Environmental Innovations: Institutional Impacts on Co-operations for Sustainable Development

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Summary

A suitable strategy for achieving sustainable development is to foster environmental innovations. Environmental innovations, however, suffer from so-called "double externalities", because apart from innovation spillovers they also improve the quality of public environmental goods, which can be used without cost by free riders. Those innovation spillovers can be avoided through co-operation. Furthermore co-operations can be considered as advantageous because environmental innovations often depend on interaction in research and development, production, selling and disposal. This paper analyzes as to what extent institutional factors impact co-operative arrangements of innovative organizations in the development of new environmental technologies. It applies a multi-dimensional institutional analysis focusing not only on institutional arrangements which exist among organizations but also on opportunities and constraints provided by the institutional environment in which these organizations are embedded. Expanding the existing research we will conclude what kind of policy measure may support the success within networks of environmental oriented innovators.

Keywords: Environmental innovation, Co-operation, Sustainability, Institutional analysis, Policy measures

JEL Classification: L14, O31, Q55, Q58

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1. Introduction: Institutional Impacts on Co-operations for Environmental Innovations

The long-term conservation of natural resources and environmental quality by promoting sustainable development requires a fundamental change in production and consumer patterns. An appropriate strategy for achieving a sustainable development is to foster environmental innovations. Environmental innovations can be described as innovations that aim at reducing resource inputs, decreasing the negative environmental impacts and/or substituting environmental goods by produced capital (Blazejczak et al. 1999). However, environmental innovations are not generated to the extent necessary for sustainable development. Given the specific character of environmental innovations, it can be assumed that the co-operation of different kinds of actors would increase the likelihood that those innovations can emerge. This is because many environmental innovations depend on coordinated work in research and development (R&D), production, selling and disposal. Furthermore those co-operations may reduce the high risks of R&D activities, increase R&D productivity and secure the access to resources, which can not be easily acquired from the market (Karl; Möller; Matus 2004: 4-7).

We argue, however, that the success of co-operations for environmental innovations depends to a significant extent on the institutional conditions under which those co-operations take place. Therefore, this study analyzes what kind of institutional structures in a market economy are able to foster the dynamics of environmental oriented technological development. Empirically we aim at evaluating firstly, what kind of incentives exist for co-operation partners, secondly which factors hinder or support the engagement in co-operations, and thirdly – based on these findings – how public innovation policy can promote those co-operations. We understand co-operations as exchange relations between economic agents, where the commitments of the transactions partners are not completely specified in the contract (Williamson 1987). Depending of the position of the partners in the valued added process, we differ between horizontal and vertical relations. Whereas horizontal co-operations take place among competitors, vertical co-operations cover interfirm-relations at different stages of the value added process (e.g. supplier-user relations). This definition includes not only business actors, but also universities and public research institutes. Cooperative activities between more than two partners are considered as networks.

Given the lack of knowledge about the population of cases, relevant factors and interrelations, which play a role in co-operations for the development of environmental innovations, our study has to be considered as an explorative case study analysis. Its main goal therefore is not to come to generally valid conclusions on the object of investigation. It rather aims at identifying individual factors, which affect those co-operations either in a supportive or obstructive way. Our results stem from 13 explorative case studies on environmental-oriented innovative co-operations in Germany, which concern different kind of innovation, different sectors and comprehend a wide spectrum of co-operations.

In the following we will firstly present the interdisciplinary and theory-based analytical approach, which we have developed on the basis of institutionalists theories applied by various academic disciplines. We will then present quantitative results on co-operations for environmental innovations,

which originate from a special data analysis of a German industry survey (Section 3). This analysis provides information about the occurrence of co-operations for the development of environmental innovations in different industrial sectors as well as about existing co-operation barriers. The quantitative results are assessed to get some insights into relevant criteria for the selection of the case studies. In section 4 we present our qualitative findings based on the explorative case studies. In the final section we systematically evaluate our researcch results and discuss policy recommendations.

2. Systemic-Integrative Approach

Our systemic-integrative research approach has been designed in a way, which not only balances strengths and weaknesses of the different fields of institutionalist theory. Rather the approach provides a cross-disciplinary framework, which considers institutions both as a dependent variable (understanding institutions as the intentional result of targeted actions of innovative organizations) as well as an independent variable (understanding institutions as factors which influence the actions of organizations during their innovation processes). In this context, institutional analyses have shown that a variety of institutional factors have an impact on innovation, such as the respective regulatory framework, the organization of research and development and the characteristics of markets and firms (Grande; Kaiser 2003, Karl; Möller 2003).

Furthermore, our integrative approach considers innovation processes under a systemic perspective. A systemic view on innovation processes has been developed since the end of the 1980s as an attempt to establish a new understanding in innovation research, which was different primarily from so-called resource-based approaches (Lundvall 1992, Nelson 1993, Edquist 1997, Kaiser; Prange 2004). The latter ones stated that successful innovations were largely the result of the internal resources and capabilities of a firm while external factors were of only limited importance (Teece; Pisano 1994). However, resource-based approaches failed to explain why firms, which have similar resources at their disposal, show significant variations in innovative output. Against a firm-based perspective systemic approaches have argued that the technological capability of a firm is in a substantial way determined by the institutional environment in which the firm is embedded.

All in all, the integration of different institutionalist theories under a systemic perspective aims at understanding the framework conditions for innovative organizations and their modes of coordination, which exist under a given institutional environment. Therefore, an institutionalist approach to the study of innovative co-operations requires the consideration of institutional factors at different levels of analysis. In order to provide for such a multidimensional perspective our project referred to the work of J. Rogers Hollingsworth (2000) who proposed a structuring of the field of institutional analysis by differentiating five analytical levels. His concept does not only allow for accounting institutions as dependent and independent variables, it also provides guidance for the evaluation of institutional stability and the likelihood of institutional change (Hollingsworth 2000: 6 ff.). Figure 1 illustrates the different levels of analysis and their relation to institutional factors, which are important for the study of co-operations for environmental innovations.

Figure 1: Levels of institutionalist analysis

Levels	... HOLLINGSWORTH (2000)	... with reference to environmental innovations
1. Level	*Instituions:* Norms, Rules, Conventions, Habits and Values	Trust, Environmental Awareness
2. Level	*Institutional Arrangements:* market, states, hierarchies, etc.	Co-operational formations, contractural arrangements, security- and control mechanisms
3. Level	*Institutional Sectors:* financial systems, business systems, research systems etc.	Institutional framework conditions: regulation, public R&D and innovation policies
4. Level	*Organizational Structures*	Organizational Structures, esp. in view of different conditions that apply to small and large firms
5. Level	*Outputs and Performance*: administrative decisions, sectoral and societal performance	Evaluation: ▪ Innovative and co-operative success ▪ Impact of state actions

The first level refers to **basic societal norms, rules, and conventions** to which the largest stability can be attributed. These institutions reflect actors' preferencens and thus impact for example – at the macro level – the outcomes of political decision-making processes or – at the micro level – the modes of coordination and information flows among individual actors. In view of inter-organizational relations these institutions effect the stability and durability of co-operations as well as the role of trust in such relations.

The second level concerns **institutional arrangements** between innovative organizations. Such relations exist on a continuum between hierarchies, networks and markets while associations or voluntary agreements can play a role in organizations which act within the same environment (Streeck; Schmitter 1985). For our analysis we focus here on inter-organizational modes of coordination, which reflect the motivation for co-operation and the allocation of resources and powers between actors.

Institutional sectors constitute the third level of analysis. For innovation processes the most relevant sectors are the education-, research-, the financial-, and the regulatory systems. Comparative systemic innovation studies have shown that these sectors differ across countries or regions in terms of the provision of resources for innovative organizations. Moreover there are variations in the modes of coordination, which exist between innovative organizations and the various sectors. This holds true, for example, for relations, which exist within the science and research system. For the study of co-operations for the development of environmental innovations, it can be assumed that institutional sectors are of high importance primarily in view of relations between actors who develop and produce environmental technologies and those who implement them.

The fourth level of analysis focusses on the **internal strucuture of innovative organizations**. Here we can assume that a change in societal norms, for example an increase of environmental aware-

ness, directly impact the strategic options of firms. Firms may react to this by implementing organizational innovations, such as the Eco-Management & Audit Scheme (EMAS), in order to optimize their products and processes. In terms of external relations of a firm, those certifications also signalize to partners and consumers that the firm takes into account the environmental effects of their activities.

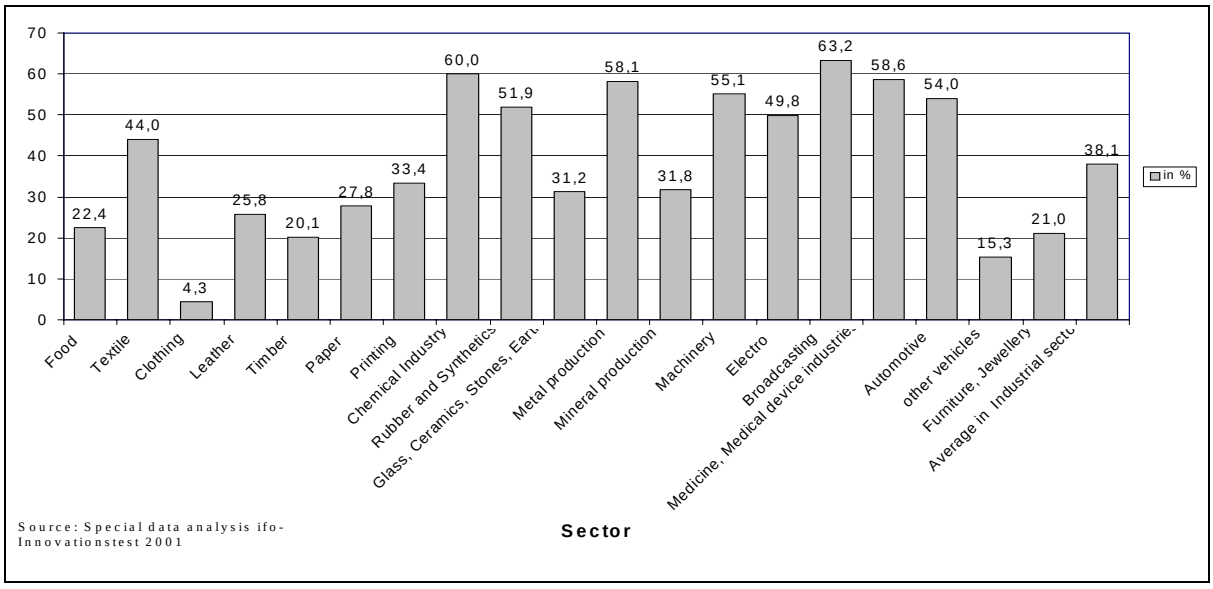
At the fifth level the analysis turns to outputs and performance of institutions and organizations. For the purpose of our study we evaluate the performance of co-operations. Moreover, we evaluate as to what extend public policies had an impact on the course and results of the co-operations.

3. The quantitative findings: the special data analysis of the "ifo-Innovationstest"

In 2001, we commissioned a special data analysis of the "ifo-Innovationstest" in order to get information about the frequency and forms of co-operations for the development of environmental innovations and about the existence of barriers to co-operative firms within the manufacturing industries identified in different sectors.[2] The main findings of this analysis can be summarized in the following way:

- The frequency of co-operations differs significantly among industrial sectors. As figure 2 shows, the number of firms that have been involved in at least one co-operation (without specific environmental objective) was highest in the broadcasting-, chemical and medical device industries (between 58 and 63 percent) and lowest in the textile and clothing industries (only 4 percent).

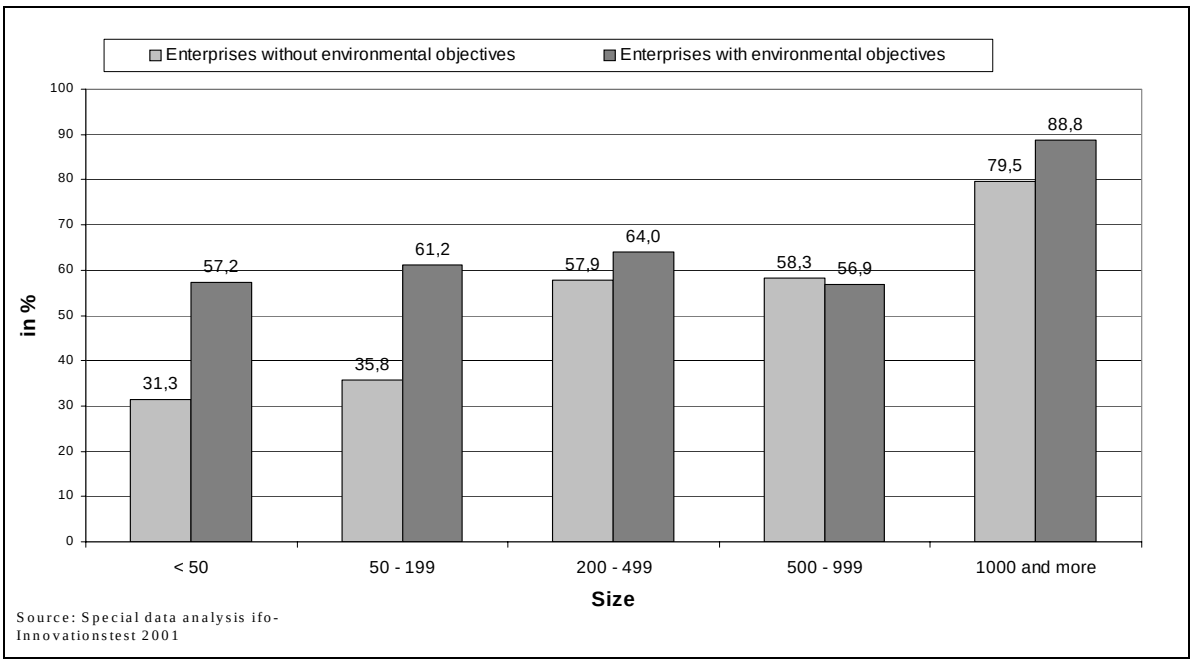
Figure 2: Intensity of co-operation of firms in different sectors 1995 bis 1999



[2] The analysis is based on data surveyed in 2000 for the years 1995 to 1999. They refer to the frequency of co-operations between firms according to different industrial sectors (NACE code), different firm size and differrent organizational forms of co-operation. Co-operations targeted at environmental innovations are defined as innovation processes, which aim to reduce ecological damage. Ifo-Innovationstest (2001).

- The intensity of co-operation is further determined by the size of the firm. The engagement of firms with more than 200 employees is significantly above the average while that of small and medium-sized companies is slightly below the average. Between 1995 and 1999, three quarters of the firms with more than 1,000 employees were involved in a co-operation. However, if co-operations are targeted at environmental innovations the engangement of small and medium-sized companies increases substantially. This might point to the fact that SMEs either try to compensate their lack of resources through co-operations or they consider environmental innovations as a mean of market differentiation (cf. figure 3).

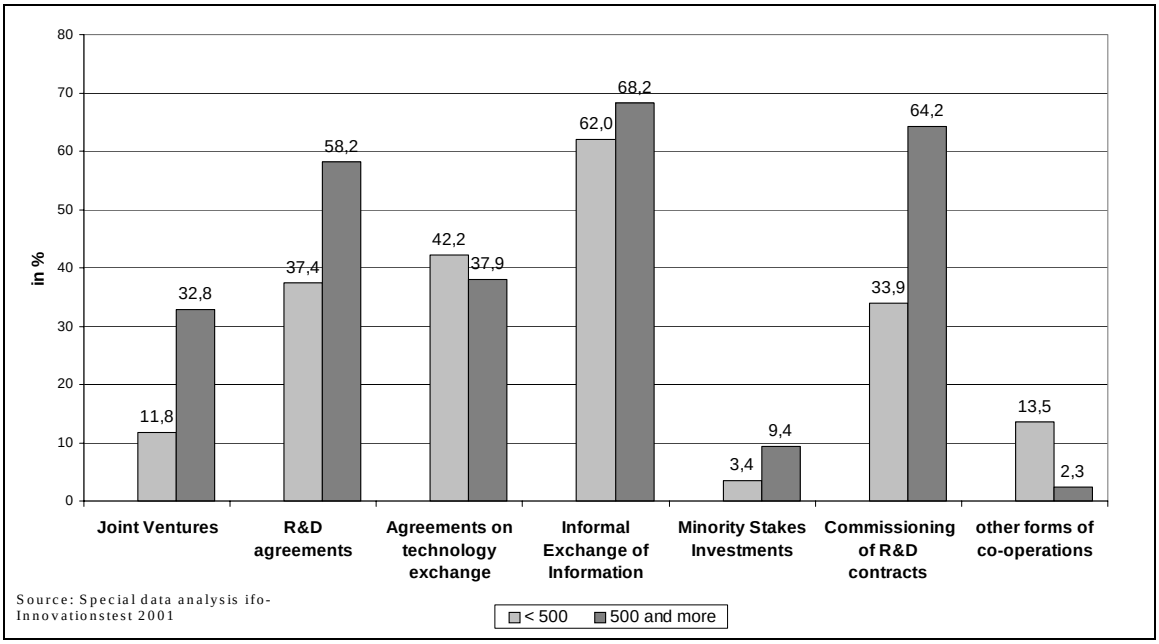
Figure 3: Intensity of co-operation of firms with different size 1995 bis 1999 (with and without environmental objectives)



Source: Special data analysis ifo-Innovationstest 2001

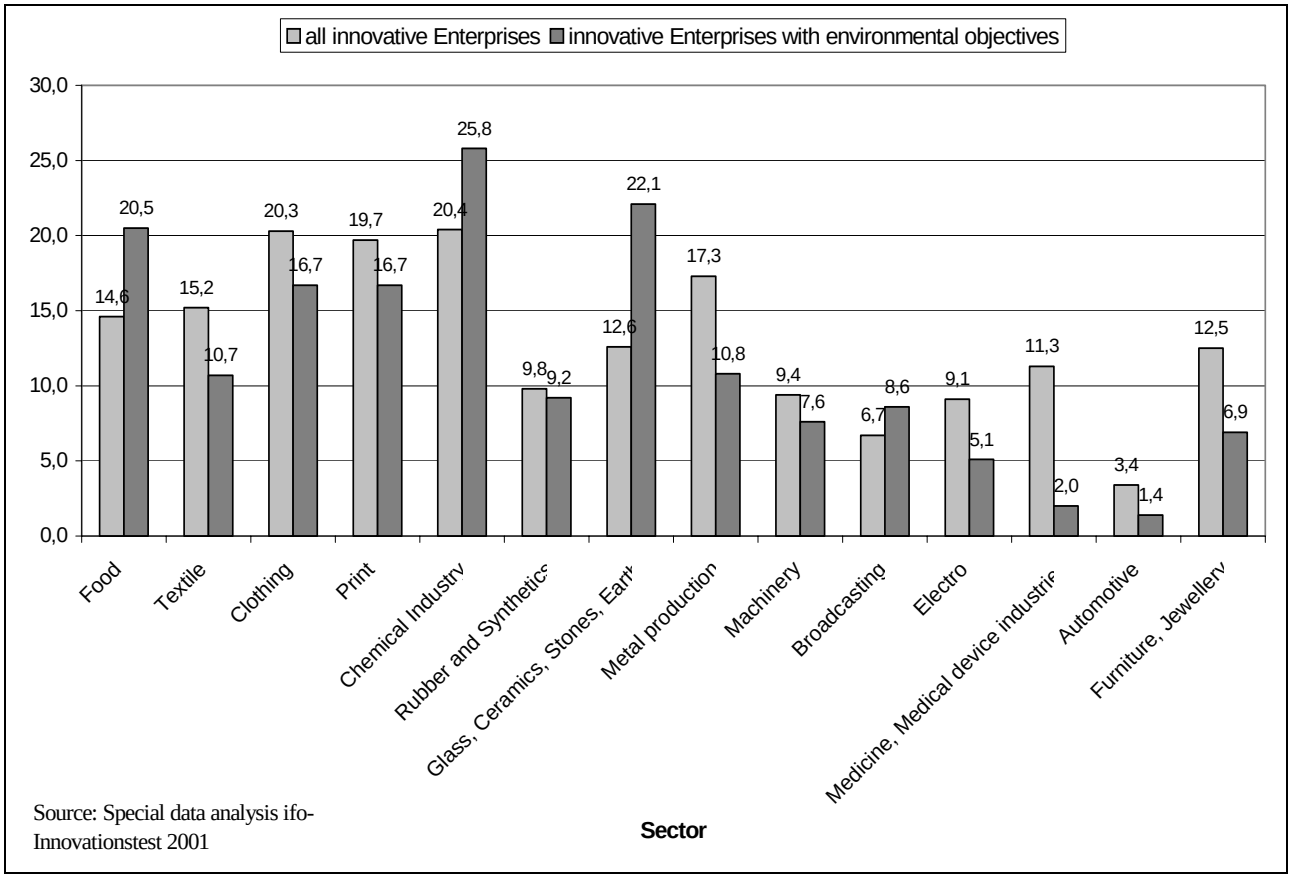
- Both the size of the companies as well as the objective of the co-operation has an impact on the organizational form of the co-operation. Basically, the most common forms of co-operation are the informal exchange of information, the commissioning of R&D contracts and the R&D co-operation. The latter one, along with joint ventures, is however most common between larger firms. Independent of the size of the firms, minority stakes investments play only a minor role in Germany. As figure 4 shows, this dominant forms of co-operation also hold for relations aimed at the development of environmental innovations, whereby firms with up to 499 employees more strongly engage in agreements on technology exchange, informal information exchange and R&D agreements. Technology exchange is also more important for smaller than for larger firms, while larger firms are again more often involved in joint ventures.

Figure 4: Organizational forms of co-operation with environmental objectives between firms of different size 1995-1999



- In view of the existence of barriers to co-operation the data analysis shows that a high frequency of co-operations in a given sector does not indicate that there are no significant burdens. On the contrary, in the chemical industry, for example the number of co-operations is above average. Nontheless, firms in this sector also more often reported barriers to co-operation which actually increase in co-operation aimed at the reduction of ecological damage. As figure 5 also shows, firms with co-operation problems vary in terms of the perceptions of barriers to co-operation across sectors. Firms producing medical devices, measurement instruments, electronic goods or textiles reported fewer co-operation problems if the innovation refers to environmental goals.

Figure 5: Barriers to co-operation among firms and between firms and public research organizations, 1997 bis 1999 (for different sectors)



Source: Special data analysis ifo-Innovationstest 2001

Recapulating the results of the data analysis it can be stated that different industrial sectors vary significantly in terms of the intensity of co-operation and the perception of barriers to co-operation. Therefore, the project considered sectoral variations in the case study selection process taking into consideration sectors with high co-operation intensity (such as the chemical insdustry) as well as sectors with lower intensity (such as the food industry). We also considered sectoral variations in the perception of barriers to co-operation and the role the size of a firm plays for co-operations for environmental innovations.

4. The qualitative results: the analysis of the case studies

4.1 Criteria of the case studies

The results of our research project are derived from 13 explorative case studies on environmental-oriented innovative co-operations, which concern different kind of innovation, different sectors and comprehend a wide spectrum of co-operations (see figure 6).

On the one hand, we consider co-operations, which are directly affected by existing or forthcoming environmental regulation (PRINT-SME, RECYCLING and PRINT-MNE) and as in the case of RECYCLING with high co-operation need. While the case study PRINT-SME is focusing on co-operations with small and medium size enterprises (SME), the case study PRINT-MNE comprises also multinational enterprises (MNE).

Similar to the case studies in the print industry, we analyse two case studies in the food sector which are based on different incentive mechanisms (CHOCO, BEER). While CHOCO was mainly driven by rationalization potentials, BEER was initiated by a threatening regulation in this sector. Both case studies are in a sector, which is indicated by a relatively low co-operation intensity in which, at the same time, insufficient co-operation possibilities are, however, often named by environmental-oriented innovators as an innovation barrier. This co-operation problem is also relevant in the chemical industry albeit high co-operation intensity can be observed here. At the same time the regulation intensity is very high in the chemical industry. In this sector we analyse the case study ORGA. The research object refers here particularly to the collaboration between multinational enterprises and research organizations for the development of organizational environmental innovations. Organizational or institutional innovations are also of interest in CERTIFICATE, a case study, which is characterized by a heterogeneous structure of the partners involved and a high number of co-operation partners. This case study contains interesting aspects for the diffusion of environmental innovations. The co-operations here and in other co-operations have been endogenously developed (e.g. RECYCLING, PRINT-SME). In contrast to all other case studies the government doesn't play a role in this co-operation, neither in form of regulation nor in form of promotion or coordination.

The PATENT case study analyses co-operation partners who are not directly concerned by environmental regulation for whom, however, a research or market potential can be established by the development of environmental technologies. Against the background of surpassing high patent activities of German enterprises in the area of environmental technology (Legler et al. 2002: 16f.) the PATENT case study reflects an innovation area, in which the German economy takes a leading position (measured against the Europe-wide patented inventions) and thus simultaneously ensures potential markets by its trade mark rights. The PATENT and the WATER case study as well concentrate on technologies for the prevention of water pollution and with it on a field of environmental protection where German environmental technology suppliers achieve almost the half of the total sales volume (Legler et al. 2002: 40). While the PATENT case study concentrates on the development of

new environmental technologies, the WATER case study contains interesting aspects for the diffusion of environmental technologies. The WATER-co-operation is less important for the development of new technologies but rather interesting for the problem-specific implementation of new environmental technology that requires cooperative action.

The co-operation of enterprises of different size is considered among others in the case studies AUTO and IPP-AUTO. Both case studies are established in the automotive industry, which is characterized by high co-operation intensity. Compared to other sectors co-operation problems are with only 1.4% of the environmental innovative enterprises significantly seldom seen as barrier for environmental innovation in the automotive sector. Against this background interesting information about favorable co-operation constellations could be expected here.

While the promoting aspect is relevant for the realization of cooperative innovation projects in most case studies (with the exception of CERTIFICATE and PRINT-SME), the coordination function of the government is particularly significant in the case studies IPP-HOUSEHOLD, WATER, IPP-AUTO, and IPP-SME. Accordingly, the co-operations WATER, IPP-AUTO, and IPP-SME include not only enterprises but also ministries or local authorities to a certain extent. With the concept of Integrated Product Policy (IPP) which is object of the co-operation in the case studies IPP-HOUSEHOLD, IPP-CAR, and IPP-SME a new policy approach has been analysed. Policy measure focus more on moderation than on regulation here and therefore one can expect special challenges with regard to cooperative behavior of the partners involved. Finally our case studies consider constellations of co-operation that comprise intermediary partners in the function of initiators, coordinators and moderators respectively. The intermediaries show different characteristics and vary from research organization (PRINT-SME, CHOCO, IPP-SME, BEER) and independent organization of public law (IPP-AUTO) to private companies with or without profit interest (RECYCLING, CERTIFICATE).

Figure 6: Survey of case studies

Case study	*Sector*	*Innovation*	*Role of the Government (Regulation, Promotion, Coordination)*	*Cooperation partners*
Print-MNE	Printing machine	Process Innovation	- Regulation for the protection of Environment and Health	- MNE, SME, $RO_{private}$
Print-SME	Printing Sector	Process optimization	- Regulation for the protection of Environment and Health - Promotion	- SME, $RO_{private}$
Recycling	Recycling Management (different Sectors)	Organizational Innovations, Product und Process Innovationen	- Announcement of environmental Regulation - Promotion	- esp. SME, RO_{public}
Choco	Food Sector	Process Innovation	- Promotion	- MNE, SME, $RO_{private}$
Beer	Food Sector	Process Innovation	- Forthcoming Regulation - Promotion	- SME, IO
Patent	Environmental Technology	Process Innovation	- Promotion	- RO_{public}, $RO_{private}$, SME
Water	Public Water Provisions	Process Innovation	- Promotion - Coordination	- SME, MPA, local authorities
Certificate	Forest Management	Organizational Innovation	- No role	- MNE, SME, IO, local authorities
Orga	Chemical Industry	Organizational Innovation	- Promotion	- MNE, RO_{public}, $RO_{private}$
Auto	Automotive Industry	Product Innovation	- Promotion	- MNE, SME, RO_{public}
IPP-Auto	Automotive Industry	Organizational Innovation	- Promotion - Coordination	- MNE, SME, IO, MPA
IPP-SME	Engineering	Product Innovation	- Promotion - Coordination	- SME, RO, MPA
IPP-Household	White goods (household appliances)	Product Innovation	- Promotion - Coordination	- SME, RO_{public}

*Abbreviation: MNE (Multinationale Enterprises), SME (Small and medium Enterprises), $RO_{private}$ (Private Research Organizations), RO_{public} (Public Research Organizations), IO (Intermediary Organizations), MPA (Ministry or public authority)

To analyze the different case studies systematically, a structured criterion pattern was developed which takes into account both the factors derived from the theory and the empirical results of the case studies (figure 7). The system permits the evaluation of all case studies according to consistent criteria.

Figure 7: Structure for the analysis of the case studies

Partner Configuration and Project Background	Characteristics of Environmental Innovation	Co-operation Needs and Objectives	Institutional Conditions of Co-operation	Evaluation
▪ Type of co-operation partners (Size, intermediaries), NGOs etc.) ▪ situational Factors (Industry and market structure)	▪ Type of Innovation and Technology (Product, process, organizational innovation; additive or integrated technology) ▪ Innovation conditions (R&D intensity, complexity) ▪ Innovation risks (Market potential, specificity, diffusion of the innovation)	▪ Resources ▪ Network aspects ▪ Sizes and specialization advantages (critical mass effects)	Institutional levels: (1) Norms, values, rules (Confidence, trust, environmental awareness) (2) Institutional Arrangements (Co-operation and contract structure, safeguarding and control mechanisms) (3) Institutional Sectors (Regulation, promotion, coordination) (4) Internal structure of the organization	▪ Co-operation success ▪ Innovation success ▪ Effects of state governance

Altogether, the systematics above include the institutional conditions, partner configuration considering situational factors, co-operation needs derived from the characteristics of the environmental innovation as well as the co-operation aims and the incentive and barrier structures. The partner configuration reflects the type of co-operation partners and particularly the different size and function of the partners. Situational features like industry and market structure provide information to the project background. The characteristics of the environmental innovation include the type of technology (product-, process, organizational innovation), the specific innovation conditions (research intensity and complexity) and the innovation risks such as specificity or market potentials of the innovation. The resources and network aspects as well as the sizes and specialization effects reflect the co-operation needs and the aims of the co-operation and illustrate in this way relevant incentive and barriers factors of the co-operation. The analysis of institutional aspects orientates at the multi-dimensional institutional model represented in chapter 2 and also contains trust aspects, co-operation and contract structures, safeguards and control mechanisms as well as state institutions in form of regulation, promotion or coordination. Each co-operation case results in a short evaluation with respect to the co-operation and innovation success as well as to the effects of the state governance.

4.2 Results of the case studies

The results of the case studies show three institutional factors that are particularly interesting.[3] The focus is on the role of intermediary organizations, the meaning of trust in cooperative relations as well as the effects of different governance mechanism in environmental policy. Related to the case studies the following indications can be derived:

INTERMEDIARY ORGANIZATIONS

As the case studies demonstrate, intermediary organizations have a positive effect on the co-operation behavior for the development of environmental innovations. Intermediary organizations are characterized by a neutral position within the co-operation structure. They follow no special own interest except the success of the co-operation or have only such interests in mind which do not negatively affect other partners or the performance of the co-operation. Intermediary organizations have an important meaning in overcoming different kind of resource bottlenecks. On the one hand, they play an important role in environmental oriented co-operation if co-operation barriers has to be overcome that are based on uncertainties about appropriate co-operation possibilities or partners and insufficient resources for the organization of co-operations. On the other hand, intermediaries are particularly important for cooperative development of environmental innovations if rationalization and market potentials are not sufficient or uncertain and co-operation advantages are to low in relation to the resources that need to be invested. In addition to the information and resource problems (BEER, PRINT-SME) intermediaries may take over an important function if power asymmetries between the co-operation partners have to be compensated (IPP-AUTO). And finally intermediaries are of importance if trust affects the co-operation behavior, as it is the case particularly in the co-operation with competitors (e.g. PRINT-SME, PRINT-MNE, CHOCO). In these cases intermediaries can help to overcome barriers for enterprises and research organization in co-operation for sustainable development.

Depending on the context of the emergence and position of the intermediaries within the co-operation "internal" and "external" intermediaries can be distinguished. While “internal” intermediaries mean agents which endogenously emerge in the co-operation, "external" intermediaries are partners who are exogenous, i.e. arisen independently of the co-operation and implemented into the co-operation consciously. The latter can further distinguish between intermediaries who initiate the co-operation and such who were included in the co-operation due to their aptitude to overcome certain co-operation problems (resource problems, power asymmetries, trust problems).

Furthermore intermediary organizations can improve the conditions for the (state) governance of environmental oriented innovation co-operations at least in two different ways. First, they facilitate the initiation of co-operations and help to stabilize them (e.g. IPP-AUTO). In these cases, state governance can build on established co-operation and coordination structures without having to establish these by considerable resource effort. Second, intermediary organizations facilitate the use of

[3] For a detailed discussion of the research results, see Karl / Möller / Matus / Grande / Kaiser (2004).

alternative non-order regulation instruments. As the example of PRINT-MNE shows, the success of voluntary self-binding agreements can be improved by such organizations even if the initial conditions (a comparatively high number of enterprises as well as high competitive intensity between vital economics agents) seem to be unfavorable. In this case this kind of self-regulation led to a considerable relief of the state, because

- a faster adaptation of norms to the respective state of the art of technology could achieved,
- the government was not directly involved in conflicts of interest between manufacturers of printing machine and suppliers of solvents,
- the government could count on the standardization performance of a private intermediary (Ronge/Körber 1996: 13).

TRUST IN CO-OPERATIONS

Trust plays an essential role in all case studies.[4] The rationales behind this are different depending on co-operation constellation and especially on

- the partner configuration (e.g. competitors),
- the object of the co-operation (e.g. marketability, competitiveness),
- the extent of information asymmetry between the partners and
- the degree of mutual dependence.

A definite correlation of trust with regulations or safeguards within the co-operation derived from the theory couldn't be approved by the case studies. The reason can be seen in the conception of trust. The analysis should differentiate more exactly between the kind of the respective regulation and control mechanisms on the one hand and their effects on the different dimension of trust (personal, organizational trust and system trust) on the other hand. Despite of the uncertain multidimensional effects the importance of trust for compensating incomplete contracts and safeguards has been approved by all case studies.

Furthermore the distinction of trust in personal-related, organizational and system/institutional trust has been affirmed by our explorative case studies. The relevance and the relation of personal-related and organizational trust diverge depending on the size, structure and business or research orientation of the co-operation partners (organization purpose). The importance of personal-related trust increases with the increasing size of the enterprise (RECYCLING). Personal-related trust is parallel to organizational trust in small enterprises; particularly if the management is actively involved in the collaboration. The larger the enterprises are the more trust is focused on persons (e.g. PRINT MNE in form of environmental protection officer, ORGA). If the personal-related trust takes over an important function in the co-operation, then personnel discontinuities (fluctuation) of the co-operation

[4] For more details on the trust concept used in this research project, see Möller (2004).

partners can have an negative effect on the collaboration and the innovation effort within the co-operation.

There is no systematic assertion derived from the case studies to explain what kind of trust plays a dominating role depending on the co-operation phase. Despite of this most of our case studies shows that such a distinction is feasible. So it can be recognized that personal-related trust primarily plays a role to initiate co-operations. This also explains why most of the co-operations are based on already existing contacts (e.g. BEER, WATER, IPP-AUTO, PRINT-MNE, IPP-HOUSEHOLD). If reputation based on previous project plays a role for the co-operation, it should be further analyzed whether such recourse to well-known partners is caused by trust or by an ignorance of alternative partners or even exogenously influenced by public financier. Taking these factors into account, we could identify constellations where information deficits or exogenous factors haven't been relevant (e.g. WATER and PRINT-MNE). System trust plays an important role for initiating co-operation projects if these projects are started to fulfill announced regulation in time. In this case it is of decisive importance that these announcements are reliable because they often induce considerable investments particularly for SME. Though return on investments can only be achieved if the enterprises can manage to differentiate their performance on the market once the regulation has been coming into force.

The significance of organizational trust increased in the course of the co-operation. That can be seen among others in the comparatively limited coverage of contracts (e.g. IPP-AUTO, IPP-SME, ORGA, PRINT-SME, BEER). Such contractual rules often played no more role in the course of the co-operation. Sanction mechanisms have not been coming into force if the projects failed or problems arose. In the IPP-Auto case study a contract was signed after project end at all. In this context the role of system/institutional trust should be considered ambivalently. On the one hand, contracts offered by the public funding institution have been sufficient in most cases. On the other hand, the partners in a co-operation proceeding problematically have been conscious that they didn't have any real chance to enforce their co-operation agreements without endangering the co-operation.

Finally depending on the expectation that trust is refer to (competence trust, intentional trust) we could derive some first results. All indications are that the importance of intentional trust dominates in collaboration with competitors while competence trust has a special relevance in co-operation where know-how and technological knowledge play a central role. Contractual arrangements for the marketing of research results (e.g. property rights, patents rights) are not a sign for the lack of intentional trust between the partners if it serves as protection, particularly against third parties.

ENVIRONMENTAL POLICY INSTRUMENTS

Our case studies show that actors who produce or implement environmental innovations are increasingly affected by environmental regulations originating primarily from the European level. As a consequence, a delay in transferring European regulations in national law as well as the non-implementation of announced regulation has a negative impact on the willigness of innovative organizations to engage in respective co-operations. Moreover both scenarios are likely to reduce actors' institutional trust in the political and regulatory system. Environmental regulations certainly

have the potential to raise firms' awareness for environmental problems and their willingness to engage in co-operations (PRINT-MNE, RECYCLING). In case that a firm anticipates new market opportunities it is not even necessary that the firm is directly affected by the regulation.

For this reason, environmental policy can positively impact the innovative behaviour of firms especially through the improvement of framework conditions, for example through intermediaries that support the firms' engagement in co-operations (Print-MNE, CHOCO, PATENT), while public R&D funds determine, inter alia, the constellation of actors and the targeting of co-operations.

Integrated Product Policy (IPP) can be characterized as a new concept of environmental policy at the regional, national, and the European level (Rennings et al. 2004). Its main advancement is the consideration of negative environmental impacts of products along the whole life cycle. This however requires that all relevant actors – producers, supplier, consumers and recycling firms - have to be involved in the process in order to reveal potentials for environmental improvement. Our case studies have shown that in practice those actor constellations are very complex and therefore difficult to establish. Nevertheless, even in cases in which only some of the relevant actors have become involved, it was possible to optimize the respective product (see esp. IPP-SME). Contrariwise the success of an IPP project can be at risk if one important link is missing. As shown in IPP-HOUSEHOLD, a consumer-oriented environmental innovation is likely to fail if the project does not involve producers and distributors. This point to the fact that even outside regulation state intervention is an ambitious task. In the respective case it would have been beneficial if environmental policy had tried to improve the marketing conditions, probably by using labelling instruments.

In some cases our studies indicate that the governance of environmental innovations increases the demands for horizontal and vertical policy coordination. This holds true, for example, in cases in which public organizations aim at forstering environmental goals with public procurement procedures. Primarily vertical policy coordination is also important in view of the introduction of new policy instruments. Integrated Product Policy, for example, has been strongly promoted by the European Commission since the end of the 1990s while actual IPP related projects have been financed primarily at national and regional levels.

5. Conclusions: Implications for innovation policy

Although our cases studies have an explorative character, we can draw at least some conclusions of how public policies can foster active participation in environmental co-operation. We again focus here on the three dimensions, which have proven to be the most yielding indicators: intermediary organizations, the role of trust in co-operations, and the impact of environmental policy instruments.

We found that **intermediaries** generally have a favorable effect on co-operations for the development of environmental innovations. They help to overcome co-operation barriers through initiation, coordination or management of co-operations. However, the support of environmental co-operations through intermediaries has to be examined in the individual case. It seems that interme-

diaries are of special importance in cases in which the co-operations advantage cannot be completely realized on the firm level.

In terms of **institutional arrangements** our case studies showed that it is crucial already in the phase of conception of projects to consider also the phase after the termination of projects in order to establish sustainable or durable networks. This is important because from the beginning on the basis is set for a durable and independent cooperative structure, capable to survive also without public support. Informal co-operation structures favor the cooperative development of environmental innovations. However it is difficult to identify this form of co-operation and therefore, it is hardly to be directly influenced. Economic policy measures may affect indirectly, in which corresponding framework conditions, e.g. in the form of working groups or the formation of forums, are developed. This type of actions can help to develop informal relations and in this way the exchange of relevant (environmental) knowledge can be supported.

Measures supporting **trust** can be at the centre of the institutional framework of environmental oriented co-operations, besides the possibility to establish contact structures (working groups, forums) above described. State institutions have a great influence on the so-called institutional trust. The expectations of the economic agents respect to credibility, consistency and transparency of governance measures are directly based on their own experience and indirectly on those experiences of others. This primarily applies to implementation of announced regulatory measures.

In the area of **governance measures**, at least one of the case studies (PRINT-MNE) demonstrates that specific inter-industry conditions are favorable for the successful implementation of self-binding agreements. In such types of cooperation it seems that self-binding agreements is the favor regulation form to be considered. Furthermore pilot projects initiated by public authority can also foster the diffusion of new environmental technology, particularly if they are related to leading technology, motivating further actors to invest in such technology. Besides this, pilot project seem to be suitable to promote environmental oriented co-operations if through them a sufficient reputation can be built and durable (network) structures can be established. The developed reputation can serve as a base of trust for future co-operations and attract other transaction partners (Karl; Möller 2003: 207)

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