10. East German Industrial Research: Improved Competitiveness through Innovative Networks

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10.1 Formulation of the Problem

Although the number of industrial R&D staff has been consolidated and the competitiveness and profitability of external industrial research institutions improved in East Germany, obvious differences between the features of East and West German innovation activities still exist; in particular those of R&D. Innovation activities in East Germany are characterised by a high share of small and medium-sized companies which often show a lack of potential for complex R&D projects. Both the share of industrial R&D staff and the industrial share of economic activity are lower than in West Germany. Moreover, less funds are available for R&D staff (Meyer-Krahmer et al. 1998; Pleschak et al. 2000).

One way of reducing the problems emerging from this situation is the synergy of innovative potential in networks. This is not only necessary because of the complex starting position of East German industrial research, but also in order to meet the demands on industrial research which arise from international innovation competition. This contribution shows the chances for innovation activity which evolve from the establishment of networks, and the conditions which are required for their successful use.

10.2 Requirements of Innovation Activity

Innovation activity is characterised by complexity in many different respects. Firstly, it affects the innovation process which reaches from the idea for new products, and solutions to processing and organisational questions, through research and development, production planning, and market introduction up to broad market penetration. These are problem solution processes characterised by risk, the division of labour, numerous interactions with surrounding fields, and inter-disciplinary co-
operation. The generation of new knowledge requires close co-operation between all participants, in particular regarding application-oriented basic research and the industrial application of R&D results from different scientific disciplines.

Moreover, the complexity of new technology is increasing. This demands not only higher standards of knowledge, skills, and experience on the side of the R&D staff, but also forces all innovation actors to communicate intensively. Co-operation is indispensable if one wants to meet the technological challenge of international competition.

Decisions about innovation activity are also very complex in character. In the case of an institution, they require reflection and a method of working which overlaps and links individual departments; moreover, customers, suppliers, marketing partners, investors and other actors from this area must be integrated into the preparation and the finding of decisions. Especially market conditions and customers’ requirements set economic, technical, and time standards for the whole innovation process.

Within the innovation system, the division of labour is being intensified. In East Germany, this is shown by external industrial research institutions, which have come into existence since 1990 due to the new profile of the research field; their economic consolidation has been realised in the past years due to their closeness to the market and to customers. The emergence of specialised R&D institutions working in close co-operation with the market does not represent a specifically East German situation but is the general tendency of innovation systems. It is understood that such R&D institutions must complement each other and become integral systems again, either by co-operating in networks, or through direct co-operation contracts. In many large companies, de-centralisation and outsourcing lead to a relaxation of traditional forms of organisation, and create the chance for independent economic activities in specialised departments. Several factors recommend a deeper division of labour between innovation actors:

- Due to their economic situation, small companies cannot afford to finance specialised R&D staff, the utilisation of which would be too limited.
- In order to enlarge their capacity, to reinforce their innovative capacity, or to introduce results of basic or applied research into their innovation process, medium-sized and large companies make temporary use of additional potential.
- Growing complexity and the system character of products and processes require special knowledge within the R&D sector, as well as experience in many fields of natural science and technology, which are not available to an individual company.
- R&D requires special instruments and equipment, processes, information, etc., the utilisation of which does not meet with the requirements of operational effi-
ciency, and which can often be provided by external firms faster and more cost-effectively.

- On the one hand, specialisation generates advantages due to the gaining of competence, synergy effects, the division of risks, and the completion of capacities. On the other hand, specialisation also stimulates learning effects on the side of partners, and closer relationships between research and the industrial utilisation of research results.

- The tendency towards concentration on core businesses leads to the outsourcing of those fields of activity which companies themselves cannot fulfil efficiently.

The deeper division of labour within the innovation process forces partners into increased co-operation. This is particularly true for the co-operation between small and medium-sized companies, as well as with external industrial research institutions. Sustained competitiveness is only guaranteed for those companies or R&D institutions which are able to adapt, and which are willing and ready to co-operate. The value of an innovation is not determined by a single innovator but by the whole innovation system in the figurative sense of a close weave of relationships between the innovation-relevant actors. Especially in East Germany with its industrial culture of small enterprises, a high level of co-operation and inter-links is required to enable innovative developments. Large companies – especially those with their own R&D departments – are almost non-existent in East Germany.

In networks as a special feature of co-operation, complementary resources, several actors, and inter-dependent co-operative activities are tied up to reach the common objective "innovation process" in the framework of co-operation, which must not necessarily be formally regulated. Synergies between the networking actors reduce their risks and accelerate the R&D process. The staff's qualification is supported by the knowledge and technology transfer taking place in the network. Networks can provide favourable framework conditions for the control of innovation requirements such as complexity, inter-disciplinary co-operation, and comprehensiveness (Koschatzky/Zenker 1999).

The fact that the East German situation is characterised by torn networks, broken-off business relationships, a lack of time and money for the establishment of new business relationships, potential network partners' lacking confidence in the efficiency and survival of East German companies, hinders innovation (Gemünden/Ritter 1999). In East Germany there is a lack of large companies serving as the core of crystallisation for networks; co-operation abilities, as well as fundamental information about potential partners, must be improved for regional actors.

For this reason external industrial research institutions serve the function of a "hinge" between producing companies and basic or applied research. They contrib-
ute to knowledge and technology transfer; in innovative networks, their role as a service company close to production is primarily the support of small and medium-sized companies. If this co-operation is not realised, then companies renounce the chance to integrate results of basic and applied industrial research into their new products and processes, and thus the character of a unique position for their innovation. Thus, overcoming the non-interlocked structure of East German companies is a central task of innovation management (Gemünden et al. 1997).

An essential element of the innovation system in East Germany is formed by the external industrial research institutions which have come into being, and which act on the market as R&D service companies and institutions. They work close to the market and are thus forced to consider industrial problems as the point of departure of their own R&D. Due to their R&D potential they are able to combine basic industrial research and the practical utilisation of R&D results. They open up innovation potential and make it useful for small and medium-sized enterprises situated close together, and are effective not only on an international but also on a regional level.

10.3 Joint Operation of Innovative Potential in Networks

10.3.1 Network Actors

As has been shown, the small and medium-sized innovative companies or R&D institutions in East Germany do not have the economic force to meet the requirements of international innovation competition. There is a lack of specialists in the different fields of technology and scientific disciplines, which prevents them from coping with the necessary inter-disciplinary character of R&D, as well as with the system character of innovations. Close inter-linking with basic research represents a problem due to a lack of funds. Small and medium-sized enterprises also encounter problems for the internationalisation of innovation process. However, in order to have access to top level research and to open up new markets, internationality is indispensable.

Moreover, it is hard for small enterprises to take advantage of effective labour division, to finance efficient instruments and equipment, and to achieve cost advantages through higher output quantities. Nevertheless, if they want to be competitive, even SMEs must meet with these requirements.

To overcome this problematic situation, one option could be the collaboration of the following innovation actors in networks:
Companies with a common interest in R&D, production and marketing, which, through co-operation, would be enabled to offer and market system solutions to their customers;

Universities and non-university research institutions which, on the one hand, are interested in the utilisation of results from their basic and applied research, and which, on the other hand, need feedback about experience with practical use, as well as problem recognition on the side of industrial users;

Sales partners which, due to their knowledge of target markets, customers’ wishes and requirements, as well as the market participants’ conventions, contribute to the opening-up of markets through network partners, which ease traditional market structures, and impart marketing know-how while establishing their own position on the market;

Suppliers which find partners from the network actors for steady relationships between customers and suppliers, and which contribute to reinforcing the network through innovative developments (equipment, materials);

Customers which have a reference effect as key customers, which first benefit from the advantages of a product and thus contribute to the distribution on the market;

Innovative service companies, which either introduce special R&D know-how or which, as consultants, help to introduce operational methods, to carry out market surveys, or to improve efficiency through process analyses;

Public agencies which contribute to the regional integration of networks, and which derive impulses from these for regional development;

Competitors, which play an efficient role as partners for the enforcement of regulation and admission activities, as well as for the elaboration of norms and standards, or which improve their market chances as a bidders’ association.

Consequently, networks are based on the links between the networking partners, the economic objectives they have agreed upon, and their common interests. As was proved, innovations not only depend on teachable and learnable knowledge which can be logically derived, or reproduced in a structured way, but also on knowledge emerging from an environment based on experience (empirical or tacit knowledge), which comes into existence more in an intuitive and situative way, and which is therefore not generally accessible. Personal relationships between all network partners represent an important source of such knowledge and its practice-effective utilisation. Innovations based on this kind of knowledge instead of generally accessible knowledge are hard to imitate (Noppeney 1997). Due to the knowledge and technology transfer taking place in the network, staff qualification is supported, and learning processes are generated.
Spatial aspects of networks play an important role for the development of East German innovation potential: the establishment of networks is most advanced in some centres of crystallisation, e.g.

- Jena (bio-technology, optics and laser industry),
- Dresden (micro-electronics),
- Berlin and its surroundings (medical technology, information and telecommunication technology),
- Chemnitz (mechanical engineering),
- Freiberg (coating technology).

In order to initiate regional co-operation between all participants of the innovation process, the Federal Ministry of Education and Research has organised the promotional competition "InnoRegio" in the new Federal States. It is aimed at contributing to the development of new products, processes, and services, and to the establishment of a congruent regional profile on an educational, research, and economic level; moreover, all actors should be involved in the regional innovation dialogue. In this way, the reinforcement of the innovation competence and competitiveness of specific regions is planned. Networks are an important pre-condition for this.

The fact that far from all innovation actors co-operate in networks is shown by a study of the eight technology centres (TGZ) of the free state of Thuringia (cf. Table 10-1).

**Table 10-1: Frequency of contacts between the technology centre of Thuringia and other technology actors (n=8 centres)**

<table>
<thead>
<tr>
<th>Type of contact</th>
<th>University</th>
<th>Technical college</th>
<th>Non-university research institution</th>
<th>External research institution</th>
<th>Companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exchange of information</td>
<td>6</td>
<td>7</td>
<td>5</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Joint projects</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Joint events</td>
<td>6</td>
<td>5</td>
<td>6</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Supply of consultants</td>
<td>6</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Common use of technical equipment</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Transfer of research results</td>
<td>5</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 10-1 shows the frequency and type of contacts between these technology centres and other technology actors. The university and remaining scope of knowledge, the economic structure and innovation potential form the framework conditions for co-operation between regional actors. Networks provide the best pre-conditions for the establishment and development of contacts.

10.3.2 Advantages of Networks

Innovative networks possess the advantages shown in Table 10-2. The regional concentration of inter-linked companies can lead to considerable productivity advantages, better chances for innovation, and more favourable pre-conditions for founding activities (Porter 1999).

Table 10-2: Advantages of working in innovative networks

- Gaining know-how- and competence, in particular during transfer to new technology, acquisition of external knowledge, learning effects
- Synergy effects in the areas of R&D, marketing, manufacturing, and information
- Improved market situation due to system solutions
- Double work is avoided, capacities are complemented
- Risk sharing and risk reducing
- Utilisation of advantages of size and specialisation
- Reduced development periods, acceleration of market introduction, advantages of flexibility
- Development of long-term business relationships
- Reduced transaction costs for the opening up of co-operation relationships
- Stronger position in negotiations with large companies and regional groups with a common interest
- Co-ordination of actions regarding the network environment (capitalists, consultants)
- Benchmarking of the internal efficiency

The efficiency and competitiveness of network partners are increased, the chances for success of business relationships are improved due to joint R&D projects, common strategies for industrial property rights and questions of certification, customer and market related activities, production-related tasks, marketing activities and relationships with suppliers. Due to the transfer of experience and its feedback for the company, learning processes are started. In this way, every participant derives advantages which otherwise are only typical for large companies. The degree to which management is actually improved depends on the structure, content and intensity of
relationships in the network, as well as on the respect of the principle of quid pro quo by all partners.

### 10.3.3 Co-operation in Networks

Above all, radical innovations form the basis of long-term economic growth. Therefore, companies and R&D institutions must carry out innovation activities in close co-operation, based on common objectives. This procedure is necessary to assure, for example:

- that the point of departure for research is the real task of industrial utilisation, in order to ensure that research results can be realised on a technical level;
- that the absorptive capacity for preliminary research is available in the companies, and that their own development of new principles, effects, or processes will be passed on to new products;
- that production technical requirements are taken into account during construction, and that conclusions are drawn from constructive design in time for manufacturing investments;
- that R&D is confronted with customers’ and market requirements, as well as with economic criteria.

This type of collaboration reaches far beyond general network relationships and requires formally regulated co-operation, based on objectives already agreed upon by the partners. However, networks are the basic unit for such co-operative relationships. Project-related co-operation brings specialised potential together with specific strong points; thus, access to external knowledge is improved, development periods are shortened, the risk of each participating company is reduced, and innovation projects which a single company could not realise due to a lack of financial, personnel and material resources are made possible. It is understood that co-operation is also problematic: strategies must be revealed, independence is reduced, and there is additional expenditure for co-ordination and communication. Therefore, co-operation management is needed in order to decide when, with which partners, how, and for what objective co-operation should be initiated (Pleschak/Sabisch 1996).

In the framework of jointly carried out innovation projects, co-operation between actors should work in such a way that only minimal expenditure is necessary for co-ordination at the interfaces, and that the loss of time and information is as limited as possible. Although it is possible to reduce the number of interfaces by the integration of functions within the innovation process, there are economic limits to such reductions due to the actual co-operative character of innovation processes and the advantages of specialisation arising from them. An important point of departure for
the control of interfaces are strategies commonly decided on by all involved partners. These take shape in the framework of networks.

Although co-operation is indispensable for innovation success, it is not unproblematic (cf., for instance, the contribution of Fritsch in this volume). This is shown by several facts:

- Due to the uncertainty and the risk of innovation processes, a clear contractual regulation of co-operation is impossible. Contracts always include "soft" elements.
- In general the user is not able to assess the value of a R&D result which is transferred from research to development.
- The spreading of research results to other users often cannot be avoided, so that sole exploitation is endangered.
- R&D-related information is often locally anchored, and its transfer is linked with considerable expenditure. The understanding of information is based on the whole supply of information, which is naturally not available for the partner; thus, his ability to understand is limited. In many cases, information can only be documented in a limited way, and close personal contacts are required for comprehensive understanding.
- The user of R&D results himself does not always have the absorptive capacity to recognise the potential use of the R&D performance, to adapt this external knowledge to his own purposes, and to further develop them.
- The ability to communicate and to learn is not sufficient on the side of the partners in order to correctly grasp and reflect on problem situations in the innovation process; there could also be a lack of consciousness or confidence regarding co-operation with partners, or the efficiency of potential partners is called in question.

Conditions for successful co-operation can be improved by the learning and decision-making processes which take place in networks.

_East German innovative potential_ does not yet make full use of the possibilities of R&D co-operation (Pleschak et al. 2000). Table 10-3 shows the frequency of R&D co-operation between East German innovative companies or institutions and other innovative actors. However, the type of co-operation is not specified. It can be anything from an information exchange to co-operation regulated by contract. It is shown

- that research institutions co-operate mostly with other university and non-university research institutions,
- that R&D service companies have more R&D co-operation than producing innovative companies, except for co-operation with universities. In fact, in the area of
R&D projects, producing companies co-operate more with university research institutions than R&D service companies,

- that only a minor role in R&D co-operation is played by those innovation-supportive service companies which do not have their own R&D available such as consultants and transfer institutions.

Table 10-3: Frequency of R&D co-operation between companies and institutions and other innovative actors (in %)

<table>
<thead>
<tr>
<th>Innovative actors</th>
<th>Producing companies (n=59)</th>
<th>R&amp;D service companies (n=49)</th>
<th>External research-institutions (n=34)</th>
<th>Non-university research – institutions (n=14)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producing companies</td>
<td>54</td>
<td>69</td>
<td>76</td>
<td>71</td>
</tr>
<tr>
<td>Service companies with their own R&amp;D</td>
<td>20</td>
<td>51</td>
<td>44</td>
<td>21</td>
</tr>
<tr>
<td>Innovation supportive service companies without their own R&amp;D</td>
<td>12</td>
<td>20</td>
<td>32</td>
<td>7</td>
</tr>
<tr>
<td>Non-university research institutions</td>
<td>49</td>
<td>57</td>
<td>88</td>
<td>86</td>
</tr>
<tr>
<td>Universities</td>
<td>73</td>
<td>53</td>
<td>76</td>
<td>86</td>
</tr>
</tbody>
</table>

Source: Pleschak et al. (2000: 88).

There is a relatively limited frequency of co-operation between companies and R&D service companies on the one hand, and non-university research on the other hand. It is true that companies and R&D service companies have their own considerable R&D potential; however, an extension of R&D co-operation with research institutions certainly also includes attractive options to improve efficiency and competitiveness.

The problem is even more obviously shown by a study of the areas in which R&D co-operation takes place. According to Table 10-4, only one fifth of the companies or R&D service companies have co-operation relationships with basic research; on the other hand, only every third external research institution has connections with basic research. There are obviously more co-operation relationships in the area of applied research; however, the share is only about 60% for companies and R&D service companies. Most of their co-operation subjects are product innovation, with a distinctly lower share of process innovation.
Table 10-4: Frequency of areas of R&D co-operation (in %)

<table>
<thead>
<tr>
<th>Areas of R&amp;D co-operation</th>
<th>Producing sector (n=59)</th>
<th>R&amp;D-service companies (n=49)</th>
<th>External research-institutions (n=34)</th>
<th>Non-university research institutions (n=14)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic research</td>
<td>17</td>
<td>16</td>
<td>35</td>
<td>79</td>
</tr>
<tr>
<td>Applied research</td>
<td>61</td>
<td>57</td>
<td>91</td>
<td>71</td>
</tr>
<tr>
<td>Product development</td>
<td>85</td>
<td>90</td>
<td>79</td>
<td>43</td>
</tr>
<tr>
<td>Process development</td>
<td>41</td>
<td>45</td>
<td>47</td>
<td>63</td>
</tr>
</tbody>
</table>

Source: Pleschak et al. (2000: 90).

In order to provide industry with better options for R&D co-operation, the Ministry of Economy and Technology has launched the promotional programme PRO INNO (innovation competence for middle-class companies), which fosters the following projects:

- Joint co-operation projects between companies,
- Joint co-operation projects between industry and research institutions,
- Co-operation projects which are transferred from a company with a R&D mission to a research institution,
- Initial industrial projects,
- Staff exchange between companies, or between companies and research institutions,
- With the help of this promotion, technical and economic risks of R&D as well as the transaction costs companies have to bear in the case of co-operation should be reduced; in this way, industry should be encouraged to make more efforts in favour of R&D.

10.3.4 Pre-conditions for Networks

Networks function provided that every participant introduces competence into the network, that there is an absorptive capacity for external knowledge, as well as the capacity to adapt and further develop the knowledge. Network partners must be able to communicate and to learn in order to be prepared for problems and for the partners. Consequently, networks are characterised by a culture of interactions. Co-operation is based on personal contacts and the respect of non-written rules. Typical hallmarks of successful networks are openness, honesty, confidence, the common definition of objectives, readiness to co-operate, as well as consensus about and co-
ordination of interests. Contractual regulations should counter the risks of uncontrolled drifting away of knowledge and revealing of strategies.

A decisive pre-condition for innovation success is a competent management of network relationships. In general, every network actor has his own forms of coordination, which are seldom coherent with those of his partners. Therefore, networks require independent forms of steering co-ordination, as well as harmoniously suitable instruments of co-ordination (commissions, plans, communication meetings, etc.) (Munser 1998). Table 10-5 summarises the pre-requisites for successful performance of innovative networks. In order to counter the risk of unilateral individual benefits from network performance, the presence of neutral network managers can make sense.

Table 10-5: Pre-requisites for the successful performance of innovative networks

- Learning and communicating ability of the network partners
- Ability to absorb and deliberate upon information
- Concentration on the partners' problem situation, similar problem solution behaviour, comparable competence for the solution of problems
- Long-term, stable business relationships, processes of interaction, and bonds.
- Independent profile of every network partner, which is complementary to that of the other network partners
- Openness towards and confidence in network partners
- Avoiding hierarchies in the network
- Redundancies in the network to avoid dependence
- Voluntary co-operation
- Connection of resources and utilisation of the co-operation
- Spatial proximity between of the partners without delimitation from supra-regional knowledge and information transfer
- Economic advantages due to co-operation
- Development of innovation-relevant relationships with the surroundings
- Interface management and moderation

In order to avoid the loss of time and information, as well as a lack of co-ordination, network co-operation requires an interface management. In networks very different actors co-operate, with equally different interests and objectives. On the one hand, it is obvious that the individual participant has improved prospects for success due to the integration into a network, with the resulting system effects and lower transaction costs; on the other hand, individual participants need a learning process in order
to integrate the chances offered through networks into their own work; moreover, co-ordination is required for the assessment and generalisation of experience and to reach agreement upon common strategies.

The tasks of a network management include (Gemünden/Ritter 1999):
- Preparing the ground for business relationships,
- Information exchange between the different companies,
- Network marketing and sale of network components,
- Planning, organisation and financing of joint projects,
- Planning, co-ordination and joining of common activities,
- Establishment and maintenance of the infrastructure,
- Co-operation with regional decision-makers,
- Creation of an image for the network,
- Conflict management.

Networks are a form of collaboration between actors involved in an innovation process which can lead to synergy-producing effects. Due to the fact that information and the knowledge about innovation always come into existence, and are made use of, on a local level, networks are often characterised by a strongly local dimension. Their functioning depends on the level of regional innovation potential, on the congruence of the elements of the innovation system with regard to the contents (according to branches, R&D areas, degrees of specialisation), and on the level of inter-connection between the actors. Regions provide the framework for people with the same cultural background and understanding of problems (Koschatzky/Zenker 1999). Spatial proximity in a region enables the kind of personal contacts which are an important pre-requisite for learning in networks. Since the elements of networks, as well as their objectives and methods, are characterised by regional conditions, there is no universally valid scheme for the establishment of networks.

10.4 Final Remarks

Despite the fact that networks have already been established in East Germany and that there is openness and readiness for participation in networks, the co-operation between the elements of the innovation system does not yet meet the requirements. However, interconnection is crucial for the functioning of an innovation system, and particularly important for increasing the efficiency of the East German innovation system, which is characterised by many small and medium-sized companies. To realise the above mentioned effects, the establishment and development of net-
works should be supported for a limited time; however, the establishment of networks as an end in itself should be avoided. Favourable effects for the co-operation of innovative potential in networks are:

- Support of the network management in order to relieve the involved partners in their short-term additional charge of establishing networks, and to reduce their workload of moderation and co-ordination. At the beginning, synergies in the network are not opened up automatically but are essentially the result of learning processes. Provided that there is sufficient experience on the side of management, networks become autonomous due to their economic advantage and the network partners' own interest (knock-on promotion).

- The support of innovation projects which target the network as a whole, and which cannot be financed solely through market relationships due to their high risk.

- The support of networks as a whole where they play a particularly important role for regional development, where they give impulses for regional growth, or development chances for structurally weak regions.

- The support of innovation projects which require work in close co-operation in order to train co-operation and the division of labour (joint projects for radical innovation with a high degree of novelty, high risk, and high complexity). This would help to reduce the capacity and financing bottlenecks of small and medium-sized companies, as well as of research institutions, in the starting phase of comprehensive projects; moreover, the bringing together of potential of basic research, applied research, development, manufacturing and market introduction would be guaranteed.

10.5 References


