



Trapped in a net: network analysis for network governance

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Abstract

Purpose – Especially at the regional level co-operation is seen as a prerequisite for innovation and competitiveness. Hence, political interest in fostering knowledge intensive networks is high. New forms of governance and additional strategic intelligence for decision makers are requested. Thus potential of the social network analysis (SNA) is discussed as methodology providing the information needed for strategic management of innovation networks. The aim of this paper is to assess the impact as a regional governance tool.

Design/methodology/approach – First, benefits and risks of innovation networks are discussed based on literature review. Second, the potentials of the SNA for their systematic monitoring are examined. Herewith specific attention was paid to the manageability and reduction of complexity to demonstrate SNA applicability for network governance. Analysis was based on automated data retrieval of electronic documents available, e.g. at governmental institutions, research databases, and the internet. Results are exemplified by studying knowledge intensive networks in Styria.

Findings – The applied set of IT based tools and visualisation of regional co-operations based on SNA provides a comprehensive view of the interdependencies and the embeddedness of different institutions as well as actors of the region. Based on this visualisation conclusions are drawn concerning network management by analysing specific attributes of interest, concerning partners, cooperative behaviour, balance of power, openness and embeddedness of the network.

Originality/value – Network benefits success may not be achieved automatically. Strategic management is crucial for success. The paper demonstrates how social network analysis may be applied on automatic retrieved data on involved organisations and key players to strengthening the strategic intelligence of (regional) decision makers and help them meet the governance challenges of the network economy.

Keywords Knowledge management, Networking, Internet, Communication technologies, Governance

Paper type Research paper

1. Strategic policy intelligence for network governance

1.1 *Knowledge intensive networks as policy issues*

Increasing technological complexity due to growing trans- and interdisciplinary characters of technologies, strong competition, and shortening product-cycles force organisations to concentrate and specialise further on their core competencies. Thus, intensified co-operative activities function as prerequisite as well as a result of the increased disintegration of innovation processes (Storper, 1996). Comprehensively denominated as knowledge intensive networks and functioning as systems these co-operations bring together different actors, resources and activities (Casti, 1995). They optimally answer to the requirements of the new paradigms of innovation (interactively and non-linear, embedded in systems of innovation) and promise a successful way of strengthening innovation capacities.

In consequence, political interest in fostering knowledge intensive networks is high even if traditional ways of intervening are mainly impeded. New forms of governance are requested. Fostering co-operative activities means an engagement in structural



dimensions of the innovation system, addressing not an individual organisation but whole (sub-)systems of innovation (e.g. science-industry co-operation). Fostering strategic partnerships between varying actors (research institutions, universities, industry, etc.) by bundles of concerted measures aims at shaping local, regional or sectoral innovation systems more effectively.

These kinds of political interventions qualify as multi-actors and multi-measures programmes (MAPs). MAPs exceed by far the funding of single co-operation projects, which has so far dominated national as well as European co-operation programs. As complex network approaches MAPs ask for different governance schemes than funding collaboration in the context of a concrete project (Bührer *et al.*, 2003). They cover a huge variety of proactive features and management practices, depending both on the National Innovation System in the respective country (especially the institutional setting) and on the problems addressed (Edler *et al.*, 2004a). Since the mid 1990s MAP-programs constitute one of the main trends of RTDI-funding (OECD, 2001a,b).

MAPs-initiatives, often referred to as “competence centres” or “competence networks”, have been undertaken in the United States (University-Industry Cooperative Research Centres), Japan (Engineering Research Associations) or Australia as well as in many European countries. Here EU-funding keeps a focus on project-orientated collaborations, while national funding schemes concentrate more on the intensification of interdependencies and interactions between their different subsystems and actors. They often focus especially on regional innovation systems: for example Sweden (Competence Centres), France (pôles de compétitivité), Finland (Centres of Excellence) or Austria (Competence Centres and Competence Networks) (Schibany and Jörg, 2005).

Governance challenges in MAP-programs are immense and diverge significantly from traditional ways of political interventions. Due to the complexity of the programs, their ambitious objectives, and their claim to alter well-rehearsed habits of different actors (insufficient co-operation) MAP programs cover long(er) funding periods. The appraisal of aptitude and adequacy of the chosen network partners and network structures is complex. The risk that the integrative and holistic approach of the MAP-program gets lost and decomposes in single quite isolated lines of actions is enormous. The identification of success factors and the impact of the funded networks on the intellectual capital of the regional innovation system prove to be extremely challenging. As these programs focus on the development of new structures and on the change of individual as well as institutional behaviours also their monitoring processes are more demanding over the whole program-period and beyond. Politicians have to skip their role solely orientated on the financing aspect and have to extend their governance understanding. In MAP-programs their role extends to a stimulating, enabling, moderating, as well as evaluating, and monitoring player of the system (Edler *et al.*, 2004a).

1.2 Additional strategic policy intelligence needed

These governance challenges imperatively require additional know-how and enhanced strategic policy intelligence for regional decision-makers. Hence new instruments capable of monitoring, measuring, documenting and developing the information needed about knowledge intensive networks as subsystems of (national, regional,

sectoral) systems of innovation are required. So far mainly evaluations (ex-ante, mid-term or ex-post) have procured the corresponding strategic policy intelligence. During the last years intellectual capital reports have been increasingly used to get additional information about central organisations of the innovation systems (universities, research institutions, etc.) incorporating more thoroughly their intangible assets. But first attempts to apply these instruments similarly to their knowledge intensive networks and to provide politics with strategic information about these networks show – besides some important achievements - also some crucial deficiencies.

Common IC-reporting systems as used so far cannot completely capture the complexity of the induced networks and offer therefore no sufficient instrument for the governance challenges intrinsically tied to knowledge intensive networks. In this context, the Social Network Analysis (SNA) promises a certain reduction of the complexity by visualising the set of interlinkages between the different actors. The visualisation allows a holistic intuitive perception of a network, its different features, as well as its embeddedness in the regional innovation system. All in all, it provides important indicators for the networks' strengths and weaknesses.

2. On benefits and risks of networking

Society and the economy have been undergoing a transition in the last ten to fifteen years, towards the formation of a networked society and a networked economy. In almost all fields of economic activity a high potential for the solution of problems and the improvement of effectiveness and efficiency has been ascribed to co-operation and networking.

2.1 Expected positive effects

After years of inflationary praise of networking, co-operation issues, the need for networking and the reasons for it, are nowadays discussed more controversially in the extant literature. Though, unanimity prevails more or less with reference to the following benefits: By collaboration in knowledge intensive networks advantages of size, co-operation and specialisation may be reached, also called economies of scope and scale as well as positive externalities of network activities (Koschatzky, 2001). This may strengthen the innovation capacities of each of the network partners, and allow a dynamic as well as efficient configuration of the regional innovation system. Further economic functions (see Nesta and Mangematin, 2002; Sternberg, 1999 etc.) are the reduction of uncertainties in the innovation process, a decrease of innovation costs as well as the reduction of transaction-costs and costs of co-ordination. In addition, also collective learning, the transfer of implicit knowledge as well as the reduction of innovation risks by a common culture, by fewer communication problems and by trust constitute advantages of network activities. Also the following aspects act as stimulants for cooperative activities:

- In most cases the starting point for networking processes involving different parties is a situation of inadequate coordination in a given working sector or thematic area. Networking, then, is designed to create better intrinsic coordination between the parties.
- Usually the challenges that occur are of a multi-dimensional nature. This calls for co-operation and a coordinated approach on the part of the players.

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- Networking offers potential improvements of effectiveness and efficiency.
 - Potential synergies between parties that have not cooperated in the past may be realised.
 - Improved communication speeds up processes and helps quality assurance.

At the regional level, the promotion of regional co-operation is expected to yield the following benefits:

- Strengthening of the innovation-capacity, and the dynamic and efficient shaping of the innovation system.
- Raising value creation and competitiveness, so guaranteeing existing jobs and creating new ones at regional level.

The organisational form in which co-operation is realised (or should be realised) is that of a network. In the ideal or typical case networks are non-hierarchical virtual spaces for communication with horizontal links. In this context networks have also been described as the “infrastructure of success”. However, we must make a distinction between networks on the one hand that are set up and managed in accordance with formal criteria, and informal networks on the other.

Networks can form an essential basis for boosting efficiency and for regional innovation, since they are as a rule more flexible and open than organisations: in a dynamic environment, organic structures are superior to highly formalised and deterministic ones (Davis, 1995), as they are more capable of learning and adjustment performance can more easily be achieved. Equally, however, networks can develop a formalism of their own and “petrify”. Their effects then become dysfunctional, especially in relation to learning capability and the capacity for innovation.

Thus, knowledge intensive networks per se are no guarantee for success and innovative development of the networking partners. The networks’ ability to learn, their adaptability and their absorption capacity are decisive. These features are assured by structural, organisational factors on one hand (loose relations, dense communication etc.) and by individual competencies of each of the network partners on the other hand (capacity of absorption). Different organisational factors of the network are of different influence to its intellectual capital and its potential for success. At the same time varying network objectives and conditions ask for diverse structural solutions and different factors of success.

By this time many networks have come into being, and perhaps “networking” has in some cases rather been done to death, as a supposed cure-all solution. In the present project it has been assumed that in view of the manageable number of key players (both on the economic and on the academic side) and as a result of the iterative process of the formation of individual networks as self-organising systems, the same leading institutions and persons are going to be involved more than once, resulting in bottlenecks and overload phenomena, so that the network approach, at least in the form in which it is currently pursued, is reaching its limits.

On the other hand, the concentration on a small number of players can have advantages: players can link themes, you get more experienced teams, and there is more rapid availability within these teams. But it can also lead to considerable disadvantages: closed circles come into being, there is a reluctance to involve new persons, and the network is more susceptible to breakdown. Above all, though, there is

the risk that the innovative dynamism of the network will be lost. The reason for this lies in the necessary adjustment on the part of the members, which forms the basis for the definition of common targets and a common strategy and for ongoing efficiency improvements.

On the individual level this simply means that communication will be improved by stable relations, which are in a position to reduce the uncertainty component on the basis of a high degree of mutual confidence. In the course of network formation confidential relationships come into being, the flow of information between players within the network increases – while correspondingly decreasing in relation to outside players. The network develops an independent culture of its own. The high level of agreement in perception and behaviour makes it easier to define a common goal. Existing tasks are handled with greater efficiency, but at the same time there is less openness towards ideas outside the network. These are experienced as disconcerting and/or as offering competition (Weyer, 1993). On the level of group formation this phenomenon is known as "group think" (Janis, 1982).

In social network analysis this is described as the "weakness of strong ties", which leads to a decrease in adaptability and innovative capability (Monge and Eisenberg, 1987; Grabher, 1994). "To sum up: only when we are successful in preventing or breaking up the 'thickening' associated with the integration of networks will it be possible to maintain the innovative functional capacity of networks" (Morath, 2002).

2.2 Network breakdown

The risk of network breakdown is associated with the following factors:

- *Size of the network*: with a large number of members, it is more difficult to manage conflicts and regulate common activities. As a result there is an increased risk of blockades coming about (see Scharpf, 1993).
- *Interest in short-term benefits of co-operation*: when there is an over-intense focus on the short-term benefits to the individual members, long-term trends may be overlooked. Lengthy processes of adaptation may fail to be carried out (Hellmer *et al.*, 1999). Inflexible thinking patterns and processes can develop (Fürst and Schubert, 1998).
- *Improved efficiency vs flexibility*: well established but informal structures make it more difficult to redistribute resources and power. Blockades come about, so that no decisions will be taken to the disadvantage of strategically important members (see Hellmer *et al.*, 1999). Only those strategies will be realised that are in the interest of these members (see Windeler, 2001).
- *Co-operation vs conflict capability*: a high internal pressure to adapt can lead to a closed attitude to the surrounding environment, and result in signals in contradiction of one's own opinions and strategies. The "group think" phenomenon referred to earlier may occur. The integration of new members is blocked, especially when they have different opinions.

So the instability of the network, sclerotic networks, an uncontrolled drain of knowledge and competencies, dilemmas of communication, the entropy of the network as well as the reduction of redundancies bear important risks and dangers. From the point of view of the promotion and control of networks, this means that these factors

lead to networks with deficits. The cost of which may exceed the benefits they are supposed to bring about. If we attempt to summarise the opportunities and risks associated with networks, it gives us the results in Table I.

2.3 Central issues for social network analysis

In view of the risks of network breakdown, we can see it as being an important task of network control to manage a balance between stability and innovation, improved efficiency and flexibility. In this context, the contribution of social network analysis lies in facilitating an overall view of the "networking of networks", above all at regional level, i.e. providing a way of visualising the multiple involvement of the relevant institutions and players, and so conducting an assessment of these with the help of the relevant indicators. The complexity is especially reduced when the analysis can be based on automated data retrieval of electronic documents available, e.g. at governmental institutions, research databases, and the internet.

For this work to be carried out, it is essential that an adequate datapool should exist. As in the case of the regional research environment we have to do with heterogeneous items of information that are not centrally collected, the first emphasis must be on data collection:

- What items of information are needed with a view to presenting the situation?
- What materials (documents, questionnaires, survey results etc.) are the most important ones needed for the analysis? What potential, and what limitations, follow from the materials used?
- How and in what form is the information accessible?
- How can reproducibility be ensured?

The following more in-depth questions are also of interest, with a view to supporting the control and optimisation of research networks:

- What structural elements can be visualised in a differentiated way, so supporting the reception of the study? (e.g. different types of organisations and partnerships)
- Are there non-integrated elements in the research environment? (Which institutions/companies/persons do not form part of the networks?)

Opportunities	Risks
Networks as social capital Increase of effectiveness on the basis of collective action Resource pooling Establishment of network resources Use of sectoral resources, capabilities and skill advantages Learning effects Changed social practices based on shared learning	Network breakdown Decision blockades Structurally conservative tendencies dictate action Disintegration or excessively close connections Blocked negotiations Externalisation of costs High communication costs

Source: Based on Meckling (2003)

Table I.
Opportunities and risks of networks

- What formal involvements also lead to “active” cooperative partnerships (with an output of projects or publications)?
- Integration vs differentiation of sub-networks: what thematically different partnerships are composed of the same institutions and/or persons?
- What partnerships have arisen in the course of time, how have they developed, and which research fields or thematic areas develop with greater dynamism than others?
- Are the networks sufficiently capable of renewing themselves (new players, adaptation in terms of content, links to the “outside world”...)?
- Which persons are concerned by which issues? What is their key function, what kinds of network are they involved with and in what kind of function (and in connection with what kind of issues)?

Such questions can be answered especially by studying the dynamic development of networks by making use of documents as, e.g. contracts, project descriptions, member lists etc. Access to these documents however is usually restricted. The project therefore analysed, to what extent web based resources are available and good enough in their quality to study regional innovation systems and their development.

Experiences prove the feasibility of the approach. Conclusions for recommendations on standardised data formats as well as further research questions have been drawn which are of special interest for governmental institutions who are interested in strategic measures and their effectiveness on regional innovation networks.

3. The crucial issue of the right database

The handling of network issues asks for models of strategic and soft governance interventions and underlines the necessity of enhancing a corresponding strategic policy intelligence. Important instruments for monitoring and managing networks are reporting systems for intellectual capital, as, e.g. the balanced scorecard. These systems have been used not only for companies and research institutions (e.g. Austrian Universities) but also for their networks (e.g. NANONET-Styria, NOEST-Network and others). However common IC-reporting systems, especially indicators in use show important deficiencies regarding knowledge intensive networks, their specific characteristics as well as their monitoring requirements. Social network analysis offers a better understanding of co-operations, e.g. by visualising shareholders, common projects and activities, interrelatedness of institutions by their representative interspecific indicators.

3.1 Layers of research networks

Visualisation and analysis of research networks should provide a good overview on relevant networks and their actors thus enhancing their strategic governance. Document retrieval and analysis of different forms of interactions are thereby a necessary starting point (additionally to qualitative interviews with actors).

The following layers of a regional research system have been identified respectively:

- Co-operations (formalised or informal networks, centres, cluster).
- Organisations (research institutions, companies, governmental funding institutions).
- Projects (of organisations, within co-operations).
- Persons (representing their organisations in formal and informal relationships).

3.2 Typology of research co-operations

Co-operations within a research systems differ in aims and character, a variety of different documents are available accordingly as described in Table II.

3.3 Typology of information sources

The internet provides a good resource for an automated retrieval of structural components of a regional research system. However information available is highly heterogeneous, show different levels of details, updated at different time series and in no way standardised. (e.g. in terms of organisational structure, board members and management positions, employees, co-operations, projects and publications etc.). Results of an internet investigation can thereby only function as baseline for further discussions and deepening for specific research questions.

Web sites and their content are rated by convelop as “third order source of information” whereas:

- “First order sources of information” are information which has an official character and is produced directly by the organisation as internal rules of procedure, contracts, IC reports, publications, patents etc.

Type of co-operation	Characteristics	Specific documents available
Conferences and events	Networking, fostering co-operation with, “VIPs of the region or topic” Strongly related to specific individuals	Invitations, speakers, participants, sponsorships Press information
Formal and informal networks	Relatively open in their strategic goals, relatively strongly related to participating individuals	Protocols, resolutions, statements, interviews
Committees, boards	Governance of organisations and networks	Contracts, board decisions, protocols
Competence-centres; clusters	Formal co-operation, clearly structured, shareholding	Partnership agreements, projects, publications, evaluation reports, annual reports
Development partnership	More specific and limited, e.g. on a certain project or product	Partnership agreements
Projects: Regional, national, international Research and applied	Precise objective, limited time schedule	Proposals, project reports, publications, evaluation reports
Governmental structures	Political governance	Guidelines, decisions, funding database

Table II.
Types of co-operation, their characteristics and information sources

- “Second order sources of information” are: protocols, curricula vitae, member lists etc.
- “Third order sources of information” are: press reports, content of web sites, links on web sites (e.g. to other organisations).

3.4 Containment of data sources

When considering a regional innovation system, even the retrieval of basic information on organisations as, e.g. management and employees, board members, shareholding is time consuming and needs strict evaluating mechanism concerning the reliability of results. Aims of visualisation have therefore to be narrowed.

In the following example Styrian research institutions and their participation in governmentally funded research networks as well as shareholding of competence centres as well as personal representations have been the main focus of interest.

4. A comprehensive look at an innovation system – the example of Styria

As shown above IT-based tools and methods allow gathering a database for the monitoring of regional innovation networks. Their exemplary application for the region of Styria offered revealing details about the regional innovation system.

4.1 A comprehensive look at the regional innovation system

The Styrian innovation system (see Figure 1) encompasses a broad variety of institutions and actors: five universities, two universities of applied sciences, five national and one regional research institution, 15 science-industry cooperative

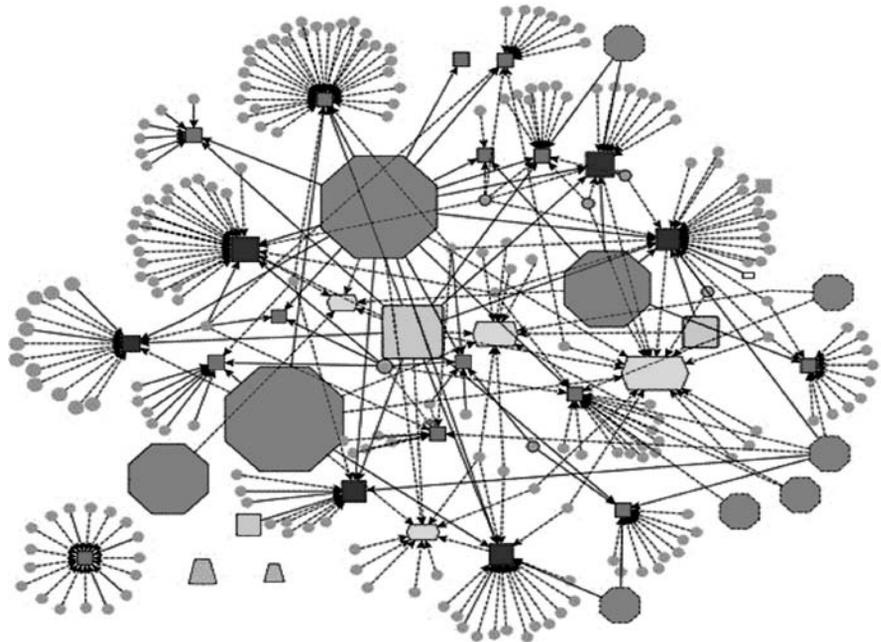


Figure 1.
Comprehensive look at the
Styrian innovation system

laboratories, 18 competence centres and a few cooperative research entities of the industry. In the database for the Network Analysis all research institutions were included as well as all their staff and their cooperative engagements – as far as they were displayed in the internet.

The regional universities and research institutions (light grey octagons as well as medium grey squares) are intensively interwoven by regional cooperative initiatives. Especially the 18 regional competence centres (dark grey squares) and the people working there play an important role for interlinking the different regional institutions. They also constitute a crucial interface to the regional industry (dots). Over the last years the physically bound co-operation initiatives like the competence centres have been complemented by broader thematically focussed networks. These networks (hexagons) serve as co-operation and communication platforms that set out to coordinate and focus expertise and concepts of specific thematic fields in Styria. Hence their impact on the regional network is also significant especially as they involve all kind of different partners. Only the regional universities of applied sciences take a quite isolated role in the innovation system.

4.2 Institutional strategies for networking

The Network Analysis also allows interesting conclusions concerning co-operation strategies of single institutions of the region. If one takes a detailed look at each of the regional institutions, significant differences come up concerning both the degree of involvement in the innovation system as well as the personnel interlinkages. Figure 2 shows for example the embeddedness of one of the regional universities with specific regard to competence centres (hexagons in light grey if they are in the region, in dark grey if they are somewhere else in Austria). The involvement is carried out by scientific as well as administrative staff working for both the university and one or more competence centres. Persons (dots), who interlink at least four different institutions of the region, and their relation-lines are displayed with the thicker lines. Persons who work in two different institutions of the region are shown by the dark grey circles. Figure 3 shows a similar co-operation strategy of the Styrian research institution. Both institutions show only a few cooperative initiatives with competence centres and in both cases only few people – in some cases even only a single person – is engaged in the co-operation. Thus, the relationships seem to be quite instable und dependent on this person. But the networking strategies of these two institutions also include a formal involvement. The cooperative activities are not stabilised by the number of actors involved but by the degree of formalisation.

The co-operation strategy of the technical university of Styria (see Figure 4) differs radically from the ones shown above. It pursues a broad variety of co-operation initiatives with competence centres. Staff of the technical university is engaged in a great number of competence centres and each of the co-operation is even undertaken by several persons. The participation of a certain number of different persons in the co-operation process suggests that real cooperative project work is done. The formal level of integration on the other hand is not seen as that important. The higher number of competence centres, in which the technical university is engaged, can be explained by the size of the technical university on one side and the largely on technical issues orientated issues of the competence centres on the other side.

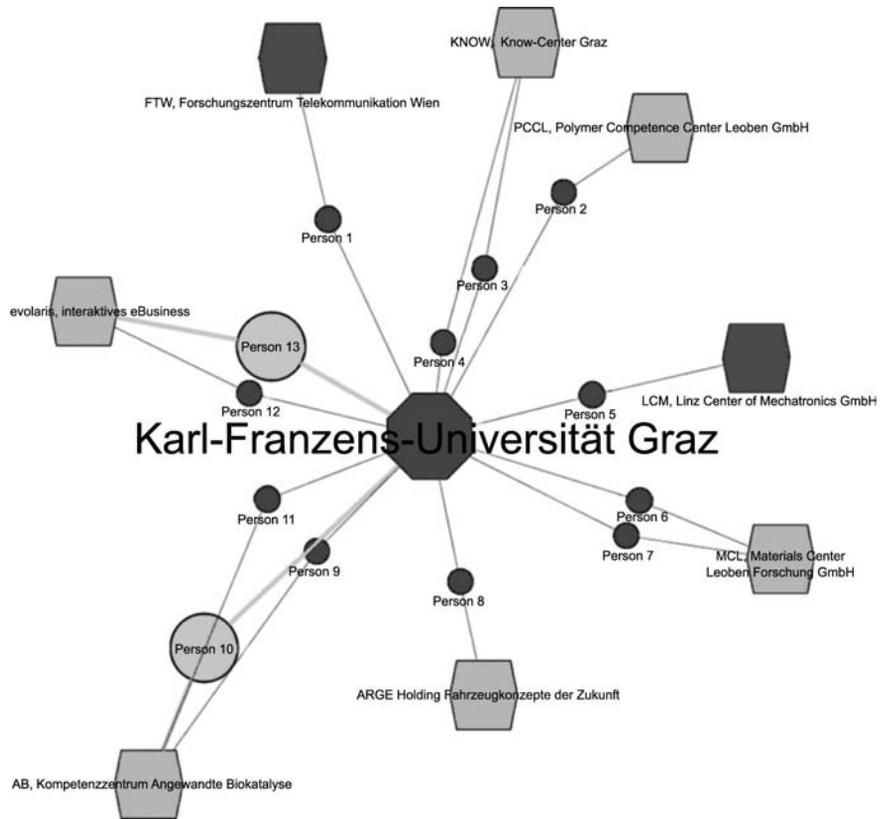


Figure 2.
One regional university
and its relations to
competence centres

4.3 Co-operative behaviour of the individual players in the innovation system

However irrespectively of the different institutional strategies for networking, the figures shown above also point up clearly that co-operation – in a first step – is always based on individual behaviour. In a second step it might be more formalised and broadened. This holds true for the regional innovation system as well. The network analysis made it possible to identify the top-16 actors of the regional innovation systems. That means, altogether 16 regional actors who were engaged in at least four different institutions of the Styrian innovation system in parallel. These top-16 persons act as essential pillars of the regional network. At the same time these actors also show a high degree of formal interlinkages among each other. The risk of a closed shop seems imminent; the openness and permanent change of the network has to be kept in mind. But after all, these actors also show interlinkages with institutions from outside the region.

Figure 5 illustrates the individual network of one of the top-16 persons of the Styrian innovation system (person 0). Once again the regional universities are displayed as octagons, the regional research institutions as squares, the competence centres as hexagons and the thematic network initiatives as trapezoids. Regarding their integration in the competence centres, the network analysis reveals that the top-16 actors already connect 16 competence centres in and outside the region. Only six competence centres of

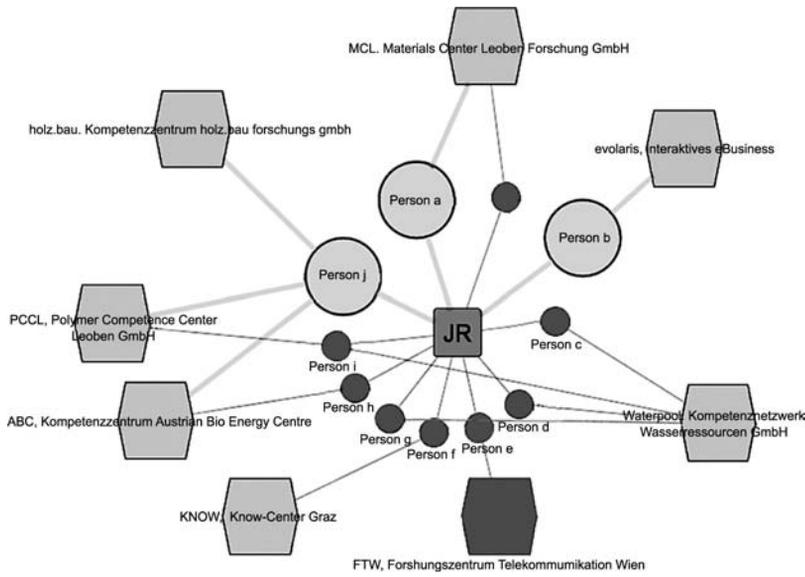


Figure 3.
The regional research institution and its relations to competence centres

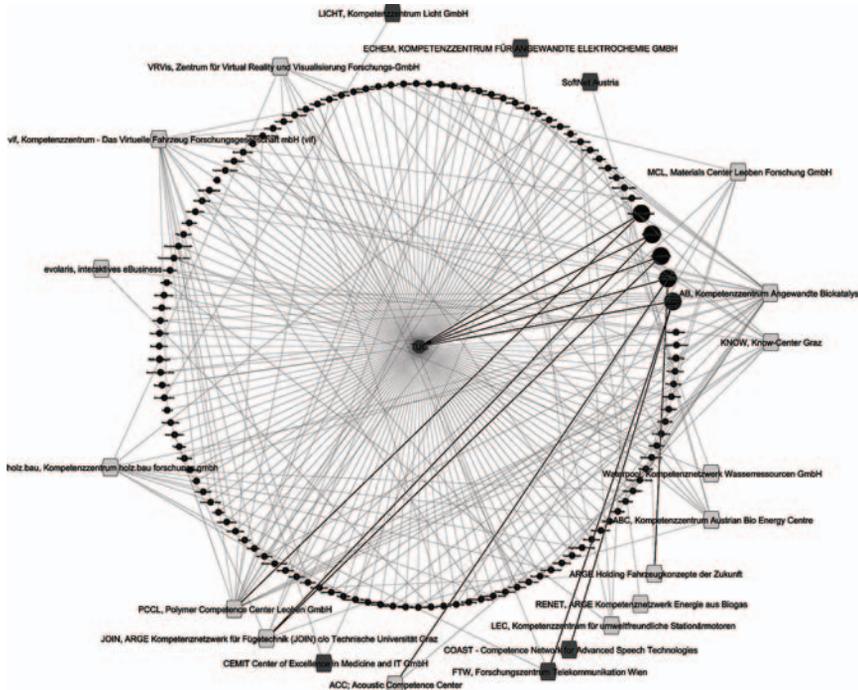


Figure 4.
The technical university and its relations to competence centres

Network attributes	Guiding questions
Network partners	<p>Absolute number in total</p> <p>Which subgroups of the regional innovation system are represented and in which proportions?</p> <p>Which actors of the different institutions are involved?</p> <p>Who is missing? (main institutions, actors, companies)</p> <p>Who shows multiple network activities?</p>
Cooperative behaviour	<p>Cooperative behaviour in terms of multilateral relationships versus single firm, bi-or trilateral links in the framework of the regional networks?</p> <p>Do specific institutions/actors show a significant bias towards a specific kind of partners (partners of the same institutions, partners of the same region, partners of the same scientific community, etc.)?</p> <p>Does the set of network partners change over the time? Are existing co-operation-links deepened or even further selected? Or is the number of network partners enlarged and broadened?</p>
Balance of power	<p>Number of main network nodes?</p> <p>Which institutions /actors are dominating by playing an important role in many networks?</p> <p>Which institutions/actors are dominating by centering the main communication lines?</p> <p>To which subgroup of the regional innovation system do they belong?</p> <p>How many one-way and single track relations as bottlenecks of a stable network are to be found?</p> <p>Is a certain redundancy in the network to be identified to reduce dependencies on single institutions/actors?</p>
Openness of the network	<p>Does the set of partners vary in the different networks or is a limited number of well known partners to be found?</p> <p>New interactive paths for broadening and formalizing the set of cooperative partners?</p>
Embeddedness of the network	<p>Interregional as well as international embeddedness of the network to use external sources of knowledge and get involved in supraregional flows of information?</p>

Table III.
Guiding questions for strategic management of research networks

involvement in the regional innovation systems are varying significantly. Amongst others they depend on the institutional setting, the scientific background and the specific role of the institution/actor in the innovation system. In this context some shortcomings of social network analysis become obvious which may partially be overcome by further differentiations and specialisations in the database:

- The reasons for a certain cooperative behaviour are left in the dark. Often historical tracks, legal restrictions, institutional conditions etc. are determining cooperative activities. Sudden changes in the legal context, e.g. may have a considerable impact on co-operation possibilities of single institutions/actors and thus on the regional network setting all in all (as, e.g. the autonomy of the Austrian universities).
- Co-operation strategies of the regional institutions/actors in general are visible only at a very formal level. The real co-operation processes in terms of ongoing co-operation projects can hardly be displayed by means of automatic retrieved

data. This is mainly due to a lack of data as cooperative behaviour is difficult to standardise and to be recorded (heterogeneous sources from regional, national, and international governmental institutions would have to be comprised in order to visualise the overall co-operation activities).

- So far, the formal functions of the cooperating actors in their mother institutions (administration, scientific staff, management, etc.) are neglected. A further differentiation is necessary to concentrate on and compare the same type of actors (as, e.g. economic vs scientific management and scientists).
- Additionally a further differentiation concerning the specific subjects the institutions/actors are dealing with is crucial. This will deliver detailed information on specific communities or regional areas of scientific expertise.

At regional level the network development can be reflected under the assumptions that:

- the number of key players is limited (concerning the economic sphere as well as the scientific one) and
- by iterative and independent development of networks and centres self organisation leads to multiple involvement of the same leading institutions and actors. This might lead to bottleneck effects and work overload for specific actors, leading to a restriction of positive network effects (expected positive effects are: “quick links” between different subjects, good team performance, easy and efficient information flow, etc.).
- the multiple involvement of the same leading institutions and actors may also risk a sclerotic network, a closed shop. The openness of the network, the systematic integration of external and different backgrounds and know-how will be decisive.

Especially networks, which are acting close to the market tend to concentrate on a limited number of well-known partners and to keep therefore quite closed to others. Therewith, barriers are built up for circulating knowledge and information into as well as out of the network in the innovation system lead to limited effectiveness and efficiency. On the other side especially industrial partners behave more responsible for the network in quite “closed shops” when they feel more secure.

At this point regional decision makers are questioned; they have to clarify the specific purposes of the different networks. By means of social network analysis (SNA) they might evaluate if a given set of involved partners is apt to reach the specific network objectives. In addition the comprehensive visualisation provided by SNA allows considering the overall quantum of regional co-operation activities at once, thereby offering means to analyse of their interplay, complementarily and compatibly.

When SNA is systematically applied as monitoring instrument dynamic information may be gathered on network development over time. Networks are living systems, permanently changing. Relationships may be deepened, but may also be abandoned. Communication links may be broadened and diversified, but may also be given up. The number of partners may change significantly. Therefore time is a vital factor for the governance of regional networks. If SNA is systematically set up, dynamic network development may be including in monitoring efforts.

Some of these considerations – and thereby the derived measurement and indicator design – depend heavily on strategic governance aims for a specific network and its

activities. At this juncture politics is asked to define clear objectives as well as corresponding guidelines for network activities, e.g. in the framework of its MAP-programs.

5.2 Identification of governance options and final conclusions

IT based tools and methods linked with SNA constitute an important instrument for regional governance. Regional networking per se is no guarantee for regional innovation capacities and regional competitiveness. In order to get the best results out of regional co-operation processes decision makers have to play an active role in steering and managing the regional set of networking activities. In this respect SNA may provide them with detailed information needed on:

- how framework conditions for co-operation processes should be set (fostering communities of practice, geographic range, financial range, timeline etc.);
- what kind of guidelines and constraints for a specific network should be given (e.g. who should participate, network size, legal construction, diversity, etc.).

While considering the risks of network breakdown network governance should be considered as important topic, allowing a balance of stability and renewal, of an increase in efficiency and flexibility accordingly. As a string point the impact of SNA lies in providing an overview at the regional level and thereby visualising multiple embeddedness of relevant institutions and actors, which might be further optimised by means of SNA derived indicators.

In this context SNA is an appropriate regional communication instrument. It systematically delivers a comprehensive overview of a regional innovation system as well as sound information on specific ongoing co-operation processes. Herewith it provides a basis for some fundamental discussions concerning the openness of the regional networks, the use of external sources for know-how or the integration of still missing potential key players.

Though, discussions in more detail will soon be reliant on additional data. For these governance issues, which prove to be of greater interest complementary surveys will be necessary like analyses of publications, interviews, qualitative surveys, discussions with specific scientific communities (e.g. in regional fields of strengths).

SNA has been identified as helpful instrument for a systematic monitoring of regional innovation system and their sub-networks. At the same time it reveals interesting points for a more thorough examination.

In general, regional decision makers should claim more standardised data from regional institutions – especially the ones benefiting from regional funding – about co-operation partners, projects, and so on. Ideally regional innovation actors agree upon a common set of monitoring data, which will be regularly updated. This would be crucial not only for network analysis but also for other governance tasks. However these types of agreements need considerable time.

Meanwhile as a first step regional decision maker may concentrate on information on formal co-operations (steering committees, etc.), which are available easily. With the visualisation of these network structures a regional discussion may be launched, regional institutions obliged and issues for further discussions identified.

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