro-firms got in contact with the ACIB and asked for support in identifying a technically and financially feasible solution; some workshops consisted in just one self-employed person, earning about US$ 300 per month with this activity.

Commercially available small wastewater treatment stations proved to be too expensive. A commercial firm proposed a central treatment station for the micro-firms; in this case transport would have been too expensive.

ACIB again got in contact with Resíduo Zero (RZ) which developed a tailor-made, cheap solution. It consisted in building a tank where the wastewater was deposited. RZ identified a chemical substance which, at a cost of R$ 10 - 20 per month, binds the dyestuff and reduces the pH-value, thus generating water clean enough to be reused in the production process and a sand-like sludge which can be disposed as ordinary waste. The cost of the construction material for a new tank was usually about R$ 400, although RZ found ways of cutting this down to R$ 250 by using recycled construction material. RZ visited 60 to 70 firms which might have used this process. It also assisted firms in constructing the tank and understanding the process without charging for this service; part of the cost was covered by ACIB, part was written off as investment in establishing RZ as a competent and credible service provider. In the end the process was installed at about 30 firms; many of the other firms had gone out of business due to economic reasons in the meantime. The project involved no direct cooperation between the micro-firms except for visits of microempresarios at the site of pilot installations.

Projeto Ecogoman, SC

The project Ecogoman involved Brazilian and German textiles and starch firms, government, and research organizations. It aimed at adapting to the specific Brazilian circumstances a process to recycle starch used in the finishing of textiles fabric. So far, the starch content in effluents poses significant problems for wastewater treatment as it causes a high demand for oxygen. GTV, a German machine building firm, had developed an equipment which not only recycled 85 % of the starch but also reduced use of water and electricity and allowed the recycling of other inputs like colours and caustic soda. This equipment, however, had been developed to deal with synthetic starch whereas Brazilian firms commonly use natural starch based on manioc.

The project was launched in 1995 due to the initiative of the textiles research institute in Denkendorf / Germany (ITV), which had been working with firms in Brazil before. It persuaded a group of Brazilian firms to lobby for a joint project under the umbrella of scientific-technological cooperation between Germany (BMFT / BMBF) and Brazil (Ministry of Foreign Affairs). A group of six Brazilian firms was formed: four home textiles firms (Artex, Döhler, and Karsten from Santa Catarina, and Alpargatas Santista from São Paulo) and two starch producers (Inpal, Inquil). They joined a project with a group of seven German manufacturers of equipment, starch, and textiles. The project is governed by a steering committee that consists of CNPq (Brazil's national science council), IEL/SC,[7] BMBF and

7 IEL (Institutio Euvaldo Lodi) is a branch of the Federation of Industries. Its traditional task was to organize internships for university students in firms. In the specific case of Santa Catarina, IEL has widened its scope

DLR (as executive agency of BMBF). The costs of the project which have been estimated at R$ 6 million were divided between the governments of Germany, Brazil, and the state of Santa Catarina, and the firms involved.

The first phase of the project involved the training of Brazilian engineers in Germany, starting in November 1995. The first months of 1996 saw the testing of starches, conducted by Brazilian researchers in Brazil. In June 1996 the equipment from Germany arrived. Getting it through customs, avoiding to pay import taxes which would have amounted to about R$ 1.5 million, was no easy task. It was mainly due to IEL's effort that both aims were achieved. Most spectacularly, IEL succeeded in persuading the state government to give a waiver on import duties; it pointed out that this was, first of all, a research project and not a commercial venture. When the equipment arrived by mistake in Santos in the state of São Paulo rather than a port in Santa Catarina, IEL persuaded the secretary of finance of Santa Catarina to seek a waiver from CONFAZ, the council of the state secretaries of finance, a fact that may have positive implications for future projects of this kind which may also count on import duty exemption.

Practical tests started in August 1996 at a plant of Alpargatas Santista in São Paulo. They were conducted by a team of five Brazilian engineers who were employed on a full-time basis, German engineers who repeatedly stayed in Brazil for several weeks, and firm's engineers who worked with the project as a part of the regular workload. It soon became obvious that adapting the equipment to natural starch would be more complicated than expected; at the end of the test phase at Alpargatas the expected recycling ratio was still missed by far. However, there was a learning process, and things improved after the equipment was transferred to Döhler in Joinville in March 1997. In November 1997 the equipment was transferred to Karsten in Blumenau. By March 1998, the recycling ratio had got close to the desired level of 85 %, and recycling ratios for other inputs were above expectations.

The Ecogoman project does not involve direct technical cooperation between the participating Brazilian textile firms. Nevertheless, persuading firms to open themselves for technological development, and sharing their learning processes with engineers external to the firm, is seen as quite an achievement by local actors. Before this, firms were, due to secrecy considerations, unwilling to let anybody look into their production technology.

The Ecogoman project will probably lead to sustained capacity building. The Brazilian engineers involved in the project are going to be employed at the Environmental Center of SENAI in Blumenau; the idea is to use their know-how to offer support to firms for further upgrading in environmental technology. At the time of the field research, there was still one

---

of activity, starting to offer real services to firms. Apart from the Ecogoman project this included information dissemination on ISO 14000, the coordination of a benchmarking study with firms, and the creation of a venture capital fund.

firm left where the equipment was to be tested. What will happen with the equipment afterwards was unclear.

Associação Paranaense de Empresas de Tratamento de Superfície, Curitiba, Paraná

The formation of the Paraná Association of Surface Treatment Firms (Associação Paranaense de Empresas de Tratamento de Superfície, APETS) was the result of an initiative started by a technical cooperation project between CITPAR and GTZ. CITPAR, the technology integration center, is an entity that aims at giving technological support to firms in Paraná; it is attached to the Federation of Industries of Paraná. The German technical cooperation project supports parts of its activities. From GTZ side, it is part of the IBD program (integrated advisory service for the private sector); it was started in 1992 and will terminate at the end of 1998.

To understand the APETS story it is important to look at the evolution of the IBD project. Initially, its main goal was to generate exports by upgrading SMEs in Paraná. However, it soon became obvious that the overwhelming number of SMEs in Paraná were so utterly uncompetitive that exports were a remote possibility. The project thus changed its focus towards improving the survival conditions of firms which were struggling fiercely to cope with the new framework after the opening of the market, and more so after the end of inflation. Among other things, it focused on small garment firms which together employed ten of thousands of workers and where exit rates were very high.

The problem was that the project's activities were not very visible. Therefore, it decided to create a success story, i.e. some activity that would yield a quick and visible impact. In order to identify possible points of departure, project personnel got in contact with different agents, inter alia the association of the metal-engineering industry (Sindicato da Indústria Metalmecânica). CITPAR thus organized a first workshop in 1995 where it was suggested that the galvanic industry might be an interesting target group. On the one hand, it mainly consisted of small firms with all sorts of technical and management deficits, including severe environmental problems. On the other hand, it had good growth perspectives, especially due to new foreign direct investment in the passenger car industry (Renault, Audi, Chrysler).

The first step in addressing the galvanic industry was to prepare a diagnosis of the sector, which was based on visits to 51 formal-sector firms (altogether, it was estimated that the sector consisted of about 80 formal and maybe 200 informal firms). CITPAR then organized another workshop to present the results and to define actions. Apart from the firms, it invited a number of representatives from other agencies: the Federal University of Paraná (UFPR), the local technology institute TECPAR which, in fact, is mostly an MSTQ organization, the local technical school of SENAI, the CEFET technical college, the Association for Surface Treatment (ABTS), which apparently is dominated by the suppliers of chemical inputs, the metal-engineering industry association, banks, the SME support organization SEBRAE, the

state government, and the state environmental agency IAP. The output of this workshop was a plan of action which defined the responsibilities of several agencies.

An important consecutive activity was to invite a technical expert from Germany (a professor from Fachhochschule Aalen, a polytechnic, who specializes in surface treatment) to visit, during 15 days, five firms as well as the laboratories at TECPAR and UFPR. He suggested a number of improvements which could be implemented in firms with little investment, and he started to train a UFPR professor in identifying and implementing such measures. The most obvious improvements were the implementation of the Lancy cleaning process for parts which had been treated with cyanide (a relatively cheap and easy process which is, however, not used by technologically more advanced European firms), the introduction of cascades (i.e. a small basin with three chambers instead of the usual one, a measure that dramatically reduces the water consumption), the change of the zinc treatment from cyanide to acid, changes in factory layout, and others. For instance, in one firm the installation of the cascade bath reduced the water consumption in the phosphatizing process from 240,000 to 10,500 liters / month. Another firm reduced its overall water consumption by 80 %, thus saving about R$ 800 per month with an investment in cascade tanks of about R$ 2000. The implementation of the improvements was accompanied and supported by a student of FH Aalen who stayed for five months and wrote his diploma thesis on the experience; the thesis is now being translated and adapted to create a manual for firms.

The creation of APETS, which has about 40 member firms, took the whole process one step further. The idea behind this initiative was to create a forum for the ongoing cooperation between firms, and to create the conditions for a sustainable solution to the wastewater problem. APETS is a forum where firms discuss their problems and possible solutions. This includes ongoing cooperation with UFPR in terms of upgrading of processes and training of employees, inviting (at the cost of the firms) external specialists for seminars, and joint visits to fairs. A further incentive for firms to participate in APETS is that its members will receive electrical energy at a lower rate than non-members, a benefit that was negotiated between CITPAR and the local electricity utility COPEL.

In order to tackle the wastewater problem, about ten of the member firms decided to form a cooperative to set up a wastewater treatment station; another eleven firms have joined since. They defined, together with the UFPR professor, a technically and economically viable solution which requires an investment of about R$ 150,000. The largest part of that will probably be financed with funds from the Ministry of Science and Technology which has a special line of support for joint university-industry projects. It will be decided in June 1998 whether funds will be allocated to this project. Firms who take part in this venture will for one to two years not be fined by IAP for not disposing of sludge (provided that the sludge gets stored adequately, without causing a health hazard).

A further effect of the initiative was that TECPAR trained an engineer and set up a special laboratory for testing the galvanization baths of firms. Behind this activity is the following observation. The quality of galvanizing baths deteriorates over time, and there are two

possible options in dealing with this: add more chemicals or replace the whole bath. In the past, the tests of galvanizing baths were usually conducted by technicians of the firms which supply the inputs. There is little doubt that they had a certain bias to declare baths unusable prematurely as this increased their sales. Setting up a laboratory at TECPAR gives firms another option: If the results of a given galvanizing process are no longer satisfactory, they can send a sample of a given bath to TECPAR for testing in order to identify the exact cause of the problem, and to suggest possible solutions like filtration or adding a specific chemical in a precise dose. Interestingly, a parallel laboratory is being created at UFPR to make sure that there is no monopoly, i.e. to exert performance pressure on providers of testing services.

The incentives which convinced firms to start all these efforts are less obvious than in other cases. Apparently, there was a series of factors:

- Firms were aware of their environmental problems and were willing to do something about them.

- There was little immediate pressure from IAP, the state environmental agency, but as firms were aware of their problems they perceived that they might come under intense pressure at any given time. Moreover, as the certificate for operation has to be renewed every two years, problems with IAP were foreseeable. However, 60 % of APETS member firms so far are not registered with IAP, and would prefer to keep things this way.

- There was little immediate pressure from customers, although this has changed in the meantime. For instance, first-tier suppliers of firms like Volvo are under pressure to implement the QS-9000 system or its equivalents, and they pass this pressure on to their subcontractors. Moreover, as some of them are running just-in-time inventory schemes, they do not want to run the risk that a supplier all of a sudden is closed down by the environmental agencies.

- Firms that did something to improve their environmental record also hoped that this might in the end lead to a constellation where competitors without any such effort, and with accordingly lower costs and prices, might be squeezed out of the market, either by customers or by the environmental agencies.

- Overall awareness of environmental issues increased to the extent that Curitiba began to present itself as a showcase of urban environmental policy.

Pilot Plants in Energy Efficiency, Rio de Janeiro

In 1996 SEBRAE-RJ, the branch of Brazil's parastatal SME-support organization responsible for the state of Rio de Janeiro, started a joint project with GTZ to stimulate a move towards efficient use of energy in industry, especially in SMEs. One of the motivating factors was the observation that, whereas energy intensity in industry had been reduced substantially in

advanced countries, in some cases by more than 50 %, it had remained stable in Brazil between 1970 and 1990, and that in 1990 the energy efficiency of Brazilian industry was low.

Table 1: Energy efficiency in industry (energy consumption in industry in MJ / US$ gdp 1985)				
Country	*1970*	*1980*	*1990*	*% change 90/70*
USA	6.7	5.3	4.0	-40.3
Canada	7.7	8.0	6.1	-20.8
France	5.6	4.3	3.0	-46.4
Germany	7.9	6.0	4.1	-48.1
Italy	6.2	4.5	3.7	-40.3
UK	10.4	6.4	4.5	-56.7
Japan	7.7	4.9	3.5	-51.4
Spain	6.0	6.1	5.0	-16.7
Brazil	7.3	7.1	7.1	-2.7

The first step was to establish cooperation with other organizations which have an interest in this field; these were the vocational training system (SENAI) and a government-funded MSTQ and technological research institute (Instituto Nacional de Tecnologia, INT). The second step was to identify particularly energy-intensive industries, namely manufacturing of bricks, refurbishing of tyres, coffee roasting, manufacturing of sausages, and bakeries. The third step was to identify firms who would be willing to take part in an exercise to examine energy efficiency potentials.

The basic idea was to identify firms which for some reason were open to change, and to take them as pilot plants for energy efficiency measures. Such firms had to commit themselves to permit visitors from other firms to visit their factory; this was one of the features that were laid down in a contract that included fines in case a firm did not permit visitors into its factory. The hope was that the success in the pilot plants would convince other entrepreneurs not only of the viability but also of the economic potential of energy efficiency measures, particularly in terms of improved competitiveness.

The project has been cooperating with ten firms so far (four brick manufacturers, two firms in the tyre refurbishing business, two coffee roasters, one sausage producer, and one bakery). The energy efficiency potential in these firms has exceeded the expectations. The following table gives an overview of possible measures in the brick industry. To assess these data it is important to know that Brazilian brick manufacturers tend to be way behind best practice; they usually employ circle ovens or Hoffmann ovens, i.e. 19th century technology. The first of the pilot firms is only right now setting up a tunnel oven, a technology developed in the early 20th century in industrialized countries. With an investment of about R$ 310,000 it will have a payback period, based on energy savings alone, of about one year. Apart from that, it will improve the quality of the bricks and reduce scrap from 7 % to 1.5 %.

Table 2: Energy Efficiency Potentials in the traditional Brick Industry			
	investment (R$)	annual savings (R$)	life cycle of equipment (years)
Electrical			
Correction of power factors	1,800	3,600	5 - 10
Installation of high-efficiency motors	5,693	7,420	10 - 15
Thermical			
Reuse of heat from circle ovens	31,000	29,440	5 - 10
Reduce the heat stores in circle ovens	96,000	13,380	2 - 6
Equipment to dry bricks before burning	50,000	102,000	10 - 15
Improve burning in Hoffmann oven	5,000	4,581	5 - 10

In the particular case of the brick industry the project could build on an existing initiative of brick manufacturers in the northern part of the state. They started to upgrade in the 1980s, stimulated both by increasing demands, especially in terms of quality, from their main customers (large civil construction firms), and by visits to fairs and brick factories in Europe, revealing the gap with best practice. In 1991, these firms set up their own association (Sindicato de Cerâmica para Construção e Olaria do Médio Vale do Paraiba, Sincovap) as they were frustrated with the lack of support and services offered by the existing association that was organized on a statewide basis.

Firms were already looking for energy efficiency potentials when they got in contact with the SEBRAE/GTZ-project. As they had been in contact with consultants who specialized only in isolated parts of the production process, the efficiency potentials revealed by the SEBRAE/GTZ-project consultants exceeded their expectations by far. These efficiency potentials were discovered by engineers at INT and a professor from the Federal University of Rio de Janeiro; they amounted to 22 % of electrical and 53 % of thermical energy input. An indirect effect of the project is a changed modus of communication with the representatives of equipment vendors who often exaggerated potential benefits of new equipment and are more honest and modest now that the firms are better informed due to close contact with SEBRAE, SENAI, and INT.

Apart from the direct work with firms the project aims at setting up a database and producing information material on energy efficiency (at SEBRAE), and training numerous entrepreneurs, employees, consultants, and teachers as well as producing teaching material to be used for distance learning with firms' employees (at SENAI). In fact, one of the main effects of the project has been to establish cooperation between firms, SEBRAE, SENAI, and INT. A further contribution of the project is to get firms and banks in contact with each other. This is motivated by the observation that improving energy efficiency often requires investment in new equipment, and that SMEs find it difficult to get access to credits for equipment purchases, a phenomenon that reflects the poor development of Brazil's finance system – while it was brilliant in dealing with hyperinflation, it never developed (for the same reasons) a practice of conceding medium-term credits to private firms, especially SMEs.

II Comparison of the experiences

Point of departure

When looking at the different experiences it is useful to distinguish supply- and demand-driven cases. NMA and the two cases in Blumenau are clearly demand-driven: firms were under acute pressure to resolve a well-defined environmental problem. The Ecogoman project also fits into this pattern as firms were determined to do something about starch-rich effluents due to general pressure from the environmental agency; in this case a certain element of supply-drive was involved due to the acquisition activities of ITV. The experiences in Paraná and Rio de Janeiro are both supply-driven, i.e. have been initiated by German technical assistance projects. However, both could count on a target group that was already motivated to get things going; a typical problem of technical assistance, namely convincing the target group of its own deficiencies, was no issue here. Apparently, these days it is not difficult for an agency seeking to assist the private sector in Brazil to identify groups of firms which are open to change as the pressure on firms to improve their performance has increased tremendously with the opening of the market and the stabilization of the macro-economic framework, even though this does not necessarily mean that firms most in need of assistance are most open to change and support.

Type of firms involved

A broad spectrum of types of firms was involved in the experiences – from world-class large-scale firms (some of the participants of NMA) to one-person-workshops in the case of printing shops in Blumenau. Nevertheless, the observations do not fit nicely in the preconception of a clear correlation between size / competitiveness and environmental awareness. Things are more complicated:

- Although they are mostly small firms, the galvanic firms in Paraná were fully aware of the environmental problems they cause, and were seriously seeking for a resolution. If one assumes that there is a "natural" trajectory for a firm (from end-of-pipe treatment to process-integrated measures to environmental management), the small galvanic firms were more or less on par with some large firms in Joinville, which are leaders and global players in their respective industries but which – because they are in the metal-engineering and electromechanical industry and intensive in assembly rather than transformation – are less likely targets of environmental control. The experiences in Brazil thus indicate that firms' level of environmental activity is more correlated with the branch and intensity of environmental impacts created than with the size of firms.

- There is also no clear pattern regarding the role of multinational firms. Some of the galvanic firms in Paraná are second- or third-tier suppliers to firms like Volvo and Siemens. First tier suppliers to Volvo report that the company has so far not defined a

strategy towards ISO 14000, and that their pressure on galvanic firms is rather due to the fact that they fear a disruption of their just-in-time delivery schedule with Volvo in case a galvanic firm is closed due to environmental violations. In Blumenau, the participants in the landfill site group include a subsidiary of an U.S. cardboard manufacturer and the local franchise of Coca-Cola. The cardboard firm recently received instructions from headquarters to conduct an environmental audit. Support from headquarters, however, meant nothing more than sending a checklist and an auditor; there was no further support like instruction manuals describing the reasons for the exercise, the philosophy behind it, and the practical procedures. On the other hand, Coca-Cola Inc. has clearly defined that its franchises have to be certified according to ISO 14000 by 1999. Assistance to franchises includes printed material and workshops, but also creative measures like support for recycling campains. The Blumenau franchise is involved in a campaign in which pupils are stimulated to collect empty Coca-Cola cans. If they collect a given quantity, their school receives a PC for free.

Incentives for firms to participate

Firms participate in the different activities for different reasons. Immediate pressure was important in the cases of Joinville and Blumenau. This pressure arose mostly from the state environmental agency. In the cases of the Ecogoman project and in Paraná and Rio de Janeiro it was imminent rather than immediate pressure that convinced firms to do something about the environmental burden they caused.

Pressure from customers played a lesser role. Textile firms in Santa Catarina used to suffer this pressure in the past. As they have invested in wastewater treatment and substituted hazardous inputs in their production process this pressure is less relevant today. Moreover, it is restricted to manufacturers of home textiles since clothing producers have largely stopped their exports to Europe where pressure from customers is most intense. It has already been noted that multinationals in Paraná like Volvo or Siemens do not exert much pressure regarding the introduction of environmental management so far.

One further remark is in order here: Being under pressure is a relative notion. If a given firm feels under pressure at a given point in time, it is still possible that pressure will get more intense in the future. In other words, if a firm explains that it pursues a given activity because it feels under pressure it is important to discuss the quality of the pressure.

Mode of organization, formal work modus, informal aspects, and development trajectory

The intensity of cooperation among firms varied vastly. It was most intense in the case of the NMA, and also quite intense in the cases in Paraná and Rio de Janeiro; in the latter, close cooperation had started before the firms got involved with the SEBRAE/GTZ-project.

Environment-related cooperation among firms reflects a broader trend in Brazilian industry. In the past, there was very little cooperation among firms, a feature that reflects the specific circumstances not so much of latecomer industrialization but mostly of the economically unstable high-inflation environment. We have hypothesized that environmental issues are a promising point to entry for inter-firm cooperation as firms do not perceive it as a core activity (at least as long as environmental activities mainly refer to end-of-pipe-measures) and have thus less misgivings regarding possible loss of business secrets (Meyer-Stamer et al 1996). The experiences documented in this paper support this hypothesis, although certain modifications are in order:

- There is not a "natural" trajectory from a single-issue activity to a broader focus – not even in the environmental field. In certain cases, the focus of cooperation has constantly widened; this is most prominent in the cases of NMA Joinville and Paraná / galvanic firms. This has not occurred in the two cases in Blumenau. In the case of Paraná, the widening scope of cooperation increasingly touches on the key activities of firms and involves collective technological learning processes. In the case of the NMA, it is likely that something similar will happen if the núcleo becomes the focal point for information exchange on environmental management. The Ecogoman experience may give rise to further technology cooperation projects among leading textile manufacturers, although only little enthusiasm can be detected in this regard at the level of executive boards.

- The Rio de Janeiro / energy efficiency experience illustrates that other points of entry to inter-firm cooperation exist. In the case of the association of brick manufacturers, three points apparently have been crucial: a strong pressure from customers regarding product quality, a strong local leadership, and a we-against-them constellation between firms in the northern part of the state and less competitive firms (and a not-too-active association) elsewhere.

Organizing agent

A further essential point regarding inter-firm cooperation regards the role of business associations. All the cases documented in this paper involved business associations. More precisely, they involved business associations that are in a profound transformation process. Brazilian business associations were created by law as part of a corporatist system in the 1930. This legal framework still exists, and many business associations still reflect the corporatist heritage – as membership is mandatory, they show little inclination to do anything to secure the legitimation of their organization with its members apart from ad-hoc lobbying efforts. It is interesting to note that things were not much different at associations with voluntary membership, i.e. the ACIs. The situation changes to the extent that internal democratization processes occur within corporatist business associations, allowing frustrated members to take over their association and to start to restructure it so that it offers real services. The alternative is, like in the cases in Paraná and Rio de Janeiro, to found new associations.

In any case, there is strong evidence that business associations do play an essential role in organizing inter-firm cooperation. To do this on a sustained basis, it is critical that they have a minimum number of professional staff, at the very least to take care of the administrative work involved in cooperation projects. ACIs in Joinville and Blumenau as well as IEL-SC have this staff. In the cases of Paraná and Rio, associations so far are maintained through voluntary work of members. This, however, is only feasible because administrative capacity is available elsewhere – at CITPAR in the case of Paraná, at SEBRAE in the case of Rio de Janeiro.

Role of German technical assistance

All the examined projects involved some kind of cooperation with Germany (technical assistance in five cases, scientific-technological cooperation in the case of Ecogoman). In the case of the technical assistance projects, two different patterns can be identified:

- indirect, facilitating activities,
- issue-oriented, stimulating activities.

The cooperation project with ACIs in Santa Catarina exemplifies the first type. It aimed at organizational development in ACIs, i.e. reshaping ACIs in such a way that they react flexibly to new challenges and opportunities, or are even able to actively create new opportunities. Organizing núcleos was instrumental towards achieving this goal. Neither of the three cases in Joinville and Blumenau was the direct result of the technical assistance project. They reflect a more responsive mode of action of the ACIs, something that according to local actors has to a significant degree been stimulated by the technical assistance project.

The projects in Paraná and Rio de Janeiro exemplify the second type, i.e. issue-oriented, stimulating activities. The project in Rio was deliberately started to address energy efficiency issues in industry. The project in Paraná perceived environmental problems of the galvanic industry as an opportunity to solve one of its main problems, namely to find a way to contribute to firms' quest for competitiveness in an environment where there was little tradition and experience with interaction between firms and institutions at the mesolevel. The project in Rio de Janeiro has not been designed to contribute to organizational development in one of the organizations involved (SEBRAE, SENAI, INT), whereas it does stimulate a much closer cooperation between these organizations. The project in Paraná has stimulated organizational development within CITPAR, an organization that has existed since the mid-1980s which, according to local observers, is nowadays much more dynamic and firm-oriented than it was before the project started.

Competition aspects

Many Brazilian businesspeople find the notion that firms should cooperate on whatever issue not convincing at all. In their view, firms are competitors, and as such there is just no way how they might cooperate. Moreover, cooperation may have had a specific meaning in the past. One of the ABETS member firms mentioned that it had once before tried to organize an association. The immediate effect was that it was blacklisted by one of its main customers who suspected that the firm was trying to organize a cartel.

At the same time, it is largely undisputed that, especially in industrialized countries, competition and cooperation not only go hand in hand but that cooperation is actually a necessary prerequisite to survive in a highly competitive environment; neologisms like "coopetition" have been created to address this observation. This includes both formal cooperation, like in strategic alliances, and informal cooperation through various means of communication (e.g. communication with suppliers and customers, and with competitors in fora like conferences and professional associations). "Learning by interaction" is an essential means of coping with the increasing velocity of technical change and surviving in competitive markets.

All this means that stimulating cooperation among firms, even with respect to environmental issues, is by no means an easy task. It involves a lot of effort by leaders in the business sector, by business associations, and by other agents like SME support organizations. The experiences presented in this paper show that cooperation is possible, even in activities that are close to technological core competences and among firms who are direct rivals, like in the case of the Ecogoman project. It appears that, once cooperation has started to work well, it is a self-reinforcing mechanism. For instance, representatives from the NMA firms are quite enthusiastic about their núcleo and find it extremely complicated to explain why such cooperation so rarely takes place. After a certain period firms find it quite natural to balance cooperation and competition concerns.

III Inter-Firm Cooperation and Environmental Technology and Management

The purpose of this section is to draw a number of conclusions from the case studies. It addresses two main issues. First, is combining two difficult tasks, namely stimulating inter-firm cooperation and environmental management, a promising venture? Second, how can different types of target groups and partner constellations be addressed?

Trajectories in inter-firm cooperation and in environmental management

An effort to stimulate inter-firm cooperation in environmental management faces an enormous challenge as it tries to combine two extremely complex issues:

- Convincing firms to cooperate is a difficult task, especially if they do not have a previous experience with cooperation and hence view the idea of inter-firm cooperation with suspicion and reluctance.

- Convincing firms to deal with environmental management, which normally is perceived as just adding costs to production, is no less complicated.

At the same time, the cases presented before illustrate that cooperation is possible, even in an environment in which inter-firm cooperation hardly existed in the past, and in which trust among firms is low. In fact, some of the cases seem to indicate that combining the two difficult tasks – stimulating cooperation and environmental management – does not multiply the problems but actually reduces them. In order to understand this point, it is useful to take a look at the process, i.e. to understand typical trajectories in both inter-firm cooperation and environmental management.

Inter-firm cooperation follows the normal logic of cooperation (Axelrod 1984), i.e. it is strongly path-dependent. If there is little or no cooperation, there will probably be little trust between firms, and firms will be unwilling to disclose information. The preconditions for any attempt to involve firms in cooperation are unfavorable. If one actor tries to break through this negative circle of non-cooperation and if the entrepreneurs do not perceive positive results this will reinforce their reluctance to cooperate with each other. If the outcome is positive, this will over time lead to intense cooperation. Asked by an external observer for the reason for this cooperation, company representatives will then consider inter-firm cooperation perfectly obvious. Hence, cooperation is often a self-reinforcing process in which trust is continuously being strengthened.

This desirable process of change from reluctance to cooperation, towards a positive experience stimulated by a change agent and a self-reinforcing tendency towards further and closer cooperation between firms, requires

- a careful selection of the change agent,

- an equally careful selection of the issue to be addressed by the initial cooperation,

- the facilitation of the subsequent steps of cooperation.

A move from non-cooperation to cooperation will hardly occur without a major change in the mindset of entrepreneurs, something that is often induced by crisis or external shocks. In order to sustain cooperation it is necessary to accompany, facilitate, and evaluate at least one whole cycle of cooperation, with a view to creating organizational conditions for a repeatable process rather than concentrating on one specific single output.

Stimulating cooperation, i.e. inducing the very profound change from a non-cooperative to a cooperative game, is a demanding task. In the case of Brazil we documented certain cases where the change took place in the face of a heavy crisis which uncovered the disfunctionality

of traditional un-cooperative behavior (Meyer-Stamer 1998). Clearly identifiable, individual local change agents have played a crucial role in these changes. In the case of ACIs in Santa Catarina, a German technical assistance project played a major role.

Stimulating cooperation is a time-consuming process since it involves the fragile process of accumulating trust. It is more promising in fields with little incentive to default. Trying to start cooperation in a field like marketing of technology is thus not promising. Things are different when it comes to environmental issues.

- These are often seen as a secondary issue inside the firm.
- There is often an environmental agency or an important client who is expected to put pressure on firms to comply with environmental requirements, i.e. there is an external "enemy" that helps to convince the "victims" of the value added of joint action.

Regarding environmental management, firms in Brazil seem to follow the same trajectory that has been observed in industrialized countries (Porter and Linde 1995), as Brazilian environmental policy has been applying the same patterns as in Europe and the US. It begins with the enforcement of environmental legislation and/or demands of customers, which typically leads firms to implement end-of-pipe measures and to substitute certain inputs (e.g. hazardous dyestuff in the textile industry). Subsequently, firms examine their production processes from a different angle, e.g. they reduce the generation of sludge (which is costly to dispose of) or substitute certain inputs altogether, modifying their production process. This sequence often includes the identification of so-far undiscovered potentials to increase productivity or quality; in the innovation economics terminology: it challenges path dependency and thus changes the innovation trajectory, leading to a new search pattern to optimize production processes and implement organizational changes.

Once they have reached the latter stage, firms begin to understand that environmental issues are not just a nuisance and an additional cost-factor, but may actually reveal competitiveness potentials by identifying win-win-options. This is reinforced when new equipment becomes available that increases both productivity and product quality and in most cases allows for an improved environmental performance. Firms then develop a real interest in environmental management systems as these are helpful to both comply with environmental legislation and improve business performance. Leading companies in Santa Catarina have reached the stage where they prepare for ISO 14000 certification (one textile firm in Blumenau was the first national firm to be certified), and they go on examining how to integrate environmental management in a more systematic and consistent way into their overall management system.

The case of the NMA Joinville shows how these two trajectories can reinforce each other. At the outset, there was very little cooperation and no environmental management. The NMA initially was a rather strange activity that involved individuals from the fringes of firms to deal with just one specific problem. Then two things happened:

- Ongoing work in the núcleo created trust and the focus of the group widened to include new and broader issues.

- Environmental issues became more important as firms followed the learning trajectory in environmental management described before.

Currently, it seems very likely that the NMA may become the main forum for joint learning on environmental management, an issue that has attained high priority in many of the participating firms. Environmental management is becoming an important element of creating a competitive advantage. Some years ago, firms would have found the idea of a joint learning process on a key management issue ridiculous. Today it seems perfectly obvious, thanks to the experience of the NMA.

It is, however, essential to acknowledge that several factors coincided which made this case of inter-firm cooperation in environmental management possible, and that some or all of them would also be required in other cases:

- external pressure, which may be acute or imminent (like in the case of Paraná),

- at the outset clearly defined, measurable goals of cooperation (to avoid the impression of futility among the participants),

- professional facilitation of the cooperation process by an agent external to the firms,

- a certain consistence of the group which helps to create trust and commitment (in the case of the NMA all participants repeatedly pointed out how important it was that only professionals, and no owners, were part of the group).

Addressing different types of firms and constellations

There are four basic constellations regarding the introduction of environmental management in firms: Firms may or may not be under pressure to comply with environmental legislation, eco-standards, etc., and firms may or may not have established detailed cost accounting and embarked on a continuous and systematic search for efficiency potentials.

The importance of environmental pressure on firms has repeatedly been stressed in this paper; in nearly all of the cases (i.e. except energy efficiency / Rio de Janeiro) it was the most important or at least a crucial factor. The issue of cost accounting and search for efficiency has not been addressed so far. Reducing a complex reality to a simple dichotomy, two types of firms can be distinguished regarding these issues. On the one hand, there are firms which have established detailed cost accounting and which are systematically searching for potentials to raise efficiency. Contrary to popular perceptions, they are a minority, even in industrialized countries. The popularity and wide application of concepts like lean manufacturing, re-engineering, and total cost management illustrates this observation. In the

specific case of Brazil, very few firms, even among the leading ones, actually had detailed cost accounting systems until the early 1990s (Fleury and Humphrey 1993). This was not a high priority at that time because limited efficiency was no problem in the closed market. What determined the success of a firm was not productive efficiency but effective financial management, i.e. keeping liquidity high and indebtedness low and understanding quickly the new rules of the game after the frequent macroeconomic stabilization plans.

So, on the other hand, there is a huge majority of firms, mostly micro, small and medium-sized firms, which do not have sophisticated cost accounting systems and pursue, at best, idiosyncratic efforts to raise efficiency. The latter feature has been acknowledged by economists as an ubiquitous phenomenon; they have been described and explained by terms like "satisfycing", "bounded rationality", and "path dependence". **Satisfycing** refers to the observation that firms may not seek to maximize their profit but rather be contented with stabilizing a certain level of profitability, especially if seeking higher profit implies much higher risks. **Bounded rationality** refers to the observation that it may actually be inefficient or even impossible for an economic agent to check all possible alternatives when he makes a decision so that he rather bases his decisions on recent experiences and rules of thumb. **Path dependence** refers to the observation that past decisions limit current options: for instance, if a firm has opted for a given cost accounting software package it will not easily switch to another one, even if after some months of operation major flaws become visible.

Combining these features leads to the following matrix with four stylized constellations:

	Detailed cost accounting, systematic effort to raise efficiency	No / general cost accounting, idiosyncratic effort to raise efficiency
Pressure to comply with environmental legislation / eco-standards	(1)	(3)
No pressure	(2)	(4)

There may be good prospects for measures to stimulate environmental management in the fields 1, 2, and 3, whereas they do not appear promising in field 4. From the perspective of a technical cooperation pilot programme like P3U, the problem is that probably the majority of firms in a country like Brazil do belong to field 4. Field 1 typically refers to well-organized, competitive firms like those participating in the NMA Joinville and the Ecogoman project. There were no obvious field 2 examples involved in the research for this paper, except for a few participants of the landfill group in Blumenau. Field 3 refers to firms like the small printing shops in Blumenau and the galvanic firms in Paraná. The important point is that it is unpredictable when such firms will move from field 4 to field 3. Environmental agencies admit that they cannot systematically control all firms, i.e. a large number of micro, small, and medium-sized firms in their jurisdiction is never visited by inspectors, and many are not even known to the authorities. The selection of firms that are actually being controlled is mainly based on complaints, for instance by neighbors noticing who denounce odors or colorful effluents.

At the same time, firms in fields 3 and 4 are the typical target group of technical assistance projects in both the private sector development and environmental management areas. One can conceive several ways of bringing the message of environmental management to these firms:

- The first and easiest option is to wait until these firms come under environmental pressure. The drawback is that it may take years for this to happen. However, this must not be bad news for support organizations that can only deal with a limited number of customers, and one may suppose that the number of industries and firms coming under environmental pressure will continuously grow, especially as large firms have their environmental management systems established and become effective and as environmental agencies shift their focus to micro, small and medium-sized firms. Therefore, just dealing with firms under pressure may employ all the resources available to existing support organizations.

- A second option is to team up with environmental agencies to pursue a carrot-and-stick approach. The idea is to formulate sectoral programs for certain heavily polluting industries, where environmental agencies implement existing legislation (preferably in a cooperative way and without a bias for end-of-pipe measures) and SME support organizations come in to help firms in coping with this pressure. The drawback is that pressure from the environmental agency will probably create a hostile atmosphere which hampers interaction with the SME support institution, especially if business owners perceive the latter as another government agency, thus deterring the use of voluntary instruments of environmental management at the company level.

- A third alternative is a carrot-and-carrot approach. The idea is that environmental agencies give preferential treatment to pro-active firms which are seriously engaged in the introduction of environmental management, like in the case of Paraná where galvanic firms participating in the treatment station project are exempted from fines for storing their galvanic sludge. It is important to understand that in the past things often worked the other way around: Firms with established environmental measures were more visible and hence inspected more intensely, and often were fined more consequently, than firms without any such measures. Inspectors of environmental agencies found it easier to check on well-organized firms with transparent processes, whereas, for instance, controlling a disorganized firm with a multitude of emission sources was much more complicated. It is obvious that this created perverse "incentives": Firms with well-established environment-related activities and environmental management systems are more vulnerable to government enforcement. This is due to Murphy's law, i.e. even in a well-organized firm some things will go wrong sometimes, and it is easier to detect such occurrences. Moreover, environmental legislation may be inconsistent or establish unrealistic standards. As long as the performance of inspectors is implicitly or explicitly measured against the number of fines they impose, it will be complicated to move from perverse to sound incentives. The cases both of Santa Catarina and Paraná show that some environmental agencies are moving from conflictive towards cautiously cooperative relations with firms. Under such conditions a carrot-and-carrot approach may work. At the same time, it is

important to note that, as long as perverse incentives prevail, firms may hesitate to implement techniques like environmental cost management, even if they promise substantial savings in costs and materials, as long as this increases their vulnerability to enforcement.

- A fourth option is to cooperate with large companies in their efforts to support smaller firms. Especially in the environmental field large firms play a crucial role as certification according to the ISO 14000 system of standards implies the extension of environmental management towards suppliers, mostly small and medium-sized firms. It is by no means certain that large firms have the means and willingness to support their suppliers in introducing environmental management, especially if foreign firms do not get adequate support from headquarters. Partnership with SME support organizations, which in turn are typical partners of international technical assistance, appears as a promising option. The problem is that a substantial part of the small business sector would not be targeted as it is not part of supply chains.

- A fifth option is to identify a group of firms under high competitive pressure with substantial potential for eco-efficiency (e.g. brick manufacturing was chosen in Rio de Janeiro due to its enormous potential in energy efficiency). However, this approach is risky as firms may perceive that other measures (like cheap credit for modern equipment, training of employees, or lobbying for protection against pressure) appear more promising than addressing the competitiveness issue from an eco-efficiency angle. It also ignores the typical learning trajectory outlined above. If firms had occasional conflicts with environmental enforcement, and even more if they never had such contact and rely on hearsay, they tend to have a highly developed a-priori skepticism regarding anything related to environment.

None of these alternatives seems to be a first-best option. Each of them may be appropriate under specific conditions.

Learning to cooperate

When firms actually start to deal with environmental management and are willing to do this collectively, it is crucial to understand that cooperation is an evolutionary process. The first step in stimulating a group-centered approach is to identify a group of firms that, for some reason, is under pressure to do something about its environmental impact and its competitiveness. Firms which have been under immediate pressure by an environmental agency or by customers face clear incentives and are the easier target group for support in environmental management. Additional pressure resulting from the need to reduce costs of resource consumption in order to stay in the market or become more competitive is helpful. Such firms may find the idea of forming a group to react collectively instead of individually to external pressure immediately convincing, so that it is easier to overcome their cooperation-unfriendly predisposition.

The second step is to identify an organization or a person that can organize and facilitate the work of the group, i.e. who is both credible and competent (with respect to technical issues as well as the moderation of group processes). The experiences from Santa Catarina and Paraná indicate that business associations are promising candidates, provided they have professionals who are up to this task. In order to get the group to move and go, it is useful to refer to proven methodologies like the one refined by Fundação Empreender (see http://www.fe.org.br). It is, however, essential to understand that business associations are in a complicated situation when it comes to environmental issues. On the one hand, an association with a minimum of strategic capacity will stimulate environmental learning processes among its member firms since experience shows that environmental pressure does increase sooner or later. On the other hand, member firms will expect the association to delay this process as much as possible, i.e. to lobby against strict environmental measures. This means that officials of business associations may have to develop a somewhat schizophrenic attitude. To overcome this , a business association may try to push a proposal for the carrot-and-carrot approach outlined above.

In order to actually facilitate the work of the group it is important to accept that it takes some time for learning processes to occur. It is unlikely that a short-track can be found to circumvent the typical sequence outlined above (although supporting agents may succeed in creating a learning curve steeper than usual). It is important to consider the psychology of firm owners in this context. Businesspeople seem to have a kind of natural tendency to perceive environmental concerns as a middle-class luxury, something they cannot afford, especially if they own micro or small firms. They tend to see themselves as heroic entrepreneurs fighting for survival in a hostile environment anyway, and environmental concerns appear to be just another invention to make survival more complicated. Regarding environmental management, there are specific obstacles in micro, small and medium-sized firms.

In the case of micro and small firms, selling environmental management to businessowners is all the more complicated as, in the first place, they often do not really have a management *system* worth this name. In other words, the introduction of environmental management is a synonym for a transition from improvised to systematic management, which, in turn, means that the introduction of environmental management offers the opportunity to upgrade the overall management system. This process, however, involves a lot of training and learning, and thus will take time; in addition, it can make an important contribution to economic dynamism.

Consequences for the work of development agencies

This has two implications for agencies that try to disseminate environmental management tools. On the one hand, it is unlikely that such firms will immediately hop onto the environmental management wagon. On the other hand, however, they may be promising candidates for no-cost and low-cost instruments like good housekeeping (GTZ-P3U 1998). It

will be essential to emphasize cost reduction potentials and to keep the environmental issue in the background, perhaps even to avoid environmental terminology altogether, at least initially.

In the case of medium-sized firms in which a certain degree of division of labor exists, the situation is different since owners tend to delegate environmental issues, like managing wastewater treatment or solid waste, to specialized employees. In this case, moving along the trajectory from end-of-pipe measures to environmental management involves profound changes in the internal power structures of the firm as the environmental person moves from a fringe to a core position. It is unrealistic to expect the process to be quick and smooth. What can be expected is that support via technical assistance reduces some of the pains and the time needed for this process.

A further important conclusion is that it is useful to involve environmental agencies in stimulating eco-efficiency. Their pressure is an important reason why firms do something about the environment. Combining carrot and stick, i.e. not only put pressure on firms but also support them in complying with ecological requirements, appears to be a plausible approach. However, the degree to which an environmental agency can support firms is necessarily limited. At the same time, it is important to acknowledge that the learning trajectory mentioned above includes important learning processes inside environmental agencies. They tend to have a profoundly hostile view of firms as they perceive them, often correctly, as major environmental hazards. In dealing with firms, they tend to think that the better the stick is, the better. The problem is that their officials often have no on-hands experience inside firms and therefore do not easily understand how businesspeople think and act. The understanding of each others mode of activity and incentives was an important outcome of contacts between the NMA Joinville and FATMA. As soon as firms deal systematically with environmental issues, they tend to develop environmental consciousness, a tendency that environmental agencies do not always appreciate. Agency officials keep believing in the big carrot approach, something that often leads them to enforce implementation of environmental measures in an inflexible and dysfunctional way, namely by insisting on certain methods and technologies rather than stimulating firms' creativity to not only come up with the most efficient solution for a given problem but also to embark on a new trajectory of continuous improvement to minimize environmental impact.

Support is mostly required from other meso-level organizations**,** which can also help in moderating interaction between the environmental agency and firms. It has been mentioned above that government agencies, including SME support agencies, may not be the most promising candidates to support companies in the environmental field because firms see them as a potential Trojan Horse, i.e. fear that they disclose information on environmental impact to their colleagues at the environmental agency.

In the case of Brazil, it appears that organizations like SEBRAE and SENAI have credibility vis-à-vis firms when it comes to environmental issues (although both are sometimes seen by firms as government agencies, which is not true in the case of SENAI and only part of the truth in the case of SEBRAE). The credibility of business associations varies widely, but it is

indisputable that several of them are in a profound process of restructuring to change their traditional work mode (little responsiveness, top-down-organization, domination by large firms, few services to members, little effective lobbying).

With respect to the stimulation of cooperation between firms, business associations are better prepared to do this job than SEBRAE and SENAI. Actually, business associations should be the result of inter-firm cooperation (which many of them are not because they were founded by the state, who established a corporatist system sixty years ago). At least, the restructured business associations have become an important forum of inter-firm cooperation. SEBRAE and SENAI have very little experience in stimulating inter-firm cooperation; and especially SENAI has to cope with the challenge of stimulating cooperation between its own schools and member companies before it can consider moving to other cooperation issues.

In order to stimulate group-centered approaches to the diffusion of eco-efficient production practices, it is also useful to propagate positive experiences – both of environmental management within firms and of successful group activities, like those documented in this paper. Based on the experiences of Fundação Empreender, the organization that accompanies the organizational development process in ACIs in Santa Catarina, it is particularly useful to organize workshops on environmental management and group-centered approaches, including visits to factory sites, with the participation of successful businessowners / managers / engineers since they are much more credible in dealing with other businesspeople than technical assistance experts or SME support organization officials.

C Information Fora and Networkshops as Instruments for Stimulate Technological Cooperation and International Partnering

There is a long experience in technical assistance that technology transfer alone is only under very specific conditions an adequate solution for upgrading lagging firms and countries. Technology transfer works just fine between industrial countries, and successful latecomer countries like South Korea or Taiwan have shown a remarkable competence in getting the most from technology imports. However, in the vast majority of developing countries the record has been much less impressive. There were two reasons for this.

First, and most importantly, the local capacity to adequately master and manage imported technology has often been inadequate. Neither firms nor other agents had the necessary know-how to deal with imported technology, and technology-donors underestimated the effort necessary to create the necessary know-how. Financial constraints at the recipient side have also been a problem, but to a lesser extent; a huge number of failed technology transfer projects in rich oil exporting countries gives evidence of this observation.

Second, technology transfer often occurred in a hit-and-run manner, i.e. involved one-time spot transactions, whereas successful international technology transfer often involves a long-

time partnership between donor and recipient. Successful technology transfer itself requires a lot of know-how – not only of a given technology, but of technology management, management of cooperation, management of training, and so forth. A long-term partnership facilitates learning processes to build-up such management know-how.

If there is a lesson from decades of technical assistance, then it is this: Technology transfer and strengthening local technological capability are complementary activities. Technology transfer alone cannot solve problems in developing countries, but still it is extremely important to avoid "reinventing the wheel". There are two key challenges: to strengthen local technological capability to create conditions which facilitate successful transfer of technology, and to stimulate international partnerships between technology donors in industrialized or advanced developing countries and technology recipients in developing countries so that interactive learning processes can occur. These challenges apply to environmental technology as much as to other fields of technology.

Section B of this chapter addressed an important aspect of local technological capability building, namely how to generate firms' demand for environmentally sound technology. The reminder of this section addresses the issue of international partnering by presenting two specific instruments, namely information fora and networkshops.

Stimulating technological partnering

International technological partnering builds on successful technological capacity building. It involves the identification and matching of competent firms and institutions on the donor and recipient side. At the donor side, it specifically involves the identification of innovative small and medium-sized enterprises (SME). It can be assumed that established large multinational firms are present in developing countries anyway, and that they enjoy a competitive advantage based on established brand-names and networks. The barriers to entry in these countries may be substantial for SME, especially for startup firms with little experience in international management.

Any effort to stimulate information fora and networkshops has to be seen in this context. It is an attempt to stimulate the emergence of interaction between the four pillars in one specific field, namely environmental technology, and to stimulate international partnerships in this field.

Why organize and subsidize events?

Still, the question may be asked why technical assistance, i.e. a public activity, financed with taxpayer money, should be involved in an area which might as well be managed by private business. The answer is that in this field different types of market failure are highly probable:

- There is the high uncertainty of technological development, the standard argument for government activism in science and technology. There are two main risks involved in technological development within firms, but also in research institutes which are not fully funded. First, there is the risk that a given R&D project leads nowhere so that there are no future earnings to pay back current costs. Second, there is the problem of appropriability, i.e. the risk that the result of an R&D project leaks out so that the agency who financed it cannot appropriate the entire benefits. Both risks induce firms and technology institutes to undertake less R&D than would be desirable in a macro-economic perspective.

- Technological development involves interactive learning, technology cooperation, and networking. However, cooperation involves obvious risks (e.g. losing secrets) whereas its benefits may be much less obvious. Therefore, interaction will be less intense than would be desirable in a macro-economic perspective if government or other actors (e.g. business associations) do take it upon them to stimulate it.

- Cooperation always involves high transaction costs (preparing meetings, time for meetings, follow-up, disseminating information in the network, resolving conflicts, etc.). Return on cooperation must be quite high, especially for private actors to be willing to incur such costs. Again, cooperation will be less intense than is desirable in a macro-economic perspective unless government or business associations cover part of the transaction cost.

- If the search for technological solutions is left to individual agents, it is likely that they will identify only a limited set of possible solutions and vendors of equipment. It is also likely that the results of their search will be limited to large vendors and expensive solutions as large firms can incur higher expenses for advertisement and marketing. Involving different actors in identifying technological solutions for given environmental problems can broaden technological diversity. Identifying technological options in a cooperative way raises the probability of finding an appropriate solution.

I What is the interrelationship between an information forum and a networkshop?

The purpose of an information forum is to stimulate international partnering between technology donors and recipients. The purpose of a networkshop is to stimulate networking between (mainly domestic) actors from the different pillars. Both are complementary activities. There is neither a hierarchical relationship between both, nor is there a clear sequence. A networkshop is useful in generating topics for an information forum, and an information forum can be helpful in convincing local actors of the advantages of cooperation and thus the usefulness of a networkshop. In effect, what is desirable is an iterative process that includes both information fora and networkshops. In the second round of events one might even conceive of an event that is both an information forum and a networkshop.

What are the aims of an information forum?

An information forum aims both at bringing domestic and foreign actors together and at stimulating interaction between domestic actors. Typical events would include a workshop, a symposium, or a roundtable, either as singular activities or as part of larger events like a fair or an exhibition. An information forum should neither be a marketing affair with an unidirectional information flow not a scientific conference without clear, tangible results. It should also not be a fair or exhibition that is neither being specifically prepared, i.e. has not started to identify potential partners in advance, nor being accompanied by moderated dialogues, workshops, symposia, etc.

It is essential for the success of an information forum to identify an issue in a given sector that can realistically be discussed during the duration of an information forum, which will typically be between two and three days. Addressing too broad an issue runs the risk of producing an event with an enormous time pressure, with unclear results, and thus frustration and alienation among the participants. This may compromise the whole process of organizing events and stimulating cooperation. Striking a balance between modesty and ambition is a delicate task, and it is hardly conceivable that one might define general rules on how to do this.

More specifically, limiting the scope of an information forum means focusing on issues like urban waste disposal, or wastewater treatment in a given industrial branch (or set of branches with comparable problems and options), or recycling in a given industrial branch. It is not useful to organize events that span the whole spectrum of environmental technology.

What are the aims of a networkshop?

A networkshop pulls together actors from each of the four pillars. It has two distinct aims. One is to find a solution for a given problem, the other is to stimulate cooperation. The second aim, stimulating cooperation in order to contribute to the emergence of an innovation system, is the main aim, but this can only be achieved as part of concrete ventures which tackle acute problems – cooperation in itself is not an aim that would motivate actors to participate.

Identifying a problem which is relevant for several actors so that they are willing to take part in a networkshop will usually not be difficult. The main challenge is to identify a problem that matches with the potentials and limits of such an event. The potential of such an event is, first, to bring together actors that may otherwise not meet, or may not get to constructive cooperation, and second, to identify a limited set of follow-up activities.

II Who should participate in an information forum and in a networkshop?

The key answer to this question is: The participants of an information forum and a networkshop should possess complementary assets. Typical examples would include:

- Solving water pollution problems in, say, the textiles industry. Such an event might involve industrial firms from a given sector, a financing agency, a technology and a training institute, business associations, a public SME support organization, an agency that provides information on internationally available know-how, and foreign firms. In this case, the firms have the problem. Together with business associations, technology and training institutes, and the SME support organization they can identify a solution, including (but not limited to) acquisition of technology from abroad, and the financing agency can provide funds for implementation.

- Solving solid waste problems at the local level. Such an event might involve municipalities, central or regional government representatives, technology providers and research institutes, service providers from the waste disposal business, and an agency that provides information on internationally available know-how.

The main criteria in defining participants would thus be the following:

- Has a participant assets to offer, e.g. problems and commitment to solve them,[8] know-how, financial resources, capacity as a network broker, political clout, or international contacts?

- Is a participant committed to the overall aim, i.e. strengthening the innovation system and stimulating international technology partnering? Behind this criterion are two observations. First, actors may want to participate to make sure they do not miss something that might turn out to be important, without wanting to commit themselves. Certain key actors may also want to control what is going on. Second, some actors may want to participate as they are looking for fringe benefits, without being really interested in the core activity.

- Is a participant capable of entering into cooperation, partnership, and networking? Different types of actors may actually find it difficult to do so, for different reasons. Business associations often are weak, i.e. have very limited funds and few, if any, professionals. For such an association it may be an unrealistic goal to commit itself to active participation in a network. Government agencies often suffer from rapid turnover of personnel and organizational instability, factors that make it difficult to participate in a network which requires a certain degree of continuity to accumulate trust.

8 This may appear as a bizarre criterion at first view, but in fact it is not. Knowing to have a problem, and being committed to resolving it, is the first step in a learning process, and in fact it is one of the key ingredients of economic development. Unwillingness to acknowledge problems, or lacking commitment to tackle known problems, are key obstacles to economic development.

Regarding foreign participants, these criteria apply as well, but they leave questions open: Should every foreign participant who is willing to participate and meets the criteria be accepted? Or should participation be limited to firms which decidedly suffer from the market failures mentioned above, and to associations and institutions from abroad? Answering these questions is no easy task. A realistic approximation would be this: There should be a preference for firms suffering from market failure, i.e. SMEs, especially start-ups or young firms, and associations and institutions. Their participation should be actively sought. However, if other firms from abroad are willing to participate, they should be invited, provided there is a reasonable ratio between the cost they are willing to burden and the benefit they may expect.

Part of the question who should participate is the question of how many actors should participate. In a networkshop, to keep the group workable and manageable, an adequate number should be in the range of 12 to 18 participants. In a smaller group it would be unlikely that key actors from each of the four pillars are present. A larger group will find it difficult to get to concrete results in a limited time-frame – a networkshop will last two to three days. A longer duration is unrealistic as representatives from firms and key agencies will find it difficult to spend more time outside their organization. However, it may be possible come to satisfactory results even in a larger group if it is possible to split a larger group into smaller working groups. In any case, it is crucial to avoid the kind of rituals familiar to anybody who has ever attended a large conference. Splitting into small working groups is one of the ways of achieving this.

An information forum may work with a large number of participants, depending on the characteristics of the specific event. The other main difference between an information forum and a networkshop regarding attendance is that a networkshop will in most cases involve mainly domestic actors, whereas an information forum should have a substantial presence of foreign firms and other foreign agents.

Why would domestic actors take part in a networkshop?

There are essentially four reasons why actors may take part in a networkshop.

First, there may be no or little networking so far so that getting to know each other is already a sufficient incentive. In this case it is important to look at the reasons for lack of networking. It may be due to the fact that it simply never occurred to certain actors that networking would be worthwhile. They may also have avoided it because there was no need to network, or because they felt that the costs of networking (in terms of transaction and opportunity costs as well as emotional costs) were higher than the benefits. But it may also be that behind the lack of networking lie hostility, organizational or political rivalries, profoundly different work modes between different organizations, or other factors which cannot easily be overcome. In this case, the next two reasons may help in convincing actors to cooperate.

Second, there may be networking or quasi-networking, i.e. actors know each other and have the occasional discussion, but do not really cooperate. In such a situation a networkshop may have different things to offer:

- It may introduce methodologies to intensify networking, like goal-oriented moderation and visualization techniques.

- For technology- and training-institutions, access to firms may be a motivating factor. Such institutions tend to be under increasing pressure to interact more with firms, both for political reasons and to raise additional funds, and they often encounter difficulties in actually establishing working relationships with firms. They may find a networkshop useful, especially if it gives rise to ongoing cooperation.

Third, even if institutions and firms, and government and firms, have an established relationship, communication is often not easy. A networkshop may help in improving articulation to improve quality and responsiveness of services provided by technology- and training-institutions.

Fourth, there are certain further carrots technical cooperation can offer. These include participation in information fora, contacts to firms and institutions in industrialized countries, and possibly fact-finding and networking trips to industrialized countries.

Why would domestic actors take part in an information forum?

The reasons mentioned before also apply to information fora. Moreover, it can be assumed that participation in a well-organized event that offers up-do-date information (on technology, management, regulatory issues, etc.) and opportunities to meet face-to-face representatives of firms and institutions in industrialized countries is a strong incentive, especially if the event is well prepared (for instance if matching between possible partners takes place in advance, or if there is some follow-up to accompany the process of building a partnership). Further incentives include getting in contact with technical cooperation projects and getting know-how on financing mechanisms.

Why would foreign actors take part in an information forum and networkshop?

The main incentive for foreign actors to take part is business. This applies both to firms and institutions like certification agencies or technology transfer and extension institutions. Participation in an information forum reduces risk, uncertainty, and transaction costs. Foreign firms and institutions do not have to do all the information-gathering and identification of possible partners on their own, and at their own cost.

Who should organize an information forum and a networkshop?

Information fora and networkshops should be organized by local organizations. Supporting local agencies in learning to organize such events is an important contribution of technical assistance. It is almost self-evident that organizing such events is not something that can be expected from donor agencies. Their task is rather to suggest new approaches to local actors and to provide specific know-how and, to a limited extent, financial resources.

Typical candidates for organizing such events span a wide spectrum of local organizations. They include technology transfer and extension agencies, applied research institutions, business associations, professional associations, and possibly others, like commercial firms specialized in organizing fairs and exhibitions.

III What are the main methodological issues in organizing information fora and networkshops?

It is useful to look at the sequence of events when addressing methodological issues.

First, there is preparation. In this phase, it is crucial to develop among participants a shared understanding of the aims of the event in question. It is essential to discuss what may and what will not be results. It is important to get to similar expectations regarding aims, procedures, and results. The main method to do this is intense and constant communication. Internet-based information technology is extremely helpful in facilitating this, especially in terms of setting-up a homepage which is constantly updated and in setting-up an electronic discussion list. It is not helpful if the entity which organizes an event does this on its own, without constant feedback from potential participants.

Second, there is organization and moderation of the event itself. Different methodological issues arise in information fora and networkshops:

- Information fora will have a strong content of unidirectional communication. It is crucial to assure that speakers use a good mixture of presentation techniques, i.e. not only talk but also overheads, slides, videos, and other visualization techniques. A further issue is language. As participants have different native languages, it is crucial to make sure that they can actually understand each other. Organizers of an event should always be skeptical if external participants claim a working knowledge of the local language as this will often be wishful thinking, especially when it comes to the intricacies of verbal and non-verbal communication.

- Networkshops should make use of participatory techniques like Metaplan. Compared to the traditional format of meetings, Metaplan has a series of advantages: It makes discussions more transparent, no issues which arose in the course of discussion are forgotten, discussion is more open as every participant can actively take part by writing cards, and identification and documentation of results is easy. However, it has to be

acknowledged that this technique may raise problems in certain cultural settings, especially where hierarchies are very strong and open, controversial discussion has a negative connotation. Under such circumstances it may be counterproductive to try to persuade participants to employ this technique. However, this does not mean that no visualization technique should be used. For instance, it is perfectly possible to have assistants take notes on cards, and to put these cards in a structured way onto pinboards during breaks in order to feed-back the course of the discussion to the participants, to give them an opportunity to reflect and comment on the discussion so far, and on the next issues to be addressed.

In order to stimulate networking, post-event work is essential. Part of the follow-up is the rapid documentation of the results of the event so that participants can check it against their fresh memories. Follow-up also includes discussions with frustrated participants on what went wrong, what can be done to avoid frustrations in the future, and what can be done to keep the participant in the process.

Follow-up furthermore includes covering transaction costs. Provided that the agency which organized the event has the resources to do so, it should by all means try to work as a network manager. Keeping communication and information flow between participants going, feeding additional information into the network, and preparing further meetings (including smaller, brief meetings) are time- and possibly cost-intensive activities which participants will not always be willing to cover.

A possible, albeit difficult, task of a network manager is conflict resolution. It is likely that cooperation in a network will lead to misunderstandings and actual conflict. To a certain degree, a network manager may be able to mediate between conflicting parties. In fact, it is useful that participants in a network agree on rules for conflict mediation once they acknowledge the existence of the network and their willingness for continuous participation.

IV What are the major cost factors in information fora and networkshops?

The major cost factors in information fora and networkshops are preparation and follow-up.

Specifically, the preparation phase involves the following expenditures:

- Cost of the staff in charge of preparing the event. The kind of preparation outlined above involves substantial time allocations so that staff cost can be substantial. Accordingly, it is desirable to identify a local institution that is willing to shoulder part of this burden, e.g. by covering part of the expenditures with personnel out of the core funding if they involve their employees.

- Coordination costs both of the event and the ongoing process, especially in terms of mail, phone, electronic communication, and travel.

The event itself involves the following expenditures:

- Personnel expenditure for the moderator and supporting staff.
- Rent for the place where the event takes place.
- Expenditure for documentation (staff, printing, dissemination).

Post-event work is preparation for the next event, so the follow-up involves similar expenses to that involved in preparation as outlined above.

V Case studies of information fora

En-techmart

En-techmart was an event organized in 1996 by the Asian and Pacific Center for Transfer of Technology (APCTT), an organization linked to the Economic and Social Commission for Asia and the Pacific (ESCAP), an UN body. En-techmarkt was organized in New Delhi where APCTT is located. It was a four-day-event that brought together representatives from about 100 firms within the region (China, India, Kazakhstan, Russia) and outside the region (Belgium, Denmark, Germany, Italy, USA, UK). The sectors involved covered a broad spectrum, including agroindustry, chemical engineering, electronics, telecommunications, energy, and environment. In most cases, the partners knew each other beforehand. During the event about 300 meetings took place. The immediate outcome were 20 letters of intent, memorandums of understanding, or contracts. The overall evaluation given by the participants was very positive, especially as many expected further deals to come out of the event at some later stage.

It took APCTT about nine months to organize En-techmart. Five staff members and six consultants were involved in the preparation which encompassed marketing of the event, identification of participating firms and technology transfer projects, matching of prospective partners, establishing contacts between them through correspondence, intermediation in negotiations, scheduling of the business meetings, and logistic support to the event. Furthermore, there were follow-up activities. The overall budget of the event was US$ 75,000.

En-techmart is a kind of information forum that figures somewhere in between an effort to stimulate individual partnering and an anonymous fair. The key contribution of APCTT was, first, to put a lot of effort into preparation, especially regarding identification of participants and matching them. Potential partners started to learn about each other in advance, so that in meetings during the event they did not have to bother with getting to understand each other's demands and offers but could get right down to business.

For the firms involved, the event offered a series of advantages:

- The cost and effort usually involved in identifying suppliers / customers was much reduced.
- The event gave rise to economies of scale as various potential suppliers / customers were present at the same time and location.
- The event opened opportunities for unplanned contacts based on chance meetings.

The event thus reduced substantially risk and transaction costs, and it did that for a relatively cheap price.

Trade Fair

Trade fairs are a traditional means to stimulate contacts between potential sellers and buyers of products, including equipment and technology. Their main advantage (it is not predictable what kind of contacts are going to be made) is at the same time their main disadvantage. Participation in a fair is costly for both sellers and customers; costs include participation / admission fees, the often high cost of preparing a stand, travel expenses, and the opportunity cost due to the need to allocate qualified personnel to attend potential customers. To balance cost and benefit, and advantage and disadvantage, it is useful to target a fair. Overall, the last decades have seen a strong tendency towards ever more specific fairs. Across-the-board industrial fairs, like the Hannover fair, increasingly gave way to specialized fairs, typically for individual industrial branches or sub-branches. But, again, this is not the perfect way out of the disadvantages of fairs since a supplier with a broad product spectrum would have to present in a large, an increasing, number of fairs.

Basically, there are two ways of dealing with the trade-offs involved in the organization of fairs, both of which have their merits. On the one hand, one can leave if to the market. The organizers of fairs are largely for-profit organizations. A fair that does not meet with the expectations of sellers and customers will simply exit the market, and a fair organizer without a clear perception of its customers will sooner or later exit the market, too. On the other hand, there is some justification for an – albeit low – subsidy element in fairs, based on the market failure argument outlined above. Especially when it comes to international fairs in new segments, risk and uncertainty will undermine the prospects of success even of an event that basically makes a lot of sense. Its success will depend, firstly, on the ability of organizers to identify and target a segment that makes sense to both sellers and customers, i.e. which is neither too broad nor too small so that sellers meet a reasonable number of seriously interested customers, and vice versa. Secondly, it depends on the effort put into the preparation of the event, not only in terms of targeting but also regarding the dissemination of advance information on sellers and what precisely they have to offer, and perhaps also customers.

Symposium

A symposium is a kind of event that can take place both independently and as a complementary activity to a fair. In fact, successful fairs and symposia often take place in parallel and reinforce each other's relevance and attractiveness. The basic idea behind a symposium is to introduce additional information, beyond the information given by potential sellers. Speakers in symposia include independent business consultants, academics, public servants from regulatory agencies and the like, and others, apart from firm representatives. They establish the opportunity to get a compact information about the state-of-the-art of technical trends, conceptual discussions, regulatory issues, and the like in a given sector.

VI Alternatives and complementary activities to information fora

There are further activities which may be alternatives to information fora but which will rather be complementary activities, like information visits. Taking business executives and high-ranking government representatives, including from technology and training institutes, to other countries is common practice in technical cooperation. It often has an eye-opening effect, as technologies and organizational solutions which they could not imagine, and were therefore resisting, prove to work perfectly well elsewhere.

However, such trips face several problems. First, they are costly, both in terms of travel expenses and regarding opportunity costs as high ranking staff is not available at its organization of origin. Second, it is unrealistic to assume that decision-makers from firms and institutions can devote a lot of time to such trips. This is the reason why this will mostly be a complementary activity: it builds awareness and introduces new ideas into a domestic process, the backbone of which are events which take place in the home country.

Strengthening environmental technological capability and stimulating international technological partnering is a process that should involve different kinds of activities and events. Networkshops are crucial to stimulate interaction between actors. Different kinds of information events are essential to facilitate international flow of know-how and technology. Events of the En-techmart style appear particularly promising as they avoid the typical problems of anonymous fairs and display a favorable cost-benefit-ratio. Taking decision makers to trips abroad can be a useful instrument both in an early phase of the process, to open eyes and build awareness, and at a later stage, as a follow-up to networkshops and information fora aiming at dealing with specific issues.

D Bibliography

Addis, Caren: Emerging Forms of Industrial Governance: Promoting Cooperation Between Small and Large Firms in Brazil, in: Competition & Change, Vol. 2, 1997, No. 1, pp. 95 - 124

Axelrod, Robert: The Evolution of Cooperation. New York: Basic Books, 1984.

Edquist, Charles (ed.): Systems of Innovation. Technologies, Institutions and Organizations, London, Washington: Pinter, 1997, pp. 1-35

Fischer, Hartmut: Environmental Cost Management. Transparencies for presentation. Bonn: GTZ-Pilot Programme for the Promotion of Environmental Management in the Private Sector of Developing Countries (P3U-Working Paper No. 12e), 1998

Fleury, Afonso, and John Humphrey: Human Resources and the Diffusion of New Quality Methods in Brazilian Manufacturing. Brighton: Institute of Development Studies (Research Report 24), 1993.

GTZ-P3U: 'Good housekeeping'. A new environmental management tool for managers and technical experts. Bonn: GTZ-Pilot Programme for the Promotion of Environmental Management in the Private Sector of Developing Countries, undated

GTZ-P3U:Good Housekeeping Guide for Small and Medium-Sized Enterprises. Bonn: GTZ-Pilot Programme for the Promotion of Environmental Management in the Private Sector of Developing Countries (P3U-Working Paper No. 9e), February 1998

Hillebrand, Wolfgang, Dirk Messner, and Jörg Meyer-Stamer: Strenghtening Technological Capability in Developing Countries, Berlin: German Development Institute, 1993

Lundvall, Bengt-Aake (ed.): National Systems of Innovation. Towards a Theory of Innovation and Interactive Learning, London: Pinter Publishers, 1992, pp. 169-187

Meyer-Stamer, Jörg, Bernhard Adam, Stefan Bantle, Alexandra Lauer and Daniela Mohaupt: Industrielle Netzwerke und Wettbewerbsfähigkeit. Das Beispiel Santa Catarina / Brasilien, Berlin: Deutsches Institut für Entwicklungspolitik, 1996

Meyer-Stamer, Jörg: Inter-Firm Cooperation in Environmental Management: Experience from Santa Catarina/Brazil, Bonn: GTZ-Pilot Programme for the Promotion of Environmental Management in the Private Sector of Developing Countries (P3U-Working Paper No. 7e), 1997

Meyer-Stamer, Jörg: Path Dependence in Regional Development:Persistence and Change in Three Industrial Clusters in Santa Catarina / Brazil, in: World Development, Vol. 26, 1998, No. 8

Meyer-Stamer, Jörg: Technology, Competitiveness and Radical Policy Change: The Case of Brazil, London: Frank Cass, 1997

Naschid, Rafti, Joyce Miller, Christof Vosseler: Good Housekeeping Guide for Small & Medium-Sized Enterprises. Bonn: GTZ-Pilot Programme for the Promotion of Environmental Management in the Private Sector of Developing Countries (P3U-Working Paper No. 9e), 1998

Nelson, Richard R. (ed.): National Innovation Systems. A Comparative Analysis, New York, Oxford: Oxford University Press, 1993

OECD (Directorate for Science, Technology and Industry): National Innovation Systems, Paris (mimeo), 1997

OECD: Effective Technology Transfer, Co-operation and Capacity Building for Sustainable Development, Common Reference Paper No. 75, Paris (OECD Working Papers), 1994

OECD: Technology and the Economy. The Key Relationships, Paris: OECD, The Technology/Economy Programme, 1992

Porter, Michael E., and Claes van der Linde: Green and Competitive: Ending the Stalemate. Harvard Business Review, Vol. 73, No. 5, pp. 120-34, 1995.