Modeling transdisciplinary cooperation in the agriculture sector for European Innovation Partnerships

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Abstract: European Innovation Partnerships (EIPs) are a new instrument to promote innovations and to overcome sector specific gaps in technology transfer. Particularly in the present day agriculture sector, there is a strong perception of a valley-of-death in innovation processes. This study had the overall objective to develop a model for transdisciplinary cooperation and innovation brokerage on the federal level of Brandenburg in Germany in the pre-implementation phase of EIP. The formative approach combined two methodological streams: first we adapted a stage-gate-process elaborated initially for product optimization in industry. Secondly, we framed a design for business model development. The process aimed to 1. identify innovation gaps, 2. assess political and socio-economic frame conditions, and 3. investigate structural elements for a pilot innovation network. The gates were used to validate the results with regional stakeholders' requirements. The process revealed a need for organisational innovations atop of technical or service innovations. We therefore developed a model structure for formal collaboration targeting the innovation capacity within the regional agriculture sector and validated the potential modes of operation against a set of predefined criteria. We highlight the significance of undertaking regular calibration with the evolving policy planning at higher levels and the necessity for permanent translation to the context of regional stakeholders. The effort to form new organisations can be supported by methods from ex ante policy assessment and business model development. The function of innovation brokerage can be integrated into a newly formed innovation network if this function is not sufficiently provided for by existing organisations.

Keywords: business model development, innovation broker, Common Agriculture Policy, organizational innovation

Introduction

The European Commission orientated its current funding strategy towards the generation of innovations as a means to address societal challenges and to enhance Europe's competitiveness against the background of globalisation and fiscal constraints. European Innovation Partnerships (EIP) will be a new instrument introduced specifically to promote cross-sector cooperation networks to close gaps between the provisioning of research results and the application in practice (EU COM, 2012, 2013). Although this gap is well perceived in the agriculture sector, structural barriers are pointed out by local farmers and decision makers in regional administration that pose a barrier to contributing effectively to an innovation process (Barbier & Elzen, 2012; EU SCAR, 2012). In consequence, the EIP on Agricultural Sustainability and Productivity is among the first to be launched by the European Commission.

The European approach reflects an overall consideration of investing in innovation networks within the agricultural sector (World Bank, 2012). Ekboir (2012) sees benefits in a more rapid

development, more effective use of resources and expansion of capabilities. He distinguishes the deliberate creation of such networks from spontaneous emergence and provides catalytic factors for fostering their consolidation from an administrative practitioner's perspective. Palmberg and Lemola (2012) highlight the critical dependence on how well governments are capable to obtain and analyze the impacts of innovation policy as well as future technological and market trends. This involves the integration of key ministerial bodies such as finance or education in planning, clear visions and priorities as well as sound organization by a coordinating body.

Factors to be considered for better innovative performance have been studied in the creation of strategic SME networks (Thorgren et al. 2009). Findings imply that configuration, formation and governance rely on bottom-up processes and a functioning network administration. Some SME networks rely on brokers to bridge cognitive or technical limitations (Kirkels & Duysters, 2010) or for decision support in identifying profitable inventions (Hoppe & Ozdenoren, 2005). In the agriculture sector, the concept of innovation brokerage is increasingly gaining interest from the policy side for its prospect to facilitate the formation and maintenance of innovation networks (Klerkx & Leeuwis, 2008). The realization is, however, found to be dependent on a process of institutional change at a macro-level (Klerkx et al., 2009) and entails organizational adaptation first of all on the part of the ministries. Klerkx & Gildemacher (2012) give recommendations on the incorporation of innovation brokers for policy makers, but the question remains how innovation brokerage can be designed within the specific context of one region.

This study was conducted in the context of technical assistance to the Ministry of Infrastructure and Agriculture (MIL) in Brandenburg, Germany, in developing a viable strategy towards fostering operational groups for EIP. An operational group is expected to be constituted for developing and applying innovative practices, products and technologies by involving farmers, scientist, advisers, NGOs or enterprises (EU COM, 2012). The objectives of our study were to

1) Identify what type of innovations are required in the region;
2) Assess the frame conditions for a consolidated transdisciplinary approach;
3) Investigate structural elements for a viable pilot innovation network.

Approach

The study was pursued within a formative approach of strategy development by the Brandenburg ministry over a term of 16 months. Two frame conditions were set in advance: 1. to perform investigation in close cooperation with ministerial representatives, and 2. to address a thematic topic of articulated interest among regional farmers.

We set up a procedure based on stages and gates (Cooper, 1990, 2008). A stage-gate process breaks up a project into several singular self-contained phases of activity (stages) each followed by a decision to either discontinue the process or to proceed (gates). Similar approaches are applied in industry to optimize and speed up innovation development by following a systematic sequence of steps. We applied it to ensure that each step of investigation was transparent to and controlled by the donor and to guarantee that the results of each step met the articulated needs of the farming sector. The decisions were taken by a steering body representing the ministry, farmers' associations, farmers and representatives from adjacent business sectors. We designed one stage each for identifying the demand for innovation support, for assessing European and federal political frame conditions, and for investigating the model structure. A fourth stage was designed to validate potential operation. Due to delays in adjournments on the European level, a last stage for evaluating actual operational activity was not conducted up to this point.

Multi-perspective situation analysis

Theories concerned with organizational structures in the context of innovation reviewed by Damanpour & Gopalakrishnan (1998) distinguish innovations by being administrative or technical, radical or incremental, as well as in early initiation or implementation stages of development. The European Commission aims to achieve diversity and thus adopted a broad definition of innovation that includes technologic innovations next to combinations of new and existing knowledge, as well as organizational changes in management or behaviour (EU COM, 2013).

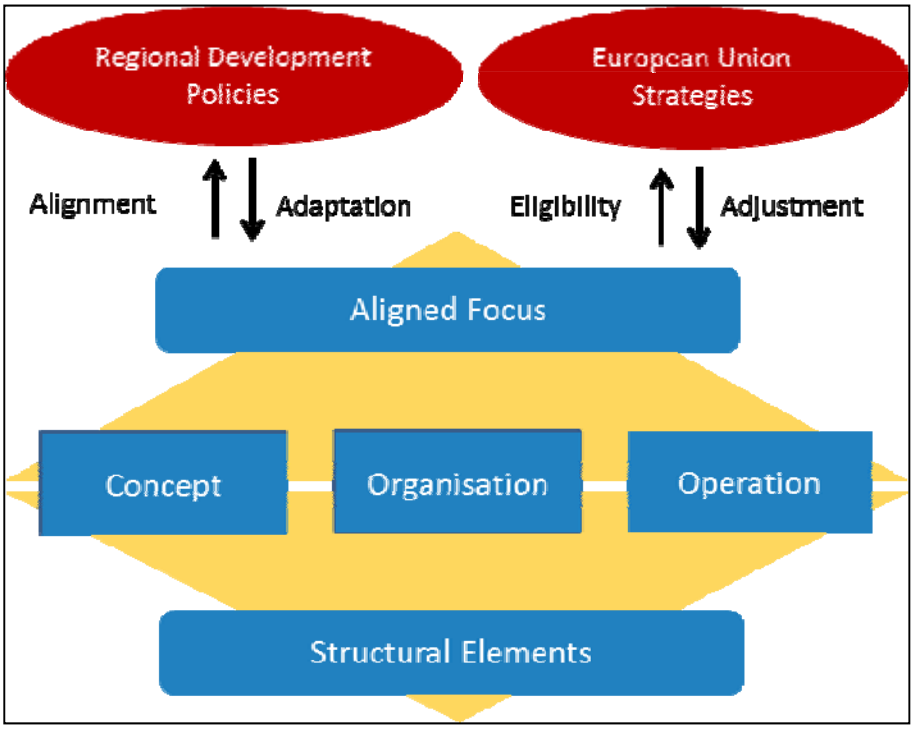
To gain an understanding on the type of innovation needed under consideration of the above-named dimensions, we conducted a multi-perspective analysis with experts from research, government agencies, and farmers. Participants were selected to cover as broad as possible the agriculture sector sensu stricto (arable and grassland farming, fruit and vegetable production and animal husbandry). The first named groups were analysed in focus groups (Finlay et al., 2005; Kitzinger, 1994; Gibbs, 1997). The main purpose was to draw upon respondents' attitudes, feelings and experiences in regard to innovation processes. The group of farmers and farmers' associations was interviewed individually after realising hesitance on the side of the addressed to join in – what was in their eyes – a rather theoretical discussion. A set of questions based on a document survey on the regional context of innovation guided the open discourse as well as the interviews. The results were summarized in along the following headings:

- What are specific needs for support in the Brandenburg farming sector?
- What gaps were perceived in past innovation processes?
- What resolutions can support future innovation management?

Analysis of frame conditions

The two main targets for EIP are to promote productivity and efficiency in yield gains, and to maintain sustainability for agriculture. The European Commission suggests implementing EIPs by seeking synergies with existing policies, in particular the CAP Rural Development Policy, the Union Research and Innovation Policy and Cohesion Policies (EU COM, 2012). In order to achieve a comprehensive integration of policies, this step of investigation involved a comparative legal evaluation along two main criteria: eligibility for funding, and accordance with legal requirements in form and content. The analysis was conducted for the federal, national and European level and under consideration of the previous results. It involved a review of legal documents and personal communication with representatives from all levels of administration. Based on the evaluation of summarised results, the potentials for coherence with legal requirements as well as the alignment with existing funding strategies were derived (Fig. 1).

Figure 1: Investigation and formation of viable structural elements for a pilot innovation network.



Business model design and validation

In the final step, business model design was carried out based on the concept of Chesbrough & Schwartz (2007), Chesbrough (2010). Structural elements were identified, evaluated and combined to form possible model options, upon which one option was marked for further investigation by the steering group. This option was scrutinized by comparison and benchmarked with existing organisations whose business models fulfil a similar function in other regions than Brandenburg. The adapted model was then taken forward in a business plan for further implementation in later stages of policy implementation. Since final validation of the model from the point of operational viability can only be conducted after implementation and testing, effectiveness and success were at this stage of the project estimated against the following criteria:

- measurable interaction between different stakeholder groups;
- Compliance with articulated needs articulated by farmers within the region;
- provision for a tangible output recognized by agricultural practice;
- compliance with the general criteria of business operation (efficiency, effectiveness);
- results that can be monitored in terms of impact on farm level (gain in yields);
- results that can be monitored in terms of impact on regional level (jobs within the region).

Results

Demand for innovation support

The multi-perspective analysis yielded a matrix with over 130 perceived needs for innovation support, gaps in an innovation process and ideas for resolution. Statements referring to the needs within the agricultural sector turned out to be detailed as well as heterogeneous across the three expert groups, and comprised very specific (e.g. specific harvest technology) as well as comprehensive challenges (e.g. conservation of land as a resource).

Regarding the perceived gaps in innovation processes, systemic gaps were pointed out consensually that were non-specific to agricultural sections or certain areas. Gaps could be named in gov-

ernance bodies, where structural changes within the ministries had led to a decline of professional knowledge and deficient planning reliability for farmers. Further gaps were located at the interface between research and practice, indicated by lacking incentives to involve in technology transfer and differences in priorities. Suggestions for resolution were detailed and practical. Clustering showed consensus across expert groups on topics such as regular communication of research results, centralisation and consolidation of knowledge provision and consultancy, implementation of systematic experimental research, permanent provision of a technology transfer office, financial participation of farmers to uphold experimental research stations and concentration on region specific challenges within the farming sector.

In summary, we found the gaps to be procedural and administrative rather than technical or topical. The results showed a need for an organisational innovation atop of technical innovations in order to address socio-economic gaps and to lay a better foundation for innovation capacities.

Eligibility and alignment with frame conditions

Brandenburg region is characterised by a dense and diverse research infrastructure in the agriculture, food and environmental sectors on the one side and a large fraction of highly qualified farmers and smallholders on the other. With an orientation of trade chains towards the capital city of Berlin, there is a dense network of brokers, technology transfer offices and downstream enterprises with accessibility to funds and market awareness (Bonneval 2012). On the other hand, significant changes in structure in the last 15-20 years have led to privatisation and fragmentation in agricultural extension and thus to an undervalued potential for innovation in the region (Dimter et al., 2008, König et al., 2011). A socio-economic analysis conducted in 2012 suggested four investment priorities: 1. linking agriculture and food sector, 2. utilisation of the research sector, 3. implementation of mediators and brokers, and 4. strengthening of producer networks (BonnEval, 2012). The European Commission by articulating three targets 1. efficient production of food products, 2. sustainable use of natural resources and adaptation to climate change, and 3. a balanced development of rural areas (DG Agri, 2012) plans to address challenges in food security, competitiveness, resource management, climate change, sustainable development of rural areas, biodiversity conservation and conservation of cultural landscapes (EU COM, 2012).

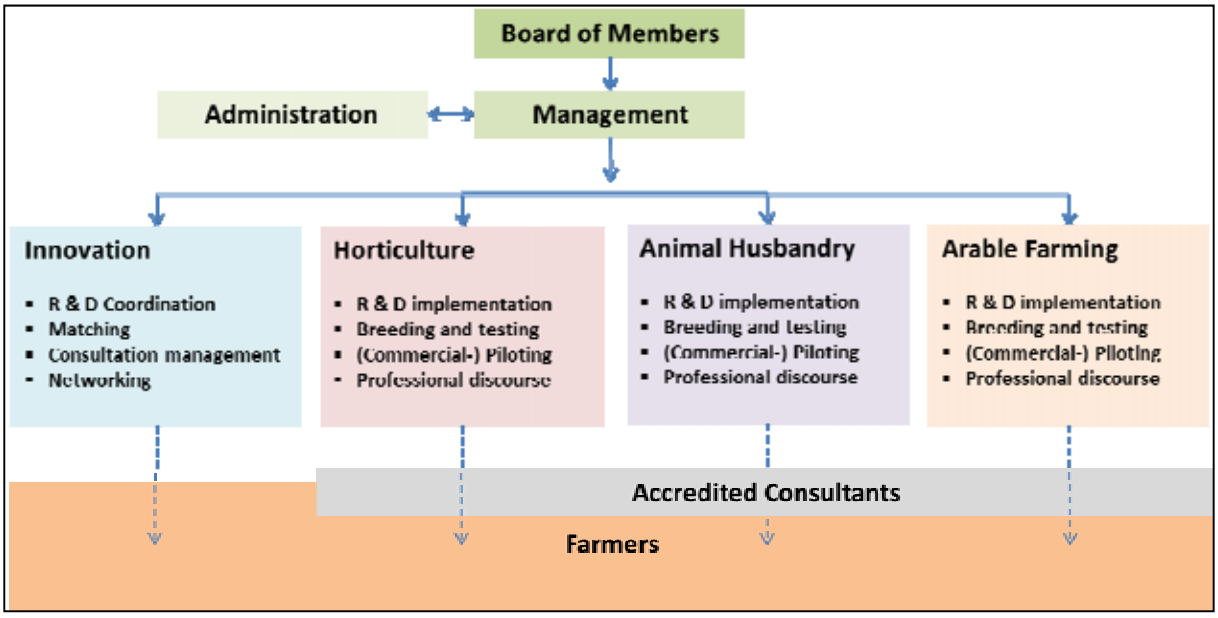
For an alignment with regional specificities we derived the following priorities for a pilot network for innovation: 1. long term financing plan beyond the funded period, 2. structural links to all agricultural sections including the food sector, consultancy firms and agriculture research, 3. location outside any of the existing sectoral stakeholder groups in order to ensure the neutrality of a centralised approach, and 4. the consideration of remaining elements existing in experimental research and field trials in order to safeguard regional know-how and infrastructure.

For the provision of eligibility and adjustment to European Union Strategies we identified the following priorities: 1. the network shall be capable of conducting actual project implementation (in contrast to an administrative body), 2. the network must have the aim to generate innovations as an end in itself, and 3. representatives of all relevant groups within the value chain must be members of the network.

Design of a pilot innovation network

The steering group acknowledged the potential for a centralised body to address the needs in knowledge and technology transfer within the agriculture sector. The next phase resulted in a model that comprised the conceptual, organisational and management structure for channelling the cooperation between practice, administration, policy and science and that should act as a symbiotic link between research and practice with the mission to generate relevant and sustainable innovations for the agricultural sector.

Figure 2: Pilot innovation network model for innovation brokerage.



Conceptual structure

The legal frame (German e.V.) was selected to match the previously identified priorities. The benefits gained were a flexible membership structure (all relevant stakeholder groups can be represented, members easily be added or replaced), beneficial organisational requirements (no capital is needed for the initial foundation, membership fees can be introduced and adjusted easily, disintegration in case of failure is non-bureaucratic), and obligation for a statutory programme definition (wide definition of the scope is possible, orientation of projects can be influenced by regular membership meetings, industrial activities are permissible).

Organisation

The pilot innovation network was designed simple in outline yet with the potential to advance and expand according to future requirements. Fig. 2 shows the minimum structure needed to address improved efficiency in innovation management based on the previous project results.

a) Board of members: this was perceived the most influential element in regard of programme orientation within the innovation network. Members work on an honorary base and have equal voting power. The board includes relevant farmers' associations, one government agency for sovereign experimental research, one trading company, one farmer for each relevant section of agriculture, one public technology transfer office and the relevant university bodies. Representation of the research sector should ultimately be considered according to its focus on education and training.

b) Management: two full-time staffs take on network management. Responsibility should be equally shared between technical, administrative and business matters on the one side, and research, planning and professional alignment issues on the other.

c) Administration: This element should be as lean as possible. Main functions such as service and support, accounting and IT may be coordinated internally while actual services (legal advice, IT support services or personnel accounting) may be ensured by external providers.

The innovation network was designed to have four departments linked by tasks and focus. The departments in their entirety are to ensure the information flow to farmers, either directly or via consultants tied loosely to the structure by formal accreditation.

a) Innovation brokerage: all interaction between innovation partnership and stakeholders is coordinated by this department. It functions as a front-office and at the same time coordinates all information flow between the other departments. Four tasks were found crucial in function:

- *R & D Coordination:* Derivation of research questions from practical and articulated needs within the agriculture sector, and programming of research.
- *Matching:* Development of projects, brokerage of tools and topics as well as provision of knowledge and technology.
- *Consultation Management:* Obligation to ensure the information flow directly or indirectly via consultants as well as the coordination of accreditation activities.
- *Networking:* Accomplishment of all networking activities on the regional, national and European level, between sectors and between research, policy and practice.

b) Departments of experimental research: All departments interact with each other, with the innovation broker as well as with experts and accredited consultants. These departments are responsible for generating knowledge in application and practice. Four tasks were assigned:

- R&D performance: execution of projects relevant to respective fields of specialisation.
- Breeding and testing: generation of knowledge and technologies for adapting to future challenges within the agricultural sector.
- (Commercial-) Piloting: creation of good practice examples, proofs-of-concept for test cases and business exploration.
- Professional discourse: Cross-fertilisation in between sections internally as well as technical interaction with representatives from upstream or downstream industries and the consulting sector.

Operation of the model

The core element of operations was seen in the brokerage function of the entire innovation network. From this central point of business operation, the structure was complemented by a set of operating processes that were designed to enliven effective implementation and thus constitute the organisational innovation. The following functions were derived as core elements of operation:

- Institutional links to all groups of actors by way of organization and activity,
- Overview of the state-of-the-art in all related sectors, and provision of knowledge in action,
- Capacities to flexibly combine different sets of knowledge to a problem context also on farm, and to strategically prioritise issues for the policy and research sectors,
- Presence in public, societal as well as professional discourse by way of routine,
- Independency of particular interests within a single section of the sector due to inherent transdisciplinary operation by way of organisation and program orientation.

Validation of the model

The pilot innovation network was investigated for viability within the limits of the regional production system and under consideration of the regional research infrastructure. Validation was undertaken by checking the structural elements against a set of previously defined criteria.

a) Provision of measurable interaction between groups: permanent integration of the innovation broker was seen as a key element to maintain long-term interaction and information flow. The design provides for different channels of communication. The outcome can be measured by number of projects, partners or topics, or the quality of the research programme.

b) Compliance with articulated needs: the membership board was designed to address the agriculture sector from the different perspectives of research, policy and planning, and from a comprehensive as well as an on-farm perspective. The innovation broker is to ensure continuous matching of research results and practice requirements, while the institutionalised linkage with consultants by accreditation safeguards a neutral correction body independent of the membership board.

c) Provision of tangible output recognised by farmers: The model structure foresees commercial activities and financial participation of farmers to maintain the innovation network beyond the funding period. The amount of income from distributing research results and from accreditation can be measured and thus reflects recognition of output.

d) Compliance with general criteria of business operation: The organisational structure was kept lean due to the inclusion of remaining structures integrated into the departments of experimental research and the voluntary input by board of members. Administrative and business oriented leadership within the management was planned for.

e) Results with an impact on farm-level: The departments of experimental research were planned to achieve output directly for the farming sector. Farmers can influence output via their representatives in the board of members or directly via membership fees. Expected outputs include knowledge and technologies for adaptation to future challenges and are thus expected to have an impact on farm-level.

f) Results with an impact on regional level: The innovation broker, the board of members and also the accredited consultants were seen as "ears" to the region. Regional planning can influence output via public representatives in the board of members or directly via involving with the innovation broker through the given channels. Expected impact was seen in an enhanced awareness of needs in education, research, practice and policy.

Discussion

Applicability of the approach for further innovation networks

We think that the approach used in this case study can be applied to support the generation of innovation networks in other regions than Brandenburg. The sequence of steps may of course lead to differing intermediate results (e.g. technical or service innovations). The first two stages of the process (multi-perspective situation analysis and analysis of frame conditions) are perceived as a useful support of desk top planning in the responsible ministerial departments. The latter two stages (design and validation of an innovation network) are seen as particularly useful for all stakeholder representatives with an interest to trigger a deliberate process of network generation.

Strategic planning on the government level may involve techniques such as back-casting, road mapping or the Delphi method to support the negotiation of priorities and the setting of stepping stones toward an intended goal (De Smedt et al., 2013). The division of the process into a systematic sequence of steps has the benefit of continuous calibration with the evolving frame conditions during the pre-implementation phase of the policy (stages) and the representatives of the stakeholder groups (gates). Due to a general mismatch between administration processes and innovation processes, there is a permanent need to translate internal as well as external develop-

ments to the different contexts of the stakeholder groups to maintain mutual understanding of process and goals. On the policy side, we found a general trend to favour economically relevant stakeholders, independent from their disposition to involve in the generation or adoption of innovations. From an innovation perspective, niche actors are equally important in designing innovations to regional key players. We recommend the selection of stakeholders to include representatives from as many sector sections as possible with a focus on actors from boundary areas of the sector, anomalous career development or business progression, or out-of-the-way business approaches, thereby following some principle guidelines of innovation design (Chiva & Alegre, 2009; Dorst & Cross, 2001).

Two hurdles are worth mentioning. Firstly, the ongoing reduction of infrastructure for experimental research during the course of the study is found to obstruct future-oriented and innovation generating activities, and thus impede the accomplishment of European targets if no suitable and timely alternatives are set up. Secondly, the willingness of stakeholder groups to cooperate in a joint formation process is not necessarily comparable between regions. Limitations, however, can deflate effective cooperation. This would need to be further analysed from a psychological or sociological perspective and cannot be addressed within the frame of this study.

Innovation brokerage of transdisciplinary networks

The solution to bridging gaps between knowledge systems is found to be rather simple in nature and solutions exist to learn from (Gebhardt & Pohlmann, 2013; Spoelstra, 2013). Yet the organizations from either sector do not seem adequately geared to perceive the practical needs and at the same time address them beyond a funded project time frame. Reasons include different priorities, lacking financial and personnel capacities, lacking competencies in technology transfer, differing functions or an overly avoidance of risk. This calls for an institutionalised structure to fulfil the functions of a broker (Klerkx et al., 2009; Howells, 2006; Bessant & Rush, 1995). The pilot innovation network reveals very different functions constituting effective innovation brokerage. We therefore argue that an effective innovation broker can only be an organisation (in opposition to an individual consultant), since the functions are partly conflicting and need to be split to several heads in the operation of an organisation (Hermans et al. 2013, Klerkx & Leeuwis, 2008b). General requirements would be knowledge of all relevant actor groups, understanding of their individual agendas and an ability to communicate in respective languages.

We recommend the analysis to first of all focus the type of innovation needed, so that a decision of who to involve can be taken early in the process. Innovation brokerage can be designed either following a top-down planned approach with a coherent assemblage of superordinate and administration-oriented partners or a competitive and bottom-up approach with a rather technical and problem-oriented composition of partners. We think that the first approach is well-applicable to form an organisational innovation as was done in this study.

Conclusion

Our study focused the design of innovation brokerage in a specific region and in co-creation with the managing authorities and local stakeholders. Based on our findings, business model design can help to work along the set of given requirements. Benefits are seen in the potential to build new structures as well as to include existing structures into a new model, to understand and manage socio-economic implications of policy development and to assess developments from a long-term business operation perspective. The approach may help to raise political awareness of gaps in the innovation system and to set priorities accordingly while at the same time pointing out regional capabilities. Further monitoring during later stages of implementation might show an impact of the approach to explicitly and openly include the innovation broker in the business model on the formation of local bottom-up innovation processes.

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