Science, Technology & Innovation Studies Vol. 3, May 2007
ISSN: 1861-3675

STI Studies
www.sti-studies.de

The role of public policy in promoting technical innovations.
The case of the regional innovation network InnoPlanta

Jobst Conrad (Technical University Berlin)

received 18 Sept. 2006, received in revised form 28 March 2007, accepted 23 April 2007

Abstract

The purpose of this article is to demonstrate and to discuss on the basis of an in-depth case study the range and limitations of public policy aiming at promoting the development of regional innovation networks and clusters. This is done first by denominating main criteria, potentials and problems of a public policy promoting regional clusters (section 1), second by describing the development of the network association InnoPlanta and its major framework conditions (sections 2 and 3), third by summarizing the actor constellation of the network and the innovation pattern and market perspectives of InnoPlanta's research projects (sections 4 and 5), fourth by then pointing out the structure and role of public promotion policy in this process (section 6), fifth by comparing promotion objectives with results achieved (section 7), and sixth by drawing some conclusions concerning successful promotion policy in the case investigated and in general (section 8).

As shown in the case study, the role, success or failure of public policy promoting the development of regional innovation networks and clusters depend on its favourable interaction dynamics with the existing social and economic contextual conditions. Therefore, referring to the in-depth case study of Conrad (2005), on the one hand these framework conditions are sketched in somewhat more detail, and on the other hand the article does not focus on one specific theoretical question, but tries to combine various analytical perspectives to explain the role and success of public promotion policy in the case of InnoPlanta. Consequently, this article concentrates on explaining the role of the BMBF InnoRegio program, in particular, for the development of the regional innovation network InnoPlanta, and not on this type of public promotion policy per se.

1 Introduction: promoting regional clusters

Addressing in general terms main criteria, potentials and problems of a public promotion policy striving for the creation of innovative regional clusters, first the respective key terms are specified in more detail.

According to Meyer-Krahmer (1999: 43), technology and innovation policy[1] aims at

- the formation and shaping of the research landscape of a country,
- the generation of favourable financial and other framework conditions for basic research, long-term application-oriented research and industrial research,
- the building and shaping of an innovation-oriented infrastructure,
- and the conscious and sometimes unconscious influencing of technology development towards certain goals (competitiveness, living circumstances, infrastructure, long-term programs).

Instead of steering technology development, it is actually rather caused by it due to systematic reasons. Since it cannot directly steer research and development processes at a substantive level, it addresses research institutions, i.e. formal organisations and not research activities themselves (cf. Daele 1989, Schimank 1991).

Innovation networks may be conceived of as inter-organisational social systems which achieve technological and organisational formation of (their) structure by positive self-reinforcing feedback mechanisms, and they are necessarily cognitive networks which aim at the solution of a task and not just at balancing and coordinating their interests. Regional innovation networks denote networks concentrated in one region with the primary aim and task – according to their own reasoning – to produce innovations by utilizing regional competencies and communication.

Cluster presuppose the existence of regional networks (at least in a wider sense), but may well be limited to sector-related actors and arrangements of a region. Particularly, in newly emerging markets a local sector-specific cluster develops if the critical mass is transcended in a region resulting from sector-specific company agglomeration in a region and sufficient local circumstances. Typically few key persons coordinating different activities in the region play an important role. Cluster formation depends on the interplay of appropriate sector-specific conditions (in particular accumulation of human capital, new start-up firms, innovation-oriented sectors, synergies between firms, and disposable venture capital), a favourable market situation[2], and the existence of corresponding actors and networks.[3] Additionally, sufficient regional boundary conditions are required, such as a local infrastructure, the ability of local actors to found new companies, the availability of services and the existence of relevant public education and research institutions (cf. Blind/Grupp 1999, Brenner/Fornahl 2002).

As the success of regional innovative networks and clusters crucially de-

[1] Innovation policy can be seen as the integral of science, education, research, technology and public policy (initiatives) oriented towards industrial modernisation in order to improve the competitiveness of a (national) economy or of selected sectors.

[2] "Ein neuer lokaler branchenspezifischer Cluster entsteht in der Regel, während der Markt für die Produkte der Branche stark anwächst... Darüber hinaus kann eine Clusterbildung durch eine Öffnung des Marktes hervorgerufen werden." (Brenner/Fornahl 2002:27)

[3] Regional entrepreneurship and networks play an important role as promoters concerning initiation and success of cooperation and coordination processes during the development phase of a local sector-specific cluster by acting as germ cell and example for other actors and getting them to cooperate. (Brenner/Fornahl 2002:28)

pends on the interaction dynamics of relevant influencing factors, its pathway and modality should be investigated, conceptualised and modelled. However, corresponding attempts are hardly found in social science research and literature, e.g. on regional innovation networks.

Concerning the possibilities and limitations of a promotion policy striving for the formation of self-supporting regional innovation networks and clusters, the following conclusions seem to be justified according to Brenner/Fornahl (2002)

(1) Public policy can stimulate and promote the formation of (regional innovative) clusters, but cannot generate them itself. To enlarge the probability of their formation mainly measures to improve the (regional) infrastructure appear to be appropriate, e.g.

- the establishment or improvement of (continued) educational institutions;
- the support or improvement of the framework conditions for setting up new companies;
- the establishment of research institutions or direct support of innovation processes;
- the improvement of (regional) infrastructure for companies.

These measures should be executed in accordance with regional and sectoral objectives. In most cases the effective application of policy measures is only feasible at certain points in time in certain places. Therefore promotion policy should be limited in time until a cluster formed in less than a decade, and should take into account the systematically limited number of (possibly) successful regions as geographical locations of regional innovation networks and local sector-specific clusters.

(2) Promotion policy may influence the sites as well as the strength of a cluster. However, policy-making has only limited steering know-how due to information deficits and high transaction costs (cf. Keck 1987).

As a result, the probability of successful policy measures increases if politics does not intervene as an external authority, and if it develops, instead, coordination processes and problem solving capabilities together with the regional actors concerned in order to adapt them to regional and sector-specific characteristics.

Not every measure must be executed at the same policy level; instead various political actors may intervene – in a supplementary manner – with different measures at the same time. This requires close cooperation and coordination between the participating policy levels. Since regional actors may react differently to promotion policy, additional pick-up effects (*Mitnahmeeffekte*) have to be avoided as far as possible by appropriate organisation of promotion measures.

(3) Concerning the four preconditions of cluster formation described above, improving regional boundary conditions constitutes the best possibility for promotion policy to have significant effects.

In said conditions, apart from the support of innovation processes the most effective measures are the ones to educate labour force and to create sector-specific infrastructure. A further measure is to support the foundation of companies immediately after the formation of a new market. Promotion policy has much less chances to influence sector-specific self-reinforcing processes, at least as long as the state is not able to act itself as buyer. Similarly, the foundation of regional firms can only be supported by indirect measures aiming at regional communication and diffusion processes. Furthermore, attitudes and opinion of the population mainly depend on cultural aspects and on structures having already developed in the past so that policy can influence them weakly at best.

On the one hand, promoting innovative (regional) clusters is politically attractive, because a major result can be achieved with relatively small efforts if the preconditions of cluster formation described above are given, because promotion policy can be limited in time for good reasons, and because it can expect additional indirect positive effects on competitive and innovative capabilities and regional development in general.

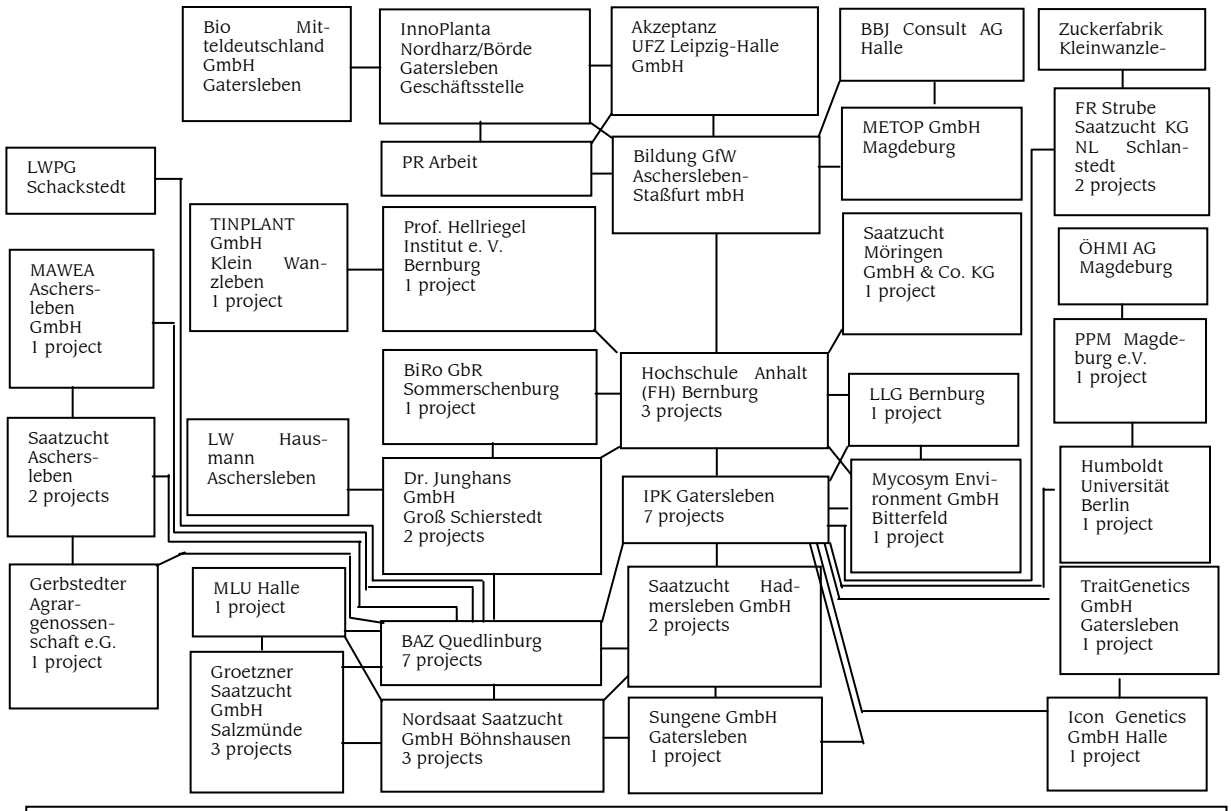
On the other hand, a promotion policy aiming at connecting global innovations with regional competencies is in conflict with a regional policy aiming at equal living conditions and standards, as the former sharpens interregional gradients by the successful development of promoted regions.

2 Development of InnoPlanta

Like most of the rural areas of the eastern German states, the region Nordharz/Börde, situated between Magdeburg and Quedlinburg, can be characterised by low economic strength and dynamics and high rates of unemployment. It has at its disposal, however, a long and continuous tradition and expertise in the field of special cultures, cultivating spice and herbal plants, and seed cultivation, supported by respective favourable climatic conditions. This is important because internationally competitive plant breeding is the bottleneck of the economic implementation of the potentials of plant genetics (Voß et al. 2002).

In the late 1990s *regional* efforts were started to improve in a medium-term perspective the economic power of the state of Sachsen-Anhalt by goal-oriented support and coordination of

Figure 1: Cooperative networking of project partners within InnoPlanta



Source: InnoPlanta secretariat

research, development and the opening up of new markets in the field of new biotechnologies on the basis of these regional traditions and competencies. These regional efforts met with the InnoRegio program of the *federal* ministry for education, research and technology (BMBF), a program for supporting – on a competitive basis – the self-organisation of regional innovation networks in the eastern German states. It was based on the intention to advance economically promising research and development in cooperative arrangements of local industrial companies and research institutes by providing corresponding seed money in the InnoRegio program of altogether 255 Mio. € over a period of five years (BMBF 2000).

The InnoPlanta association, newly founded in 2000, initiating, organising and administrating corresponding regional research efforts and networks of its members in plant biotechnology, became winner of that InnoRegio competition and received about 20 Mio. € between 2001 and 2006.

The cooperating actors from science and industry, participating in approximately 30 funded plant biotechnology R&D projects, mainly organised themselves as a regional innovation network in order to receive public funding for their research interests, and therefore considered themselves reasonably as a kind of pork barrel. Figure 1 represents the corresponding institutions involved in the InnoRegio InnoPlanta, including the number of R&D projects pursued, and indicates cooperative arrangements between them in 2003 by lines connecting cooperating actors. Typically substantive intense communication among the cooperating partners is mainly taking place at the level of the different specific research projects. Apart from the necessary scientific-technological breakthroughs their chances for success crucially depend on associated competitive advantages at the global level, on the economic power and position of the participating enterprises, and on the medium-term implementation of green biotechnology in Europe. At present the latter is only realised to a very limited degree because of lacking acceptance by consumers (cf. Gaskell et al. 2003, Hampel 2004) and, until recently, by a de-facto moratorium of genetically modified food and partly field tests of genetically modified plants at the EU level.

Significantly, none of the R&D projects of InnoPlanta aims at developing any genetically modified food products, though mainly because of the then necessary huge development costs. Instead, they focus on new molecular genetic processes for plant breeding, on breeding of new resistances against important European pests in the major crop plants, on breeding of cultivated plants containing new components, and on the breeding optimisation of regionally important special cultures.

In general, the ongoing R&D projects either aim with a strong scientific orientation at the development of innovative biotechnological processes, or at niche markets by improving spice and herbal plants and regionally important cultivated plants with the help of plant biotechnological products and processes. Project costs vary between 260.000 € and nearly 5 Mio €. Subsequent market penetration of successful R&D projects typically can be expected 10 or more years after their beginning (Conrad/Steuer 2003).

During the first years (2000 – 2002) the learning process of major science-based network actors, especially of the centrally positioned plant biotechnology research institute IPK Gatersleben (Institut für Pflanzengenetik und Kulturpflanzenforschung), to (re)orient their publicly BMBF-funded R&D projects from basic research in biotechnology to market-oriented R&D projects with genuine participation of local industrial companies contributing their own financial means, too, turned out to be troublesome and painstak-

ing. The reason for this was the trade-off between their genuine scientific research interests and the pressure of the funding ministry and its associated research project management body Jülich, which is responsible for final funding decisions and project control, towards marketable development products. Nevertheless, the largely BMBF-funded InnoPlanta project scheme helps to initiate and to push regional contacts and possible future cooperative market-oriented R&D projects of scientific and economic actors.

Figures 2a and 2b give a condensed overview over the (prospective) development process of InnoPlanta over time for the past (1997-2004) and for the future (2004-2020), assuming its economic success. The figures indicate the interaction dynamics of key development determinants at the macro-, meso- and micro-level.

At the *micro-level*, over time the development of InnoPlanta as an innovation network is pointed out as resulting from its internal development dynamics; at the *meso-level*, the major regional political and economic actors and boundary conditions can be observed; and, finally, at the *macro-level*, the general (national and global) policy programs, conflicts and regulatory arrangements as well as key developments and market structures in plant biotechnology are listed. As indicated by the positioning of corresponding boxes in figures 2a and 2b, InnoPlanta and its members and additional relevant actors form the essential actor constellation which decides on and is responsible for project performance, follow-up developments and founding of biotech-start-ups.

Up till now, four phases of InnoPlanta's development – described in more detail in Conrad (2005) – may be distinguished: rise and foundation (1999-2000), establishment and formation of the structure (2001-02), consolidation and routinization (2002-04), and optimisation and continuation (2004-06). Obviously, policy influence only plays an limited role, effective mainly in the beginning of network development. Currently, the sketched development process of InnoPlanta is somewhat below the top of figure 2b. After the InnoRegio program ended end of 2006 InnoPlanta continues to acquire and perform plant biotechnology R&D projects, though at a lower level of funding and still without significant income from selling its own genuine products on the market.[4]

3 General framework conditions

Four main general framework conditions which are specified below, determine the range of InnoPlanta's possible development paths and innovation success:

- the general conditions of success for regional innovation networks and clusters;
- the innovation dynamics of plant biotechnology at the global level;
- the biotechnology policy and regulation, as well as low social acceptance of genetically modified food in Germany;
- the BMBF-InnoRegio program for the eastern German states and the regional biotechnology policy in Sachsen-Anhalt.

Cluster formation depends on appropriate sector-specific conditions, a favourable market situation, the existence of corresponding actors and networks, and sufficient regional boundary conditions (cf. Brenner/Fornahl 2002). At the level of actors, successful development of innovative networks requires a common objective, appropriate forms of organisation and communication, the necessary performance capability of participating actors, the existence of complementary competencies, and the

[4] This article was mainly written in 2005/06, and revised early in 2007.

Figure 2a: Model type development dynamics of InnoPlanta (past)
BT=biotechnology, NW=network, GfW=Gesellschaft für Wirtschaftsförderung

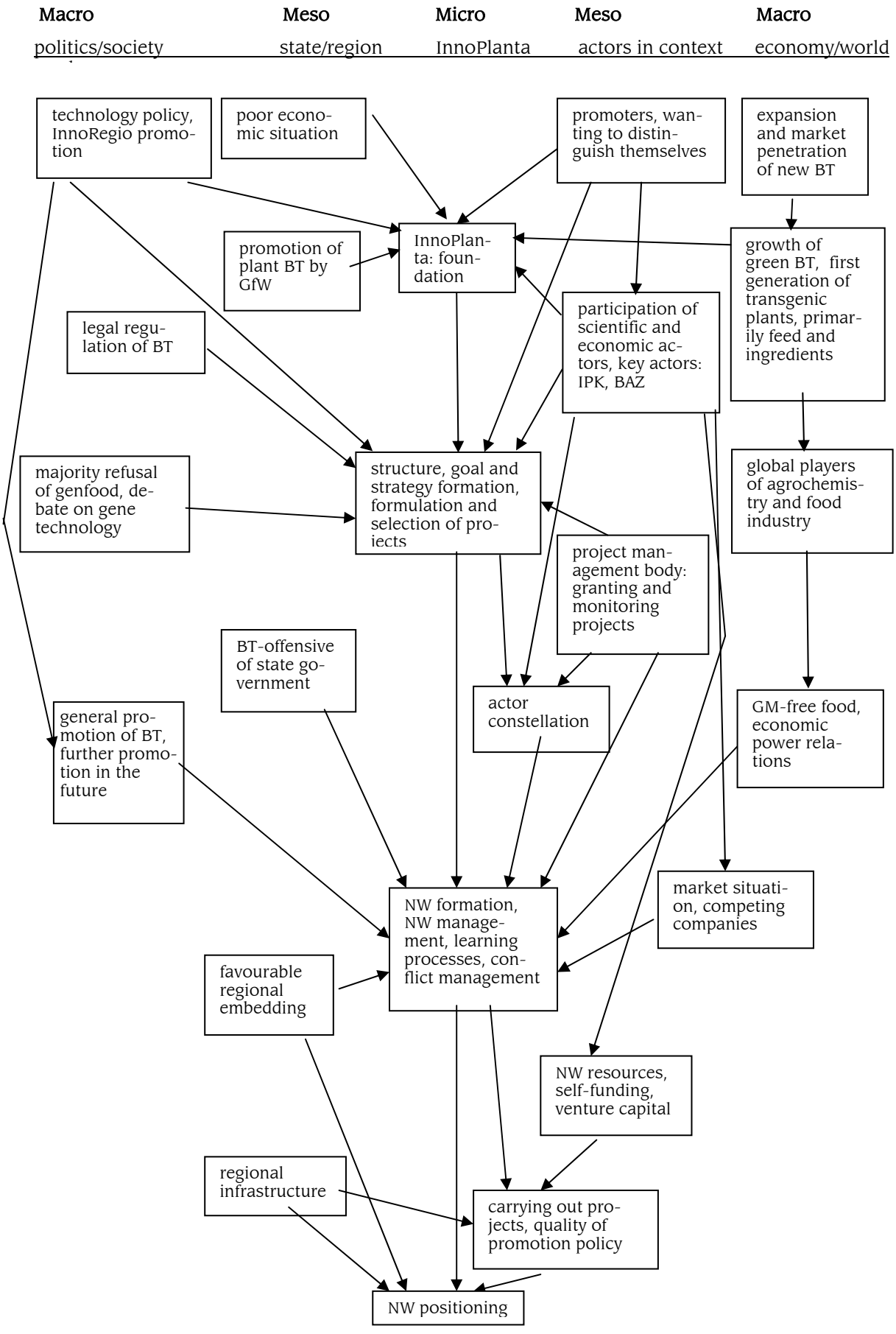
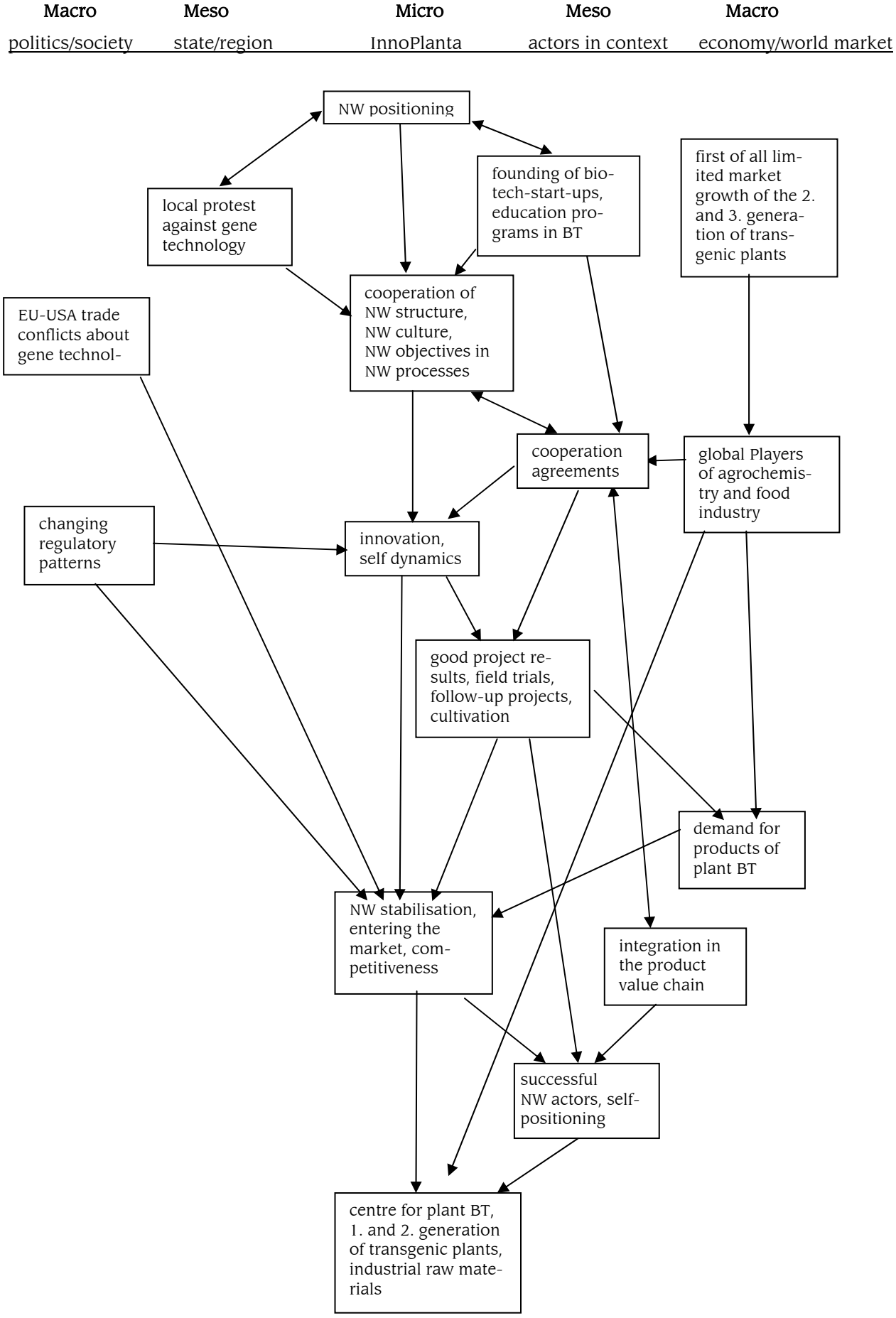


Figure 2b: Model type development dynamics of InnoPlanta (future)

BT=biotechnology, NW=network,



capacity to bring them into innovative projects (Eickelpasch et al. 2002). These conditions meanwhile can be seen as fulfilled to quite some degree in the case of InnoPlanta.

The expected mid- and long-term commercial potentials of agrobiotechnology are considered multifarious in spite of current low acceptance of many products (Menrad et al. 1999). Different areas of applying plant genetic engineering have to be distinguished (cf. Voß et al. 2002), such as improvement of agronomic properties, food-oriented utilization or industrial raw materials. Growth rates and profitability of GM (genetically manipulated)-based output properties and even more of molecular farming are considered much higher than the ones of GM-based input properties[5], and already for 2010 their market potential is optimistically estimated fivefold the latter one (cf. Kern 2002, Vogel/Potthof 2003). So, in principle, the application possibilities and perspectives of plant biotechnology can be judged as manifold and positive. Whereas many mainly diagnostic and technical methods of breeding using gene technology are already well established, the manifold and broadly utilized creation and diffusion of transgenic plants, however, remain questionable for the foreseeable future because of economic, technical and biological reasons (Vogel/Potthof 2003).

The development of transgenic plants lasts 6 to 12 years. The chance of market introduction of a successful laboratory development is less than 1%. Development costs amount to about 50 Mio. €. Without large markets allowing rapid return on investment these development costs and additional costs of separate harvest and identity preservation are too high. However, the demand of these transgenic plants frequently is not secured, particularly as long as the food industry pursues a strategy of GM-free food.

Furthermore, the insertion of several alien genes and their tissue- and stage-specific exprimation with the help of specific promoters is a difficult, technical enterprise prone to failure, since the intervention into complex and well balanced metabolic processes easily leads to unwanted side effects.

Therefore the input properties of herbicide tolerance and insect resistance in few relatively easily transformable cultivated plants, i.e. soy bean, corn, canola and cotton dominate the market of transgenic plants. Plants with GM-based output properties were hardly licensed and offered on the world market in 2003, but may have a larger share after 2010.

In sum, commercial cultivation of transgenic plants with these new input properties has rapidly expanded to 102 million hectares in 2005 after its start in 1996, though concentrated in few countries: USA, Argentina, Canada, and meanwhile Brazil, India, China, too. However, diffusion of the second generation of transgenic plants with GM-based output properties should be expected only gradually and to a limited extent, involving a higher risk of (economic) failure. So the innovation dynamics of plant biotechnology at the global level tends to be a potentially highly favourable, but still relatively uncertain contextual framework condition for InnoPlanta.

Whereas red biotechnology meanwhile is socially more or less accepted and used in Germany – with the exception of genetic manipulation and utilization of human beings themselves –, the utilization and regulation of green bio-

[5] GM-based input properties stem from intentional changes of plants in one or two genes in order to influence their cultivation and yield, i.e. their agronomic properties, but not the quality of the final product itself. GM-based output properties refer to intentional changes of existing metabolic processes or to the addition of new metabolic processes by changing or adding several plant genes in order to change food properties. Molecular farming aims at utilizing plants for producing non-plant products such as pharmaceuticals or vaccines.

technology are pushed by the actors involved in its development, on the one hand, but are confronted with severe restrictions in Europe, on the other hand. These restrictions mainly stem from the combination of the following circumstances. The release of GM-plants and the import of genetically modified food in fact were largely prohibited because of the de facto EU-moratorium 1998-2004, resulting from strong political controversies in the mid 1990s. Additionally, food and feed containing at least 0,9% of substances, which are changed or produced by genetic engineering, have to be labelled correspondingly since 2004.

Furthermore, consumers can bring to bear their scepticism or non-acceptance of genetically modified food in particular, in an economically effective manner. Since the late 1990s food producers, trade and retailers in the EU pursued corporate strategies to produce and offer only (certified) GM-free food and thus contributed to blocking green biotechnology in the food sector up to the present.

In view of its multifarious potentials, its forced utilization in increasing parts of the world, and the vested interests of its promoters in agrochemistry and parts of agriculture, an ongoing longer term hindrance of green biotechnology seems unlikely, as long as no grave accident attributed to gene technology occurs. It will also remain unlikely as long as trade-conflicts and costly labelling and separation prescriptions do not make GM-food and -feed economically unviable (cf. Bernauer 2003, Paarlberg 2003, Young 2001). Thus, biotechnology policies and regulations, and lacking social demand for genetically modified food tend to partly delay plant biotechnology development processes and to restrict them to non-food properties and products, but do not prevent them *per se*. This is well reflected in the plant technology development path followed by InnoPlanta.

Finally, as shown in sections 6 and 7, public promotion and funding of (green) biotechnology by the InnoRegio program of the BMBF (see cf. Scholl/Wurzel 2002) and by the biotechnology promotion policy of Sachsen-Anhalt's government, too, were and are (necessary though not sufficient) key preconditions for the establishment and development of the regional innovation network InnoPlanta (cf. Conrad 2005).

4 Actor constellation and heterogeneous pattern of interests of the network

At the level of mainly corporate actors the actor constellation of the InnoPlanta network distinguishes itself by a clear involvement in the region, continuing engagement of its promoters, membership of interested service agencies, banks and public administration, support by (promoting) political institutions, cautious support by agricultural organisations, largely absence of opponents such as critics of gene technology, but also of global players in the agricultural, food and biotechnology industry.

At the individual level the actor constellation is mainly formed by an inner circle of 10 to 15 persons who occupy key positions in their respective (scientific, economic or political) institutions. As a community with a common purpose they attempt to get their varying interests and concerns taken into account with the help of InnoPlanta's development and orientation. Said interests consist of the acquisition of research funds, the profiling in economic policy, the establishment of educational infrastructure and study courses and finally strengthening one's position. Due to their professional positions and since they belong to the inner circle their (project) interests are more likely regarded than the ones of other members of the network who are less involved. For instance, the two key research institutions IPK Gatersleben

and BAZ (Bundesanstalt für Züchtungsforschung an Kulturpflanzen) in Quedlinburg (together) participate in more than half of all projects and receive about one third of all InnoPlanta research funds (Conrad 2005, Conrad/Steuer 2003).

Since the interests of the major (corporate) members of the network are mostly in line with each other (funding of, performing and economic viability of R&D plant biotechnology projects), they are rather compatible with the genuine interest of the network to successfully carry out such projects. Cooperation between different (research) fields and linking of differing R&D projects, however, received and still receive less support from the network members.

Manifest and latent conflict constellations mainly stem from procedural and (via bargaining) regulated conflicts about the distribution of resources and of corresponding decision competencies. The (above mentioned) structurally embedded conflict about research priorities led to acceptable solutions, too. In this context the small InnoPlanta secretariat provided an administrative forum for diverse networking activities, mainly to organise information flows and knowledge exchange, communication among network members, and project proposal procedures, to advise project proponents, to attract and convince new members, and to do public relations.

There is no opposition to and controversial internal debate about the utilization of genetic engineering in plant biotechnology within the network, although varying positions exist concerning emphasizing and focussing on it. In view of the in general disfavourable socio-economic situation of Sachsen-Anhalt the aim of and the belief in a future regional centre of plant biotechnology may well be helpful for the sustaining power and (economic) viability of InnoPlanta.

5 Innovation pattern and market perspectives of InnoPlanta research projects

The innovations in plant biotechnology by InnoPlanta members are frequently oriented towards niche markets concerning specific spice and herbal plants with well established regional expertise, since they take into account world market perspectives, and renounce the development of genetically modified food products.

The approximately 30 research projects, currently carried out by collaborative research groups from biotechnology science and industry, considerably differ with respect to the influencing factors such as project size, type of innovation strived for, market potential and market chances, GM product envisaged or not, economic consequences and social compatibility, or problems of social acceptance.[6] As a consequence, these projects have to be investigated individually, and their chances of success or failure vary enormously.

Addressing in somewhat more detail (typical) R&D processes, orientations and market perspectives of these research projects, the outlet and differentiation of InnoPlanta's innovation strategies may be summed up as follows:

(1) Referring to future use and selling of project results, relevant framework conditions as well as the perspectives of the collaborators are clearly oriented towards the world market. This may concern potential future markets of Mykorrhiza granulates or competitiveness of thyme products on the home market against cheap import goods. Furthermore, with respect to research, development and patenting,

[6] Sufficient understanding and assessment of the research projects requires rather detailed knowledge of their substance, design, development, actor perspectives and constellation, and structural contexts (cf. Conrad 2005).

the actors involved in the R&D projects know about similar projects and their differences all over the world.

(2) Due to the mainly small or eventually medium size of the regional companies involved, most R&D projects at least first aim at niche markets which are less attractive for large agrochemical or food corporations and allow for competitive advantages of specialised development competencies. Some R&D projects, however, aim at the development of basic platform technologies, such as Transgene Operating Systems of the biotech start-up Icon Genetics, which could be applied in plant breeding worldwide though typically in cooperation agreements with large biotechnology corporations. The biotechnological processes and products envisaged in the R&D projects of InnoPlanta are much less afflicted by global market conditions, trade conflicts and opposing interests (cf. Bernauer 2003, Kern 2002) than the production of genetically modified soybeans, rape, cotton and maize predominating in agrobiotechnology at present.

(3) The members of InnoPlanta took into account the currently disfavourable boundary conditions of green biotechnology, such as partly restrictive policy regulations, lacking acceptance of genfood by consumers, renunciation of genfood by most food corporations. Although nearly all members of InnoPlanta are in favour of green biotechnology they deliberately forwent to carrying out R&D project aiming at genfood products.

(4) There exist partly diverging interests and aims of the actors belonging or intentionally influencing the InnoPlanta network, such as basic research orientation versus market orientation, flexible research arrangements versus bureaucratic control schemes, differing time horizons of research, development and testing of new plant breeds, of market introduction and penetration, and of visible impacts of (technology) policy-making. Thus, the intended strengthening of regional economic performance by the market penetration of newly developed plant biotechnology products or processes will most probably demand more time than required under ideal model network conditions.

The InnoPlanta R&D projects show considerable differences in several dimensions (cf. Conrad/Steuer 2003). Success and failure are both well possible and depend on the respective specific boundary conditions of the projects. Whereas the majority of the projects involves incremental innovations, particularly those focussing on new molecular genetic processes aim at radical or at least moderate innovations and at greater market potentials. Additionally, economic considerations do play a significant role in the projects, yet address differing aspects. In one case they led to the stop of a large project.

GM technologies are in the centre of some projects and avoided in other projects. Whereas most projects would lead to a competitive advantage of the plant biotechnology products or processes under development, their technical viability and thus their successful development cannot be taken for granted at all.

Consequently, innovation pattern and market perspectives of the InnoPlanta research projects may be summed up as follows:

- Most R&D projects will probably not reach the phase of successful market introduction. However, some of them will succeed in market penetration, most likely those addressing smaller market segments of spice or herbal plants, which usually are less interesting for large (multinational) corporations.
- Differentiation in innovation strategy (cf. Porter 1990, 1998) seems to be particularly advantageous for a regional research network lacking the market power of large transna-

tional corporations as influential global players.

- Induced by the innovative efforts of the network quite some improvement of the regional scientific, technical and economic infrastructure and framework conditions may well be reached with competent actors and networks for further economically viable activities in plant biotechnology. This would contribute to the socioeconomic viability of the region Nordharz/Börde, which offers rather low attractiveness compared to other regions of Germany, but has a long tradition in agriculture and plant breeding, on the one hand, and to environmentally friendly changes in agricultural and food production in some cases, on the other hand (Conrad 2003). It remains an open question if this would be sufficient to more or less generally secure its sustainability in economic, social and cultural terms.
- The reach of the innovations, particularly those promising ones addressing spice and herbal plants and their products, will remain a relatively limited one on average. Therefore future innovations (in plant biotechnology) may well be facilitated by this InnoRegio setting, but their substantial sustainability remains uncertain due to unpredictable changing framework conditions for research and development in a future more than 10 years ahead.

6 Structure and role of public promotion policy

Public promotion policy played and plays a decisive role in the formation and the development of the regional innovation network InnoPlanta. Without the (competition-based) InnoRegio program it would hardly exist, although its initiators possibly might have created a similar (smaller) association with start-up financing provided by the state government of Sachsen-Anhalt. Public support and funds (of 20 Mio. €) thus were a necessary condition for the stable formation and possible future self-supporting development of InnoPlanta.

The same is true for further (foreseeable) programs and measures such as the recognition of InnoPlanta as a competence network in biotechnology by the BMBF or the participation of InnoPlanta members in the biotechnology program of the state government of Sachsen-Anhalt, started in 2004 and providing 150 Mio. € over a period of five years. With this program it attempts to make the state a centre not only for red biotechnology, but for green biotechnology, too, in order to strengthen its economic development. In view of the projects which are typically profitable only in the long run, these promotion programs provide windows of opportunity for InnoPlanta. They offer the chance to acquire funds beyond the InnoRegio program for promising, partly already running R&D projects with the aim to develop marketable products or processes in plant biotechnology.

The options and measures of public policy to establish innovative regional self-supporting clusters – in the field of plant biotechnology – are limited and mainly concern the support of suitable regional boundary conditions and the provision of appropriate regulatory and communicative framework conditions (cf. Bröcker et al. 2003). Corresponding public policy measures exist to a considerable degree in the case of InnoPlanta. However, they can only enable but not enforce the formation of such a cluster because both, supporting as well as restraining factors, influence its sector-related, market-related, as well as regional socio-structural, socio-cultural and infrastructural preconditions. Accumulation of human capital, founding of new firms, significant competitive advantages by innovations, synergies by cooperation, venture capital by active

local firms are favourable sector-related preconditions. An expanding market for the products of the sector usually is a necessary market-related precondition for cluster formation (Brenner/Fornahl 2002).

Necessary regional preconditions, such as the existence of educational institutions, favourable attitude and possibility of local actors to found new companies, innovative capability of research institutions and of the population, have already been mentioned in section 1. Related factors in the case of InnoPlanta are the agrochemistry and the seed industry, which are highly concentrated at the global level, as well as the growth perspectives of plant biotechnology, which vary largely according to product groups. Additionally the political controversy about green biotechnology has to be mentioned, as well as the economic and social conditions at the national and regional level, which are currently unfavourable. Finally the innovation orientation of key regional actors and their capability to cooperate and to regulate conflicts, plays a major role. After all even the insufficient infrastructure and the low attractiveness of the region has to be mentioned.

The partly coincidental concurrence of four main policy objectives and programs were crucial for the favourable situation with respect to public promotion policy in 2000:

- Already since the 1970s technology policy in Germany classified biotechnology as key technology for Germany's economic competitiveness, leading to corresponding biotechnology promotion programs with continuously rising funding budgets.
- Since the 1990s technology, innovation, economic and regional policies increasingly aim at and support – by rather complex policy programs – the development of regional innovation networks and clusters which shall thereby gain a self-supporting innovation dynamics and thus economic competitiveness and attractiveness.
- Also since the 1990s diverse promotion policy programs and financial transfers are pursued to rebuild deficient infrastructure and competitiveness of a declined economy and science in the eastern German states. The InnoRegio program, developed in this context, combines the promotion of these reconstruction efforts with an innovation policy aiming at regional cluster formation.
- The biotechnology program of the state government of Sachsen-Anhalt, started in 2003, has the same objective, but also reflects desperate measures and attempts at profiling to secure political legitimacy in view of the desolate situation of state economy and public budgets.

Concerning their substantive effectiveness two features of these promotion policies remain doubtful. On the one hand there is a rather rigid emphasis particularly in the ideological framing on mere economic procedural and evaluative concerns regarding their implementation, reflecting currently prevailing policy orientation towards short-term market success to secure legitimacy. On the other hand there are contradictory objectives of regulatory and promotion policies in (plant) biotechnology, hardly avoidable in the context of political controversy over green gene technology.

Summarizing, the substantive structural features of public promotion policy in the InnoRegio program consisted and still consists of a competition for R&D funds, initiating regional network formation, and the distribution of funds for R&D projects based on research cooperation over a period of six years. The selection of project proposals took place in a multi-step process by the network board itself, by a mixed promotion management team,

consisting of representatives from the network, the research management body Jülich, and state officials, and – as a veto power – the research management body and the funding ministry.

Although the InnoRegio program ended in 2006, further promotion programs of the BMBF are likely and also justified in view of the only long-term achievable profitability of most plant biotechnology R&D projects pursued.

Referring to the necessary positive interaction dynamics of favourable factors determining the success of the InnoRegio program, it is based on the mutually adjusted utilisation of the following instruments: First of all the fixing and operationalisation of quality goals as well as competition, incentives and agreements on objectives by the participants. Furthermore, measures are taken to realize the objectives from bottom-up, and monitoring efforts to analyse development processes and the effects of measures taken (Müller et al. 2002: 134).

Apart from a rather limited selectivity in project selection and, in the beginning, administrative problems of program implementation, leading to delaying and discouraging effects, public promotion policy clearly had a strongly promoting impact on the development of the regional innovation network InnoPlanta and thus largely fulfilled its political purpose and intention.

The InnoRegio program was a complex extensive (and experimental) policy program of the BMBF. Furthermore, it combined within one ministry different policies addressing research, technology, innovation, economic and regional development, which are mostly pursued separately, and thus had a rather coherent character.[7] However, these qualifications do not necessarily hold for the coordination of different policies pursued at different (state, federal, EU) policy levels of promotion policy because corresponding coordination efforts are largely missing.

7 Comparison of promotion objectives with achieved results

When comparing policy promotion objectives with results actually achieved, three distinctions have to be made in order to arrive at clear-cut conclusions in that respect. First, the effects of the InnoRegio program as a whole on regional scientific and economic development have to be distinguished from those on InnoPlanta and the region Nordharz/Börde, which are of interest here. Second, the achievement of short-, medium- and long-term objectives of the program may well differ and the latter ones cannot yet be evaluated at present because they can only be observed in about the next decade. Third, various objectives, such as the cooperation of regional actors, the degree of networking, creation of regional identity via networking, mobilisation of additional (economic) development impulses, may be envisaged but may be achieved with differing success.

The evaluation of these developments is based on a systematic (accompanying) study of the effects of the InnoRegio program (BMBF 2005) as well as on a detailed case study of InnoPlanta's development, including the role of promotion policy (Conrad 2005). The combination of both studies allows to give relatively clear-cut answers to the question if and to which degree (federal) promotion policy achieved its objectives. Knowing that InnoPlanta is a rather positive example among all InnoRegios promoted, the general, partially cited qualifications in BMBF (2005) can be assumed to hold for InnoPlanta, too.

The *short-term objective* of the InnoRegio program is the establishment

[7] In its starting phase it was – in financial terms – the most extensive promotion program of innovation policy for the eastern German states (BMBF 2005: 19).

of viable regional innovation networks, i.e. bringing together regional competencies for the common work on promising innovative projects.

The *medium-term objective* is the improvement of the performance capacity of the network members so that innovation processes are facilitated and their innovative capacity is enlarged, finally leading to an increase in their economic performance.

The *long-term objective* is the strengthening of the regional economy as a whole so that the strengthening of actors, together with other direct or indirect effects of the InnoRegio program leads to economic growth impulses in the region (BMBF 2005). With growing length of time, the relative importance of promotion policy decreases compared to other influencing factors due to longer cause-effect-chains.

Improvement of scientific and economic capability can rarely be attributed unequivocally to one specific variable, such as a policy program or activity. Likewise the success of any policy promoting innovation projects depends on the fulfilment of preconditions, such as a corresponding performance potential of companies and realisable projects sustainable in the future. Taking these aspects into consideration, the (possibly) observed correspondence of promotion objectives and achieved results indicates a successful promotion policy, but does not actually prove it.

With these caveats the following empirical assertions can be made about the effects of the InnoRegio program on InnoPlanta and corresponding development of the region Nordharz/ Börde:

Short-term objectives

Cooperation of different regional actors was successfully induced, although InnoPlanta only very gradually was changing its character from a pork barrel into an innovation network, and cooperation mostly remained limited to specific projects with few participating actors, respectively.

Medium-term objectives

This cooperation tended to have positive effects on the innovation potential of the companies involved and also led to first successes in project-specific innovation processes.

Long-term objectives

Furthermore, intensified communication and exchange of services and activities tended to induce positive economic impulses for the region. Finally, the InnoRegio program induced a limited self-dynamics of the newly founded InnoPlanta association. This resulted in further mobilisation effects necessary to support its self-sufficient continuation after the end of the InnoRegio program, which can be observed at least in early 2007.[8] So whereas technology and innovation policy induced the establishment of a regional innovative network in plant biotechnology, achieving subsequent successful cluster formation still remains an open question for the future. However, this was no direct aim of the InnoRegio program.

[8] For evaluating the effectivity of the InnoRegio program key criterion is the durability of the processes of networked innovative development induced by this program. Here, the preliminary results are discrepant because the members of the various InnoRegios are sceptical about their chances to continue their R&D work after the end of its funding, on the one hand, but there is a general interest in most cases to further participate in the newly established network and to continue the cooperations initiated, on the other hand. In particular, the size of new product value chains generated can be reasonably assessed only if the results of the R&D projects will be successively transformed into new products so that product inputs will be increasingly demanded by enlarged production. In addition, establishing regional product value chains by corresponding innovation networks is limited by their objectives, actor interests and economic reasons (BMBF 2005: 8, 57, 71).

In sum, the short-term promotion objectives were reached to a considerable degree, and there are some indications that the medium-term promotion objectives may be at least partially reached as well. Whereas the efficacy of the InnoRegio program – after some likely initial difficulties[9] – plausibly appears to be given for InnoPlanta and also in general, as confirmed by the perception of the InnoRegio participants (Eickelpasch 2004, BMBF 2005), its efficiency still cannot be judged because of lacking empirical criteria and comparable cases.

8 Conclusion

Putting together the insights gained from the case study and from the general analysis of promotion policy the following conclusions can be drawn concerning successful promotion policy in the case investigated and in general.

(1) At the conceptual level, technology policy combined three objectives from the InnoRegio program: to promote industry-oriented and marketable technological trajectories in the eastern German states, to rely on regions as self-organising and self-supporting actor constellations for the development of marketable key technologies, and to stimulate interregional competition for funding, technological pioneering and potential lead markets.

(2) As with other technology promotion programs, within the framework of the InnoRegio program technology policy can only provide favourable framework conditions and incentives, as well as initiate significant action and influence the basic development orientation of a regional innovation network. Its actual development, however, apart from the public funding provided depends on the resources, the capacity for action and the self-interests of a region, shaped by the availability and interests of (regional) promoters, overcoming problems of network formation, and resulting social and technological path dependencies. So technology (promotion) policy – even if specified towards regional circumstances – has very limited possibilities to steer technical innovations. Once a project has been accepted for funding technology policy can hardly substantially influence its further development and success. If a project or an InnoRegio finally will be economically successful is not within the reach of innovation policy.

(3) Increasingly, technology policy is making an effort to evaluate its own programs by accompanying research. However, it remains an open question if the results of this research in fact influence actual and future policy programs accordingly.

(4) Different from many other policy fields technology policy may follow necessary long-term perspectives although the success of corresponding policy programs remains more open than those in other more short-term oriented policies. Because of the strong economic application and market orientation of the InnoRegio program, such a long-term perspective of one decade or even more may be easily undermined politically.

It is worth noting that technology policy continued this promotional policy approach in later programs, such as "Interregional alliances for future markets (innovation fora)" or "Innovative regional growth centres".[10]

Altogether, it is reasonable to conclude that technology promotion policy fully utilized its limited potentials with respect to the self-defined objectives of

[9] Frequently, the networks and their actors underestimated the task to transform their ideas in substantive R&D projects qualified for funding, and lacked experience concerning public funding procedures and cooperation in networks (BMBF 2005:19).

[10] "Interregionale Allianzen für die Märkte von morgen (Innovationsforen)" and "Innovative regionale Wachstumskerne".

the InnoRegio program. Apart from initial practical difficulties in particular for the InnoRegio InnoPlanta it realized, its underlying conceptual approach in a well-reasoned manner.

9 References

Bernauer, Thomas, 2003: *Genes, Trade, and Regulation. The Seeds of Conflict in Food Biotechnology*. Princeton: Princeton University Press

Blind, Knut, Grupp, Hariolf, 1999: Interdependencies between the science and technology infrastructure and innovation activities in German regions: empirical findings and policy questions. In: *Research Policy* 28, 451-468

BMBF (Bundesministeriumfür Bildung und Forschung) (ed.), 2000: *InnoRegio - Die Dokumentation*. Bonn: BMBF

BMBF (Bundesministeriumfür Bildung und Forschung) (ed.), 2005: *Das BMBF-Förderprogramm InnoRegio - Ergebnisse der Begleitforschung*. Bonn: BMBF

Brenner, Thomas, Dirk Fornahl, 2002: *Politische Möglichkeiten und Maßnahmen zur Erzeugung lokaler branchenspezifischer Cluster*. Report. Jena: Max-Planck-Institut zur Erforschung von Wirtschaftssystemen

Bröcker, Johannes, et al. (eds.), 2003: *Innovation Clusters and Interregional Competition*. Berlin: Springer

Conrad, Jobst, 2003: Nachhaltigkeit grüner Gentechnik durch Konsistenz: Anforderungen an und Restriktionen von Good Governance in einem regionalen Innovationsverbund. In: Jutta Allmendinger (ed.), *Entstaatlichung und Soziale Sicherheit* (31. Deutscher Soziologentag). Teil 1. Opladen: Leske + Budrich, 355-374

Conrad, Jobst, 2005: *Grüne Gentechnik – Gestaltungschance und Entwicklungsrisiko. Perspektiven eines regionalen Innovationsnetzwerks*. Wiesbaden: DUV

Conrad, Jobst, Philipp Steuer, 2003: *Beschreibung und Evaluation der Einzelprojekte des InnoRegio-Vorhabens: InnoPlanta Pflanzenbiotechnologie Nordharz/Börde*. Report. Berlin/Leipzig

Daele, Wolfgang van den, 1989: Kulturelle Bedingungen der Technikkontrolle durch regulative Politik. In: Peter Weingart (ed.), *Technik als sozialer Prozess*. Frankfurt: Suhrkamp, 197-230

Eickelpasch, Alexander, 2004: Zur Zukunft der Geschäftsstellen - die Sicht der InnoRegio-Teilnehmer. In: *InnoRegio InfoBrief* 10, 1-2

Eickelpasch, Alexander, et al., 2002: Das InnoRegio-Programm: Umsetzung und Entwicklung der Netzwerke. In: *DIW-Wochenbericht* 21/2002: 329-338

Gaskell, George, et al., 2003: *Europeans and Biotechnology in 2002*. Eurobarometer 58.0. Report to the EU-Commission. London

Hampel, Jürgen, 2004: *Die Akzeptanz gentechnisch veränderter Lebensmittel in Europa*. Stuttgarter Beiträge zur Risiko- und Nachhaltigkeitsforschung 3. Universität Stuttgart

Keck, Otto, 1987: The information dilemma: private information as a cause of transaction failure in markets, regulation, hierarchy, and politics. In: *Journal of Conflict Resolution* 31: 139-163

Kern, Manfred, 2002: *Marktpotenziale 2010 der Anwendungen im Bereich Landwirtschaft ("Grüne Gentechnik")*. Ms. Frankfurt

Menrad, Klaus, et al., 1999: *Future Impacts of Biotechnology on Agriculture, Food Production and Food Processing*. Heidelberg: Physica

Meyer-Krahmer, Frieder, 1999: Was bedeutet Globalisierung für Aufgaben und hadlungsspielräume nationaler Innovationspolitiken? In: Klaus Grimmer et al. (eds.), *Innovationspolitik in globalisierten Arenen*. Opladen: Leske + Budrich, 43-73

Müller, Bernhard, et al. (eds.), 2002: *Kommunikation in regionalen Innovationsnetzwerken*. München: Hampp

Paarlberg, Robert L, 2003: Reinvigorating genetically modified crops. In: *Issues in Science and Technology* 19 (3): 86-92

Porter, Michael E., 1990: *The Competitive Advantage of Nations*. London: MacMillan Press

Porter, Michael E., 1998: Clusters and the new economics of competition. In: *Harvard Business Review* (November-December) 76 (6): 77-90

Schimank, Uwe, 1991: Politische Steuerung in der Organisationsgesellschaft - am Beispiel der Forschungspolitik. In: Wolfgang Zapf (ed.), *Die Modernisierung moderner Gesellschaften* (25. Deutscher Soziologentag). Frankfurt: Campus, 505-516

Scholl, Wolfgang, Ulrich G. Wurzel, 2002: *Erfolgsbedingungen regionaler Innovationsnetzwerke - Ein organisationstheoretisches Kausalmodell*. DIW-Materialien 21/2002. Berlin

Vogel, Benno, Christof Potthof, 2003: *Verschobene Marktreife. Materialien zur zweiten und dritten Generation transgener Pflanzen*. Bericht des Genethischen Netzwerks. Berlin

Voß, Rainer, et al., 2002: *Technikakzeptanz und Nachfragemuster als Standortvorteil im Bereich Pflanzengentechnik*. Report. Wildau

Young, Alasdair R., 2001: Trading Up or Trading Blows? US Politics and Transatlantic Trade in Genetically Modified Food. EUI Working Papers RSC 2001/30. Fiesole